



# PART 13

## STEEL BARGES



## PRINCIPLES FOR THE CLASSIFICATION AND CONSTRUCTION OF STEEL SHIPS

### PART 13 STEEL BARGES

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## PRINCIPLES FOR THE CLASSIFICATION AND CONSTRUCTION OF STEEL SHIPS

### PART 13 STEEL BARGES

#### Chapter 1 GENERAL

##### 1.1 General

###### 1.1.1 Application

1. The requirements in this Part are to be applied to the hull construction, equipment and machinery (including electrical equipment, hereinafter referred to as “machinery”) of steel barges (hereinafter referred to as “barges”), notwithstanding the requirements specified in other Parts (except those in [Chapter 2, Part 1A](#) as well as [Part 4, Part 5, Part 6, Part 10, Part 11](#), *IGC Code-IMO*, *IBC Code-IMO* and *ILLC*).
2. The requirements in this Part are applied to the barges as specified in the following:
  - (1) Barges carrying dry cargoes in holds
  - (2) Barges carrying dry cargoes on upper decks
  - (3) Barges carrying liquid cargoes in bulk
3. Barges carrying special cargoes other than specified in -2 are to be generally as required in this Part with a special consideration being given depending on the kind of cargoes.
4. In barges of greater than 150 *metres* in length the requirements concerning hull construction, equipment, arrangement and scantlings will be decided individually based upon the general principle of the requirements in this Part.
5. With respect to steel barges attention is to be paid to compliance with the International Convention and the National Regulations of the country in which the ship is registered or to be registered, in addition to the requirements in this Part.

###### 1.1.2 Special Cases in Application

In barges of less than 30 *metres* in length or in barges to which requirements in this Part, for some special reasons, are not directly applicable, hull construction, equipment, arrangement and scantlings are to be in accordance with the discretion of the Society, notwithstanding the provision in [1.1.1](#).

###### 1.1.3 Barges of Unusual Form or Construction or Barges Moored in Unusual Way

Barges of unusual form or construction or barges moored in unusual way are to be in accordance with the discretion of the Society.

###### 1.1.4 Equivalency

Alternative hull construction, equipment and machinery will be accepted by the Society, provided that the Society is satisfied that such construction, equipment, machinery are equivalent to those required in this Part.



### **1.1.5 Stability**

The requirements in this Part are framed for barges having appropriate stability in all conceivable conditions. The Society emphasizes that the special attention be paid to the stability by the builders in design and construction stage and by the masters while in service.

### **1.1.6 Fittings for Examination**

Ladder, steps or other facilities, by which internal examination can be performed safely, are to be provided in fore and after peak tanks, cofferdams and enclosed compartments which are similar to the above-mentioned tanks, except those exclusively used for fuel oil or lubricating oil.

## **1.2 Definitions**

### **1.2.1 Application**

The definitions of terms which appear in these Rules are to be as specified in this Chapter, unless otherwise specified elsewhere.

### **1.2.2 Length of Barge**

The length of barge ( $L$ ) is the distance in *metres* from the inside surface of stem to the inside surface of stern on the load line defined in [1.2.5](#). However, for the barges with shipshape the length of barge ( $L$ ) is the distance in *metres* on the load line defined in [1.2.5](#) from the fore side of stem to the after side of rudder post in case of a barge with rudder post, or to the axis of rudder stock in case of a barge without rudder post or stern post.

### **1.2.3 Breadth of Barge**

The breadth of barge ( $B$ ) is the horizontal distance in *metres* from outside of the frame to the outside of the frame measured at the broadest part of the hull.

### **1.2.4 Depth of Barge**

The depth of barge ( $D$ ) is the vertical distance in *metres* from the top of keel to the top of upper deck beam at side measured at the middle of  $L$ .

### **1.2.5 Load Line**

The load line is the waterline corresponding to the designed summer load draught in case of a barge which is required to be marked with load line, and the waterline corresponding to the designed maximum draught in case of a barge which is not required to be marked with load line.

### **1.2.6 Load Draught**

The load draught ( $d$ ) is the vertical distance in metres from the top of keel to the load line measured at the middle of  $L$ .

#### **1.2.7 Upper Deck**

The upper deck is normally the uppermost continuous deck.

#### **1.2.8 Superstructure**

The superstructure is the decked structure on the upper deck, extending from side to side of the barge or having its side walls at the position not farther than  $0.04B$  from the side of barge.

#### **1.2.9 Midship Part of Barge**

The midship part of barge is the part for  $0.4L$  amidships. However, for pontoon type cargo barge and similar shaped barge, the midship part of barge is the part for  $0.6L$  amidships.

#### **1.2.10 End Parts of Barge**

The end parts of barge are the parts for  $0.1L$  from each end of the barge.

#### **1.2.11 Strengthened Bottom Forward**

The strengthened bottom forward of barge is the part of flat bottom forward from the position of  $0.15L$  from stem.

#### **1.2.12 Important System**

The important system is a system necessary for safety of life and barge.

#### **1.2.13 Trusses**

Trusses are the structure to connect the bottom and deck members by pillars and diagonals, having ample strength to effectively support deck loads.

## Chapter 2 MATERIALS, CONSTRUCTION, ETC.

### 2.1 General for Materials, Construction, etc.

#### 2.1.1 Materials and Welding

1. Materials used for hull construction are to be in compliance with the requirements in [Part 10](#) or to be the equivalent materials.
2. Materials used for hull construction of barges intended to be classified as “*Smooth Water Service*” are to be in accordance with the discretion of the Society.
3. Application of steels used for hull construction is to be in accordance with the provision in [1.1.11 of Part 2](#).
4. Service limitation for materials of piping, valves and fittings is to be in accordance with the requirements in [12.1.5](#) and [12.2.2 of Part 7](#).
5. Materials used for pneumatic piping system with the maximum working pressure above 2 MPa, and for fuel oil pipes, valves and fittings in fuel oil piping system, and also for valves, distance pieces and pipes attached to the shell plating and valves attached to the collision bulkheads are to be in compliance with the requirements of standards acceptable by the Society.
6. For materials used for piping system, except for those specified in -5, Surveyor may require to submit the results of tests carried out by the manufactures.
7. Welding to be used in hull construction and important equipment is to be in accordance with the requirements in [Part 2](#) and [Part 11](#).

#### 2.1.2 Scantlings

1. The scantlings of hull structural members are framed for the case where mild steel is used. Where high tensile steel is used for hull structural members, the scantlings of which are to be in accordance with the discretion of the Society.
2. Unless otherwise specified, the section moduli of members required in this Part are those including the steel plates with the effective breadth of  $0.1l$  on either side of the members. However, the breadth of  $0.1l$  is not to exceed half of the distance between the adjacent members. Where  $l$  is the length specified in the relevant Chapters.
3. The standard depth of girders supporting frames, beams or stiffeners, unless otherwise specified, is to be one-twelfth of  $l$ , where  $l$  is the length specified in the relevant Chapters.
4. The inside radius of flanged plates is not to be less than twice but not more than three times the thickness of steel plate.
5. Girders are to be properly increased in scantlings where angle of inclination between web of the girder and shell plating is small, and suitable means are to be provided for tripping as the case may require.

### **2.1.3 Continuity of Structural Members**

Attention is to be paid sufficiently to all structural members for its strength to be kept in continuity.

### **2.1.4 Connections of Girders, Frames, Stiffeners, etc.**

1. Where girders are connected at their ends with the bulkhead or top plating of tanks, the effective supporting members are to be provided on the bulkhead or top plating of tanks at their back side.
2. Where the frames or the stiffeners are connected with brackets, unless otherwise specified, the length of arm of brackets is not to be less than one-eighth of  $l$  specified in the relevant Chapters.

### **2.1.5 Ceilings and Sparrings**

Ceilings and sparrings in hold are to be as specified in [Chapter 23 of Part 2](#).

### **2.1.6 Cementing and Painting**

Cementing and painting are to be as specified in [Chapter 24 of Part 2](#).

### **2.1.7 Equipment**

Masts and riggings, cargo handling arrangements, mooring and anchoring arrangements, towing apparatus and other fittings are to be of appropriate arrangement suitable for their respective purposes, and tests are to be carried out to the satisfaction of the Surveyor, where deemed necessary.

### **2.1.8 Carriage of Oil**

1. The requirements for construction and arrangement for carriage of fuel oils specified in this Part are to be applied to the case intended to carry fuel oils having a flashpoint above 60°C at a closed cup test.
2. The construction and arrangement for carriage of fuel oils having a flashpoint of 60°C or below at a closed cup test, are to be in accordance with the discretion of the Society, unless specified in this Part.
3. The construction and arrangement of deep oil tanks intended to carry cargo oils are to be generally in accordance with the requirements in [Chapter 22](#).

## Chapter 3 SINGLE BOTTOMS

### 3.1 General

#### 3.1.1 Application

1. The requirements in this Chapter are framed for barges less than 90 *metres* in length. The construction and scantlings of single bottoms in barges of greater length are to be in accordance with the discretion of the Society.
2. Notwithstanding the provisions in this Chapter, the construction and scantlings of single bottoms in Pontoon Barges are to be in accordance with the requirements in [Chapter 21](#).

### 3.2 Centre Girder

#### 3.2.1 Arrangements and Scantlings

All single bottom barges are to have the centre girder composed of continuous web plates in association with face plates, and the centre girder is to extend as far forward and afterward as practicable.

#### 3.2.2 Web Plate

1. The thickness of web plate is not to be less than obtained from the following formula. Beyond the midship part, the thickness may be gradually reduced and it may be 0.85 times the mid-part value at the end parts of the barge.

$$0.065L + 5.2 \text{ mm}$$

2. The height of web plates is not to be less than that of floors.

#### 3.2.3 Face Plates

1. The thickness of face plates is not to be less than the thickness of web plate amidships and the face plates are to extend from the collision bulkhead to the after peak bulkhead.
2. The sectional area of face plates is not to be less than obtained from the following formula. Beyond the midship part, the thickness may be gradually reduced and it may be 0.85 times the mid-part value at the end parts of the barge.

$$0.6L + 9 \text{ (cm}^2\text{)}$$

3. The breadth of face plates is not to be less than obtained from the following formula:

$$2.3L + 160 \text{ (mm)}$$

4. Where the pillars are provided above the face plates, the sectional area of face plates is to be increased or the face plates are to be suitably strengthened by other means.

### 3.3 Side Girders

#### 3.3.1 Arrangements

Side girders are to be so arranged that their spacing is not more than 2.5 *metres* between the center girder and the side shell plating.

#### 3.3.2 Construction

The side girders are to be composed of continuous web plates in association with face plates, and they are to extend as far forward and afterward as practicable.

#### 3.3.3 Face Plates

The thickness of face plates is not to be less than that required for the web plates, and the sectional area of face plates amidships is not to be less than obtained from the following formula. Beyond the midship part, the sectional area may be gradually reduced and it may be 0.85 times the mid-part value at the end parts of the barge.

$$0.45L + 8.8 \text{ (cm}^2\text{)}$$

#### 3.3.4 Web Plates

The thickness of web plates amidships is not to be less than obtained from the following formula. However, that thickness need not exceed obtained from the formula specified in [3.2.2-1](#). Beyond the midship parts, the thickness may be gradually reduced and it may be 0.85 times the mid-part value at the end parts of the barge.

$$0.042L + 5.8 \text{ (mm)}$$

### 3.4 Floor Plates

#### 3.4.1 Arrangement

1. In barges with the bottom of transverse framing, the standard spacing of floors is to comply with the requirements in [5.2.1](#).
2. In barges with the bottom of longitudinal framing, floors are to be so arranged that their spacing is not more than about 3.5 *metres*.

#### 3.4.2 Depth of Floors

1. Upper edges of floor plates at any part are not to be below the level of upper edge at the centre line.
2. In the midship part of the barges, the depth of floor at the toe of frame brackets is to be not less than 0.5 times  $d_0$  specified in [3.4.3-1](#). (See [Fig. 3.1](#))

3. Face plates provided on the floor plates are to be continuous from the upper part of bilge at one side to the upper part of bilge at the opposite side in case of curved floors, and extending over the floor plate in case of floors connected by frame brackets.

### 3.4.3 Scantlings

1. The scantlings of floor plates are not to be less than obtained from the following formulae:

Depth at the centre line:  $0.0625l$  (m)

Thickness:  $10d_0 + 3.5$  (mm) or 12 mm, whichever is smaller.

Section modulus:  $4.27Shl^2$  (cm<sup>3</sup>)

$S$ : Spacing of floor (m).

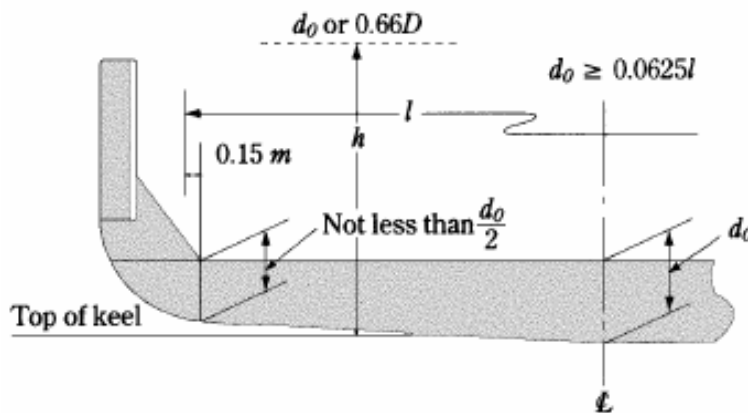
$h$ :  $d$  or  $0.66D$ , whichever is greater (m).

$l$ : Distance between the toes of frame brackets plus 0.3 metres measured at amidship. Where curved floors are provided, the length  $l$  may be suitably modified. (See [Fig. 3.1](#))

$d_0$ : Depth of floor plates at the centre line (m).

2. The thickness of face plates on the floor plates is not to be less than that required for the floor plates, and the breadth of face plates is to be adequate to prevent lateral instability of the floors.
3. Beyond  $0.5L$  amidships, the thickness of floor plates may be gradually reduced and at the end parts of the barge it may be 0.85 times the value specified in -1. But the strengthened bottom forward is not to be reduced.

**Fig. 3.1 Shape of Floors**



### 3.4.4 Frame Brackets

The size of frame brackets is to be in accordance with the following requirements, and the free edge of brackets is to be stiffened.

- (1) The brackets are to extend to the height not less than twice the required depth of floors at the centre line above the top of keel.

- (2) The arm length of brackets measured from the outer edge of frames to the bracket toe along the upper edge of floors, is not to be less than the required depth of floors at the centre line.
- (3) The thickness of brackets is not to be less than that of the floors required in [3.4.3](#).

### **3.4.5 Limber Holes**

Limber holes are to be provided in all floor plates on each side of the centre line and, in addition, at the lower turn of bilge in barges having flat bottoms.

### **3.4.6 Lightening Holes**

Lightening holes may be provided in floor plates. Where the holes are provided, appropriate strength compensation is to be made by increasing the floor depth or by other suitable means.

### **3.4.7 Floor Plates forming Part of Bulkheads**

Floor plates forming part of bulkheads are to be in accordance with the requirements in [Chapter 10](#) and [11](#).

## **3.5 Bottom Longitudinals**

### **3.5.1 Spacing**

The standard spacing of bottom longitudinals is obtained from the following formula:

$$2L + 550 \text{ (mm)}$$

### **3.5.2 Bottom Longitudinals**

The section modulus of bottom longitudinals is not to be less than obtained from the following formula:

$$8.6Shl^2 \text{ (cm}^3\text{)}$$

$l$  : Spacing of solid floors ( $m$ ).

$S$ : Spacing of longitudinals ( $m$ ).

$h$  : Vertical distance from the longitudinals to a point of  $d + 0.026L$  above the top of keel ( $m$ ).

## **3.6 Construction of Strengthened Bottom Forward**

### **3.6.1 Construction**

Construction of strengthened bottom forward is to comply with the requirements in [4.9](#).



## **Chapter 4 DOUBLE BOTTOMS**

### **4.1 General**

#### **4.1.1 Application**

1. Barges of 90 *metres* and above in length are to be provided with double bottoms. However, they may be provided with single bottoms subject to the approval by the Society.
2. The requirements in this Chapter may be suitably modified, where partial double bottoms are provided and where longitudinal bulkheads are made to reduce the unsupported breadth of double bottoms.
3. Where the longitudinal system of framing is transformed into the transverse system, or depth of double bottom changes suddenly, special care is to be taken for the continuity of strength by means of additional intercostal girders or floors.
4. Bottom structure of holds intended to carry heavy cargoes is to be subjected to special consideration.

#### **4.1.2 Manholes and Lightening Holes**

1. Manholes and lightening holes are to be provided in non-watertight members to ensure accessibility and ventilation, except in way of pillars and where such openings are not permitted by these requirements.
2. The number of manholes in tank tops is to be kept to the minimum compatible with securing free ventilation and ready access to all parts of the double bottom. Care is to be taken for locating the manholes to avoid the possibility of interconnection of main subdivision compartments through the double bottom so far as practicable.

#### **4.1.3 Drainage**

1. Efficient arrangements are to be provided for draining water on the tank top.
2. Where wells are provided for the foregoing purpose, such wells are not to extend for more than one-half depth of the double bottom nor less than 460*mm* from the bottom shell, as far as practicable.

#### **4.1.4 Watertight Girders and Floors**

The thickness of watertight girders and floors, and the scantlings of stiffeners attached to them are to comply with the relevant requirements for girders and floors, as well as the requirements in [11.2.1](#) and [11.2.2](#).

#### **4.1.5 Minimum Thickness**

No member of the double bottom structure is to be less than 6*mm* in thickness.

## 4.2 Centre Girder

### 4.2.1 Arrangement and Construction of Centre Girder

1. Centre girder is to extend as far forward and afterward as practicable.
2. Where double bottoms having non-watertight centre girder are used for carriage of fuel oil, fresh water or water ballast, the breadth of the compartments is to be less than  $0.5B$ . However, the requirement may be suitably modified, in narrow tanks at the end parts of the barge or where deemed appropriate by the Society.

### 4.2.2 Manholes

1. Manholes may be provided in every frame space outside  $0.75L$  amidships.
2. Manholes may be provided in alternate frame spaces for  $0.75L$  amidships in barges under 90 metres in length, provided that the depth of holes does not exceed one-third the depth of centre girder.
3. Where manholes are cut in the centre girder plates for  $0.75L$  amidships in barges 90 metres in length and above, the girder plates are to be compensated.

### 4.2.3 Depth of Centre Girder

The depth of centre girder is not to be less  $B/16$  unless specially approved by the Society, but in no case to be less than 700 mm.

### 4.2.4 Thickness of Centre Girder Plate

The thickness of centre girder plate is not to be less than obtained from the following formula:

$$0.05L + 6 \text{ (mm)}$$

### 4.2.5 Brackets

1. Where longitudinal framing system is adopted in the double bottom, brackets are to be transversely provided between the solid floors with a spacing not more than 1.75 metres connecting the centre girder to the bottom shell plating as well as the adjacent bottom longitudinals, and additional stiffeners are to be provided for the centre girder as may be required.
2. The thickness of the brackets specified in -1 is not to be less than obtained from the following formula. However, it needs not be greater than that of the solid floors at the same location.

$$0.65L + 2.5 \text{ (mm)}$$

3. The strength of stiffeners specified in -1 is not to be less than that of a flat bar having the same thickness as that of girder plates and having the depth not less than  $0.08d_0$ , where  $d_0$  is the depth of centre girder in millimetres.

## 4.3 Side Girders

### 4.3.1 Arrangement

1. Side girders in  $0.5L$  amidships are to be so arranged that the distance from the centre girder to the first side girder, between girders, or from the outermost girder to the side shell plating does not exceed approximately 4.6 metres.
2. In the strengthened bottom forward of barges, side girders and half-height girders are to be provided as required by [4.9.2](#).

### 4.3.2 Thickness of Side Girders

The thickness of side girder plates is not to be less than obtained from the following formula:

$$0.6\sqrt{L} + 2.5 \text{ (mm)}$$

### 4.3.3 Thickness of Half-Height Girders

The thickness of half-height girders is not to be less than obtained from the formula in [4.3.2](#).

### 4.3.4 Scantlings of Vertical Stiffeners and Struts

1. Vertical stiffeners are to be provided to side girders at every open floor, or at a suitable distance if the double bottom is framed longitudinally, and vertical struts are to be provided on half-height girders at every open floor.
2. The strength of vertical stiffeners required by -1 is not to be less than that of a flat bar having the same thickness as that of the girder plates and having the depth not less than  $0.08d_0$  (m), where  $d_0$  is height of centre girder (m).
3. The sectional area of vertical struts required by -1 is not to be less than obtained from the formula in [4.6.3](#) with necessary modifications.

### 4.3.5 Lightening Holes

Within 10% of the length of a hold from its end bulkheads, the diameter of lightening holes in the side girders is not to exceed one-third the depth of girders, this requirement may, however, be modified in a short hold and outside  $0.75L$  amidships and where suitable compensation is made to the girder plate.

## 4.4 Solid Floors

### 4.4.1 Arrangement

1. Solid floors are to be provided at a spacing not exceeding about 3.5 metres.
2. In addition to complying with the requirements in -1, solid floors are to be provided at the following locations:
  - (1) Under transverse bulkheads;

- (2) At the location specified in [4.9.2](#) between the collision bulkhead and the after end of the strengthened bottom forward.
3. Watertight floors are to be so arranged that the subdivision of the double bottom generally corresponds to that of the barge.

#### 4.4.2 Thickness of Solid Floors

The thickness of solid floors is not to be less than obtained from the following formulae:

In barges with transverse framing:

$$0.6\sqrt{L} + 2.5 \text{ (mm)}$$

In barges with longitudinal framing:

$$0.7\sqrt{L} + 2.5 \text{ (mm)}$$

#### 4.4.3 Vertical Stiffeners

1. Vertical stiffeners are to be provided on the solid floors at a suitable spacing in case of the double bottom framed transversely, and at every longitudinal in case of the double bottom framed longitudinally.
2. The strength of vertical stiffeners prescribed in -1 is not to be less than that of a flat bar having the same thickness as that of the floor plate and having the depth not less than  $0.08d_0$  (m), where  $d_0$  is height of centre girder (m).

#### 4.4.4 Lightening Holes

Within  $0.1B$  from side shell plating, the diameter of lightening holes provided in the solid floors in the middle half-length of a hold is not to exceed about one-fifth the depth of floors. This requirement may, however, be suitably modified at the end parts of barge and in exceptionally short holds and where the solid floors are suitably compensated for.

### 4.5 Open Floors

#### 4.5.1 Arrangement

Where the double bottom is frame transversely, open floors are to be provided at every hold frame between solid floors in accordance with the requirements in [4.5](#).

#### 4.5.2 Scantlings of Frames and Reverse Frames

1. The section modulus of frames is not to be less than obtained from the following formula, but in no case is it to be less than  $30\text{cm}^3$ .

$$CSHl^2(\text{cm}^3)$$

- l*: Distance between the brackets attached to the centre girder and the margin plate (*m*). Where side girders are provided, *l* is the greatest distance between the vertical stiffeners on side girders and the brackets.
- S*: Spacing of frames (*m*).
- h*:  $d + 0.026L$  (*m*).
- C*: 6.0 for open floors without vertical strut as specified in [4.5.3](#).
  - : 4.4 for open floors under deep tanks with vertical strut as specified in [4.5.3](#).
  - : 2.9 for elsewhere.

2. The section modulus of reverse frames is not to be less than obtained from the formula in -1 which *C* equal to 0.85 times specified for frames at the same location. Where no vertical strut is provided to the open floors under deep tanks *C* is to be the value as specified in [11.2.2](#).

#### 4.5.3 Vertical Struts

1. Vertical struts are to be rolled sections other than flat bars and bulb plates and to be well overlapped with the webs of frames and reverse frames.
2. The sectional area of vertical struts is not to be less than that specified in [4.6.3](#) with necessary modifications.

#### 4.5.4 Brackets

1. Frames and reverse frames are to be connected to the centre girder and margin plates by brackets of not less thickness than obtained from the formula in [4.2.5-2](#).
2. The breadth of brackets specified in -1 is not to be less than  $0.05B$  and the brackets are to be well overlapped with frames and reverse frames. The free edges of brackets are to be properly stiffened.

### 4.6 Longitudinals

#### 4.6.1 Spacing

The standard spacing of longitudinals is obtained from the following formula:

$$2L + 550(mm)$$

#### 4.6.2 Scantlings

1. The section modulus of bottom longitudinals is not to be less than obtained from the following formula, but in no case is it to be less than  $30cm^3$ .

$$CSht^2 \quad (cm^3)$$

- C*: 8.6 for longitudinals without strut as specified in [4.6.3](#).
  - : 6.2 for longitudinals under deep tanks with struts as specified in [4.6.3](#).
  - : 4.1 for elsewhere.
- l*: Spacing of solid floors (*m*).

*S*: Spacing of longitudinals (*m*).

*h*: Vertical distance from the longitudinals to a point of  $d + 0.026L$  above the top of keel.

2. The section modulus of inner bottom longitudinals is not to be less than obtained from the formula in -1 with *C* equal to 0.85 times the value specified for bottom longitudinals in the same location. Where vertical struts are not provided to the longitudinals under deep tanks, the section modulus of inner bottom longitudinals is to be as specified in [11.2.2](#).

#### 4.6.3 Vertical Struts

1. Where the spacing of solid floors exceeds 2.5 metres, a strut is to be provided between floor plates. This strut is to be rolled section other than a flat bar and a bulb plate and to be sufficiently overlapped with the webs of bottom and inner bottom longitudinals.

2. The sectional area of above-mentioned vertical struts is not to be less than obtained from the following formula:

$$2.2 SPh \text{ (cm}^2\text{)}$$

*S*: Spacing of longitudinals (*m*).

*P*: Breadth of the area supported by the strut (*m*).

*h*: As stipulated in [4.6.2-1](#).

### 4.7 Inner Bottom Plating and Margin Plates

#### 4.7.1 Thickness of Inner Bottom Plating

The thickness of inner bottom plating is not to be less than obtained from the following formula:

$$3.8S\sqrt{d} + 2.5 \text{ (mm)}$$

*S*: Spacing of inner bottom longitudinals for longitudinally framed inner bottom plating, or spacing of floor plates for transversely framed inner bottom plating (*m*).

#### 4.7.2 Barges handling Cargoes regularly by Mechanical Appliances such as Grabs

In barges which regularly handle cargoes by grabs or similar mechanical appliances, the thickness of inner bottom plating is to be increased by 2.5mm above that specified in [4.7.1](#), unless ceiling is provided.

#### 4.7.3 Intersections of Margin Plates and Shell Plating

It is recommended that the intersections of margin plates and shell plating are to be of sufficient height to protect the bottom up to the turn of bilge of shell plating by the double bottom, and for 0.2L from the stem the margin plates are to extend to the ship's sides horizontally as far as practicable.

#### 4.7.4 Thickness of Margin Plates

The thickness of margin plates is to be increased by 1.5 mm above that obtained from the formula in [4.7.1](#).

#### **4.7.5 Breadth of Margin Plates**

Margin plates are to be of adequate breadth and to extend well inside from the line of toes of tank side brackets.

#### **4.7.6 Brackets**

1. Where the double bottom is framed longitudinally, brackets are to be transversely provided at every hold frame extending from the margin plate to the adjacent bottom and inner bottom longitudinals.
2. The thickness of brackets specified in -1 is not to be less than obtained from the formula in [4.2.5-2](#).

### **4.8 Tank Side Brackets**

#### **4.8.1 Tank Side Brackets**

1. The thickness of brackets connecting hold frames to margin plates is to be increased by 1.5mm above that obtained from the formula in [4.2.5-2](#).
2. The free edges of brackets are to be stiffened.

### **4.9 Construction of Strengthened Bottom Forward**

#### **4.9.1 Application**

The provisions in [4.9](#) are to be applied to barges having the bow draught less than  $0.037L$  at the ballast condition.

#### **4.9.2 Construction**

1. Between the collision bulkhead and  $0.2L$  abaft the fore end, side girders or half-height girders are to be provided in accordance with the requirements in [Table 4.1](#). Where transverse framing is adopted, however, the half-height girders may be provided between the collision bulkhead and  $0.175L$  abaft the fore end.
2. Between the collision bulkhead and  $0.15L$  abaft the fore end, solid floors are to be provided in accordance with the requirements in [Table 4.1](#).
3. In barges having the bow draught more than  $0.025L$  and less than  $0.037L$  at the ballast condition, of which structural arrangement of strengthened bottom forward is difficult to comply with the requirements, floor plates and side girders are to be reinforced properly. However, for barges of which speed is specially small compared with  $L$  at the towed or pushed condition, this requirements may be suitably modified.

**Table 4.1 Construction of Strengthened Bottom Forward**

	Structural members
--	--------------------



Bottom construction	Side construction	Side girders	Half-height girders	Solid Floors
Transverse	Transverse	To be provided at a spacing	To be provided between side girders	at sections of hold frames
	Longitudinal	not exceeding 2.5 m		At a spacing not exceeding 2.5 m
Longitudinal	Transverse	ditto		At sections of alternate hold frames
	longitudinal			At a spacing not exceeding 2.5 m



## Chapter 5 FRAMES

### 5.1 General

#### 5.1.1 Transverse Strength

For barges with long holds or hatchways in length, additional stiffening is to be made by means of increasing scantlings of frames, provision of web frames, etc. to compensate the transverse strength of hull.

#### 5.1.2 Frames in Way of Deep Tanks

The strength of frames in way of deep tanks is not to be less than required for stiffeners on deep tank bulkheads.

### 5.2 Frame Spacing

#### 5.2.1 Transverse Frame Spacing

1. The standard spacing of transverse frames is as obtained from the following formula:

$$2L + 450(mm)$$

2. Transverse frame spacing in fore and after peaks is not to exceed 610mm or the standard spacing specified in -1, whichever is smaller.
3. The requirements in -2 may be modified, where structural arrangement or scantlings are suitably considered.

#### 5.2.2 Longitudinal Frame Spacing

The standard spacing of longitudinal frames is as obtained from the following formula:

$$2L + 550(mm)$$

#### 5.2.3 Consideration for Frame Spacing Exceeding the Standard

Where the spacing of frames is equal to or above the spacing of 250mm greater than the standard spacing in 5.2.1 and 5.2.2, the scantlings and structural arrangement of single and double bottoms and of other relevant structures are to be specially considered.

### 5.3 Transverse Hold Frames

#### 5.3.1 Scantlings

1. The section modulus of transverse hold frames provided below the upper deck between the collision bulkhead and the after peak bulkhead, is not to be less than obtained from the following formula, but in no case is it to be less than 30cm<sup>3</sup>.

$$CS_h l^2 (cm^3)$$

S: Frame spacing (m).

*l*: Vertical distance from the top of inner bottom plating or single bottom floors at side to the top of deck beams above the frames (*m*).

*h*: Vertical distance (*m*) from the lower end of *l* at the place of measurement to a point as specified in the following.

$300m < L \leq 90m$ :  $d + 0.044L - 0.54$  (above top of keel)

$L \geq 90m$ :  $d + 0.038L$  (above top of keel)

*C*: Coefficient obtained from the following.

2.6 for transverse hold frames between  $0.15L$  from the fore end and after peak bulkhead.

3.4 for transverse hold frames between  $0.15L$  from the fore end and the collision bulkhead.

2. Where the height of floor at center line is less than  $B/16$ , the scantlings of frames as specified in -1 are to be suitably increased.

### 5.3.2 Connection of Hold Frames

Hold frames are to be overlapped with heel brackets by at least 1.5 times the depth of frame sections and are to be effectively connected thereon.

## 5.4 Side Longitudinals

### 5.4.1 Side Longitudinals

1. The section modulus of side longitudinals below the upper deck is to be as required in the following (1) and (2):

(1) The section modulus of side longitudinals for the midship part is not to be less than obtained from the following formulae, whichever is greater.

$$8.6Shl^2 \quad (cm^3)$$

$$2.9\sqrt{LS}L^2 \quad (cm^3)$$

*S*: Spacing of longitudinals (*m*).

*l*: Distance between the web frames or between the transverse bulkhead and the web frame (*m*).

*h*: Vertical distance (*m*) from the longitudinals to a point specified in the following.

$30m < L \leq 90m$ :  $d + 0.044L + 0.54$  (above top of keel)

$L \geq 90m$ :  $d + 0.038L$  (above top of keel)

(2) Beyond the midship part, the section modulus of side longitudinals may be gradually reduced towards the end of barges, and may be 0.85 times that obtained from the formula in (1) at the ends. However, the section modulus of side longitudinals between  $0.15L$  from the fore end and the collision bulkhead is not to be less than obtained from the formula in (1).

2. The depth of flat bars used for longitudinals is not to exceed 15 times the thickness of flat bars.

3. Side longitudinals on sheer strakes in the midship part are to be of slenderness ratio not greater than 60.

### 5.4.2 Web Frames

1. The web frames supporting side longitudinals are to be arranged at an interval not exceeding about 4.8 metres at positions where solid floors are provided.

2. The scantlings of web frames are not to be less than obtained from the following formulae:

Section modulus:  $C_1 S h l^2 (cm^3)$

Thickness of web:  $\frac{C_2}{1000} \frac{S h l^2}{d_1} + 2.5 (mm)$

$S$ : Web frame spacing ( $m$ ).

$l$ : Vertical distance from the top of inner bottom plating or single bottom floors at side to the deck at the top of web frames. Where, however, there are effective deck transverses,  $l$  may be measured up to the lower surface of such transverse ( $m$ ).

$h$ : Vertical distance ( $m$ ) from the lower end of  $l$  to a point specified in the following, but is to be taken as 1.431 ( $m$ ), where it is less than 1.431 ( $m$ ).

$30m < L \leq 90m$ :  $+0.044L - 0.54$  (above top of keel)

$L \geq 90m$ :  $d + 0.038L$  (above top of keel)

$d_1$ : Depth of web frames subtracted by the depth of slot for longitudinals ( $m$ ).

$C_1$  and  $C_2$ : Coefficients given in [Table 5.1](#).

3. Web frames are to be provided with tripping brackets at an interval of about 3 metres and stiffeners are to be provided on the webs at each longitudinal. However, for the middle part of the span of web frames they may be provided at alternate longitudinals.

**Table 5.1 Coefficient  $C_1$  and  $C_2$**

	afterward of $0.15L$ from the fore end	between $0.15L$ from the fore end and the collision bulkhead
$C_1$	4.7	6.0
$C_2$	45	58

## 5.5 Frames in Fore and After Peaks

### 5.5.1 Transverse Frames in Fore Peaks

The section modulus of transverse frames below the upper deck forward of the collision bulkhead is not to be less than obtained from the following formula, but in no case is it to be less than  $30cm^3$ .

$8 S h l^2 (cm^3)$

$S$ : Spacing of frames ( $m$ ).

$l$ : Distance between the supports of transverses ( $m$ ), but not to be less than  $2m$ .

$h$ : Vertical distance ( $m$ ) from the centre of  $l$  to a point of  $0.12L$  above the top of keel, but not to be less than  $0.06L$  ( $m$ ).

### 5.5.2 Longitudinal Frames in Fore Peaks

The section modulus of longitudinal frames below the upper deck forward of the collision bulkhead is not to be less than obtained from the following formula. However, the modulus obtained from the formula is to be increased by 25% between  $0.15D$  and  $0.05D$  from the top of keel and 50% below  $0.05D$  from the top of keel.

$$8Shl^2(cm^3)$$

$S$ : Spacing of longitudinals ( $m$ ).

$l$ : Distance between the supports of longitudinals ( $m$ ), but not to be less than  $2m$ .

$h$ : Vertical distance from the longitudinals to a point of  $0.12L$  above the top of keel ( $m$ ), but not to be less than  $0.06L$  ( $m$ ).

### 5.5.3 Transverse Frames in After Peaks

The section modulus of transverse frames below the upper deck forward of after peak bulkhead is not to be less than obtained from the following formula, but in no case is it to be less than  $30cm^3$ :

$$8Shl^2(cm^3)$$

$S$ : Spacing of frames ( $m$ ).

$l$ : Distance between the supports of transverses ( $m$ ), but not to be less than  $2m$ .

$h$ : Vertical distance ( $m$ ) from the centre of  $l$  to a point specified in the following.

$30m < L \leq 90m$ :  $d + 0.044L - 0.54$  (above the top of keel)

$L > 90m$ :  $d + 0.038L$  (above the top of keel)

## 5.6 Superstructure Frames

### 5.6.1 Scantlings

The section modulus of superstructure frames is not to be less than obtained from the following formula:

$$CSlL(cm^3)$$

$S$ : Frame spacing ( $m$ ).

$l$ : Tween deck height ( $m$ ), but not to be less than  $1.8$  metres.

$C$ : Coefficient obtained from the following.

For  $0.125 L$  from the fore end:  $0.74$

For others:  $0.57$

## **Chapter 6 PEAK CONSTRUCTION**

### **6.1 General**

#### **6.1.1 Application**

1. The provisions of this Chapter are applied to the bottom and the side constructions of both end parts. Arrangements to resist panting between both peaks are to be of those maintain a continuity of the structures.
2. The side frames are to be in accordance with the requirements in [Chapter 5](#).

#### **6.1.2 Swash Plates**

In fore and after peaks used for deep tanks, effective swash plates are to be provided at the centre line of the hull or the scantlings of structural members are to be suitably increased.

### **6.2 Arrangements of Construction forward of the Collision Bulkhead**

#### **6.2.1 Constructions and Arrangements**

1. In the place forward of the collision bulkhead, the deep centre girder or the longitudinal bulkhead at the centre line is to be provided, or trusses connecting the centre girder with the deck construction by struts and diagonals are to be arranged.
2. In barges with transverse framing, the floors having sufficient depth are to be arranged in every frame and they are to be supported by the side girders provided at an interval of about 2.5 metres and below. Frames are to be supported by the construction specified in [6.2.2-5](#) to [-7](#) with the spacing of about 2.5 metres.
3. In barges with longitudinal framing, bottom and side longitudinals are to be supported by bottom and side transverse girders provided at an interval of about 2.5 metres. Bottom and side transverse girders are to be supported by side girders and side longitudinal girders or cross tie provided at an interval of about 4.6 metres, respectively. And side transverse girders are to be effectively connected with bottom transverse girders.

#### **6.2.2 Transverse Framing**

1. The thickness of floors and centre girders are not to be less than obtained from the following formula, but need not exceed 11mm:

$$0.045L + 5.5(mm)$$

2. The floors are to extend to such a height as being necessary to give adequate stiffness to the structure and are to be properly stiffened with stiffeners as may be required.
3. The upper edges of the floors and centre girders are to be properly stiffened.
4. The thickness of side girders is to be made nearly equal to that of center girders and the height of side girders to be made adequate corresponding to the floor depth.

5. Where the panting beams are provided at every frame together with perforated steel plates fitted up thereon from side to side, the scantlings of panting beams and steel plates are not to be less than obtained from the following formulae:

Sectional area of panting beams:  $0.1L + 5(cm^2)$

Thickness of steel plates:  $0.02L + 5.5(mm)$

6. Where the side stringers are provided, their scantlings are not to be less than obtained from the following formulae:

Depth of stringer:  $0.2l (m)$ , 2.5 times the depth of slots for transverse frames or the value obtained following formulae, whichever is the greatest.

$L \leq 90m$ :  $0.0053L + 0.25(m)$

$L > 90m$ :  $0.0025L + 0.5(m)$

Section modulus of stringer:  $8Shl^2(cm^3)$

Thickness of web:  $0.02L + 6.5 (mm)$

$S$ : Breadth of area supported by the side stringer.

$h$ : Vertical distance from the centre of  $S$  to a point of  $0.12L (m)$  above the top of the keel ( $m$ ), but not to be less than  $0.06L (m)$ .

$l$ : Distance between the supporting points of side stringers including connections ( $m$ ).

7. Where panting beams are provided on alternate frames and stringer plates which are connected to the shell plating are provided at each tier of panting beams, the scantlings of panting beams and stringer plates are not to be less than obtained from the following formulae.

(1) The sectional area of panting beams is not to be less than obtained from the following formula.

$0.3L (cm^2)$

(2) The scantlings of stringer plates are not to be less than obtained from the following formula. Breadth:

$L \leq 90m$ :  $250 + 5.3L (mm)$

$L > 90m$ :  $500 + 2.5L (mm)$

Thickness:  $6.5 + 0.02L(mm)$

## 6.2.3 Longitudinal Framing

1. Where the bottom transverses are supported along the center line, their scantlings are not to be less than obtained from the following formulae:

Depth of transverse:  $0.2l (m)$  or  $0.0085L + 0.18 (m)$  whichever is greater.

Section modulus of transverses:  $1.2SLl^2(cm^3)$

Thickness of web:  $0.005SLl/d + 2.5 (mm)$  or  $4 + 0.6\sqrt{L}(mm)$ , whichever is greater.

$S$ : Spacing of transverses ( $m$ ).

$l$ : Length of transverses between the supporting points ( $m$ ).

$d$ : Depth of transverse subtracted by the depth of slot for longitudinals ( $mm$ ).

2. The scantlings of centre girders are not to be less than those of bottom transverses specified in -1.

3. The scantlings of side transverses supporting longitudinals are not to be less than obtained from the following formulae:

Depth of transverse:  $0.2l_0$  (m) or 2.5 times the depth of slots for longitudinals, whichever is greater, but in no case is it to be less than obtained from the following formula.

$$L \leq 90: 0.0053L + 0.25 \text{ (m)}$$

$$L > 90: 0.0025L + 0.5 \text{ (m)}$$

Section modulus of transverse:  $8Shl_0^2$  (cm<sup>3</sup>)

Thickness of web:  $0.042 Shl_0/d_1 + 2.5$  (mm) or  $0.02L + 6.5$  (mm), whichever is greater.

$S$ : Spacing of transverse (m).

$d_1$ : As stipulated in -1.

$h$ : Vertical distance from the centre of  $l_0$  to a point of  $0.12L$  (m) above the top of keel (m), however not to be less than  $0.06L$  (m).

$l_0$ : Distance between the supports of side transverses (m).

4. Side transverses are to be provided with stiffeners on webs at every longitudinal.

5. The scantlings of side stringers supporting side transverses are not to be less than obtained from the following formula:

Depth of stringer:  $0.2l_0$  (m) or the value obtained from the following formula, whichever is greater.

$$L \leq 90: 0.0053L + 0.25 \text{ (m)}$$

$$L > 90: 0.0025L + 0.5 \text{ (m)}$$

Section modulus of stringer:  $4Shl_0l_1$  (cm<sup>3</sup>)

Thickness of web:  $0.031 Shl_1/d_1 + 2.5$  (mm) or  $0.02L + 6.5$  (mm), whichever is greater.

$S$ : Spacing of stringers (m).

$h$ : Vertical distance (m) from the centre of  $S$  to a point of  $0.12L$  (m) above the top of keel, but not to be less than  $0.06L$  (m).

$l_0$ : Overall length of side transverses (m)

$l_1$ : Length of side stringers (m)

$d_1$ : Depth of side stringers (m)

6. The scantlings of cross ties supporting the transverses are not to be less than obtained from the following formulae:

Section area:

where  $l/k$  is 0.6 and above:  $\frac{0.77Sbh}{1-0.5(l/k)}$  (cm<sup>2</sup>)

where  $l/k$  is less than 0.6:  $1.1Sbh$  (cm<sup>2</sup>)

$S$ : Spacing of transverses (m).

$b$ : Breadth of area supported by the cross ties (m).

$h$ : Vertical distance from the centre of  $b$  to a point of  $0.12L$  (m) above the top of keel (m), however not to be less than  $0.06L$  (m).

$l$ : Length of the cross ties (m).

$$k: \sqrt{I/A}$$

$I$ : The least moment of inertia of the cross ties ( $cm^4$ ).

$A$ : Sectional area of the cross ties ( $cm^2$ ).

#### 6.2.4 Trusses

The truss structure connecting the bottom and the deck is to comply with the following requirements:

(1) The sectional area of struts is not to be less than obtained from the following formula;

$$0.33Sbl/\{2.72 - (l/k)\}(cm^2)$$

$S$ : Distance between the mid-points of two adjacent spans of girders supported by the struts or bulkheads ( $m$ ).

$b$ : Distance between the mid-points of two adjacent spans of beams supported by the struts or the beam brackets at ship side ( $m$ ).

$l$ : Length of struts ( $m$ ).

$$k: \sqrt{I/A}$$

$I$ : The least moment of inertia of the strut ( $cm^4$ ).

$A$ : Sectional area of the strut ( $cm^2$ ).

(2) Diagonals in trusses are to be arranged at an angle of inclination of about 45 *degrees*, and the section area is not to be less than 0.75 times the area specified in (1) ;

(3) Where the fore peak is used for a deep tank, struts and diagonals are to be of solid section.

### 6.3 Arrangements of Construction abaft After Peak Bulkhead

#### 6.3.1 Floors

The scantlings and arrangement of floors in the after peak are to be in accordance with the requirements in 6.2.2.

#### 6.3.2 Frames

Where the length of girth between the supporting points of frame exceeds 2.5 *metres*, the scantlings of frames are to be increased or suitably strengthened to give adequate stiffness to the structure.

#### 6.3.3 Other Construction Members

Where the requirements of the constructions in the after peak are in accordance with the requirements of the fore peak in 6.2, the scantlings of transverses, stringers, longitudinal frames, struts and diagonals are to be 0.67 times the values specified in 6.2.



## Chapter 7 BEAMS

### 7.1 General

#### 7.1.1 Camber of Weather Deck

The standard camber of weather deck is one-fiftieth the breadth of deck at the midship.

#### 7.1.2 End Connection of Beams

1. Longitudinal beams are to be continuous or to be connected with brackets at their ends in such a manner as to effectively develop the sectional area and to have sufficient strength to bending and tension.
2. Transverse beams are to be connected to frames by brackets.
3. Transverse beams provided at positions where frames are omitted, such as in tween decks or superstructures, are to be connected to the side plating by brackets.

#### 7.1.3 Parts where Longitudinal Beams are transformed to Transverse Beams

In the parts where the longitudinal beams are transformed to the transverse beams, special care is to be taken to keep the continuity of strength.

### 7.2 Longitudinal Beams

#### 7.2.1 Spacing

The standard spacing of the longitudinal beams is obtained from the following formula:

$$2L + 550(mm)$$

#### 7.2.2 Proportion

1. Longitudinal beams are to be supported by deck transverses at intervals of approximately 3.5 metres, and in strength deck of midship part of barge are to be of slenderness ratio not greater than 60. This requirement may, however, be suitably modified where longitudinal beams are given a sufficient strength to prevent buckling.
2. The depth of flat bars used for longitudinal beams is not to exceed 15 times the thickness of flat bars.

#### 7.2.3 Section Modulus of Longitudinal Beams

1. The section modulus of longitudinal beams outside the line of opening on strength decks of midship part of barge is not to be less than obtained from the following formula:

$$1.14Shl^2(cm^3)$$

*S*: Spacing of longitudinal beams (*m*).

*h*: Deck load specified in [14.1](#) (*kN/m<sup>2</sup>*).

*l*: Horizontal distance between bulkhead and deck transverse or between deck transverses (*m*).

2. Beyond the midship part of barge, the section modulus of longitudinal beams outside the line of openings on strength decks may be gradually reduced, but the section modulus is not to be less than obtained from the following formula:

$$0.43Shl^2(cm^3)$$

$S$ ,  $h$  and  $l$ : As specified in -1.

3. The section modulus of longitudinal beams, except where specified in -1 and -2, is not to be less than obtained from the formula in above -2.

#### **7.2.4 Deck Transverse supporting Longitudinal Beams**

Deck transverses supporting longitudinal beams are provided at the positions of solid floors.

### **7.3 Transverse Beams**

#### **7.3.1 Arrangement of Transverse Beams**

Transverse beams are to be provided on every frame.

#### **7.3.2 Proportion**

The length of transverse beams is not to exceed, as far as possible 30 times the depth of transverse beams for strength deck beams and 40 times for superstructure deck beams, respectively.

#### **7.3.3 Section Modulus of Transverse Beams**

The section modulus of transverse beams is not to be less than obtained from the following formula:

$$0.43Shl^2(cm^3)$$

$S$ : Spacing of transverse beams ( $m$ ).

$h$ : Deck load specified in [14.1](#) ( $kN/m^2$ ).

$l$ : Span measured horizontally between adjacent lines of support, or from the inner edge of beam brackets to the nearest line of support ( $m$ ).

### **7.4 Section Modulus of Beams at Deck forming the Top of Bulkhead Recess**

#### **7.4.1 Section Modulus**

The section modulus of beams at decks forming the top of bulkhead recess is to be as required in this Chapter and [10.2.3](#).

## **7.5 Section Modulus of Beams at Deck forming the Top of Deep Tanks**

### **7.5.1 Section Modulus**

The section modulus of beams at deck forming the top of deep tanks is to be as required in this Chapter and [11.2.2.](#)

## **7.6 Beams to carry Specially Heavy Concentrated Loads**

### **7.6.1 Reinforcement of Deck Beams**

Special heavy beams, deck girders, pillars etc. are to be arranged where the beams carry specially heavy concentrated loads, such as at the ends of superstructures and deckhouses, in way of masts, winches, windlasses, auxiliary machinery, etc.

## Chapter 8 PILLARS AND TRUSSES

### 8.1 General

#### 8.1.1 Arrangement

1. Pillars and trusses are to be provided in line with girders in single bottom or double bottom or as close thereto as practicable. And the structures under pillars and trusses are to be of sufficient strength to distribute the load effectively.
2. The head and heel of pillars and trusses which may be subjected to tensile loads such as pillars and trusses supporting bulkhead recesses or deep tank tops are to be efficiently connected to withstand the tensile loads.

### 8.2 Scantlings of Pillars

#### 8.2.1 Sectional Area of Pillars

The sectional area of pillars is not to be less than obtained from the following formula:

$$0.233w / \{2.72 - (l/k)\} (cm^2)$$

$l$ : Length of the pillars ( $m$ )(See [Fig. 8.1](#)).

$$k: \sqrt{I / A}$$

$I$ : The least moment of inertia of the pillar ( $cm^4$ ).

$A$ : Sectional area of the pillar ( $cm^2$ ).

$w$ : Deck load supported by pillars as specified in [8.2.2](#) ( $kN$ ).

#### 8.2.2 Load supported by Pillars

Load ( $w$ ) supported by pillars is not to be less than obtained from the following formula:

$$Sbh \text{ (kN)}$$

$S$ : Distance between the mid-points of two adjacent spans of girders supported by the pillars or the stiffeners or the girders on bulkheads ( $m$ ). (See [Fig. 8.1](#))

$b$ : Distance between the mid-points of two adjacent spans of beams supported by the pillars or the beam brackets ( $m$ ). (See [Fig. 8.1](#))

$h$ : Deck loads specified in [14.1](#) for the deck supported ( $kN/m^2$ ).

#### 8.2.3 Thickness of Plates of Pillars

1. The plate thickness of tubular pillars is not to be less than obtained from the following formula:

$$0.022d_p + 4.6 \text{ (mm)}$$

$d_p$ : Outside diameter of the tubular pillar ( $mm$ ).

This requirement may, however, be suitably modified for pillars provided in accommodation spaces.

2. The thickness of web and flange of built-up pillars is to be a sufficient thickness to prevent local buckling.

#### 8.2.4 Outside Diameters of Round Pillars

The outside diameter of solid round pillars and tubular pillars is not to be less than 50mm.

#### 8.2.5 Pillars provided in Deep Tanks

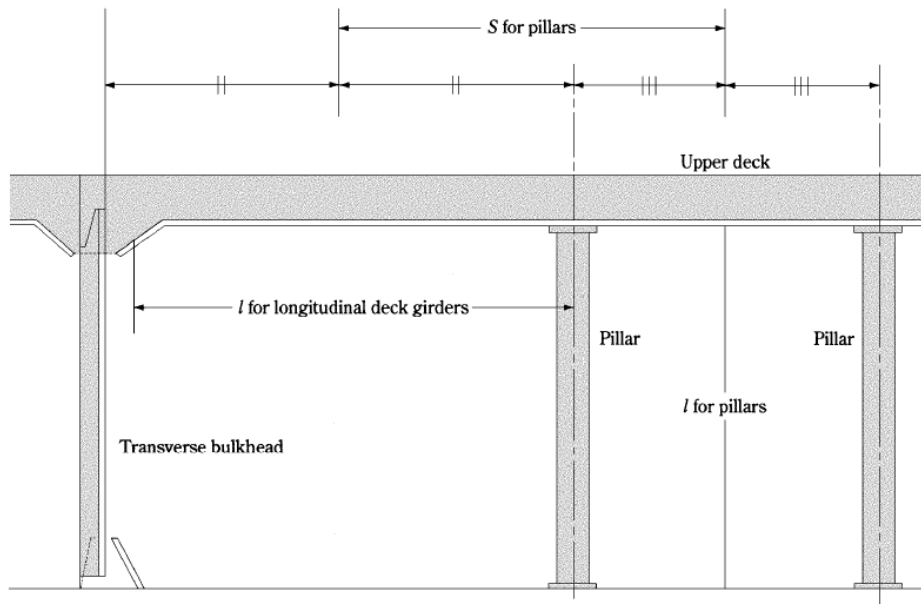
1. Pillars installed in deep tanks are not to be of tubular section.
2. The sectional area of pillars is not to be less than obtained from both the formula in [8.2](#) and the following formula:

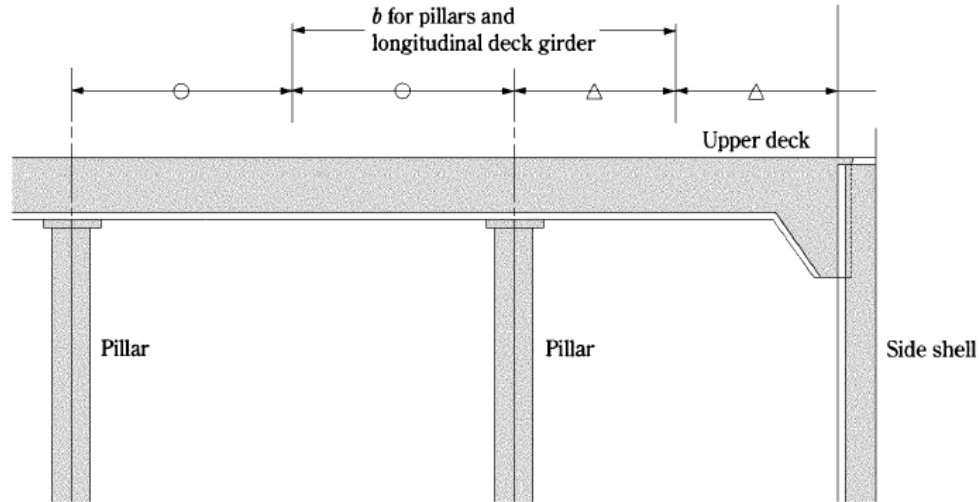
$$1.09 Sbh \text{ (cm}^2\text{)}$$

$S$  and  $b$ : as specified in [8.2.2](#).

$h$ : 0.7 times the vertical distance from the top of deep tanks to the point of 2.0 metres above the top of overflow pipe (m).

**Fig. 8.1 The Way of Measuring  $S$ ,  $b$  and  $l$  for Pillars, Transverse and Longitudinal Girder**





## 8.3 Trusses

### 8.3.1 Pillars

The scantlings of pillars in the truss structure are to comply with the requirements in [8.2.1](#).

### 8.3.2 Diagonals

1. Diagonals in trusses are to be arranged so as to have angle of inclination of about 45 degrees.
2. The sectional area of diagonals is not to be less than 0.5 times the value specified in [8.3.1](#).

## Chapter 9 DECK LONGITUDINAL GIRDERS AND TRANSVERSE GIRDERS

### 9.1 General

#### 9.1.1 Application

Deck transverse girders supporting longitudinal beams and deck longitudinal girders supporting transverse beams are to comply with the requirements in this Chapter.

#### 9.1.2 Arrangement

In way of the bulkhead recesses and the top of tanks, the deck girders are to be arranged not exceeding 4.6 *metres* as far as practicable.

#### 9.1.3 Construction

1. Deck girders are to have the face plates provided along the lower edge of girder plates.
2. Tripping brackets are to be provided at an interval of about 3 *metres* and where the breadth of face plates exceeds 180 *mm* on either side of the girder, these brackets are to be so arranged as to support the face plates as well.
3. The thickness of face plates forming girders is not to be less than that of web plates and the width of the face plates is not to be less than obtained from the following formula:

$$85.4\sqrt{d_0 l} \text{ mm}$$

$d_0$ : Depth of girders (*m*).

$l$ : Distance between the supports of girders (*m*). Where, however, effective tripping brackets are provided, they may be taken as the supports.

4. The depth of girders between bulkheads is to be constant, and not to be less than 2.5 times that of slots.
5. Girders are to provide sufficient rigidity to avoid occurrence of unacceptable deflection in decks and to avoid occurrence of unacceptable stress at the ends of deck beams.

#### 9.1.4 End Connection

1. End connections of deck girders are to be in accordance with the requirements in [2.1.4](#).
2. Bulkhead stiffeners and girders at the ends of deck girders are to be suitably strengthened to support deck loads.
3. Longitudinal deck girders are to be continuous or to be effectively connected so as to maintain the continuity at ends.

## 9.2 Deck Longitudinal Girders

### 9.2.1 Section Modulus of Girders

1. The section modulus of deck longitudinal girders outside the line of openings on upper decks of midship part of barge is not to be less than obtained from the following formula:

$$1.29bhl^2(cm^3)$$

*b*: Distance between the centres of two adjacent spans of beams supported by the girder or the beam bracket (*m*).

*h*: Deck loads specified in [14.1](#) for the deck supported (*kN/m<sup>2</sup>*).

*l*: Span between the centres of pillars or from the centre of pillar to the bulkhead (*m*). Where the deck longitudinal girder is effectively bracketed to bulkhead, *l* may be suitably modified.

2. Beyond the midship part of barge, the section modulus of deck longitudinal girders outside the line of openings on upper decks may be gradually reduced, but the section modulus is not to be less than obtained from the following formula:

$$0.484bhl^2(cm^3)$$

*b*, *h* and *l*: As stipulated in -1.

3. The section modulus of deck longitudinal girders, except where specified in -1 and -2, is not to be less than obtained from the formula above -2.

### 9.2.2 Thickness of Web Plates

The thickness of web plates is not to be less than obtained from the following formula:

$$10S_1 + 2.5(mm)$$

*S<sub>1</sub>*: Spacing of web stiffeners or depth of the girders (*m*), whichever is smaller.

## 9.3 Deck Transverse Girders

### 9.3.1 Section Modulus of Girders

The section modulus of deck transverse girders is not to be less than obtained from the following formula:

$$0.484 bhl^2(cm^3)$$

*b*: Distance between the mid-points of two adjacent spans of beams supported by girders or bulkheads.

*h*: Deck loads specified in [14.1](#) for the deck supported (*kN/m<sup>2</sup>*).

*l*: Distance between centres of pillars or from the centre of the pillar to the beam bracket (*m*).

### 9.3.2 Thickness of Web Plates

The thickness of web plates is to be generally in accordance with the requirements in [9.2.2](#).



## **9.4 Deck Girders in Tanks**

### **9.4.1 Section Modulus of Girders**

The section modulus of deck girders in tanks is to comply with the requirements in [9.2.1](#) or [9.3.1](#) and in [11.2.3-1](#) simultaneously.

### **9.4.2 Thickness of Web Plates**

The thickness of web plates is to comply with the requirements in [11.2.3-3](#).

## **9.5 Hatch Side Girders**

### **9.5.1 Girders having Deep Coamings above Decks**

Where deep coamings are provided above decks such as hatchways in weather decks, the coaming plate up to an including the horizontal coaming stiffener may be added to the calculation of the section modulus subject to the approval by the Society.

### **9.5.2 Brackets of Hatch Side Girders not extended to Bulkheads**

Where hatch side girders do not extend to the bulkheads, brackets extending for at least two frame spaces beyond the ends of hatchways are to be provided.

### **9.5.3 Strength Continuity at Hatchway Corners**

At hatchway corners, the face plates of hatch side girders and hatch end beams are to be effectively connected so as to maintain the strength continuity.

## **9.6 Hatch End Beams**

### **9.6.1 Scantlings**

The construction and scantlings of hatch end beams are to be generally in accordance with the requirements in [9.3](#) and [9.4](#).

## **Chapter 10 WATERTIGHT BULKHEADS**

### **10.1 Arrangement of Watertight Bulkheads**

#### **10.1.1 Collision Bulkheads**

The barges are to have a collision bulkhead located between  $0.05L$  and  $0.08L$  from the fore side of stem on the load line. However, in barges of 90 metres and under in length, the maximum distance from the fore side of stem may be  $0.13L$  (m).

#### **10.1.2 After Peak Bulkheads**

The barges are to have an after peak bulkhead situated at a suitable position.

#### **10.1.3 Hold Bulkheads**

The barges are to have hold bulkheads so as to make the spacing of adjacent bulkheads to be under 30m as possible, in addition to the bulkheads specified in [10.1.1](#) and [10.1.2](#).

#### **10.1.4 Height of Watertight Bulkheads**

The watertight bulkheads required in [10.1.1](#) to [10.1.3](#) are to extend to the upper deck with the following exceptions:

- (1) Where a forecastle having openings without closing appliances led to a space below the upper deck is provided, or where a forecastle of  $0.25L$  or above in length is provided, the collision bulkhead is to extend up to the forecastle deck. However, the extended part above the upper deck may be provided within the limit of bulkhead position specified in [10.1.1](#) and may be weathertight.
- (2) The aft peak bulkhead may terminate at a deck below the upper deck and above the load line, provided that this deck is watertight to the stern of the barge.

#### **10.1.5 Chain Lockers**

Chain Lockers located abaft the collision bulkhead or in the fore peak tank are to be watertight and to be provided with means for drainage by pumps.

### **10.2 Construction of Watertight Bulkheads**

#### **10.2.1 Thickness of Bulkhead Plates**

The thickness of bulkhead plates is not to be less than obtained from the following formula:

$$3.2\sqrt{h} + 2.5(mm)$$

$S$ : Spacing of stiffeners (m).

*h*: Vertical distance measured from the lower edge of the plates to the upper deck at the centre line of barge (*m*). In no case is it to be less than 3.4 metres.

### 10.2.2 Increase in Thickness of Plates of Special Parts

1. The thickness of the lowest strake of bulkhead plating is to be at least 1 mm thicker than obtained from the formula in [10.2.1](#).
2. The lowest strake of bulkhead plating is to extend at least about 600 mm above the top of inner bottom plating in way of double bottom or about 900 mm above the top of keel in way of single bottom. Where the double bottom is provided only on one side of the bulkhead, the extension of the lowest strake is to be effected up to either height according to the preceding sentence, whichever is greater.
3. The bulkhead plating in the limber is to be at least 2.5 mm thicker than given in [10.2.1](#).
4. The thickness of deck plating in way of bulkhead recesses is to be at least 1mm greater than that given by [10.2.1](#), regarding the deck plating as bulkhead plating and the beams as stiffeners respectively. In no case is the thickness to be less than that required for deck plating in that location.

### 10.2.3 Stiffeners

The section modulus of bulkhead stiffeners is not to be less than obtained from the following formula:

$$2.8 CShl^2(cm^3)$$

- l*: Span measured between the adjacent supports of stiffeners including the length of connection (*m*).  
Where girders are provided, *l* is the distance from the heel of end connection to the first girder or the distance between the girders.
- S*: Spacing of stiffeners (*m*).
- h*: Vertical distance measured from the mid-point of *l* for vertical stiffeners, and from the mid-point of the distance between the adjacent stiffeners for horizontal stiffeners, to the top of upper deck at the centre line of barge (*m*). Where the vertical distance is less than 6.0 metres, *h* is to be taken as 0.8 times the vertical distance plus 1.2 metres
- C*: Coefficients as given in [Table 10.1](#).

### 10.2.4 Collision Bulkheads

For collision bulkheads, the plate thickness and section modulus of stiffeners are not to be less than those specified in [10.2.1](#) and [10.2.3](#) taking *h* as 1.25 times the specified height.

### 10.2.5 Girders Supporting Bulkhead Stiffeners

1. The section modulus of girders is not to be less than obtained from the following formula:

$$4.75Shl^2(cm^3)$$

- S*: Breadth of the area supported by the girder (*m*).



$h$ : Vertical distance measured from the mid-point of  $l$  for vertical girders, and from the mid-point of  $S$  for horizontal girders, to the top of upper deck at the centre line of barge ( $m$ ). Where the vertical distance is less than 6.0 metres,  $h$  is to be taken as 0.8 times the vertical distance plus 1.2 metres.

$l$ : Span between the adjacent supports of girders ( $m$ ).

- The moment of inertia of girders is not to be less than that obtained from the following formula. In no case is the depth of girders to be less than 2.5 times the depth of slots for stiffeners.

$$10hl^4(cm^4)$$

$h$  and  $l$ : As specified in -1.

- The thickness of web plates is not to be less than obtained from the following formula:

$$10S_1 + 2.5(mm)$$

where:

$S_1$ : Spacing of web stiffeners or depth of girders, whichever is smaller ( $m$ ).

- Tripping brackets are to be provided at an interval of about 3 metres, and these brackets are to be so arranged as to support the face plates.

**Table 10.1 Value of  $C$**

The other end of stiffeners	One end of stiffeners	
	Lug-connection, bracketed or supported by vertical girders	End of stiffeners unattached
Lug-connection, bracketed or supported by vertical girders	1.00	1.35
End of stiffeners unattached	1.35	2.00

## Chapter 11 DEEP TANKS

### 11.1 General

#### 11.1.1 Definition

The deep tank is a tank used for carriage of water, fuel oil and other liquids, forming a part of the hull construction. The deep tanks used for carriage of oils are designated as “keep oil tanks”, if necessary.

#### 11.1.2 Application

1. Peak tank bulkheads and boundary bulkheads of deep tank (excluding the deep tanks for carriage of oils having a flashpoint 60°C and below) are to be constructed in accordance with the requirements in this Chapter. Where the bulkhead of deep tank partly serves as a watertight bulkhead, the part of the bulkhead is to be in accordance with the requirements in [Chapter 10](#), as well.
2. The requirements in [Chapter 22](#) are to be applied to the bulkheads of the deep tanks for carriage of oils having a flashpoint 60°C and below, in addition to those in this Chapter.

#### 11.1.3 Divisions in Tanks

1. Deep tanks are to be of proper size and to be provided with such longitudinal watertight divisions as necessary to meet the requirements for stability of the barge in service conditions as well as while the tanks are being filled or discharged.
2. Tanks for fresh water or fuel oil or those which are not intended to be kept entirely filled in service conditions are to have additional divisions or deep wash plates as are necessary to minimize the dynamic forces acting to the structure.
3. Where it is impracticable to comply with the requirements in -2, the scantlings required in this Chapter are to be properly increase.

### 11.2 Deep Tank Bulkheads

#### 11.2.1 Bulkhead Plates

The thickness of deep tank bulkhead plating is not to be less than obtained from the following formula:

$$3.6S\sqrt{h} + 3.5 \text{ (mm)}$$

*S*: Spacing of stiffeners (*m*).

*h*: Vertical distance measured from the lower edge of plate to the mid-point of the distance between the top of tanks and the top of overflow pipes (*m*), or 0.7 times the vertical distance measured from the lower edge of plate to the point of 2.0 metres above the top of overflow pipes (*m*), whichever is greater.

### 11.2.2 Bulkhead Stiffeners

The section modulus of bulkhead stiffeners is not to be less than obtained from the following formula:

$$7CS hl^2 (cm^3)$$

$S$  and  $l$ : As specified in [10.2.3](#).

$h$ : Vertical distance measured from the lower end to the mid-point of the distance between the top of tanks and the top of overflow pipes ( $m$ ), or 0.7 times the vertical distance measured from the lower end to the point of 2.0 metres above the top of overflow pipes ( $m$ ), whichever is greater; the lower end being regarded as the mid-point of  $l$  for vertical stiffeners, and as the mid-point of the distance between the adjacent stiffeners for horizontal stiffeners.

$C$ : Coefficient given in [Table 11.1](#), according to the type of end connections.

**Table 11.1 Values of  $C$**

The other end of stiffeners	One end of stiffeners		
	Connection by brackets	Lug-connection or supported by girders	End of stiffener unattached
Connection by brackets	0.70	0.85	1.30
Lug-connection or supported by girders	0.85	1.00	1.50
End of stiffeners unattached	1.30	1.50	1.50

### 11.2.3 Girders supporting Bulkhead Stiffeners

1. The section modulus of girders is not to be less than obtained from the following formula:

$$7.13Shl^2 (cm^3)$$

$S$ : Breadth of the area supported by the girder ( $m$ ).

$h$ : Vertical distance measured from the mid-point of  $S$  for horizontal girders, and from the mid-point of  $l$  for vertical girders, to the top of  $h$  specified in [11.2.2](#) ( $m$ ).

$l$ : Span between the adjacent support of girders ( $m$ ).

2. The moment of inertia of girders is not to be less than obtained from the following formula. In no case is the depth of girders to be less than 2.5 times the depth of slots for stiffeners.

$$30hl^4 (cm^4)$$

$h$  and  $l$ : As specified in -1.

3. The thickness of web plates is not to be less than obtained from the following formula:

$$10S_1 + 3.5 (mm)$$

$S_1$ : Spacing of web stiffeners or the depth of girders, whichever is smaller ( $m$ ).

#### **11.2.4 Top and Bottom Construction**

The scantlings of the members forming the top or the bottom of deep tanks are to be in accordance with the requirements in this Chapter, regarding the members as the members forming the deep tank bulkheads at the location.

In no case are they to be less than required for the deck plating or the bottom plating at the location. For top plating of deep tanks, the thickness of plates is to be at least 1 *mm* greater than the thickness specified in [11.2.1](#).

#### **11.2.5 Scantlings of Members not in Contact with Sea Water**

The thickness of plates of bulkheads and girders which are not in contact with sea water in service conditions may be reduced from the requirements in [11.2.1](#) and [11.2.3-2](#) by the values given below. However, to bulkhead plates in way of the location such as bilge wells are not to be applied such reduction.

For the plates of which only one side is in contact with sea water: 0.5 *mm*

For the plates of which neither side is in contact with sea water: 1.0 *mm*

### **11.3 Fittings of Deep Tanks**

#### **11.3.1 Limbers and Air Holes**

Limbers and air holes are to be cut suitably in the structural members to ensure that air or water does not remain stagnated in any part of the tank.

#### **11.3.2 Cofferdams**

1. Oiltight cofferdams are to be provided between tanks for carrying oils and those for carrying fresh water such as that for living use, boiler feed water etc., which may cause any trouble when oil mixes therein.
2. Crew spaces are not to be directly adjacent to the tanks for carriage of fuel oil. Such compartments are to be separated from the fuel oil tanks by cofferdams which are well ventilated and accessible. Where the top of fuel oil tanks has no opening and is coated by incombustible covering of 38*mm* and over in thickness, the cofferdam between such compartments and the top of fuel oil tanks may be omitted.

## Chapter 12 LONGITUDINAL STRENGTH

### 12.1 Longitudinal Strength

#### 12.1.1 Section Modulus of Hull

1. The section modulus of the hull for the midship part is not to be less than obtained from the following formulae, whichever is greater:

$$Z_1: 0.95K_1L^2B(Cb + 0.7)(cm^3)$$

$$Z_2: 6.63C[1.28K_2L^2BC_b(1 + 0.04L/B) + Ms](cm^3)$$

$K_1$  : As obtained from the following formulae:

$$L \geq 90m: 10.75 - \left(\frac{300 - L}{100}\right)^{3/2}$$

$$L < 90m: 0.03L + 5$$

$C_b$ : Block coefficient, the ratio of the volume of the moulded displacement corresponding to the load line to  $LBd$ .

$$K_2: 0.0028L + 0.46$$

$C$ : As given in [Table 12.1](#).

$Ms$ : Longitudinal bending moment in still water specified in -2 ( $kN-m$ ).

2. The longitudinal bending moments in still water,  $Ms$ , are taken the maximum sagging and hogging moments calculated for all of designed loaded and ballast conditions by the method deemed appropriate by the Society. Furthermore, in a pusher barge, the effect of the joint part is to be considered to the longitudinal bending moment.

3. For barges less than 60 metres in length the requirement of  $Z_2$  in -1 above may be dispensed with. However, longitudinal bending moment in still water are to be calculated for barges designed for special loading or ballasting.

#### 12.1.2 Calculation of Section Modulus of Hull

The section modulus of the hull is to be calculated in accordance with the followings:

- (1) The section module at the upper deck and at the bottom are to be calculated by dividing the moment of inertia of the athwartship section about its horizontal neutral axis by the vertical distance from the neutral axis to the top of upper deck beams at side, and by the vertical distance from the neutral axis to the top of keel, respectively.
- (2) Below the upper deck, all longitudinal members which are considered effective to the longitudinal strength of the hull may be included in the calculation. Above the upper deck, only the extensions of the sheer strakes may be included in the calculation.
- (3) Deck openings on the strength deck are to be deducted from the sectional area used in the section modulus calculation. However, small openings not exceeding 2.5 metres in length or 1.2 metres in breadth need not



be deducted, provided that the sum of their breadths in one transverse section is not more than  $0.06(B - \Sigma b)$

Where,  $\Sigma b$  is the sum of the openings exceeding 1.2 metres in breadth or 2.5 metres in length ( $m$ ).

(4) The area is in  $mm^2$  and the distance in metres.

### 12.1.3 Loading Manual

In order to enable the master to adjust the loading of cargo and ballast avoiding occurrence of unacceptable stress in the structure of the barge, loading manual approved by the Society is to be supplied to the master. However, this manual may not be required in the case of barges for which the Society considers such manual is not necessary.

**Table 12.1 Coefficient  $C$**

	Sagging condition	Hogging condition
Upper deck	1.00	1.03
Bottom	1.06	1.03

## Chapter 13 SHELL PLATINGS

### 13.1 General

#### 13.1.1 Consideration for Corrosion

The thickness of shell plating at such parts that the corrosion is considered excessive due to the location and/or special service condition of the barge is to be properly increased over that required in this Chapter.

#### 13.1.2 Special Consideration for Contact with Quay, etc.

For barges having many opportunities of contact with quay etc., special consideration is to be given to the thickness of shell plating to prevent indent of shell plating.

#### 13.1.3 Stems

The thickness of steel plate stem at the load waterline is not to be less than obtained from the following formula. Above and below the load waterline, the thickness may be gradually tapered toward the stem head and the keel.

$$0.1L + 4.0 \text{ (mm)}$$

### 13.2 Plate Keels

#### 13.2.1 Breadth and Thickness of Plate Keels

1. The breadth of plate keel over whole length of the barge is not to be less than obtained from the following formula.

Breadth:

$$L \geq 90m: 2L + 1000 \text{ (mm)}$$

$$L < 90m: 4.5L + 775 \text{ (mm)}$$

2. The thickness of plate keel over whole length of the barge is not to be less than the bottom shell thickness obtained from the requirement in [13.3.4](#) increased by 1.5mm, this thickness, however, is not to be less than that of the adjacent bottom shell plating.

3. As for the pontoon barges, the thickness of plate keel may be equal to that of bottom shell plating, notwithstanding the above provision of -2.

### 13.3 Shell Plating for Midship Part of Barge

#### 13.3.1 Minimum Thickness

The thickness of shell plating below the upper deck for the midship part of barge is not to be less than obtained from the following formula:

$$0.044L + 5.6 \text{ (mm)}$$

### 13.3.2 Thickness of Side Shell Plating

1. The thickness of side shell plating for midship part of barge other than the sheer strake is not to be less than obtained from the following formula:

$$4.1 S \sqrt{d + 0.04L} + 2.5 \text{ (mm)}$$

$S$ : Spacing of longitudinal or transverse frames ( $m$ ).

2. In barges with square bilge, the thickness of the lowest strake of side shell plating is not to be less than obtained from the formula in -1 and [13.3.4](#), whichever is greater.

### 13.3.3 Sheer Strakes

The thickness of sheer strakes is not to be less than 0.75 times that of the outermost strake of deck plating. In no case, however, is the thickness to be less than that of the adjacent side shell plating.

### 13.3.4 Thickness of Bottom Shell Plating

The thickness of bottom shell plating (including bilge strake and excluding keel plate) for the midship part of barge is to be as required in the following (1) or (2):

(1) In barges with transverse framing, the thickness is not to be less than obtained from the following formula:

$$4.7S\sqrt{d + 0.035L} + 2.5 \text{ (mm)}$$

$S$ : Spacing of transverse frames ( $m$ ).

(2) In barges with longitudinal framing, the thickness is not to be less than obtained from the following formula

$$4.0S\sqrt{d + 0.035L} + 2.5 \text{ (mm)}$$

$S$ : Spacing of longitudinal frames ( $m$ ).

## 13.4 Shell Plating for End Parts

### 13.4.1 Shell Plating for End Parts

Beyond the midship part of barge, the thickness of shell plating may be gradually reduced, but the thickness of shell plating for  $0.1L$  from the end parts is not to be less than obtained from the following formula.

$$0.044L + 5.6 \text{ (mm)}$$

### 13.4.2 Shell Plating at the Strengthened Bottom Forward

The thickness of shell plating at the strengthened bottom forward is to be as required in the following (1), (2) and (3):

- (1) In barges having the bow draught not more than  $0.025L$  at the ballast condition, the thickness of shell plating at the strengthened bottom forward is not to be less than obtained from the following formula:

$$2.15S\sqrt{L} + 2.5(mm)$$

$S$ : Spacing of frames, girders or longitudinal shell stiffeners, whichever is the smallest ( $m$ ).

- (2) In barges having the bow draught not less than  $0.037L$  at the ballast condition, the thickness of shell plating at the strengthened bottom forward may be as specified in [13.4.1](#).
- (3) In barges having intermediate value of the bow draught specified in (1) and (2), the thickness is to be obtained by liner interpolation from the requirements in (1) and (2).

## 13.5 Side Plating in Way of Superstructure

### 13.5.1 Side Plating in Way of Superstructure

The thickness of side plating in way of superstructure is not to be less than obtained from the following formulae, but in no case is it to be less than  $5.5\text{ mm}$ .

For  $0.25 L$  from the fore end:  $1.15SL + 2.0\text{ (mm)}$

For elsewhere:  $0.94S\sqrt{L} + 2.0(mm)$

$S$ : Spacing of longitudinal or transverse frames ( $m$ ).

## 13.6 Local Compensation of Shell Plating

### 13.6.1 Shell Plating fitted with Hawse Pipes and the Plating below

The shell plating fitted with hawse pipes and the plating below are to be increased in thickness or to be doubled, and their longitudinal seams are to be protected against damages by anchors or cables.

### 13.6.2 Shell Plating with Transverse Framing

In barges with transverse framing, special consideration is to be given to the shell plating to prevent buckling. And stiffeners of suitable scantlings spaced less than two times hold frame space are to be provided to the bottom shell for the midship part of barge. For barges less than  $60\text{ metres}$  in length, this stiffening may be suitably modified.

## Chapter 14 DECKS

### 14.1 Deck Load

#### 14.1.1 Value of $h$

1. Deck load  $h$  ( $kN/m^2$ ) for decks intended to carry ordinary cargoes or stores is to be in accordance with the following (1) through (3) :

- (1)  $h$  is to be equivalent to the standards given by 7 times the tween deck height at side of the space ( $m$ ), or 7 times the height from the deck concerned to the upper edge of hatch coaming of the above deck ( $m$ ). However,  $h$  may be specified as the maximum design cargo weight per unit area of deck ( $kN/m^2$ ). In this case, the value of  $h$  is to be determined by considering the loading height of cargo.
- (2) Where timber and/or other cargoes are intended to be carried on the weather deck,  $h$  is to be the maximum design cargo weight per unit area of deck ( $kN/m^2$ ), or the value specified in -2, whichever is greater.
- (3) Where cargoes are suspended from the deck beams or deck machinery is installed,  $h$  is to be suitably increased.

2. Deck load  $h$  ( $kN/m^2$ ) for the weather deck is to be as specified in the following (1) to (3) :

- (1)  $h$  for the freeboard deck and the superstructure deck and the top of deckhouses on the freeboard deck is not to be less than obtained from the following formula:

$$a (bf - y) (kN/m^2)$$

$a, b$ : As given in [Table 14.1](#).

$f$ : As obtained from the following formula:

$$L < 90m: 0.067L$$

$$90m \leq L \leq 150m: 0.051L + 1.45$$

$y$ : The vertical distance from load line to weather deck at side and as specified in the following:

- (a) For the deck for  $0.15L$  from the fore end,  $y$  is to be measured at the fore end.
- (b) For the deck between  $0.3L$  and  $0.15L$  from the fore end,  $y$  is to be measured at the position of  $0.15L$  from the fore end.
- (c) For the deck for  $0.2L$  from the after end,  $y$  is to be measured at the after end.
- (d) For the deck, except those in (a), (b) and (c),  $y$  is to be measured at midship.

- (2)  $h$  for deck in Line II in [Table 14.1](#), need not exceed that in Line I.

- (3)  $h$  is not to be less than obtained from the following formulae in [Table 14.2](#), irrespective of the provisions in (1) and (2). Where  $h$ -value calculated from the formulae in [Table 14.2](#) is less than 12.8,  $h$ -value is to be taken as 12.8.

3. For an enclosed part of superstructure decks and of top of deckhouses in accommodation or navigation spaces, at the first and second tier above the freeboard deck,  $h$  is to be 12.8.

**Table 14.1 Values of  $a$  and  $b$**

Column			I	II	III	IV
Position of deck			Forward of $0.15L$ abaft the fore end	Between $0.3L$ and $0.15L$ abaft the fore end	Between $0.3L$ from the fore end and $0.2L$ afore the after end	Afterward of $0.2L$ afore the after end
a	Deck plates		14.7	11.8	6.90	9.80
	Beams	$L<90m$	9.80	7.85	4,60	6.60
		$90m\leq L\leq 150m$	$9.81\ (0.84L / 100+0.25)$	$9.81\ (0.67L / 100+0.2)$	$9.81\ (0.38L / 100+0.13)$	$9.81\ (0.55L / 100+0.18)$
	Deck girders		7.35	5.90	$2.25^1$ or $3.45^2$	4.90
	Pillars		4.90	3.90	2.25	3.25
$b$			1.42	1.20	1.00	1.15

Notes:

- 1 In case of longitudinal deck girders outside the line of hatchway opening of the strength deck for midship part.
- 2 In case of deck girders other than 1.

**Table 14.2 Minimum Values of  $h$**

Column			I and II	III	IV
Position of deck			Forward of $0.15L$ abaft the fore end	Between $0.3L$ from the fore end and $0.2L$ afore the after end	Afterward of $0.2L$ afore the after end
a	$h$		$C\sqrt{L + 50}$		$C\sqrt{L}$
	Deck plates		4.20	2.05	2.95
	Beams	$L < 90m$	2.85	1.37	1.95
		$90m \leq L \leq 150m$	$0.0981 (0.23L + 8.3)$	$0.0981 (0.12L + 3.2)$	$0.0981 (0.17L + 8.3)$
	Transverse girders, longitudinal girders and pillars		1.37	1.18	1.47

## 14.2 General

### 14.2.1 Steel Deck Plating

Decks are to be plated from side to side of the ship except deck openings, etc. Decks, however, may be provided with only stringer plates and tie plates, subject to the approval by the Society.

### 14.2.2 Watertightness of Decks

Weather decks are to be made watertight. Weather decks, however, may be made weathertight, subject to the approval by the Society.

### 14.2.3 Compensation for Openings

Hatchways or other openings on decks are to have well rounded corners, and suitable compensation is to be provided as necessary.

## 14.3 Effective Sectional Area of Strength Deck

### 14.3.1 Definition

The effective sectional area of strength deck is the sectional area, on each side of the deck, of steel plating, longitudinal beams, girders and other structural members extending for  $0.5L$  amidships.

### 14.3.2 Effective Sectional Area of Strength Deck

1. The effective sectional area of strength deck for the midship part of barge is to be so determined as to comply with the requirements in [Chapter 12](#).
2. Beyond the midship part of barge, the effective sectional area may be gradually reduced, and at  $0.15L$  from both ends it is not to be less than 0.5 times the area required for the midship part.

## 14.4 Thickness of Deck Plating

### 14.4.1 Thickness of Deck Plating

1. The thickness of deck plating is not to be less than obtained from the formulae in (1) and (2). Within superstructures or steel deckhouses, the thickness may be reduced by  $1mm$  from that obtained from the formula:

- (1) The thickness of strength deck plating outside the line of openings for the midship part is not to be less than obtained from the following formula.

- (a) For decks with longitudinal beams

$$1.47S\sqrt{h} + 2.5 \text{ (mm)}$$

- (b) For decks with transverse beams

$$1.63S\sqrt{h} + 2.5 \text{ (mm)}$$

$S$ : Spacing of longitudinal or transverse beams.

$h$ : Deck load specified in 14.1 ( $kN/m^2$ ).

- (2) The thickness of strength deck plating except where specified in (1) and of other decks is not to be less than obtained from the following formula:

$$1.25S\sqrt{h} + 2.5 \text{ (mm)}$$

$S$  and  $h$ : As specified in (1).

2. Where strength deck is transversely framed, or decks inside the line of openings are longitudinally framed, sufficient care is to be taken to prevent buckling of the deck plating.

#### **14.4.2 Deck Plating forming Part of Tanks**

The thickness of deck plating which forms part of tanks is not to be less than required in [Chapter 11](#) for deep tank bulkhead plating, taking the beam spacing as the stiffener spacing.

#### **14.4.3 Deck Plating under Boilers or Refrigerated Cargoes**

1. The thickness of deck plating under boilers is to be increased by 3 *mm* above the normal thickness.
2. The thickness of deck plating under refrigerating chamber is to be increased by 1 *mm* above the normal thickness. Where special means for the protection against the corrosion of the deck is provided, the thickness need not be increased.



## Chapter 15 SUPERSTRUCTURES

### 15.1 General

#### 15.1.1 Application

1. The construction and scantlings of superstructures are to be in accordance with the requirements in the relevant Chapters in addition to this Chapter.
2. The requirements in this Chapter apply to the first tier superstructure above the upper deck. The construction and scantlings of the second tier superstructure and over above the upper deck are to be in accordance with the discretion of the Society.
3. As for the superstructures in barges with specially large freeboard, the construction of bulkhead may be suitably modified subject to the approval by the Society.

### 15.2 Superstructure End Bulkheads

#### 15.2.1 Water Head $h$

1. The water head  $h$  for the calculation of the scantlings of superstructure end bulkheads is not to be less than obtained from the following formula:

$$ac(bf - y)(m)$$

$f$ : As obtained from the following formulae:

$$L \leq 90m: 0.067L$$

$$90m < L \leq 150m: 0.051L + 1.45$$

$c$ : 1.0

$y$ : Vertical distance from the load line to a mid-point of the span of stiffeners for calculation of stiffeners, to a mid-point of the panel for calculation of thickness of the bulkhead platings ( $m$ ).

$a$  and  $b$ : As given in [Table 15.1](#).

2. The water head is not to be less than obtained from the following formulae, irrespective of the provisions in -1.:

**Table 15.1 Values of  $a$  and  $b$**

	Forward of the midship	
	$a$	$b$
Fore walls	$2.0 + L / 100$	1.2
Side walls	$0.5 + L / 150$	
After walls	$0.4 + L / 1000$	
	Afterward of the midship	
	$a$	$b$
Fore walls	$2.0 + L / 100$	1.15
Side walls	$0.5 + L / 100$	
After walls	$0.7 + L / 1000$	

**Table 15.2**

	Exposed front bulkhead	Others
$L < 50\text{ m}$	3.0	1.5
$L \geq 50\text{ m}$	$2.5 + L/100$	$1.25 + L/200$

### 15.2.2 Thickness of Superstructure End Bulkheads

1. The thickness of superstructure end bulkheads for barges is not to be less than obtained from the following formula.

$$3S\sqrt{h}(mm)$$

$h$ : Water head specified in [15.2.1](#).

$S$ : Spacing of stiffeners ( $m$ ).

2. The thickness of bulkhead plating is not to be less than obtained from the following formula, irrespective of the requirement in -1.

$$5.0 + L/100(mm)$$

### 15.2.3 Stiffeners

1. The section modulus of stiffeners on superstructure end bulkheads is not to be less than obtained from the following formula:

$$3.5Shl^2(cm^3)$$

$S$ : Spacing of stiffeners ( $m$ ).

$h$ : As specified in [15.2.1](#).

$l$ : Tween deck height ( $m$ ). Where, however,  $l$  is less than 2 metres,  $l$  is to be taken as 2 metres.

2. Both ends of stiffeners on the exposed bulkheads of superstructures are to be connected to the deck except where otherwise approved by the Society.

## **15.3 Closing Means for Access Openings in Superstructure End Bulkheads**

### **15.3.1 Closing Means for Access Openings**

**1.** The doors to be provided on the access openings in the end bulkheads of enclosed superstructures are to be in accordance with the requirements in **(1)** through **(5)**:

- (1) The doors are to be made of steel or other equivalent materials and to be permanently and rigidly fitted up to the bulkheads.
- (2) The doors are to be rigidly constructed, to be of equivalent strength to that of intact bulkhead and to be weathertight when closed.
- (3) The means for securing weathertightness are to consist of gaskets and clamping devices or other equivalent devices and to be permanently fitted up to the bulkhead or the door itself.
- (4) The doors are to be operated from the both sides of the bulkheads.
- (5) Hinged doors are, as a rule, to open outward.

**2.**

- (1) The height of sills of access openings specified in **-1.** is not to be less than 380 *mm* above the upper surface of the deck except where higher sills may be required when deemed necessary by the Society.
- (2) In principle, portable sills are not permitted.

## Chapter 16 DECKHOUSES

### 16.1 General

#### 16.1.1 Application

1. The construction and scantlings of deckhouses are to be in accordance with the relevant Chapters in addition to this Chapter.
2. The requirements in this Chapter apply to the first tier deckhouses above the upper deck. The construction and scantlings of the second tier deckhouses and over above the upper deck are to be in accordance with the discretion of the Society.
3. As for the deckhouses in barges with specially large freeboard, the construction of boundary walls may be suitably modified subject to the approval by the Society.

### 16.2 Construction

#### 16.2.1 Water Head $h$

The water head  $h$  for the calculation of the scantlings of boundary walls of deckhouses is not to be less than obtained from the formulae given in [15.2.1](#). However,  $C$  value in [15.2.1-1](#) may be as obtained from the following formula, but  $b' / B'$  is not to be less than 0.25.

$$0.3 + 0.7b' / B'$$

$b'$ : The breadth of deckhouses measured at the position considered ( $m$ ).

$B'$ : The weather deck breadth measured at the position considered ( $m$ ).

#### 16.2.2 Thickness of Boundary Wall Plating and Scantlings of Stiffeners

1. The thickness of boundary wall plating and the scantlings of stiffeners are not to be less than those required by [15.2.2](#) and [15.2.3](#), taking  $h$  as specified not to be less than those required by [15.2.2](#) and [15.2.3](#), taking  $h$  as specified in [16.2.1](#).
2. Both ends of stiffeners on exposed boundary walls of deckhouses are to be connected to the deck except where otherwise approved by the Society.

#### 16.2.3 Closing Means for Access Openings

1. Access openings of deckhouses protecting companion ways giving access to the spaces under the upper deck or the spaces in the enclosed superstructures are to be provided with the closing means at least complying with the requirements in [15.3](#).
2. Openings in the top of a deckhouse on a raised quarterdeck or superstructure of less than standard height, having a height equal to or greater than the standard quarterdeck height, are to be provided with an acceptable means of closing but need not be protected by an efficient deckhouse or companionway, provided that the height of the deckhouse is at least the standard height of a superstructure. Openings in the top of the deckhouse on a deckhouse of less than a standard superstructure height may be treated in a similar manner.

## Chapter 17 HATCHWAYS AND OTHER DECK OPENINGS

### 17.1 General

#### 17.1.1 Application

1. The requirements of this Chapter are to apply to the hatchways and other openings on the exposed parts of upper deck of the barges not engaged on international voyages and the barges of less than 24 *metres* in length.
2. For the barges of 24 *metres* and above in length and engaged on international voyages, the hatchways and other deck openings on the exposed parts of upper deck are to be in accordance with the requirements in [Chapter 19, Part 2](#) or [Chapter 19, Part 12](#).
3. Where the barge has an unusually large freeboard, the requirements in this Chapter may be reduced subject to the approval by the Society.

#### 17.1.2 Weathertightness

Hatchways and other openings on the decks are to have weathertight covers.

#### 17.1.3 Position of Exposed Deck Openings

For the purpose of this Chapter, two positions of exposed deck openings are defined as follows:

- Position I: Upon exposed upper and raised quarter decks and exposed superstructure decks within the forward 0.25*L*.
- Position II: Upon exposed superstructure decks abaft the forward 0.25 *L<sub>f</sub>* and located at least one standard height of superstructure above the freeboard deck, or Upon exposed superstructure decks situated forward of a point located 0.25 *L<sub>f</sub>* abaft the fore end of *L<sub>f</sub>* and located at least two standard heights of superstructure above the freeboard deck.

### 17.2 Hatchways

#### 17.2.1 Hatchway Coamings

1. The height of coamings above the upper surface of deck is to be at least 600*mm* in Position I and 450*mm* in Position II. But, for barges of less than 30 *metres* in length, the height of coamings may be as given in [Table 17.1](#).
2. The thickness of hatchway coamings is not to be less than obtained from the following formula, but need not exceed 11*mm*.
$$0.055L + 6.0(mm)$$
3. On the hatchway coamings, horizontal stiffeners are to be provided at an appropriate position, and the upper edges of the hatchway coamings are to be stiffened by half round bars or other suitable means.

4. The hatchway coamings are to be stiffened with efficient brackets or stays fixed with the horizontal stiffeners and the deck at an interval of not greater than 3.0 *metres*.
5. Where hatch covers of sliding type are provided, the hatchway coamings are to be suitably strengthened according to the weight of hatch covers.

**Table 17.1 Height of Coamings for Barges of less than 30 metres in Length (*mm*)**

	Area of hatchways of 1.5 $m^2$ and under	Others
Position I	380	450
Position II	230	300

### 17.2.2 Hatch Covers

1. The thickness of steel hatch covers is not to be less than obtained from the following formula, however, in no case is it to be less than 6 mm:

$$10S \text{ (mm)}$$

$S$ : Spacing of stiffeners ( $m$ ).

2. Stiffeners in steel hatch covers are to be provided at an interval of not more than 750mm and to be of section modulus not less than obtained from the following formula, but need not to exceed 27  $cm^3$ .

$$CSl^2 (cm^3)$$

$S$ : Spacing of stiffeners ( $m$ ).

$l$ : Length of stiffeners ( $m$ ).

$$C: 0.15L + 12$$

3. Stiffeners are to be provided around the edges of steel hatch cover, so as to ensure sufficient rigidity to withstand deformation while handling.
4. The scantlings of shifting beams are to comply with the requirements in -2. However,  $S$  is to be taken as the spacing of shifting beams,  $l$  as the length of shifting beams.

The thickness of wooden hatch covers is not to be less than obtained from the following formula, however, in no case is it to be less than 60mm.

$$40S \text{ (mm)}$$

$S$ : Spacing of shifting beam ( $m$ ).

### 17.2.3 Miscellaneous

1. The depth of shifting beams and the width of face bars are to be suitably designed, taking into consideration their tripping and deflection.
2. The parts supporting hatch covers and shifting beams are to be effectively strengthened.

3. The carriers for shifting beams are to be of steel, with the bearing surface of not less than 75 *mm* wide and not less than 12.5 *mm* thick.
4. The carriers on the side coamings are to be provided with appropriate devices to prevent the shifting beams from falling off.

### 17.3 Companion-ways and Other Deck Openings

#### 17.3.1 Manholes and Flush Scuttles

Manholes and flush scuttles in exposed positions on the upper or superstructure deck or within superstructures other than enclosed superstructures are to be closed by steel covers capable of being made watertight.

#### 17.3.2 Companion-ways

The height of sills of doorways above the upper surface of the deck is not to be less than given in the following [Table 17.2](#).

**Table 17.2 Height of Sills of Doorways (*mm*)**

Position	<i>L</i>	
	$L \geq 30\ m$	$L < 30\ m$
I	450	300
II	300	150

## **Chapter 18 BULWARKS, GUARDRAILS, FREEING ARRANGEMENTS, VENTILATORS AND GANGWAYS**

### **18.1 General**

#### **18.1.1 Application**

1. The provisions of this Chapter are to apply to the barges specified in [17.1.1-1](#).
2. The barges specified in [17.1.1-2](#) are to be in accordance with the requirements in [Chapter 22, Part 2](#) (except [22.8, Part 2](#))

### **18.2 Bulwarks and Guardrails**

#### **18.2.1 General**

Efficient guardrails or bulwarks are to be provided on all exposed parts of the upper and superstructure deck and the top of similar deckhouses.

#### **18.2.2 Dimensions**

The height of bulwarks or guardrails specified in [18.2.1](#) is to be at least 1 *metre* from the upper surface of deck. However, a less height than this may be accepted where this height would interfere with the normal operation of the barge, provided that other adequate protection means are provided to the satisfaction of the Society.

#### **18.2.3 Construction**

1. The bulwarks are to be strongly constructed and effectively stiffened on their upper edges. The thickness of bulwarks on the upper deck is generally to be at least 6 *mm*.
2. Bulwarks are to be supported by stiffened stays connected to the deck in way of the beams or to the effectively stiffened positions of the deck. The spacing of these stays on the upper deck is not to be more than 1.8 *metres*.
3. Bulwarks on the decks which are designed to carry timber deck cargoes are to be supported by specially strong stays spaced not more than 1.5 *metres*.

### **18.3 Freeing Arrangements**

#### **18.3.1 Freeing Arrangements**

On the weather parts of upper or superstructure deck, freeing arrangements are to be provided with in accordance with the requirements in [Chapter 22, Part 2](#).



## 18.4 Ventilators

### 18.4.1 Ventilators

1. The height of ventilator coamings above the upper surface of the deck is not to be less than given in the following [Table 18.1](#) corresponding  $L$  and the position specified in [17.1.3](#). However, a lower height may be accepted where the barge has an specially large freeboard or where the ventilator serves the spaces within unenclosed superstructures.
2. The thickness of ventilator coamings is to be in accordance with the discretion of the Society.

## 18.5 Gangways

### 18.5.1 Gangways

Satisfactory means are to be provided on the weather decks for the protection of the crew in getting to and from their quarters and other parts.

**Table 18.1 Height of Ventilator Coamings ( $mm$ )**

Position	$L$	
	$L \geq 30\ m$	$L < 30\ m$
I	900	760
II	760	450

## Chapter 19 EQUIPMENT

### 19.1 Anchors, Chain Cables and Ropes

#### 19.1.1 General

1. All barges, according to their equipment numbers, are to be provided with anchors, chain cables, ropes, etc. which are not less than given in [Table 19.1](#).
2. Anchors, chain cables, ropes, etc. for barges having equipment numbers not more than 50 and more than 3210 are to be in accordance with the descretion of the Society.
3. Anchors, chain cables, wire ropes and fibre ropes are to be in compliance with the requirements in [Chapter 3](#), [4.1 of Chapter 4](#), [Chapter 5](#) and [Chapter 6, Part 5](#).

#### 19.1.2 Unmanned Barges

1. Notwithstanding the provisions in [19.1.1](#), for the unmanned barges the following requirements are applied:
  - (1) The number of anchors may be one of the unit weight in [Table 19.1](#).
  - (2) The length of anchor chains may be half of length in [Table 19.1](#).
  - (3) Except where specified in (1) and (2), the [Table 19.1](#) is applied.
2. All equipment specified in this chapter may be omitted at the request of owner where considered appropriate by the Society.

#### 19.1.3 Equipment Numbers

Equipment number is the value obtained from the following formula:

$$W^{2/3} + 2.0hB + 0.1A$$

$W$ : Full load displacement ( $t$ ).

$h$  and  $A$  :Values specified in the following (1), (2) and (3).

- (1)  $h$  is the value obtained from the following formula:

$$f + h'$$

$f$ : Vertical distance, at the midship, from the load line to the top of upper deck beam at side ( $m$ ).

$h'$ : Height from the upper deck to the top of uppermost superstructures or deckhouses having a breadth greater than  $B/4$  ( $m$ ). In the calculation of  $h'$ , sheer and trim may be ignored. Where a deckhouse having a breadth greater than  $B/4$  is located above a deckhouse with a breadth of  $B/4$  or less, the narrow deckhouse may be ignored.

- (2)  $A$  is the value obtained from the following formula:

$$fL + \Sigma h''l$$

$f$ : Value specified in (1).

$\Sigma h''l$ : Summing up of the products of the height  $h''$  ( $m$ ) and length  $l$  ( $m$ ) of superstructures, deckhouses or trunks which are located above the upper deck within the length of barge and also have a breadth greater than  $B/4$  and a height greater than 1.5 metres.

- (3) In the application of (1) and (2), screen and bulwarks more than 1.5 *metres* in height are to be regarded as parts of superstructures or deckhouses.

#### **19.1.4 Anchors**

1. Provided that the collective mass of two anchors is not less than that obtained by multiplying the unit mass in [Table 19.1](#) by two, the mass of one of the two may be reduced to 93% of the mass given in the Table.
2. Where stocked anchors are used, the mass, excluding the stock, is not be less than 0.8 times the table mass for ordinary stockless bower anchors.
3. Where high holding power anchors are used, the mass of each anchor may be 0.75 times the table mass for ordinary stockless bower anchors.
4. Where super high holding power anchors are used, the mass of each anchor may be 0.5 times the mass required for ordinary stockless anchors. However, super high holding power anchor mass is generally not to exceed 1,500kg.



**Table 19.1 Anchors, Chain Cables and Ropes**

Equipment letter	Equipment number		Anchor		Chain cable for anchor (stud anchor for chain)			Mooring line			
			number	Mass per anchor (stock-less anchor)	Total length	Diamete			number	Length of each line	Breaking load
	Over	Up to				Grade 1	Grade 2	Grade 3			
				kg	m	mm	mm	mm		m	kN
BA <sub>1</sub>	50	70	2	180	220	14	12.5		3	80	↑ 34
BA <sub>2</sub>	70	90	2	240	220	16	14		3	100	: 37
BA <sub>3</sub>	90	110	2	300	247.5	17.5	16		3	110	: 39
BA <sub>4</sub>	110	130	2	360	247.5	19	17.5		3	110	: 44
BA <sub>5</sub>	130	150	2	420	275	20.5	17.5		3	120	: 49
BB <sub>1</sub>	150	175	2	480	275	22	19		3	120	: 54
BB <sub>2</sub>	175	205	2	570	302.5	24	20.5		3	120	: 59
BB <sub>3</sub>	205	240	2	660	302.5	26	22		4	120	: 64
BB <sub>4</sub>	240	280	2	780	330	28	24		4	120	: 69
BB <sub>5</sub>	280	320	2	900	357.5	30	26		4	140	: 74
BC <sub>1</sub>	320	360	2	1020	357.5	32	28		4	140	• 78
BC <sub>2</sub>	360	400	2	1140	385	34	30		4	140	: 88
BC <sub>3</sub>	400	450	2	1290	385	36	32		4	140	: 98
BC <sub>4</sub>	450	500	2	1440	412.5	38	34		4	140	: 108
BC <sub>5</sub>	500	550	2	1590	412.5	40	34		4	160	: 123
BD <sub>1</sub>	550	600	2	1740	440	42	36		4	160	: 132
BD <sub>2</sub>	600	660	2	1920	440	44	38		4	160	: 147
BD <sub>3</sub>	660	720	2	2100	440	46	40		4	160	: 157
BD <sub>4</sub>	720	780	2	2280	467.5	48	42		4	170	: 172
BD <sub>5</sub>	780	840	2	2460	467.5	50	44		4	170	: 186
BE <sub>1</sub>	840	910	2	2640	467.5	52	46	40	4	170	: 201
BE <sub>2</sub>	910	980	2	2850	495	54	48	42	4	170	↓ 216
BE <sub>3</sub>	980	1060	2	3060	495	56	50	44	4	180	↑ 230
BE <sub>4</sub>	1060	1140	2	3300	495	58	50	46	4	180	: 250
BE <sub>5</sub>	1140	1220	2	3540	522.5	60	52	46	4	180	: 270
BF <sub>1</sub>	1220	1300	2	3780	522.5	62	54	48	4	180	: 284
BF <sub>2</sub>	1300	1390	2	4050	522.5	64	56	50	4	180	: 309
BF <sub>3</sub>	1390	1480	2	4320	550	66	58	50	4	180	: 324
BF <sub>4</sub>	1480	1570	2	4590	550	68	60	52	5	190	: 324
BF <sub>5</sub>	1570	1670	2	4890	550	70	62	54	5	190	: 333
BG <sub>1</sub>	1670	1790	2	5250	577.5	73	64	56	5	190	⊕ 353
BG <sub>2</sub>	1790	1930	2	5610	577.5	76	66	58	5	190	: 378
BG <sub>3</sub>	1930	2080	2	6000	577.5	78	68	60	5	190	: 402
BG <sub>4</sub>	2080	2230	2	6450	605	81	70	62	5	200	: 422
BG <sub>5</sub>	2230	2380	2	6900	605	84	73	64	5	200	: 451
BH <sub>1</sub>	2380	2530	2	7350	605	87	76	66	5	200	: 480
BH <sub>2</sub>	2530	2700	2	7800	632.5	90	78	68	6	200	↓ 480
BH <sub>3</sub>	2700	2870	2	3800	632.5	92	81	70	6	200	↑ 490
BH <sub>4</sub>	2870	3040	2	8700	632.5	95	84	73	6	200	⊙ 500
BH <sub>5</sub>	3040	3210	2	9300	660	97	84	76	6	200	: 520



Notes:

- 1 Where steel wire ropes are used, the following wire ropes corresponding to the marks shown in the Table are to be provided. •, ⊕ and ⊙ show wire ropes of (6×12), (6×24) and (6×37), respectively.
- 2 Length of chain cables may be that including shackles for connection.
- 3 For barges having equipment number of 205 and below, wire rope may be used instead of cable.

## **Chapter 20 MACHINERY**

### **20.1 General**

#### **20.1.1 General**

1. The machinery is to be capable of operating satisfactorily, under the service conditions and environmental conditions on board.
2. The rotating, reciprocating and high temperature parts of machinery and live parts of electrical apparatus for which the operators or other persons are liable to inadvertently touch to, are to be arranged with suitable protections from becoming injured.
3. It is recommended that no unhealthy gases or dangerous gases which may cause fire, leak from the machinery. Where it is impracticable, the machinery is to be situated in well ventilated spaces and to be capable of discharging such gases.
4. The machinery is to be so constructed and installed as to be capable of maintenance easily.
5. The machinery used for important system is to be capable of operating easily and certainly, and to be capable of operating satisfactorily except the mooring system, when the barge inclined from the normal at any angle up to 15 *degrees* transversely and 10 *degrees* longitudinally, and when rolling up to 22.5 *degrees* from the vertical.
6. Power transmission systems, shaft couplings and gearing systems used for important system are to be so designed and manufactured as to have sufficient strength withstanding the maximum working stress under normal operating conditions.

### **20.2 Internal Combustion Engines**

#### **20.2.1 General Construction**

1. The frames and bedplates are to be of rigid and oiltight construction and bedplates are to be fixed securely to the engine seatings.
2. Ventilation of crankcase and any arrangement which could produce a flow of external air within the crankcase, is forbidden except case of (1) and (2).
  - (1) Where vent pipes are provided to crankcase: In this case, the diameters of these pipes are to be as small as practicable.
  - (2) Where a forced extraction of the gases from the crankcase is provided: In this case, the vacuum in the crankcase is not to exceed 25mm of water column.
3. Crankcase and its doors are to have sufficient strength, and the doors are to be securely fastened, so that they will not be readily displaced by an explosion.
4. The fuel oil arrangements for internal combustion engines having a carburetor are to comply with the requirements in [20.4.5](#) and additionally, the requirements in [2.4.4, Part 7](#).

### **20.2.2 Safety Devices**

1. Where risk from over-speeding of machinery exists, means are to be provided to ensure that the safe speed is not exceeded.
2. Engines having cylinder of large bore size are to be provided with a relief valve or warning device of overpressure in the cylinder, and also to be provided with crankcase explosive relief valve of an approved type.

### **20.2.3 Installation**

1. Where the structures above engines and their surroundings are constructed with combustible materials, adequate measures are to be taken in protection against fire.
2. Engines located on the weather deck are to be provided with ventilated metal hoods or to be installed in well ventilated deckhouses of steel.

### **20.2.4 Exhaust Gas Pipe Arrangement**

1. Exhaust gas pipes and silencers are to be water cooled or are to be effectively insulated.
2. Silencers are to be so arranged that they may be easily cleaned.
3. In principle, exhaust gas pipes of several engines are not to be connected together.
4. Exhaust gas pipe is to extend not less than 2.4 metres above deck on barge intended to carry liquid cargo having a flash point 60°C or below and to be provided with a suitable spark arrestor.

## **20.3 Boilers and Pressure Vessels**

### **20.3.1 General**

Boilers prescribed in [10.1.3, Part 7](#) and pressure vessels belonging to Group 1 or Group 2 prescribed in [10.1.3, Part 7](#) are generally to comply with the requirements in [Chapters 9](#) and [10, Part 7](#). Single system of fuel oil burning and feed water may be acceptable for boiler which is not used for the heating of special cargoes.

## **20.4 Auxiliaries and Piping Arrangement**

### **20.4.1 Pressure Pipes and Pipe Connections**

1. Pipes, flanges, valves and pipe fittings and their joints subject to internal pressure are to have an adequate strength conforming to the service conditions.
2. Sleeve threaded joints are generally not to be used for the joints of direct connection of pipe length and flange-pipe connections which pipings are used for fuel oil, lubricating oil or other inflammable oil systems.

#### **20.4.2 Piping Arrangements**

Piping arrangements are to comply with the requirements in [13.2, Part 7](#). However, slip-on joints complying with the requirements specified in [12.3.3, Part 7](#) may be acceptable subject to the approval of the Society.

#### **20.4.3 Sea Suction Valves and Overboard Discharge Valves**

Sea suction valves and overboard discharge valves are to be constructed and installed in accordance with the requirements in [12.3.3, Part 7](#).

#### **20.4.4 Pneumatic System**

1. Air reservoirs are to be provided with a sufficient drainage system.
2. Air compressors are to be provided with a relief valve to prevent the pressure from rising more than 10% above the maximum pressure in the cylinders.
3. In the case of water cooled air compressor, and where water jacket of compressors and coolers might be subjected to dangerous excessive pressure due to leakage into them from air pressure parts safety device for over-pressure is to be provided at their cooling space.
4. Where air reservoirs can be isolated from the relief valves prescribed in -2 or air reservoirs are charged by hand air compressor only, they are to be provided with a pressure relief device to release the pressure automatically in the event of fire.
5. Starting air piping systems for internal combustion engines are to be provided with non-return valves or other equivalent devices.

#### **20.4.5 Fuel Oil Systems and Lubricating Oil Systems**

1. Arrangements for the storage, distribution and utilization of fuel oil and lubricating oil are to be such as to ensure the safety of the barge and persons on board.
2. Machinery spaces in which oil vapour is likely to accumulate, are to be adequately ventilated.
3. Fuel oil systems are to be so arranged that defects and leakage can readily be observed, and the spaces in which the systems are installed are to be adequately illuminated.
4. Materials used for pipes, valves and other fittings of fuel oil systems and lubricating oil systems are to be of the fire resisting metals.
5. Tanks used for the storage of the fuel oil or lubricating oil and oil strainers are not to be installed above hot parts.
6. Free-standing oil tanks are to be of steel and to be of rigid construction.
7. Provision is to be made to prevent overpressure in any part of the fuel oil system and lubricating oil system. Any relief valves are to be discharged to a safe position.
8. Coamings or other arrangements are to be provided at each oil tank, oil pump and oil strainer, and suitable means are to be provided for disposing of fuel oil drains.
9. The suction pipes from all tanks, except double bottom tanks, are to be provided with stop valves or cocks secured to the tank walls.



10. Valves, cocks or other fittings fitted on tanks are to be so located in safe positions as to protect them from the external damage.
11. Main suction valves of all fuel oil tanks except for double bottom tanks are to be capable of being closed from a remote position which will always be accessible. This requirement, however, may not be applied to tanks for which the Society specially approved considering the arrangement or the capacity of the tanks.
12. Fuel oil pipings are to be entirely separated from other pipings. Where, however, it is unavoidable to interconnect to any other pipings, effective means are to be provided to prevent the accidental contamination with other liquids while in operation.
13. Lubricating oil pipings are to be entirely separated from other pipings, unless specially approved by the Society.
14. As for the systems of fuel oil having a flash point below 60°C, they are to be as deemed appropriate by the Society.

#### **20.4.6 Air, Overflow and Sounding Pipes**

1. Air, overflow and sounding pipes are to comply with the requirements in [13.6](#), [13.7](#) and [13.8, Part 7](#) except the following requirements for the inside diameter of the air and overflow pipes and for the arrangements of overflow pipes.
2. Air pipes fitted to free-standing tanks are to have sufficient area for the capacity and service conditions of the tanks.
3. Overflow pipes are to be provided to settling tank and service tank for fuel oil which can be pumped up, or to other tanks having any openings below the open end of air pipes.
4. The overflow pipes are to have sufficient area for pump capacity to prevent overflow from other opening of the tanks while liquid is filled.
5. For unmanned barges, if it is recognized that the safety of the barge is not impaired, the air and sounding pipes may be dispensed with for particular compartment, irrespective of the provision in 1.

#### **20.4.7 Bilge Systems**

1. An efficient bilge pumping system is to be provided in all barges capable of pumping from and draining each watertight compartment when the barge is on an even keel and either upright or listed 5 *degrees*. If the Society is satisfied that the safety of the barge is not impaired, the bilge system may be dispensed with for particular compartment.
2. Where common bilge main connected with branch bilge suction from each compartment is provided, at least two independent power bilge pumps are to be provided. Each pump is to be connected to the bilge main, and is to be capable of discharging the bilge effectively even where the one pump gets out of order. These pumps may be substituted by bilge ejectors in combination with sea water pump.
3. The power bilge pumps are to have sufficient capacity approved by the Society.  
Area and length of the bilge suction pipes and the bilge main are to be such that the capability of the bilge pumps is not impaired.



4. Where any source of power is not available on board, such means as manual bilge pumps are to be provided to drain each watertight compartment.
5. Where centrifugal pumps are employed in bilge drainage, they are to be of the self-priming type.
6. The manual pumps prescribed in -4 are to be located above the upper deck, or at the high convenient level which is easily accessible, and they are to be capable of operating effectively,
7. Special bilge systems are to be subjected to the approval of the Society.
8. Bilge suction pipes are to be entirely separated from pipes used for filling or emptying spaces carrying water ballast or oil.
9. Non-return valve or cock which does not permit the communication between bilge and ballast water tanks, fresh water tanks or fuel oil tanks is to be provided to bilge suction pipes connected to any pump having a sea water or fuel oil suction in order to prevent the possibility of water or fuel oil passing into the watertight compartments from the sea, fuel oil tanks or water tanks or bilge passing from one compartment to another through the bilge pipes.
10. Valves and cocks which are connected to bilge system are to be located at an easily accessible position.
11. Branch pipes of each bilge suction are to be led to mud boxes or rose boxes which are to be arranged for easy cleaning without disconnecting any joint of the pipe.
12. For barges which are intended to carry oil having a flash point 60°C or below as cargo, bilge in a pump room and compartments which are adjoining to cargo oil tanks is not to be led to compartments which do not adjoin to the cargo tanks. Further, bilge pipes in a cargo oil pump room and compartments which are adjoining to cargo oil tanks are to be entirely separated from the bilge pipes in other compartments not adjoining to the cargo tanks.
13. For unmanned barges, in general, portable pumps or other suitable drainage means are to be provided.

#### **20.4.8 Scuppers**

1. Scuppers sufficient in number and size to provide effective drainage are to be provided in the upper deck.
2. Scuppers draining weather decks and spaces within superstructures and deckhouses of which access openings are not provided with closing means complying with the requirements in [Chapter 15](#) and [16](#), are to be led over-board.
3. Scuppers from spaces below the upper deck or spaces within enclosed superstructures or enclosed deckhouses on the upper deck are to be led to the bilges. Alternatively, scuppers provided with valves may be led overboard, where the Society is satisfied that the pipes are provided with adequate protection to prevent from flooding into the board.
4. Scuppers originating at any level and penetrating the shell plating either more than 450mm below the freeboard deck or less than 600mm above the load line are to be provided with a non-return valve at the shell plating. This valve, unless required by -3, may be omitted if the piping is of substantial thickness.
5. Scupper pipes passing through the shell plating below the upper deck are to be of steel or other approved materials. Valves and shell fittings for scuppers passing through the shell plating below the upper deck are to be of steel, bronze or other approved ductile materials.

## **20.5 General Requirements of Electrical Equipment**

### **20.5.1 General**

1. The design and installation of electrical equipment are to be such as to minimize the risk of fire or other electrical accidents due to its failure.
2. Electrical equipment is to be suitable construction for marine use and provided with effective protective enclosure for environmental conditions in which the equipment is installed.
3. Insulating materials and windings of electrical equipment are to have sufficient resistance for moisture, sea air and oil vapour.

### **20.5.2 System Voltage**

1. System voltage is not to exceed :
  - (1) 500V for generators, power equipment, cooking and heating equipment connected to fixed wiring;
  - (2) 250V for lightings, heaters in cabins and public rooms, and other appliances than mentioned in (1).
2. In case where system voltage exceeding the required prescribed in -1 is adopted, they are to be subject to the approval by the Society in advance.

### **20.5.3 Clearance and Creepage**

1. The clearances and creepages between live parts and between live parts and earthed metals are to be adequate for the working voltage having regard to the nature of the insulating materials and operating conditions.
2. The clearances and creepages inside the terminal box of rotating machinery, switchboard busbars and the controlling equipment, etc. are to comply with the requirements in [2.4.12](#), [2.5.4-5](#) and [2.7.1, Part 8](#).

### **20.5.4 Limits of Temperature Rise**

#### **1. Ambient temperature**

For all electrical equipment, the following ambient temperatures are recognized as standard:

- (1) For all equipment located in compartment where the boilers are installed and on weather decks: 45°C (for rotating machinery 50°C);
- (2) For all equipment located in other spaces than specified in (1) : 40°C

#### **2. Limits of temperature rise**

The limits of temperature rise of generators, motors, switchboards, transformers and starters for motors are to comply with the requirements in [Part 8](#).

## **20.6 Earthing**

### **20.6.1 Earthing of Electrical Equipment**

Non-current-carrying metallic parts of fixed electrical equipment and portable electrical apparatus having the rated voltage of 100V and over are to be effectively earthed.

### **20.6.2 Earthing of Cables**

Metallic coverings of cables are to be electrically continuous throughout their length and to be effectively earthed at both ends, except that in final sub-circuits earthing may be at the supply end only.

### **20.6.3 Exception in Application**

Notwithstanding the requirements in [20.6.1](#), the earthing of non-current-carrying metallic parts may be dispensed with for double insulated portable apparatuses and for, where approved, other electrical equipment.

## **20.7 Protective Devices of Electrical Equipment**

### **20.7.1 General**

1. Electrical Equipment is to be protected against accidental overcurrents including short-circuit. The protective devices are to be capable of continuously servicing other circuits which are used for the electrical source and/or other important feeder circuit as far as practicable by breaking fault circuit and to be capable of eliminating damage to the systems and hazard of fire.
2. Circuit-breakers and fuses used for the protective devices are to comply with the requirements in [2.6, Part 8](#) or equivalent thereto.

### **20.7.2 Protection against Short-circuit**

1. Short-circuit protection is to be provided in each live pole of a direct-current system and in each phase of an alternating current system.
2. Short-circuit protective device is to be capable of breaking short-circuit current in the circuit satisfactorily.

### **20.7.3 Protection against Overload**

1. Overload protection is to be provided in the following line or phase:
  - (1) Two-wire *D.C.* or single-phase *A.C.* system - at least one line or phase;
  - (2) Three-wire *D.C.* system - both outer lines ;
  - (3) Three-phase *A.C.* system - at least two phase.
2. Tripping characteristics of overload protective devices (blowing out characteristics for fuse) are to be adequate for the thermal capacity of the electrical equipment and wirings protected.

#### **20.7.4 Protection of Generators**

1. Generators are to be protected against short-circuit and overcurrent by a multipole circuit-breaker arranged to open simultaneously all insulated poles. In the case of generators less than 50kW and not arranged to operate in parallel, they may be protected by a multipole-linked switch with fuses or a circuit-breaker in each insulated pole.
2. In the case of generators arranged to operate in parallel, they are to be provided with reverse power protection for A.C. system or reverse current protection for D.C. system.

#### **20.7.5 Protection of Motors**

Each motor used for important system is to be protected from short-circuit and overload. Overload protective device of motor is to have a delay characteristic to enable the motor to start.

### **20.8 Source of Electrical Power**

#### **20.8.1 Generator**

1. Aggregate capacity of generators used for important system is to be sufficient to supply the total necessary electrical power for the barge. In A.C. generators, they are to have sufficient capacity to permit the starting of the largest motor in the barge during normal operation satisfactorily.
2. Generators used for important system are to withstand any load fluctuation in normal operating condition and always be capable of supplying stable electrical power.
3. Prime movers for generators used for important system are to be provided with speed regulators which will maintain the speed withstanding the load fluctuation of generators.

#### **20.8.2 Switchboards**

1. Switchboards are to be constructed and installed in accordance with the requirements in [2.5](#), [2.6.1-1](#) and [2.6.2-1, Part 8](#) in general.
2. Switchboards used for important system are to be provided with the instruments prescribed in [2.2.2](#) and [2.5.6](#) to [2.5.8, Part 8](#), as far as applicable. Where two or more generators are provided but not arranged to operate in parallel, the instruments of switchboard are to be in accordance with the discretion of the Society.

#### **20.8.3 Section Boards and Distribution Boards**

Section boards and distribution boards are to be constructed in accordance with the requirements in [2.5.3, Part 8](#).

#### **20.8.4 Transformers for Lighting and Power**

1. Transformers for lighting and power are to be constructed in accordance with the requirements in [2.10.2, Part 8](#).

2. Transformers are to withstand any load fluctuation in normal operating condition and always be capable of supplying stable electrical voltage.

#### **20.8.5 Storage Batteries**

1. Batteries and their charging facilities are to comply with the requirements in [2.11, Part 8](#).
2. In the case of barge whose navigation lights are solely operated by electrical power, and where the power source is batteries without means of charging during normal navigation, the batteries are to have sufficient capacity for operating hours of navigation lights and operating conditions of themselves.
3. Batteries prescribed in -2 may be used for starting the internal combustion engines unless this does not give any insecure effect to the function of these batteries.

#### **20.8.6 Reserve Source of Electrical Power**

1. The barges whose navigation lights are solely operated electrical power except those for which the electrical power is supplied from pusher are to be provided with at least one set of independent reserve source of electrical power device which has the capacity to supply the power to the navigation lights at least 16 *hours* continuously. This device is to be available immediately in stead of main source of electrical power, in the event of failure of the main source of electrical power.
2. In the case of unmanned barge, arrangements are to be made to ensure that reserve source of electrical power will automatically come into operation in the event of failure of the main source of electrical power.
3. For barge which has two or more generators, one of them may be regarded as a reserve source of electrical power. In this case, all generators are to be so arranged as to be available for the source of electrical power for the navigation lights.
4. The reserve source of electrical power system may be omitted where the navigation lights having own batteries approved by the Society are used.

### **20.9 Cables**

#### **20.9.1 General**

1. Construction, application and current carrying capacity of cable are to be in accordance with the requirement in [2.9.1](#) to [2.9.17, Part 8](#), respectively.
2. In the case of barge whose electrical power is supplied from the pusher, these feeder cables are to have sufficient strength depending upon the connecting method of the pusher and barge.

#### **20.9.2 Installation of Cables**

1. Cable are to be so installed as to avoid damages due to deflection of the hull.
2. When installing cables, the minimum internal radius of bend is to be of adequate to prevent the cables from damage.

3. Where cables having different insulating materials each other are bunched together, considerations are to be given to the maximum rated conductor temperatures of each cable.

4. Where cables pass through watertight or airtight bulkheads or decks, considerations are to be given to maintain the watertightness or airtightness of these bulkheads or decks.

### **20.9.3 Mechanical Protection of Cables**

Cables fitted in locations, such as cargo holds, where they are likely to suffer mechanical damage, are to be suitably protected by pipes or ducts.

### **20.9.4 Cable Pipes and Ducts**

1. Cable pipes and ducts are to have suitable drainage.

2. Metallic pipes and ducts are to be efficiently protected against corrosion and to be earthed effectively.

Non-metallic pipes and ducts are to be of flame-retardant materials.

### **20.9.5 Securing of Cables**

Cables are to be effectively supported and secured by supports and clips which are of corrosion-resistant metallic materials or those protected against corrosion or of flame-retardant non-metallic materials taking account of kind of cable, electrical magnetic force caused by short circuit current, vibration and their installing condition except cables which are portable cords or installed in pipes.

### **20.9.6 Cable Joint and Branch**

Cables is to be jointed or branched in a suitable box with terminals, except where method of connection has no risk of deteriorating water-proof characteristics, flame retardant, mechanical strength or electrical characteristics of cables.

## **20.10 Distribution**

### **20.10.1 Shore Connections**

1. A connection box is to be provided in a suitable position where arrangements are made for the supply of electrical power from a source on shore except those prescribed in -4.

2. The connection box is to contain terminals of suitable size and a circuit-breaker or an isolating switch with fuses.

Means are to be provided for checking the phase sequence for three-phase alternating current system or checking the polarity for direct current system.

3. The cables between the connection box and the switchboard are to be permanently fixed and a pilot lamp for source and a switch or circuit-breaker are to be provided on the switchboard.

4. The switchboard may be used for a shore connection box. In this case, the fittings described in **-2** and **-3** are to be provided on this switchboard.
5. Where the electrical power source on board is a generator, interlocking device is to be provided on the switchboard to prevent parallel operation of the generator on board with the shore main.

#### **20.10.2 Navigation Light Circuits**

1. Each navigation light is to be connected independently to the navigation light control panel.
2. Each navigation light is to be controlled and protected in each pole by a switch with fuses or a circuit-breaker fitted on the navigation light control panel.
3. The navigation light control panel is to be served by independent circuit fed from the switchboard or other electrical power source panel for navigation lights.
4. Switches and fuses are not to be provided on the feeder circuits of navigation lights, except on the switchboard or on the control panel. However, automatic control devices for the navigation lights may be provided to them.
5. Navigation light control panel is to be installed at the suitable manned place except for unmanned barges.

### **20.11 Control Gears**

#### **20.11.1 Starters**

Starters for motors are to be constructed in accordance with the requirements in [2.7.1](#) and [2.8.1, Part 8](#) as far as applicable.

### **20.12 Explosion-Protected Electrical Equipment**

#### **20.12.1 General**

Explosion-protected electrical equipment is to be in accordance with the requirements in [2.16, Part 8](#).

### **20.13 Emergency Stopping Device**

#### **20.13.1 Emergency Stopping of Boiler Fans and Ventilators**

Mechanical ventilating fans for machinery space or cargo space and boiler fans are to be capable of being stopped from an easily accessible position outside the machinery space, as well as from another position.



### **20.13.2 Emergency Stopping of Fuel Oil Pumps**

Fuel oil pumps except those having small capacity are to be capable of being stopped from an easily accessible position outside the machinery space, as well as from another position.

## **20.14 Machinery and Electrical Equipment of Tank Barges**

### **20.14.1 General**

Machinery and electrical equipment of barges intended to carry crude oil or petroleum products having the vapour pressure (in gauge) less than 0.2 MPa at 38°C, or other similar liquid cargoes in bulk are to comply with the requirements in [Chapter 14, Part 7, 4.2](#) and [4.3, Part 8](#), and [4.5.3](#) through [4.5.10, Part 6](#) as well as the requirements in [20.1](#) to [20.13](#) to the exclusion of the requirements for numbers of cargo pumps and for bilge arrangements specified in [14.2.1-1](#) and [14.3.1-1](#) to [-3, Part 7](#).

### **20.14.2 Exhaust Gas Pipes for Internal Combustion Engines**

Exhaust gas pipes for internal combustion engines for tank barge are to comply the requirements in [20.2.4-4](#).

## **20.15 Spare Parts**

### **20.15.1 Spare Parts for Internal Combustion Engines and Boilers**

The Society may require to carry necessary spare parts for internal combustion engines used for important system or boilers which supply steam as power source of important system or heat source of special cargoes.

## **20.16 Tests**

### **20.16.1 Tests at the Manufacturer's Work**

1. Boilers and pressure vessels are to be tested in accordance with the requirements in [Chapter 9](#) and [10, Part 7](#).
2. Pipes, valves and other fittings used for compressed air piping having a maximum working pressure exceeding 2 MPa are to be tested with hydrostatic pressure of 1.5 times the maximum working pressure after completion of welding, bending or machining.
3. Valves, cocks and casting distance pieces fitted to the shell plating of the barge below the load water line are, after finished, to be tested with hydrostatic pressure of 0.5 MPa.
4. Fuel oil tanks with their fittings which do not form a part of the hull construction are to be tested with a hydrostatic pressure corresponding to a head of water not less than 2.5 metres above the top plates.

5. Generators, switchboards, motors and their starters and transformers used for important system are to be tested in accordance with the requirements in relevant Chapter of [Part 8](#). Voltage regulation of generators and transformers at load characteristics test is to be in accordance with the discretion of the Society.
6. Cables are to be tested in accordance with the requirements in [2.9, Part 8](#).
7. Explosion-protected electrical equipment is to be subjected to the tests prescribed in [1.2.1-3, Part 8](#).

#### **20.16.2 On Board Tests**

1. Popping test and accumulation test for safety valve of boiler are to be carried out in accordance with the requirements in [9.9.3-14](#) and [-15, Part 7](#).
2. Piping systems including pumps, strainers and heaters for fuel oil, lubricating oil, cargo oil and others used for inflammable oil are to be subjected to test, after installed on board, with hydrostatic pressure of 1.5 times the maximum working pressure. The pressure test of the pipings connected to the pumps which have been subjected to hydrostatic test before assembled on board, may be omitted except for fuel oil piping systems, provided that the leakage tests are carried out at operating conditions.
3. Other piping systems together with fittings are, after installed on board, to be subjected to trial.
4. Important systems are, after installed on board, to be subjected to performance test synthetically.
5. Electrical equipment is, after installed on board, to be subjected to insulation resistance test in accordance with the requirements in [2.18.1, Part 8](#).
6. Various safety devices prescribed in each Paragraph are, after installed on board, to be subjected to performance test.

#### **20.16.3 Additional Tests**

The Society may require, where considered necessary, other tests than those prescribed in this Chapter.

## Chapter 21 PONTOON BARGES

### 21.1 General

#### 21.1.1 Application

1. The requirements in this Chapter apply to steel pontoon barges with longitudinal framing intended for carriage on the upper deck only.
2. The relevant Chapters in this Rule are to apply, unless otherwise specified in this Chapter.

### 21.2 Construction

#### 21.2.1 General

Special consideration is to be given, such as provision of longitudinal bulkheads at the center line or similar strengthened constructions.

#### 21.2.2 Arrangement

Bottom transverses, side transverses and deck transverses are to be provided at an interval of less than about 3.5 *metres* in one plane.

#### 21.2.3 Bottom Longitudinals

The section modulus of bottom longitudinals is not to be less than obtained from the following formula:

$$9.5SDl^2 (cm^3)$$

*S*: Spacing of longitudinals (*m*).

*l*: Span measured between the adjacent supports of longitudinals (*m*).

#### 21.2.4 Bottom Transverses

The scantlings of bottom transverses are not to be less than obtained from the following formulae:

$$\text{Section modulus: } 7.4SDl^2 (cm^3)$$

$$\text{Thickness of web: } 10d_0 + 2.5 (mm)$$

*S*: Spacing of transverses (*m*).

*l*: Span measured between the adjacent supports of transverses (*m*).

*d*<sub>0</sub>: Depth of web (*m*).

#### 21.2.5 Side Longitudinals

The section modulus of side longitudinals is not to be less than obtained from the following formula.

$$9.5Shl^2 (cm^3)$$

*S*: Spacing of longitudinals (*m*).

- $l$  : Span measured between the adjacent supports of longitudinals ( $m$ ).
- $h$ : Vertical distance from the longitudinals to a point of  $D$  above the top of keel, but to be taken as  $0.3\sqrt{L}$  ( $m$ ), where the distance is less than  $0.3\sqrt{L}$  ( $m$ ).

### 21.2.6 Side Transverses

The scantlings of side transverses are not to be less than obtained from the following formulae:

Section modulus:  $8Shl^2(cm^3)$

Thickness of web:  $10d_0 + 2.5(mm)$

$S$ : Spacing of transverses ( $m$ ).

$l$  : Span measured between the adjacent supports of transverses ( $m$ ).

$h$ : Vertical distance from the centre of  $l$  to a point of  $D$  above the top of keel ( $m$ ), but to be taken as  $0.3 L$  ( $m$ ), where the distance is less than  $0.3 L$  ( $m$ ).

$d_0$ : Depth of web ( $m$ ).

### 21.2.7 Longitudinal Beams

1. The section modulus of longitudinal beams for the midship part is not to be less than obtained from the following formula:

$0.77Shl^2(cm^3)$

$S$ : Spacing of longitudinal beams ( $m$ ).

$l$ : Span measured between the adjacent supports of longitudinal beams ( $m$ ).

$h$ : Deck load specified in [14.1](#) ( $kN/m^2$ ).

2. Beyond the midship part, the section modulus of longitudinal beams may be gradually reduced, but the section modulus is not to be less than obtained from the following formula:

$0.43Shl^2(cm^3)$

$S, h$  and: As specified in -1.

### 21.2.8 Deck Transverses

The scantlings of deck transverses are not to be less than obtained from the following formulae:

Section modulus:  $0.48Shl^2(cm^3)$

Thickness of web:  $10d_0 + 2.5(mm)$

$S$ : Spacing of deck transverses ( $m$ ).

$l$ : Span measured between the adjacent supports of deck transverses ( $m$ ).

$h$ : Deck load specified in [14.1](#) ( $kN/m^2$ ).

$d_0$ : Depth of web ( $m$ ).



## 21.3 Peak Construction

### 21.3.1 Application

1. The bottom and the side constructions of both end parts are to be in accordance with the provisions in [Chapter 6](#).
2. The fore peaks and after peaks to be used for deep tanks are to be as required in [Chapters 6](#) and [11](#).

## **Chapter 22 TANK BARGES**

### **22.1 General**

#### **22.1.1 Application**

1. The construction and equipment of the tank barges are to be in accordance with the requirements in this Chapter, where “tank barge” means a barge intended to carry crude oils, petroleum products having a vapour pressure (in gauge) less than 0.2 MPa at 38°C, or other similar liquid cargoes in bulk.
2. The construction and scantlings of tank barges are to be in accordance with the relevant Chapters in addition to this Chapter.

#### **22.1.2 Cofferdams**

1. In tank barges intended to carry oils having a flashpoint 60°C and below, cofferdams are to be provided between cargo oil spaces and other spaces such as accommodation spaces, general cargo holds under upper decks and machinery spaces being regarded as source of ignition, etc.
2. The cofferdams prescribed in -1 may be concurrently used as pump rooms.
3. Fuel oil or ballast water tanks may be concurrently used as cofferdams prescribed in -1 subject to the approval by the Society.

#### **22.1.3 Airtight Bulkheads**

Airtight bulkheads are to be provided for the isolation of cargo oil (flashpoint 60°C and below) pumps and pipings from electric installations or machinery where source of ignition is normally present.

#### **22.1.4 Ventilation**

1. Efficient ventilation is to be provided in spaces adjacent to cargo oil tanks. Air holes are to be cut in every part of the structure where there might be a chance of gases being “pocketed”.
2. Efficient means are to be provided for clearing oil tanks and pump rooms of dangerous vapours by means of mechanical ventilation or by steam.
3. Ventilation systems in pump rooms are to be of mechanical extraction type capable of circulating sufficient air to give at least 20 air changes per *hour* for the total volume of the pump room to prevent accumulation of cargo vapours.

Wire mesh screen with mesh of size suitable are to be fitted at the exhaust ducts, whose outlets are to be led to the safe position above the weather deck. The ventilation fan is to be of non-sparking construction. The ducts are to be arranged to permit ventilation from the vicinity of the pump room bilge, immediately above the transverse floor plate or bottom longitudinals. An emergency intake located 2 *metres* above the pump room lower grating is to be arranged to the trunks, and this emergency intake is to have a damper which is capable of being opened or closed from the weather deck and lower grating level.

4. In tankers carrying oils having a flashpoint above 60°C, the capacity of ventilation in the pump rooms specified in -3 may be modified.
5. The requirements in -3 are applied to the ventilation fans and wire mesh screens for the spaces adjacent to the cargo oil tank specified in -1.

## **22.2 Structural Members in Cargo Oil Spaces**

### **22.2.1 Longitudinal Strength**

The section modulus of the hull for the midship part of the tank barges is not to be less than that specified in [12.1.1](#), increased by 3 per cent.

### **22.2.2 Thickness of Members**

The thickness of structural members in cargo oil spaces is to be in accordance with the following:

- (1) The thickness of shell plating is to be as required in [Chapter 13](#). But the thickness of shell plating obtained from the formula in [13.3.2](#), [13.3.4](#), and [13.4.2](#), is to be increased by 0.5 mm above that;
- (2) The thickness of upper deck plating is to be as required in [Chapter 14](#). But the thickness of upper deck plating obtained from the formula in [14.4.1](#) is to be increased by 0.5 mm above that;
- (3) The thickness of webs of girders is to be increased by 1 mm above that obtained from the relevant formulae;
- (4) The thickness of bulkhead platings is to comply with the requirements in [Chapter 11](#). However, in no case are the requirements in [11.2.5](#) to be applied.

### **22.2.3 Scantlings of Members**

The section moduli of bottom longitudinals, side longitudinals, longitudinal beams, transverse girders, bulkhead stiffeners and longitudinal girders in cargo oil spaces are not to be less than 1.1 times that of obtained from the formulae in [Chapter 21](#).

## **Chapter 23 BARGES INTENDED TO BE CLASSIFIED AS LIMITED SERVICES**

### **23.1 General**

#### **23.1.1 Application**

1. The requirements of this Chapter are applicable to the barges intended to be classified as Limited Services.
2. The relevant Chapters are to apply, unless otherwise specified in this Chapter.

### **23.2 Barges intended to be classified as “Coasting Service”**

#### **23.2.1 Application**

The requirements in [23.2](#) are applicable to the barges intended to be classified as “Coasting Service”.

#### **23.2.2 Reductions of Scantlings of Members**

1. The scantlings of structural members may be reduced by the ratios given in [Table 23.1](#) in relation to the requirements in the relevant Chapters, but in no case is it to be less than each minimum scantling in the same table.
2. Reduction of scantlings of members other than given in [Table 23.1](#) may be made at the discretion of the Society.
3. The scantlings of the structural members of deck beams supporting deck cargoes, inner bottom plates and longitudinals supporting heavy cargoes and deep tanks are not to be reduced from the values specified in the relevant Chapters, notwithstanding the provisions in -1 and -2.

#### **23.2.3 Equipment**

Equipment given in [Table 19.1](#) are to be provided according to their equipment numbers obtained from the formulae in [Chapter 19](#). However, the mass of one of the two anchors may be reduced to 85% of the mass given in the [Table 19.1](#). The mass of an anchor required to be provided with for unmanned barges with exception of those for which provision [19.1.2-2](#) are applied, is not to be less than given in [Table 19.1](#).

#### **23.2.4 Bilge Discharge Systems**

In bilge discharge systems, the number of two bilge suction pumps specified in may be reduced to one.



### 23.3 Barges intended to be classified as “Smooth Water Service”

#### 23.3.1 Application

The requirements in [23.3](#) are applicable to the barges intended to be classified as “*Smooth Water Service*”.

#### 23.3.2 Reduction of Scantlings of Members

1. The scantlings of structural members may be reduced by the ratios given in [Table 23.1](#) in relation to the requirements in the relevant Chapters, however, in no case are to be less than minimum scantlings given in [Table 23.1](#).
2. Reduction of scantlings of other members than given in [Table 23.1](#) is to be in accordance with the discretion of the Society.
3. In no case the scantlings of structural members such as deck beams supporting loads, inner bottom platings and inner bottom longitudinals supporting heavy loads and members of deep tanks are to be less than obtained from the requirements in relevant Chapters, irrespective of the requirements in -1 and -2.

#### 23.3.3 Height of Hatchway Coamings, etc.

Height of hatchway coamings, sills of doors, etc. may be reduced to the heights specified in [Table 23.2](#).

#### 23.3.4 Hatch Covers

1. The hatch covers may be of shelter type.
2. The thickness of steel hatch cover, on which cargoes are not carried, may be 4.5 mm.
3. Stiffeners are provided at suitable intervals in the steel hatch covers, and the section modulus of stiffeners, on which cargoes are not carried, may be obtained from the formula in [17.2.2-2](#) taking  $C$  as 1.7.

#### 23.3.5 Equipment

1. Equipment given in [Table 19.1](#) may be provided by reducing one rank according to their equipment numbers obtained from the formula in [Chapter 19](#).
2. The mass of one of the two anchors is to be of the mass specified in -1 and another may be reduced to 85% of the mass specified in -1. However, in unmanned barges with exception of those for which provision [19.1.2-2](#) are applied, the number of anchors may be one of the mass specified in -1.

#### 23.3.6 Air Pipes

Where air pipes extend above the exposed parts of the upper decks, the height between deck and open end and the closing means at open end are to be in accordance with the discretion of the Society.

#### 23.3.7 Bilge Discharge Systems

In bilge discharge systems, the number of two bilge suction pumps specified in [20.4.7-2](#) may be reduced to one.

**Table 23.1 Reductions of Scantlings of Members and Minimum Scantlings**

Items	Coasting Service	Smooth water Service	Minimum scantlings
Longitudinal strength	5%	10%	–
Shell platings (including plate keels)	5%	10%	6mm, except superstructures
Minimum thickness of deck plating	1mm	1mm	5mm
Section modulus of frames ( including bottom longitudinals)	10%	20%	30cm <sup>3</sup>
Section modulus of beams	15%	15%	–
Section modulus of deck girders	15%	15%	–
Thickness of plates of double bottom members	1mm	1mm	5.5mm
Thickness of plates of single bottom members	0.5mm	10% or 1mm whichever is smaller	–
Plate thickness and section modulus of superstructure end bulkhead	10%	10%	

**Table 23.2 Height of Hatchway Coamings, Sills of Doors, etc. (mm)**

Position	Coamings				
	General hatchways	Small hatchways (Area of hatchways 1.5 m <sup>2</sup> and under)	Companionways	Doors of superstructure end bulkhead	Ventilators
I	450	380	300	300	760
II	300	230	100	100	450