RUSSIAN MARITIME REGISTER OF SHIPPING

RULES

FOR THE CLASSIFICATION AND CONSTRUCTION OF SMALL SEA FISHING VESSELS

PART II

HULL

ND No. 2-020101-160-E

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RULES FOR THE CLASSIFICATION AND CONSTRUCTION OF SMALL SEA FISHING VESSELS

Rules for the Classification and Construction of Small Sea Fishing Vessels of Russian Maritime Register of Shipping (RS, the Register) have been approved in accordance with the established approval procedure and come into force on 1 January 2022.

The present edition of the Rules is based on the 2021 edition taking into account the amendments and additions developed immediately before publication.

The Rules are published in the following parts:

Part I "Classification";
Part II "Hull";
Part III "Equipment, Arrangements and Outfit";
Part IV "Stability and Freeboard";
Part V "Subdivision";
Part VI "Fire Protection";
Part VII "Machinery Installations";
Part VIII "Systems and Piping";
Part IX "Machinery";
Part X "Boilers, Heat Exchangers and Pressure Vessels";
Part XI "Electrical Equipment";
Part XII "Refrigerating Plants";
Part XIII "Materials";
Part XIV "Welding";
Part XV "Automation";
Part XVI "Structure and Strength of Fiber-Reinforced Plastic Ships";
Part XVII "Radio Equipment";
Part XVIII "Navigational Equipment".

REVISION HISTORY

(purely editorial amendments are not included in the Revision History)

For this version, there are no amendments to be included in the Revision History.

1 PRINCIPLES OF DESIGN

1.1 GENERAL

1.1.1 Scope.
Requirements of this Part of the Rules for the Classification and Construction of Small Sea Fishing Vessels[1] apply to metal decked sea fishing vessels from 12 to 24 m in length.
1.1.2 Scope of supervision.
1.1.2.1 All structures regulated by this Part are subject to the Register technical supervision.
1.1.2.2 The definitions and explanations relating to the general terminology of these Rules are given in Part I "Classification".
1.1.3 General provisions for determining the scantlings of hull members.
Determination of scantlings of hull members of the decked sea fishing vessels is made in compliance with the Rules for the Classification and Construction of Sea-Going Ships[2]. The thicknesses of plate structures shall not be less than those determined according to 1.1.5.
1.1.4 Corrosion allowance.
1.1.4.1 For plate structures the corrosion allowance Δs, in mm, shall be determined by the formula

$$\Delta s = u(T - 12) \qquad (1.1.4.1)$$

where u = average annual diminution in thickness of the member taken with regard to service conditions, in mm per annum;
T = planned service life of structure (24 years).

1.1.4.2 In the absence of special requirements to service conditions nor to the means of corrosion protection of the hull, for determining the scantlings of hull members according to these Rules, refer to the data on the average annual wastage in thickness of structural members given in Table 1.1.4.2.

Table 1.1.4.2

Average annual reduction in thickness of structural members

Nos.	Hull structural member	u, in mm per annum
1	**Plating of decks and platforms**	
	cargo, accommodation and working spaces	0,10
	other	0,06
2	**Side plating**	
	freeboard	0,06
	the region of waterlines	0,10
	below the region of waterlines	0,10
3	**Bottom plating, including bilge**	
	plate keel or garboard strakes	0,10
	in way of ballast compartments	0,10
	other	0,10
4	**Plating of inner bottom**	
	margin plate	0,10
	in way of engine room	0,10
	in way of ballast compartments	0,10
	other	0,06
5	**Plating of bulkheads**	
	bottom strake	0,06

[1] Hereinafter referred to as "these Rules".
[2] Hereinafter referred to as "the Rules for the Classification".

Nos.	Hull structural member	u, in mm per annum
	other	0,06
6	**Hull framing**	
	in ballast compartments	0,10
	other	0,06
7	**Superstructures, deckhouses, bulwark**	
	lower portion of the walls adjoining the decks	0,06
	other	0,06

1.1.5 Minimum thickness. Spacing.

1.1.5.1 Scantlings of plate structures of shell plating.

In any cases the thickness of shell plating, in mm, shall not be less than

$$s_{\min} = 3{,}1 + 0{,}12L. \quad (1.1.5.1\text{-}1)$$

The thickness of bilge strake, in mm, shall not be less than

$$s_{\min} = 3{,}1 + 0{,}12L. \quad (1.1.5.1\text{-}2)$$

The thickness of plate keel shall be 2 mm greater than that of bottom shell plating.

The thickness of sheerstrake, in mm, shall not be less than

$$s_{\min} = 3{,}1 + 0{,}12L. \quad (1.1.5.1\text{-}3)$$

The shell plates adjoining the sternframe, as well as the plates, to which the arms of propeller shaft brackets are attached, shall have the thickness, in mm, not less than

$$s_{\min} = 4{,}4 + 0{,}1L. \quad (1.1.5.1\text{-}4)$$

The thickness of garboard strakes, in mm, directly adjoining the bar keel, shall not be less than

$$s_{\min} = 3{,}1 + 0{,}12L + 2 \quad (1.1.5.1\text{-}5)$$

and the width shall be

$$b = (800 + 5L)/2. \quad (1.1.5.1\text{-}6)$$

1.1.5.2 Scantlings of single bottom members.

The thickness $s_{\min}$ of single bottom members, in mm, shall not be less than

$$s_{\min} = 5{,}3 + 0{,}04L. \quad (1.1.5.2)$$

For the centre girder, $s_{\min}$ shall be increased by 1,5 mm.

Floor web thickness shall not exceed the bottom shell plating thickness.

1.1.5.3 Scantlings of double bottom members.

At centre girder the depth of double bottom h shall not be less than 0,65 m.

The thickness of plate floors, in mm, between the forepeak bulkhead and 0,25L from the forward perpendicular, and in the engine room and peaks shall not be less than

$$s_{\min} = 5 + 0{,}035L. \quad (1.1.5.3\text{-}1)$$

In any case the thickness of centre girder shall be 1 mm greater than that of a plate floor.

The thickness of side girders shall not be less than that of plate floors.

In any case thickness of watertight floors shall not be less than that required for plate floors.

In any case thickness of inner bottom plating $s_{\min}$, in mm, shall not be less than

$$s_{\min} = 3{,}8 + 0{,}05L. \quad (1.1.5.3\text{-}2)$$

In the engine room the plating thickness shall be increased by 2 mm.

The thickness of brackets of centre girder and margin plate, as well as the brackets of bracket floors shall not be less than that of the plate floors accepted in this region.

Inside the double bottom the structural members, including primary members, stiffeners, brackets, etc. shall have thickness $s_{\min}$, in mm, not less than

$$s_{\min} = 3{,}9 + 0{,}05L. \quad (1.1.5.3\text{-}3)$$

The thickness of the walls and bottom plates of a bilge well shall exceed that of watertight floors not less than by 2 mm.

1.1.5.4 Side framing.

The thickness of structural members of side framing in the tanks, holds, where water ballast may be taken, and in tanks shall not be less than

$$s_{\min} = 5{,}5 + 0{,}035L. \quad (1.1.5.4)$$

1.1.5.5 Scantlings of deck members.

When thickness of deck plating is taken less than the side plating thickness, then a deck stringer shall be provided. The width of deck stringer b, in mm, shall not be less than

$$b = 800 + 5L. \quad (1.1.5.5\text{-}1)$$

The thickness of deck stringer, in mm, shall not be less than that of side shell plating

$$s_{\min} = 3{,}1 + 0{,}12L. \quad (1.1.5.5\text{-}2)$$

The thickness of deck plating and platforms shall not be less than 5,5 mm.

The thickness of sheerstrake shall exceed that of deck stringer by not less than 1 mm.

1.1.5.6 Scantlings of bulkhead members.

The plating thickness of watertight bulkheads and bulkheads of lubricating oil tanks, in mm, shall not be less than

$$s_{\min} = 4 + 0{,}02L. \quad (1.1.5.6)$$

For bulkheads of tanks (except lubricating oil tanks) thickness of plating, face plates and webs of framing members, in mm, shall not be less than 5,5 mm.

The thickness of bottom plates of bulkheads shall not be less than 6 mm.

Where sterntubes penetrate through the bulkhead plating, the thickness of the latter shall be doubled.

1.1.5.7 Scantlings of deckhouses and superstructures.

The minimum thickness of bulkheads and deck plating of deckhouses and superstructures shall not be less than 3 mm.

The thickness of the bottom plate of bulkheads of deckhouses and superstructures at least 0,5 m wide shall not be less than 4 mm.

Framing of superstructures and deckhouses shall have wall and profile flange thickness not less than 3 mm.

1.1.5.8 Spacing.

Normal spacing a_0 is 500 — 600 mm. When the distance between the primary members exceeds the normal spacing, the minimum thicknesses of the shell plates shall be increased. In any case spacing shall not exceed 700 mm.

1.2 SELECTION OF MATERIALS

1.2.1 All hull members of small sea fishing vessels belong to category I according to member categories given in Part II "Hull" of the Rules for the Classification.

Use of steels of category A is permitted for all hull structural members.

1.3 DESIGN LOADING

1.3.1 General.

1.3.1.1 This Chapter contains the basic formulae for determining the design loading on the ship's hull.

1.3.1.2 If the provisions on load points of design loading are absent, the loading is assumed to be:

on the lower edge of the plate;

at the middle of design span of the member;

at the centre of the area taking up the design pressure.

1.3.1.3 The basic parameter of design loading on the ship's hull exposed to weather is the wave factor c_w determined by the formula

$$c_w = 0{,}0856\varphi_r L \qquad (1.3.1.3)$$

where $\varphi_r = 0{,}75 - 0{,}0018L$.

1.3.2 External loading on the ship's hull exposed to weather.

The design pressure p, in kPa, acting on the ship's hull exposed to weather, is determined by the formulae:

for load application points below the load waterline (downwards for positive z)

$$p = 10z + k_x c_w (1 - 0{,}5z/c_w); \qquad (1.3.2\text{-}1)$$

for load application points above the load waterline (upwards for positive z)

$$p = k_x c_w (1 - 0{,}5z/c_w) \qquad (1.3.2\text{-}2)$$

where k_x = factor of pressure distribution over the ship's length determined according to Fig. 1.3.2-1;
z = distance of the considered hull area from the current waterline, in m,

but not less than 5 kPa.

Pressure distribution over the ship's hull section contour is shown in Fig. 1.3.2-2.

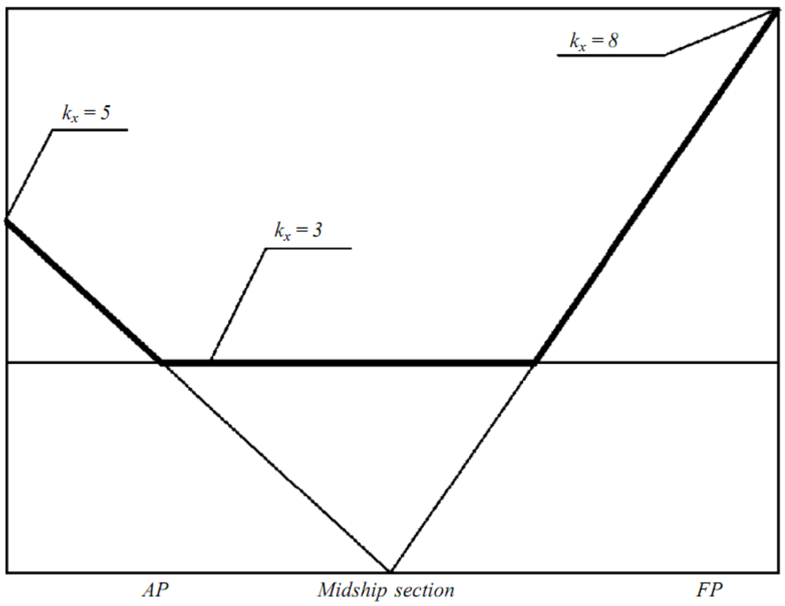


Fig. 1.3.2-1

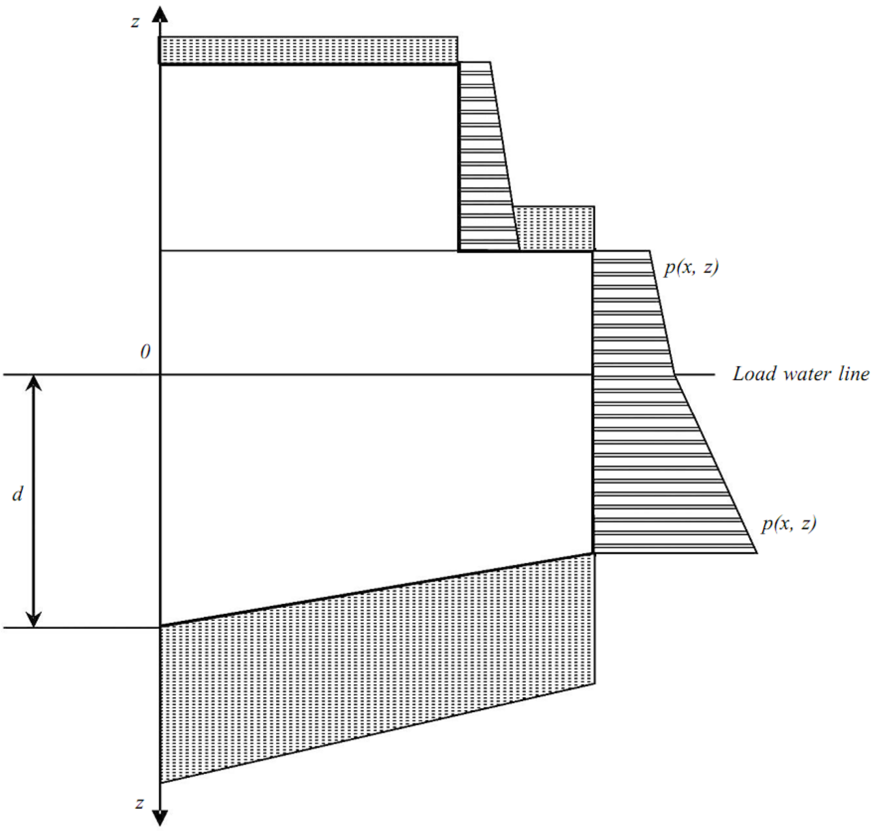


Fig. 1.3.2-2

2 GENERAL REQUIREMENTS FOR HULL STRUCTURAL MEMBERS

2.1 GENERAL

2.1.1 This Section contains general requirements for connecting elements and framing.

2.1.2 The term "framing" includes primary and deep members strengthening the plate structures.

2.1.3 Generally scantlings of primary and deep members are determined by the requirements to section modulus, moment of inertia, web cross-section area, web thickness, width of face plate.

Section modulus and moment of inertia of the member section are determined taking into account the effective flange, unless stated otherwise.

If the member is not normal to the effective flange, the section modulus shall be increased in proportion to 1/cos α.

Rounding of the required scantlings of structural members generally shall be made in direction of increase. Plate structure thicknesses shall be rounded to the nearest 0,5 mm or integer of millimeters.

2.2 SPAN AND EFFECTIVE FLANGE OF MEMBER

2.2.1 The design span of framing l is measured along the member face plate as the shortest distance between its span points.

The span point position if the bracket with straight or effective flange is installed at the end of the bracket (refer to Fig. 2.2.1-1). For the bracket with a free or curvilinear (concave) edge, the span point position is taken according to Fig. 2.2.1-2 but not more than half the bracket leg from its end.

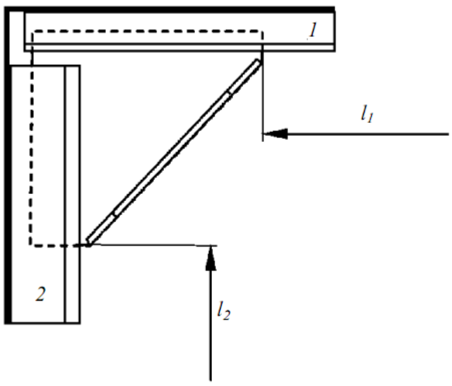


Fig. 2.2.1-1

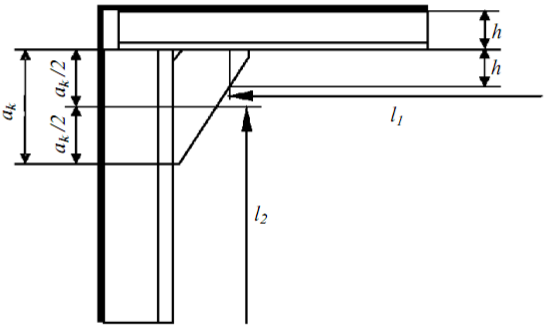


Fig. 2.2.1-2

2.2.2 The thickness of the effective flange is taken equal to its mean thickness in the considered section of the member.

The width of the effective flange a_f, in m, is determined by the following formulae and taken equal to the lesser value:

$$a_f = l/6;$$

$$a_f = (a_1 + a_2)/2 \quad (2.2.2)$$

where a_1, a_2 = distances of the considered member from the nearest members of the same direction located on both sides of the considered member, in m.

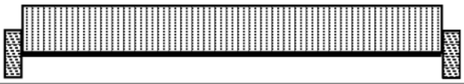
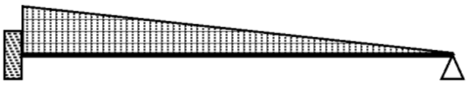
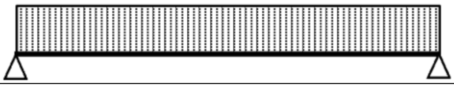
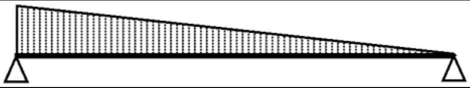
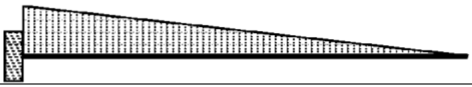
2.3 FRAMING

2.3.1 Section modulus of primary members and deep members W, in cm^3, shall not be less than

$$W = 1000\frac{Ql}{m\sigma_s k_\sigma}\omega_k \tag{2.3.1}$$

where $Q = pal$ — total load on the member considered, in kN;
l = design span, in m;
m = factor of bending moment, which value for the basic primitive cases of member insertion and fixation of the ends is accepted according to Table 2.3.1;
$k_\sigma = 0{,}8$ — factor of permissible stresses;
σ_s = yield stress of member material, in MPa;
$\omega_k = 1 + 0{,}2\Delta s$ — factor of corrosion allowance for rolled section;
a = distance between the considered primary and deep members, longitudinal or transverse; if the members are located at various distances, a means half the sum of distances of the adjoining members from the considered member, in m;
p = design pressure on the structures, in kPa.

Table 2.3.1

Nos.	Designed structure type	On support		Over span
		m	n	m
1		12	0,5	24
2		10	0,7	23,3
3		8	0,63	14,2
4		7,5	0,8	16,8
5		–	0,5	8
6		–	0,67	7,8
7		2	1	–
8		3	1	–

For built-up welded members the required web cross-section area shall be determined by Formula (2.3.2) with a subsequent increase in thickness by the value of Δs.

For built-up welded members the section modulus shall comply with the requirements of 2.3.1, the section elements thickness shall be increased by the value of corrosion allowance Δs.

2.3.2 The net sectional area of primary and deep member webs f_w, in cm^2, shall not be less than

$$f_w = 10\frac{nN_{\max}}{0{,}57\sigma_s k_\tau}\omega_k \tag{2.3.2}$$

where $N_{\max}$ = the maximum shear force, in kN;
n = shear force factor in the span point, which value for the basic primitive cases of members insertion and fixation of the ends shall be taken according to Table 2.3.1;
σ_s = yield stress of member material, in MPa;
$k_\tau = 0{,}7$ — factor of permissible shear stresses;
for ω_k, refer to 2.3.1.

2.3.3 Width of flanges of deep members generally shall not be less than 15 thicknesses for angle and 30 thicknesses for T-section. Deep members made of flat bars are not allowed.

2.3.4 In the case of framing member connections, the flanges of the smaller members being cut, generally shall be continued in their plane in the form of stiffeners or brackets welded to the webs (refer to Fig. 2.3.4). All elements of such connections shall be welded with double weld.

2.3.5 In the case of overlapping member connections (refer to Fig. 2.3.5), the smaller member shall have the welded area of the length, as a rule, not less than 1,5 the member height. This member area shall be welded all round by continuous weld.

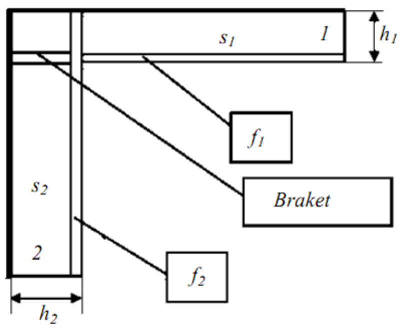


Fig. 2.3.4

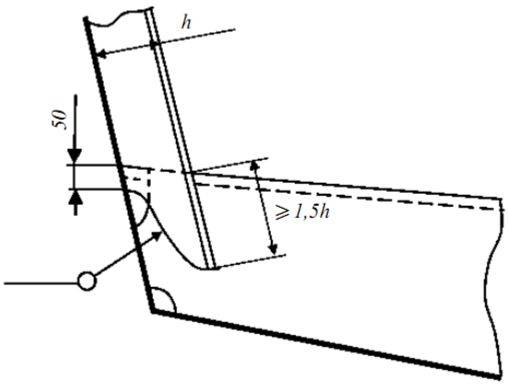


Fig. 2.3.5

2.4 OPENINGS IN HULL STRUCTURES

2.4.1 It is recommended to allocate all the openings in the longitudinal ship hull bracings in such a way that their longer side goes along the ship.

2.4.2 All the corners of any rectangular opening in the longitudinal bracings shall be rounded by the radius not less than 0,1 of the cutout breadth.

2.4.3 Openings (if there are several ones) in the shell plating and bulkheads shall be allocated in such a way that they would not cause considerable weakening of the hull cross-section.

2.4.4 It is allowed to make lightening openings without cross-section compensation in the walls of the bottom stringers and floors, if the following is provided:

.1 height of the opening is not less than 0,4 of the bracing height, and axis of the opening is located amidst the bracing height;

.2 opening length/height ratio is below two;

.3 distance between two adjacent openings is not less than the length of the smallest one of these both openings;

.4 corners of the openings are rounded in the appropriate way.

If height of the openings in the framing wall exceeds 0,6 of its height, then the framing wall shall be reinforced.

2.4.5 It is not allowed to make openings in the beam wall right under ends of the knees that fix the beam, and close to the supports either. The opening edge shall be located at the distance from the knee end not less than 1/2 of the beam height. Distance from the edges of any openings in floors and web bracings to the edges of the openings used for passing the longitudinal framing beams shall not be less than the height of these beams.

2.4.6 Height of the fastening openings in the framing shall not exceed 1/5 of the beam height, but shall not be less than 90 mm. Length of the fastening openings shall be taken equal to 15 thicknesses of the plating adjacent to the framing, but not more than 150 mm. If dimensions of the fastening openings are increased, thickness of the framing areas weakened due to the openings shall be increased also.

2.5 PILLARS AND PANTING BEAMS

2.5.1 Pillars shall be fitted in the areas where the deep members are connected. Pillar heel shall be connected with the doubling deck plating or flange of deep members.
2.5.2 The web of the framing members connecting with heels of pillars or panting beams shall be strengthened by stiffeners or brackets to prevent the member deviation or web buckling.
2.5.3 Total loading on the pillar, panting beam of bracket floor or panting beam Q, in kN, is determined by the formula

$$Q = p l_m b_m \tag{2.5.3}$$

where p = design pressure in way of pillar axis or panting beam exposed to weather or from the shipping cargo, whichever is greater, in kPa;
l_m = extension of the area supported by the pillar or panting beam fore and aft the ship, in m;
b_m = extension of the area supported by the pillar or panting beam athwartships, in m.

2.5.4 The cross-section area of the pillar or panting beam f, in cm^2, shall not be less than the one determined by iterative method according to the formula

$$f = 10k \frac{Q}{\sigma_{cr} k_\tau} \omega_k \tag{2.5.4}$$

where $k = 2$ — buckling strength margin;
Q = total loading according to 2.6.3;
ω_k = factor of corrosion allowance according to 2.3.1;
$k_\tau = 0{,}7$ — factor of permissible shear stresses;
σ_{cr} = critical stresses determined according to Euler stresses:

$$\sigma_{cr} = \sigma_s \left(1 - \frac{\sigma_s}{4\sigma_e}\right) \text{ at } \sigma_e > 0{,}5\sigma_s;$$

$$\sigma_{cr} = \sigma_s \text{ at } \sigma_e \le 0{,}5\sigma_s$$

where $\sigma_e = 206 \frac{i}{f l^2}$;
σ_s = yield stress of member material, in MPa;
i = the minimum moment of inertia of the pillar or panting beam cross section, in cm^4;
l = design length of pillar or panting beam, in m.

2.6 ALUMINUM ALLOY STRUCTURES

2.6.1 Dimensions of aluminum alloy bracings shall be determined by converting the respective dimensions of bracings for steel structures. Converting shall be carried out according to the formulae given in Table 2.6.1 without taking into account the minimum bracing dimensions for steel structures.

Table 2.6.1

Parameter	Design formula
Thickness of the shell deck plating (without coating), plating of bulkheads, internal enclosures and other plate parts	For superstructures: $s_a = \sqrt{s\sigma_s/\sigma_{sa}}$ For the main hull: $s_a = 0{,}9s\sqrt{s\sigma_s/\sigma_{sa}}$
Section modulus of members	$W_a = W\sigma_s/\sigma_{sa}$
Cross-section area of pillars	$f_a = f\sigma_s/\sigma_{sa}$
Moment of inertia of pillars and members	$I_a = 3 \times I$
Notes: 1. Values s, W, f, I required by these Rules for steel may be taken without taking into consideration the corrosion allowance. 2. Value σ_{sa} is the conventional yield stress of aluminum alloy, in MPa, but not more than 0,7 of its ultimate strength.	

2.6.2 Dimensions of cross-sections of the stempost, sternpost, bar keel and propeller shaft brackets made from aluminum alloys shall exceed dimensions of the cross-sections recommended for the case when steel is used by 1,3 times.

2.6.3 If continuous welds (fillet and butt ones) are located in the maximum stress areas, then, depending on the aluminum alloy used and welding technique applied, strength reduction in the weld area shall be taken into account.

2.6.4 The bimetallic (steel–aluminum) pressed elements for connection of steel and aluminum alloy structures may be used.

2.7 CORRUGATED STRUCTURES

2.7.1 The thickness of bulkhead plating is determined according to 1.1.5.6 taking a equal to b and f, whichever is the greater, shown in Fig 2.7.1.

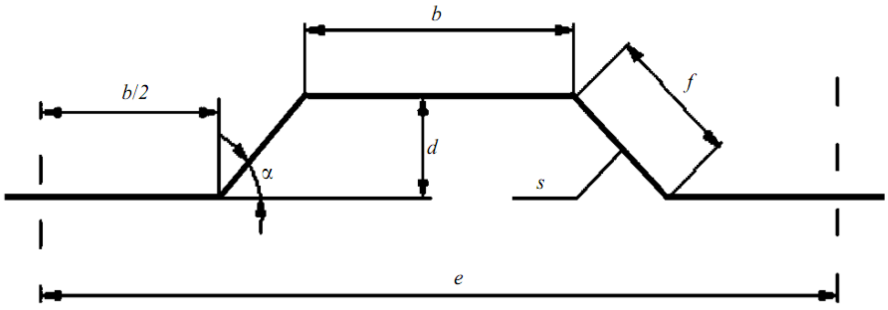


Fig. 2.7.1

2.7.2 The section modulus of trapezoidal corrugation W, in cm^3 (refer to Fig. 2.7.1), shall not be less than that determined by the formula

$$W = kez^2(b/80s)^2 \tag{2.7.2-1}$$

where k = factor equal to:
15 — for the forepeak and afterpeak bulkheads;
12 — for watertight bulkheads;
9 — for other bulkheads;
z = height measured from amidst height l to the deck, in m;
for e, s, b, refer to Fig. 2.7.1, in cm;
l = height of the bulkhead, in m.

For the calculations made according to Formula (2.7.2-1) b/s ratio shall not be taken more than 46 and angle α shall not be less than 45°.

Section modulus of trapezoidal corrugation W, in cm^3 (refer to Fig. 2.7.1), is determined by the formula

$$W = sd(b + f/3) \tag{2.7.2-2}$$

where for d, s, b, f, refer to Fig. 2.7.1, in cm.

For other corrugations the strength equal to the strength of corrugations shown in Fig. 2.7.1 shall be provided.

2.7.3 It is allowed to use corrugated structures for watertight hull bulkheads and secondary structures — enclosures, deckhouse walls and roofs, etc.

Strength of corrugated structures shall not be less than that of the respective flat structures.

2.7.4 For secondary structures corrugations of triangular cross-section with rounded apex are permitted (refer to Fig. 2.7.4). Recommended dimensions of corrugation elements for secondary structures are given in Table 2.7.4.

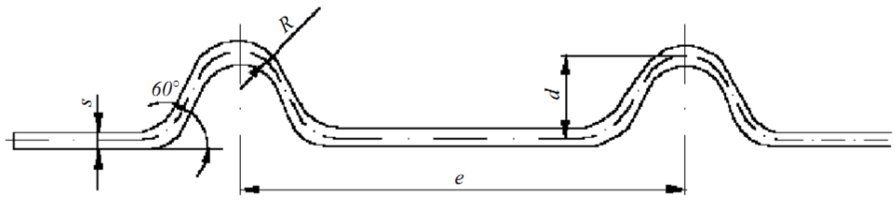


Fig. 2.7.4

Table 2.7.4

Corrugation height d, in mm	Distance between the axes e, in mm	Rounding apex radius R, in mm	Plate thickness s, in mm	Minimum section modulus W, in cm^3	Moment of inertia I, in cm^4
Corrugations of triangular cross-section					
30	390	15	3	3,18	7,67
			4	4,22	10,17
30	435	15	3	3,21	7,90
			4	4,26	10,50
30	470	15	3	3,22	8,02
			4	4,28	10,65
40	320	15	3	4,62	13,95
			4	6,18	18,65
40	370	15	3	4,68	14,6
			4	6,26	19,55
40	400	15	3	4,72	14,9
			4	6,30	19,9

2.7.5 Connection of flat and corrugated bulkheads with the bottom and deck by means of overlap joints of bottom and deck plates is shown in Fig. 2.7.5-1, and the same for bulkheads in superstructures — in Fig. 2.7.5-2.

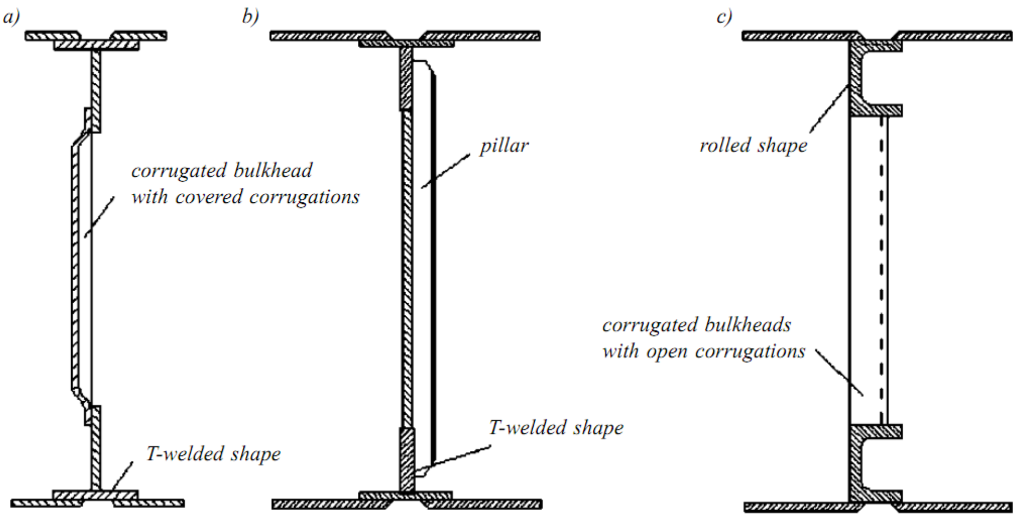


Fig. 2.7.5-1

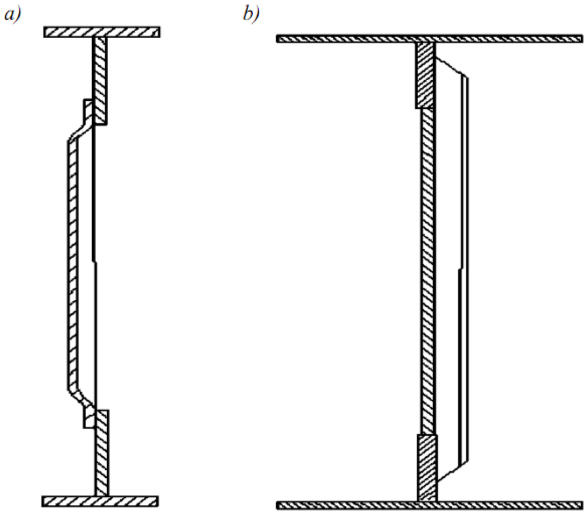


Fig. 2.7.5-2

2.8 STEMS AND SHAFT BRACKETS

2.8.1 Cross-section area of the underwater part of bar stem f, in cm^2, shall not be less than

$$f = 1{,}2L - 4. \tag{2.8.1}$$

The welded stem plates shall be strengthened with transversal brackets, which shall overlap the joints of the stem with the shell plating at the distance less than 1 m. Thickness of the brackets shall not be less than the thickness of the adjoining shell plating.

Above the summer waterline the stem sectional area may be gradually reduced to 70 % of the value determined by Formula (2.8.1), as well as the distance between the brackets may be increased 1,5 times and the thickness of stem plates may be reduced to that of the shell plates adjoining the stem.

2.8.2 Over the ship area from the keel to the counter, the scantlings of rectangular solid propeller post of sternframe, in mm, shall not be less than

thickness $s = 1{,}6L + 20$;

width $b = 1{,}2L + 85$.

Above the counter sectional area of sternframe may be gradually reduced to 40 % of the value of the propeller post sectional area corresponding to the scantlings mentioned above.

The lower part of the sternframe shall be extended forward from the propeller post and shall be attached to not less than one floor.

The thickness of the propeller boss shall not be less than 30 % of the propeller shaft diameter.

3 WELDED STRUCTURES AND JOINTS

3.1 GENERAL

3.1.1 Any change in the shape or section of the members of welded hull structures shall take place gradually. All the openings shall have rounded corners and smooth edges.

3.1.2 The scantlings of sections and the thicknesses of plates used for longitudinal members shall change gradually throughout the ship's length.

3.1.3 Transition to the lower beam wall height shall take place over the length equal to not less than double difference between the height of the walls; flanges of the beams shall be joined smoothly.

3.1.4 Difference between thicknesses of the joined plates shall not exceed 0,3 times the thickness of the thicker plate. If the difference is higher, edge of the thicker plate shall be cut to edge. The cut shall extend over the length equal to at least 5 times the difference between the plates thickness $5\Delta s$, or according to the standards recognized by the Register.

3.1.5 In tight structures, as well as in non-tight subject to intense vibration, stiffeners and similar details shall be fitted to prevent hard spots in the plating in the way of face plates and at the toes of brackets.

3.1.6 The length of the unsupported plating between the end of longitudinal and the nearest web normal to direction of the member shall not be more than $4s$ or 40 mm, whichever is the lesser (s = plate thickness, in mm).

3.1.7 In way of the ends of bulwark, bilge keel and other details welded to the hull, as well as generally of gutterway bars, their height shall decrease on the length of not less than 1,5 times the height of these members.

3.2 CONNECTION OF FRAMING MEMBERS

3.2.1 Framing members shall have butt-welded joints, as well as overlapping joints.

3.2.2 Overlapping joints may be allowed, except in the regions with intense vibration.

3.2.3 Brackets, in general, shall be made of the material with the same yield stress as the material of the members connected.

3.2.4 Bracket leg size a_{br}, in mm, is determined by the formula

$$a_{br} = 50\sqrt{W/s} \quad (3.2.4)$$

where W = required section modulus of the smaller member connected, in cm^3;
s = web thickness of the wall of the mentioned member, in mm.

3.2.5 Thickness of bracket shall not be less than the web thickness of the mentioned member and not less than 2,5 % of length of the free edge of the bracket if the bracket has no flange or face plate.

3.2.6 Free edge of the bracket, which length is more than 45 bracket thicknesses, shall have a flange. Width of the flange shall not be less than $8s$ and not more than $10s$ (s = thickness of bracket). The bracket flange shall not be extended to the flanges (face plates) of the joined stiffeners (gap shall be 2 – $3s$) and shall not be welded to them.

3.2.7 Width of face plate or flange b, in mm, depending on their thickness s_f, in mm, shall not be more than

$$b = \frac{200s_f}{\sqrt{\sigma_s}} \quad (3.2.7)$$

where σ_s = yield stress of the flange material, in MPa.

3.2.8 The size of brackets may be reduced:

by 25 % where the joint is made without gaps and the bracket has a flange (face plate);

by 15 % where the joint is made with one gap and the bracket has a flange (face plate);

by 10 % where the joint is made with two gaps and the bracket has a flange (face plate).

For members with two gaps it is recommended to use the brackets with a flange (face plate) welded by overlapping with 40 mm overlap.

3.2.9 The radius of the rounded brackets shall not be less than the depth of the smaller members connected.

3.2.10 In general, the brackets shall be made of the material having the same yield stress as the material of the framing members connected. In order to reduce the weight of the joined assembly and improve its manufacturability it is allowed to use high-strength steels, if the appropriate validation is presented.

3.2.11 Framing members, which webs are located in one plane (beam with frame, frame with floor, etc.), may be joined with each other by brackets. Face plates of brackets shall not be welded to the face plates of framing members.

3.2.12 Thickness of the brackets shall not be less than thickness of the thinner web of the connected members; or 2,5 % of the working edge length for flat brackets and 2 % — for brackets with flange, whichever is the greater. For overlapping bracket joints it is reasonable to extend the bracket to the platings, increasing its thickness but reducing the height as shown in Fig. 3.2.12.

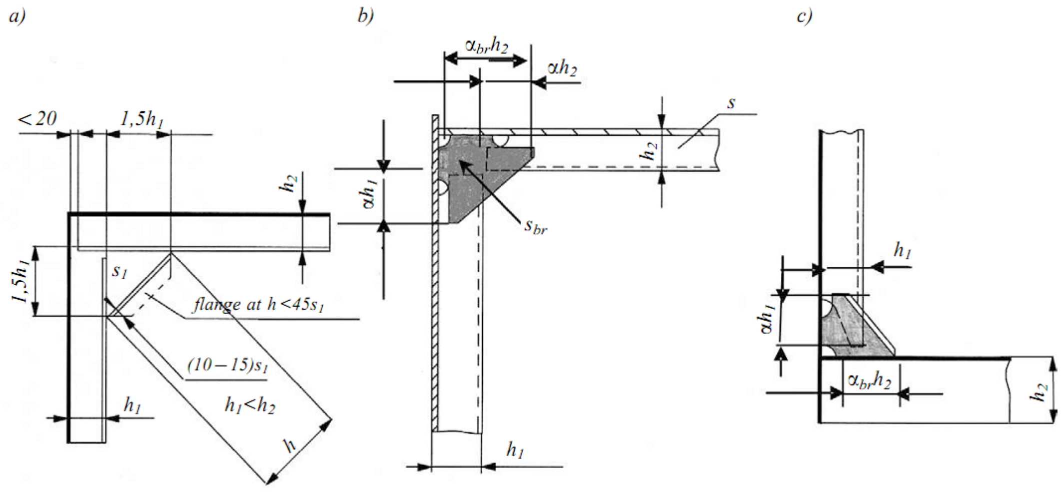


Fig. 3.2.12

3.2.13 For overlapping joints of the framing member connections shown in Fig. 3.2.12 (*b*, *c*) size of brackets is determined by the formulae:

bracket thickness

$$s_{br} = \frac{4\sigma_{sm} W_f}{\sigma_{s\,br}(\alpha_{br} h_m)^2} \tag{3.2.13-1}$$

where σ_{sm} = yield stress of the member material, in MPa;
W_f = the maximum section modulus of the member with the effective flange, in cm^3;
$\sigma_{s\,br}$ = yield stress of the bracket material, in MPa;
α_{br} = 1,0 – 1,8 — specified factor of the bracket length increase with respect to the member depth;
h_m = depth of the largest framing member (h_1 or h_2), in cm;

overlap length factor

$$\alpha = \frac{F_m}{2 h_m \alpha_1 B s_w k_3} \tag{3.2.13-2}$$

where F_m = member cross-section area, in cm^2;
h_m = member depth (h_1 or h_2), in cm;
α_1 = strength factor of the fillet overlap weld;
$B = 2$ — single weld;
s_w = thickness of the member web, in cm;
$k_3 = 0{,}5$ — safety factor.

3.2.14 In case of thickening of the deck and side plating, it is allowed to use simplified connections of transverse framing members of decks and sides and attachments of the bulkhead ends shown in Figs. 3.2.14-1 — 3.2.14-3.

Thickening factor of the abutting plates is determined by the formula

$$\alpha_1 = \frac{2 W_f \sigma_{sw}}{s a \sigma_s} \tag{3.2.14-1}$$

where W_f = the maximum section modulus of the framing member, in cm^3;
σ_{sw} = yield stress of the member material, in MPa;
a = spacing of the primary members, in cm;
σ_s = yield stress of the strengthened plate material, in MPa;
s = thickness of the deck or shell plating, in cm.

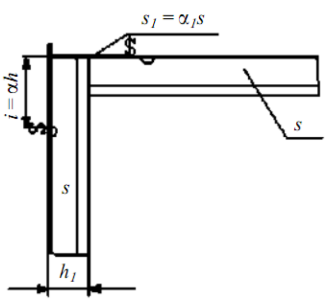


Fig. 3.2.14-1

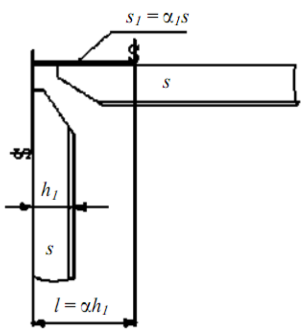


Fig. 3.2.14-2

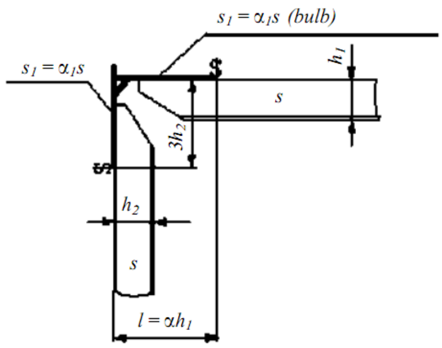


Fig. 3.2.14-3

Member overlapping length factor with respect to the strengthened plate width is determined by the formula

$$\alpha = \frac{0{,}57F_m}{0{,}5hs} \qquad (3.2.14\text{-}2)$$

where F_m = cross-sectional area of the primary members, in cm^2;
h = depth of framing member, in cm;
s = thickness of framing web, in cm.

Thus the ends of the members shall be welded to the strengthened plates with T-butt weld with full penetration over the length αh.

3.3 STRUCTURE OF DEEP MEMBERS

3.3.1 At the ends of the longitudinal deep members of the bottom, sides and deck (deck girders, side girders, side stringers, etc.), their height shall be gradually decreasing over the length equal to one and a half depth of the member web; their ends shall be attached to transverse members. When the end is on the transverse bulkhead, they shall be extended beyond the bulkhead in the form of brackets for the distance not less than one spacing.

3.3.2 The face plates and/or webs shall be sniped at the member ends depending on the structure used for attachment of members.

3.4 WELDED JOINT PARTS

3.4.1 Arrangement of welded joints. Welded joints shall be arranged in the least stressed structural sections, as far as possible from abrupt changes of sections, openings and areas that were subjected to cold forming.

3.4.2 Details of welded structures shall comply with 1.7.4 of Part II "Hull" of the Rules for the Classification.

3.4.3 There shall not be any welded joints within the areas that were subjected to cold bending and have the internal radius less than 3 plate thicknesses. Distance from the weld to commencement of such bend shall not be less than 3 plate thicknesses, the distance between welded joints may be reduced on the basis of appropriate technical background, which includes tests and strength calculations taking into account welding stresses and deformations.

3.4.4 When butt welds cross the fillet welds, openings shall be made in the latter ones right above the intersection points.

3.4.5 In the local stresses concentration zone it is required to install reinforced plates without use of overlay plates. If it is not possible to do without overlay plates, they shall be welded around the entire contour; if the surface is considerable, these plates shall be fastened with plug lap joints at the interval not exceeding 30 thicknesses of the overlay plate.

3.4.6 Edges of knees, face plates and member webs shall be welded around and have no strikes. The same is also relevant to cutouts of water pipes, air ducts, passages of beams and welds.

3.4.7 Shoulders of knees and brackets installed for reinforcement of the webs (longitudinal foundation frames inclusively) shall not be welded to the face plates of the latter.

3.4.8 It is not recommended to weld face plates of the longitudinal foundation beams to plating of transverse bulkheads or double bottom plating.

3.4.9 Welding of beam shoulders to the edges of cutouts is not allowed in the areas where beams pass through non-tight structures.

3.4.10 In order to form fastening cutouts (canals) near transverse watertight structures (bulkheads, floors), it is allowed not to extend longitudinal beams of the bottom and deck to the walls of these structures. Distance between the end face of the beam and the structure wall shall not be more than 20 mm.

3.5 TYPES AND DIMENSIONS OF FILLET WELDS

3.5.1 Fillet welds of hull structures shall be welded by continuous or intermittent welds (refer to Fig. 3.5.1) according to Table 3.5.2.

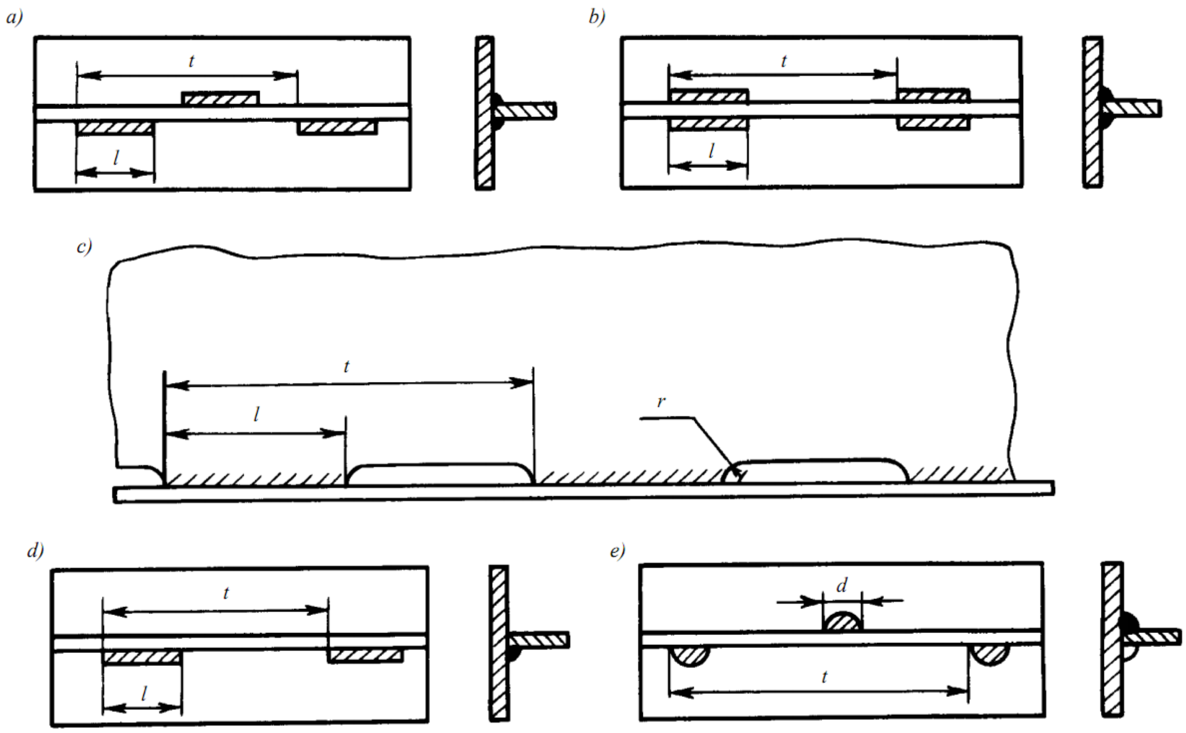


Fig. 3.5.1
Weld types: *a* — staggered intermittent; *b* — chain intermittent; *c* — scalloped; *d* — single intermittent; *e* — staggered spot

3.5.2 The design throat thickness of fillet welds a, in mm, for manual and semi-automatic welding shall not be less than
for single weld

$$a = 2{,}0\alpha st/l; \quad (3.5.2\text{-}1)$$

for double weld

$$a = \alpha st/l \quad (3.5.2\text{-}2)$$

where α = weld factor given in Table 3.5.2;
s = thicknesses of the lesser of the parts joined, in mm;
t = weld pitch, in mm;
l = weld length, in mm.

For continuous welding t/l in Formulae (3.5.2-1) and (3.5.2-2) shall be assumed as 1.

Table 3.5.2

Nos	Connection of structural member	Weld factor	Permitted:		
			staggered intermittent and chain intermittent welds	single continuous welds	single intermittent welds
1	**Stem and sternframe, propeller shaft brackets, bar keel**				
1.1	Separate parts with each other and with the plating	0,40			
2	**Bottom framing**				
2.1	Side girder webs and watertight floors to shell plating, double bottom plating and top face plates of stringers and floors	0,20	×		
2.2	Side girder webs and watertight floors to shell plating and face plates in the way of seatings of internal combustion engines	0,30			
2.3	Plate floors to side girders	0,35			
2.4	Webs of plate floors to bilge strake	0,40			
2.5	Watertight floors and side girders to shell plating and double bottom plating	0,35			
2.6	Side girders to bulkheads	0,40			
2.7	Side and bottom frames to shell plating	0,15	×	×	×
3	**Side framing**				
3.1	Walls of web frames and side stringers to shell plating and their face plates	0,20	×		
3.2	Web frames and side stringers with each other and to bulkheads	0,40			
3.3	Frames to shell plating and their face plates in region of 0,20 of the ship's length from perpendiculars and also in ballast and oil tanks and in engine room	0,20	×		
3.4	Ditto, elsewhere	0,15	×	×	×
3.5	Side longitudinals to shell plating				
4	**Deck framing**				
4.1	Deck transverses and girders to deck plating and face plates	0,20	×		
4.2	Deck transverses to side plating and girders	0,40			
4.3	Girders to bulkheads	0,40			
4.4	Hatch end beams to deck plating, their face plates and shell plating	0,35			
4.5	Beams to deck plating	0,15	×	×	×
4.6	Hatch cargo coamings to deck and fan coamings to deck	0,35			
4.7	Pillars to deck and double bottom plating	0,40			
4.8	Deck stringers of decks to shell plating	0,50			
4.9	Deck stringers of platforms to shell plating	0,40			
4.10	Bulkheads of superstructures and deckhouses to deck	0,40			
5	**Bulkheads**				
5.1	Vertical webs and horizontal girders to bulkheads plates and their face plates	0,20	×		
5.2	Vertical webs and horizontal girders with each other and to face plates of bottom, side and deck framings	0,20			
5.3	Vertical and horizontal stiffeners of bulkheads to bulkhead plates of bulkheads and their face plates		×	×	×
5.4	Forepeak and afterpeak bulkheads of water and oil tanks to shell plating and deck	0,40			
5.5	Other watertight bulkheads to shell plating or double bottom plating and deck	0,35			

Nos	Connection of structural member	Weld factor	Permitted:		
			staggered intermittent and chain intermittent welds	single continuous welds	single intermittent welds
6	**Seatings**				
6.1	Plates, brackets and knees of seatings for internal combustion engines with each other, to shell plating and face plates	0,40			
6.2	Member plates of other seatings for machinery and boilers to shell plating and face plates	0,30			
6.3	Brackets and knees of seatings for machinery to members	0,40			
6.4	Ditto to face plates	0,30			
6.5	Top plates (face plates) to vertical plates, brackets and knees	0,50			

The ratio between the leg length of the fillet weld and height of the isosceles triangle inscribed into cross-section of the weld (refer to Fig. 3.5.2) shall be assumed as $k = 1{,}4a$ or $a = 0{,}7k$.

When semi-automatic or automatic welding is employed instead of the proposed manual welding, the weld throat thickness or leg length (whichever is adopted in calculation) may be reduced in height for single-run welds but not more than 30 %.

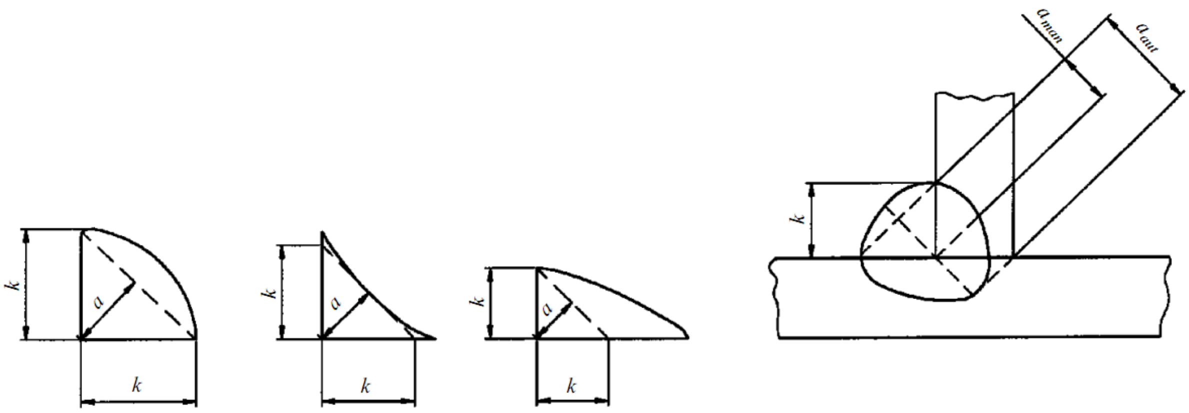


Fig. 3.5.2

Throat thickness of fillet weld shall not be less than

s, in mm	a, in mm
3 — 4	2,5
5 — 8	3,0

3.5.3 If the thickness of the joined plates is up to 5 mm, single intermittent fillet welds may be used.

3.5.4 For intermittent fillet welds length of fillet weld l shall not be less than 50 mm, weld pitch t shall not be more than 150 mm. The throat thickness of the intermittent fillet weld shall not be more than 0,6 times the plate thickness (for plate thickness up to 6 mm — 0,7 times the plate thickness).

3.5.5 In T-joints of hull structures that are subjected to effect of considerable impact and variable loads (seatings for internal combustion engines, etc.), abutting wall edges with the thickness over 8 mm shall have one-sided or double-sided bevel; the welds shall have concave shape in their cross-section with smooth transition to the surface of the welded plates (refer to Fig. 3.5.5).

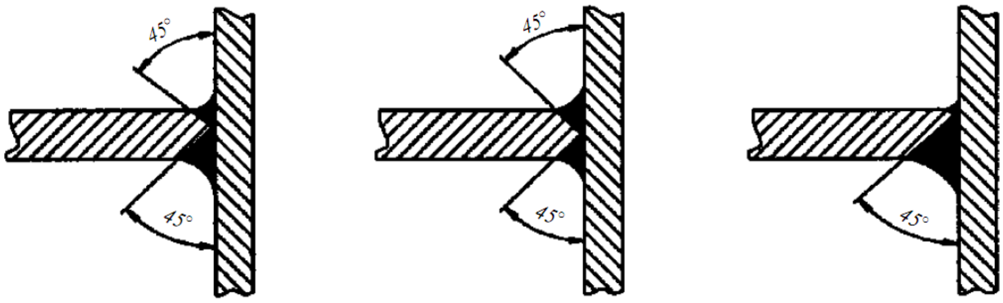


Fig. 3.5.5

3.6 WELDING OF PARTS

3.6.1 Webs and face plates of free ends of bulkhead pillars and other members, i.e. ends that are not secured by brackets or not welded to transversals, shall be welded by a double continuous fillet weld with weld factor $\alpha = 0{,}4$ (refer to Fig. 3.6.1).

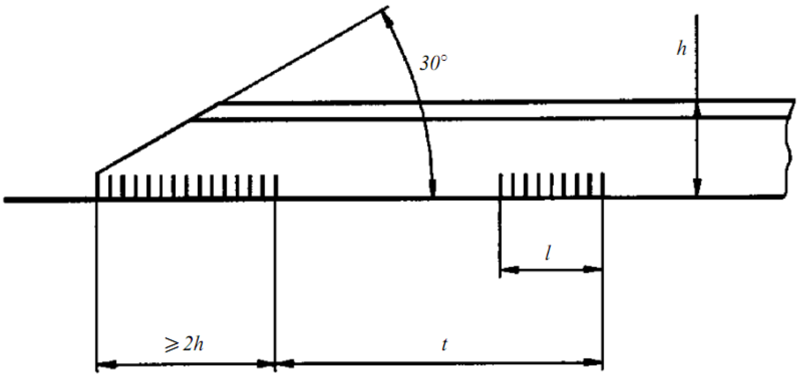


Fig. 3.6.1

3.6.2 Webs, on the edges with openings with length more than 20 mm, shall be welded by double weld by both sides of the openings on the length equal to the length of the applied intermittent weld (refer to Fig. 3.6.2).

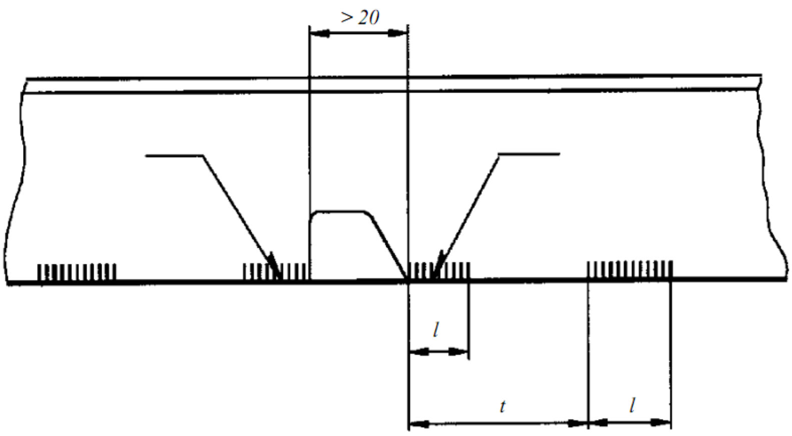


Fig. 3.6.2

3.6.3 Brackets shall be welded to the framing, plating and bulkheads by double continuous fillet weld with weld factor $\alpha = 0{,}4$.

3.6.4 On those member sections where brackets are installed, the welds for connection of the member web to face plate and to the joined plate shall correspond to dimensions of the weld (length, leg) that joins the bracket with the member.

3.7 WELDING OF OVERLAPPING CONNECTIONS

3.7.1 It is allowed to use overlapping welded connections for hull structures listed in 1.1.2.1, except the following:

.1 side, bottom and deck platings of engine room;
.2 hull structures in the way of main engines;
.3 bottom platings in the way of propeller shaft supports;
.4 bottom structures in the way of propellers;
.5 stern structures in the way of azimuth thrusters;
.6 web members, except overlapping welds for connection of ends of single board idle frames with ends of beams and floors and connection of elements of double bottom bracket floors;
.7 elements of hull structures subject to the effect of considerable efforts (at the limit of permissible stresses), and also members, which may be affected with overloading in the course of operation.

3.7.2 For arrangement of overlapping welds, the requirements of 3.4.1 and 3.4.2 shall be met.

3.7.3 The length of overlap shall not be less than b, in mm, determined by the formula

$$b = 1{,}5s + 20 \qquad (3.7.3)$$

where s = thicknesses of the thinner of the parts joined, in mm.

3.7.4 Overlapping connections of hull structures shall be welded all round by continuous fillet weld in such a way that the welds shall form closed contours. Fillet weld factor shall be 0,4.

3.7.5 It is allowed to join butts and grooves of the shell plating, inner bottom plating and inner sides by welding on the remaining backing, thickness of which shall not be less than thickness of the thicker of the plates joined; at that the backing shall be arranged on the internal side of the plating. Thus the plate edges shall be to the extent possible located in one line (refer to Fig. 3.7.5). Distance between the plate edges shall not be less than $3s_1$ where s_1 = thicknesses of the thicker of the parts joined.

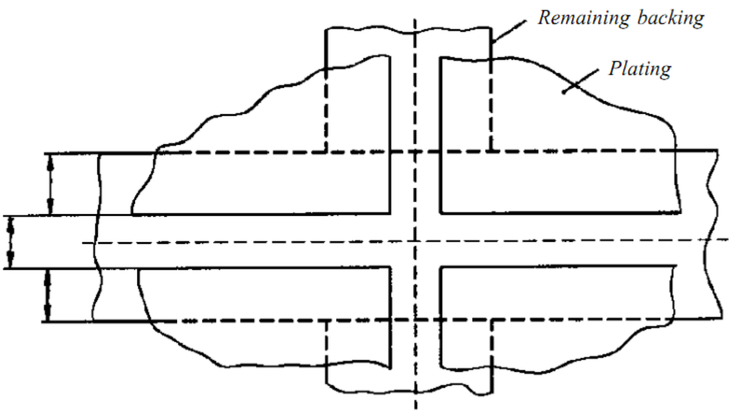


Fig. 3.7.5

3.7.6 The remaining backing mentioned in 3.7.5 for the plating butts shall be joined with a plate of a transverse bulkhead or transverse frame; for the plating slots it shall be joined with a plate of the inner bottom, side stringer or platform. It is allowed to use rolled sections as the remaining plating backing (refer to Figs. 3.7.6-1 and 3.7.6-2).

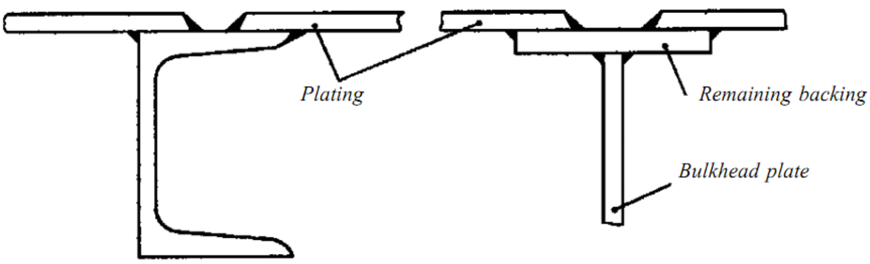


Fig. 3.7.6-1

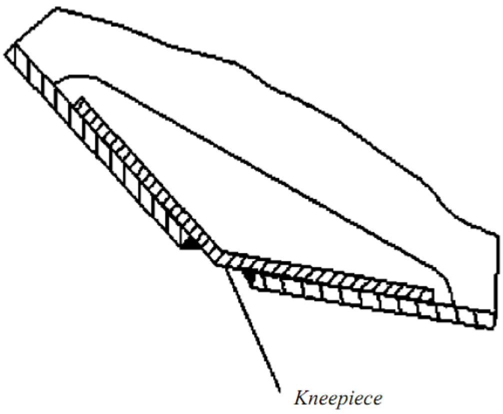


Fig. 3.7.6-2

Joint of the deep member web or bulkhead plate with the remaining backing of the shell or inner plating shall be arranged between two internal welds of the backed welded joints.

3.7.7 It is not allowed to make butts of plates of the deep member webs and flanges at a distance less than 150 mm from the respective edges of the platings joined by overlapping welding (refer to Fig. 3.7.7).

3.7.8 Where welding of T-joints by fillet welds is impossible, plug welds (refer to Fig. 3.7.8, *a*) or tennon welds (refer to Fig. 3.7.8, *b*) may be used.

The length l and pitch t shall be determined as for scalloped frames according to 3.5.4.

3.7.9 Where aluminum alloy structures are welded according to Table 3.5.2, it is not permitted:

.1 to use intermittent welds (except in scalloped construction);

.2 to use scalloped construction in the regions of intense vibration (refer to 1.7.1.6 of Part II "Hull" of the Rules for the Classification).

The throat thickness of the welds shall not be less than 3 mm, but not more than 0,5s (for s, refer to 1.7.5.1of Part II "Hull" of the Rules for the Classification).

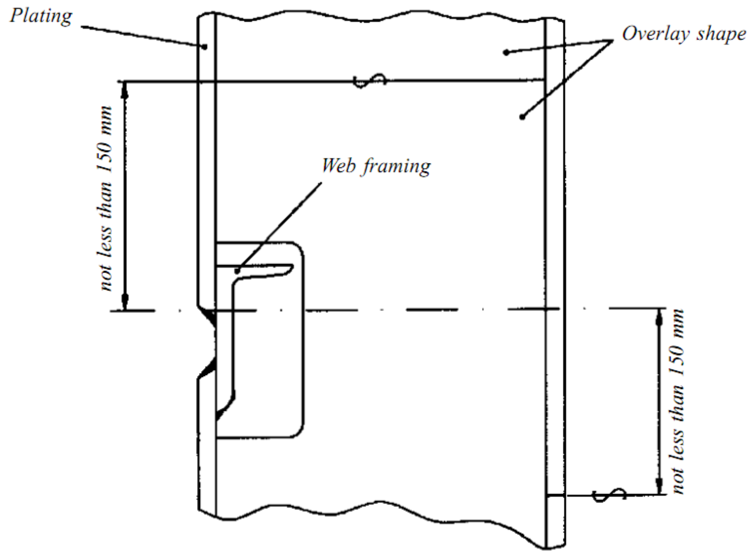


Fig. 3.7.7

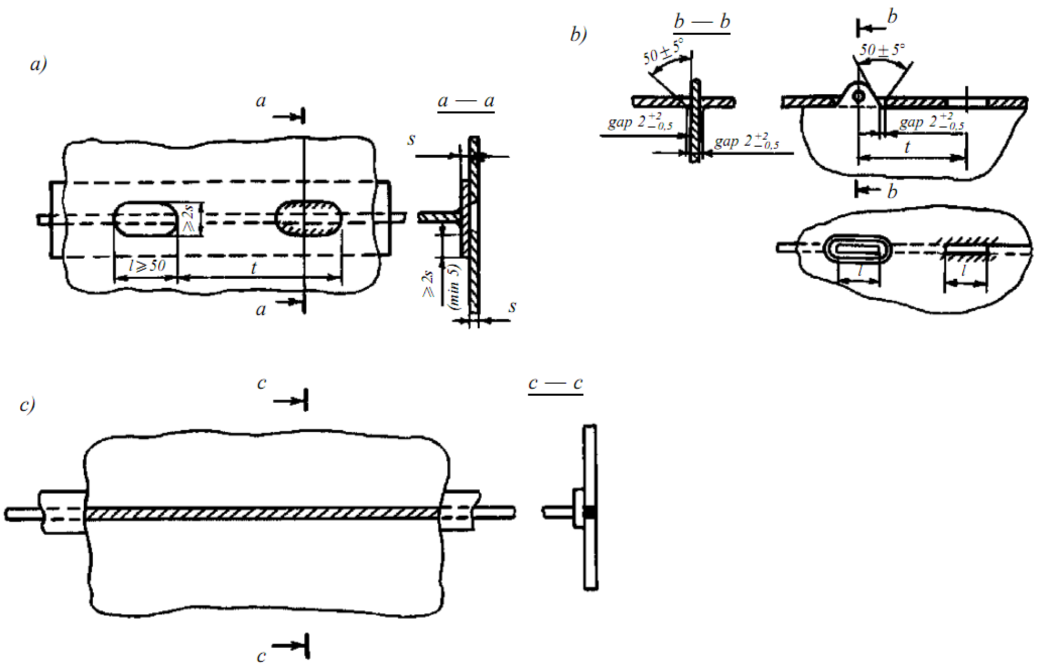


Fig. 3.7.8

4 SPECIAL HULL STRENGTHENING

4.1 GENERAL

4.1.1 Requirements of this Section cover the ships mooring at sea and having trawling arrangements.

4.2 STRENGTHENING FOR MOORING AT SEA

4.2.1 To prevent damage during mooring at sea, at the shipowner's will the ship's hull is fitted with longitudinal fenders or other damping arrangements. Side grillage is strengthened by means of increasing the sheerstrake and deck stringer thickness by the value of up to 2 mm.

4.3 STRENGTHENING FOR TRAWLING OPERATIONS

4.3.1 For ships having stern or side trawling arrangements, due to increased diminution of thickness of the hull structures interacting with the trawl and its elements, the thickness of these structures is 2 mm greater than design value.

In the regions where the trawling machinery and devices are arranged, the hull is strengthened appropriately. Scantlings of the strengthening elements are determined by calculation.

4.4 ICE STRENGTHENING

4.4.1 These requirements regulate the minimum strength level necessary to withstand ice load, as well as hull structure of ice class **Ice1** ship with intended for episodic independent navigation in fine broken open pack ice of non-Arctic seas up to 0,40 m thick.

4.4.2 To avoid high risk of damage due to interaction with ice the ship hull is recommended to have such a shape that the angle between the centerline plane and the tangent to the summer load waterline (drawn in way of the bow perpendicular) shall not be more than $\alpha_0 = 50°$.

4.4.3 Ice strengthening along the hull length are installed in the bow region A, and by the hull depth — in the region of alternating draught according to Fig. 4.4.3.

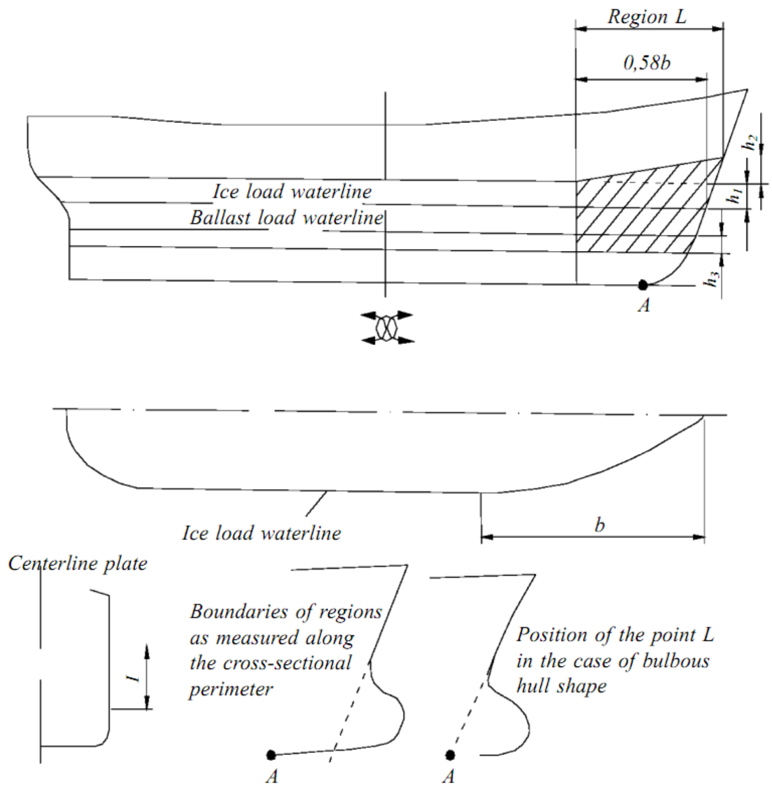


Fig. 4.4.3

4.4.4 The length of regions of ice strengthening along the ship at the load waterline level shall not be less than 58 % of distance b between the bow perpendicular and the section, in which the load waterline has the maximum width but not more than 0,23L.

4.4.5 The length of region of ice strengthening at the hull depth shall be such that:

lower boundary of strengthening is below the ballast waterline for not less than $h_3 = 0{,}50$ m;

upper boundary of strengthening in the stern section of region A is above the ice load waterline for not less than $h_1 = 0{,}50$ m; it shall be elevated above the load waterline as per the linear law to the forward boundary of region A for the value of $h_2 = 0{,}20$ m.

4.4.6 Structure of ice strengthening of ship's side grillage and design ice load are determined according to 3.10 of Part "Hull" of the Rules for the Classification.

5 WATERTIGTHNESS OF HULL, SUPERSTRUCTURES, DECKHOUSES

5.1 GENERAL

5.1.1 Requirements of this Section are based on the following assumption that the ship design excludes easy water penetration inside the hull, superstructures and deckhouses under normal operating conditions.

5.1.2 Number of holes in the hull shell plating below the main deck shall be minimal.

5.1.3 Ships with the engine room located at the stern shall have not less than 3 watertight transverse bulkheads (including the forepeak bulkhead) extending to the deck. The engine room shall be separated from other compartments by two bulkheads. If the engine room has another location, number of transverse bulkheads shall not be less than 4.

5.1.4 As a rule, any hull compartment, superstructure or deckhouse except the forepeak and afterpeak shall have not less than two exits or manholes. Doors, manholes and ventilation openings in the forepeak bulkhead are not allowed.

5.1.5 All the openings in the plating that lead to compartments below the deck shall be fitted with reliable means preventing the water penetration.

5.1.6 Openings on the deck that may remain open for a long time under operating conditions (cargo handling operations, etc.) shall, to the extent possible, be shifted towards the ship's centerline plane.

5.1.7 Accesses, except emergency ones, to the main ship's spaces and compartments located under the deck shall, to the extent possible, be from the superstructure and deckhouse spaces.

5.1.8 External doors for passage to superstructures, deckhouses, companions, capes, as well as deck hatch covers, sidescuttles and windows shall have the strength not less than that of the hull structural members, in which they are installed.

5.2 TIGHTNESS TEST OF SHIP'S HULL

5.2.1 Tightness tests of ship's hull shall be carried out according to the provisions of Appendix 1 to Part II "Hull" of the Rules for the Classification.

Russian Maritime Register of Shipping

Rules for the Classification and Construction of Small Sea Fishing Vessels
Part II
Hull

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