RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

RULES

Part I Polar Class Ships and Ice Class Ships

2011 AMENDMENT NO.1

Rule No.27 30th June 2011
Resolved by Technical Committee on 3rd February 2011
Approved by Board of Directors on 25th February 2011

Rule No.27 30th June 2011
AMENDMENT TO THE RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

"Rules for the survey and construction of steel ships" has been partly amended as follows:

Part I POLAR CLASS SHIPS AND ICE CLASS SHIPS

Amendment 1-1

Chapter 1 GENERAL

1.1 General

1.1.1 Application

Sub-paragraph -3 has been amended as follows.

3 Where a ship is intended to be registered as an ice class vessel (hereinafter referred to as "ice class ship" in this Part) for navigation of the Northern Baltic complying with the *Finnish-Swedish Ice Class Rules* ~~*2008*~~*2010* or in the Canadian Arctic complying with the *Arctic Shipping Pollution Prevention Regulations*, the materials, hull structures, equipment and machinery of the ship are to be in accordance with the requirements in **Chapter 1** and **Chapter 5** of this Part in addition to those in other Parts.

1.2 Definitions

1.2.5 Hull Areas

Sub-paragraph -2 has been amended as follows.

2 The ~~forward~~ bow, ~~midship,~~ midbody and ~~aft~~stern regions in way of hull part are defined for I*A Super*, I*A*, I*B* and I*C* ice class ships and the ~~forward~~ bow region is defined for I*D* ice class ships as follows:

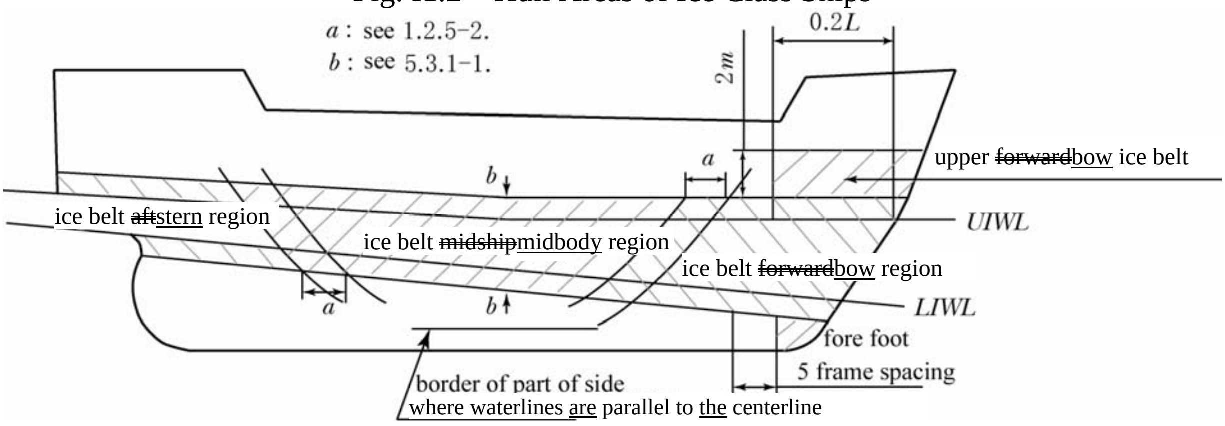
(1) ~~Forward~~ Bow region
From the stem to a line parallel to and 0.04*L* aft of the forward border line of the part of the hull where the waterlines run parallel to the centerline. For I*A Super* and I*A* ice class ships the overlap over the border line need not exceed 6 *metres*, and for I*B*, I*C* and I*D* ice class ships this overlap need not exceed 5 *metres*.

(2) ~~Midship~~Midbody region
From the aft boundary of the Forward region to a line parallel to and 0.04*L* aft of the aft borderline of the part of the hull where the waterlines run parallel to the centreline. For I*A Super* and I*A* ice class ships the overlap over the borderline need not exceed 6 *metres*, and for I*B* and I*C* ice class ships this overlap need not exceed 5 *metres*.

(3) ~~Aft~~Stern region
From the aft boundary of the midship region to the stern

Fig. I1.2 has been amended as follows.

Fig. I1.2 Hull Areas of Ice Class Ships



Chapter 5 ICE CLASS SHIPS

5.1 General

5.1.1 Application

Sub-paragraph -2 has been amended as follows.

2 The requirements in this Chapter are framed for the ice strengthening of ships which are intended to navigate in the Northern Baltic complying with the *Finnish-Swedish Ice Class Rules* ~~*2008*~~*2010* or in the Canadian Arctic complying with the *Arctic Shipping Pollution Prevention Regulations*.

5.1.2 Maximum and Minimum Draught

Sub-paragraph -3 has been amended as follows.

3 If the summer load line in fresh water is anywhere located at a higher level than the *UIWL*, the ship's side is to be provided with a warning triangle and with an ice class draught mark at the maximum permissible ice class draught amidships. (see **Fig. I5.1**)

5.2 Design Ice Pressures

5.2.1 Design Ice Pressures

Sub-paragraph -1 has been amended as follows.

1 Design ice pressure (P) is not to be less than that obtained from the following formula:

$C_d\, C_p\, C_a\, p_0$ (MPa)

where

C_d: As given by the following formula. However, C_d needs not to exceed 1.0.

$$C_d = \frac{ak+b}{1000}$$

$$k = \frac{\sqrt{\Delta H}}{1000}$$

Δ : Displacement (t) of the ship on the maximum draught specified in **5.1.2-6**

H : Engine output (kW)

a and b : As given in **Table I5.2** according to the region under consideration and the value of k.

C_p: As given in **Table I5.3** according to the ice class and the region under consideration.

p_0: The nominal ice pressure; the value 5.6 MPa is to be used.

C_a: As given by the following formula. However, C_a is not to be less than 0.35 but need not to exceed 1.0 ~~and where C_a is less than 0.6, C_a is to be taken as 0.6~~.

$$\cancel{C_a = \frac{47-5l_a}{44}}\quad \sqrt{\frac{0.6}{l_a}}$$

l_a : To be taken as specified in **Table I5.4** according to the structural member under consideration.

Table I5.2 has been amended as follows.

Table I5.2 Value of *a* and *b*

	~~Forward~~Bow region		~~Midship~~Midbody & ~~Aft~~Stern regions	
	$k \leq 12$	$k>12$	$k \leq 12$	$k>12$
a	30	6	8	2
b	230	518	214	286

Table I5.3 has been amended as follows.

Table I5.3 Coefficient C_p

Ice Class	~~Forward~~Bow region	~~Midship~~Midbody region	~~Aft~~Stern region
I*A Super*	1.00	1.00	0.75
I*A*	1.00	0.85	0.65
I*B*	1.00	0.70	0.45
I*C*	1.00	0.50	0.25
I*D*	1.00	-	-

Table I5.4 has been amended as follows.

Table I5.4 Value of l_a

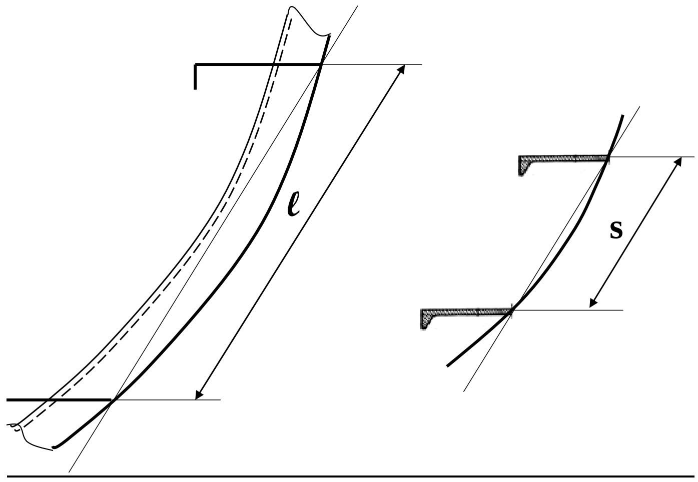
Structural member	Type of framing	l_a (*m*)
Shell	Transverse	Frame spacing
	Longitudinal	~~2~~1.7-spacing of frame
Frames	Transverse	Frame spacing
	Longitudinal	Span of frame
Ice stringer	-	Span of stringer
Web frame	-	2-spacing of web frame

Note:

The frame spacing and spans are normally assumed to be measured ~~in a vertical plane parallel to the centerline of the ship. However, if the ship's side deviates more than 20 degrees from this plane, the frame distances and spans are to be measured along the side of the ship.~~along the plate and perpendicular to the axis of the stiffener for plates, along the flange for members with a flange, and along the free edge for flat bar stiffeners. For curved members, the span or spacing is defined as the chord length between the span or spacing points. The span points are defined by the intersection between the flange or upper edge of the member and the supporting structural element. (See **Fig. I5.2**)

Fig. I5.2 has been added as follows.

Fig. I5.2 Definition of the Frame Span *l* and Frame Spacing *s* for Curved Members



5.3 Hull Structures and Equipment

5.3.1 Shell Plating

Sub-paragraph -1 has been amended as follows.

1 The vertical extension of the ice belt is to be as given in **Table I5.6** according to the ice class and is to comply with the following requirements.

(1) Fore foot
For I*A Super* ice class ships with the shell plating below the ice belt from the stem to a position five main frame spaces abaft the point where the bow profile departs from the keel line is to have at least the thickness required in the ice belt in the ~~Midship~~midbody region.

(2) Upper ~~forward~~bow ice belt
For I*A Super* and I*A* ice class ships with an open water service speed equal to or exceeding 18 *knots*, the shell plate from the upper limit of the ice belt to 2*m* above it and from the stem to a position at least 0.2*L* abaft the forward perpendicular, is to have at least the thickness required in the ice belt in the ~~midship~~midbody region. A similar strengthening of the bow region is to apply to a ship with lower service speed, when it is, *e.g.* on the basis of the model tests, evident that the ship will have a high bow wave.

(3) Side scuttles are not to be situated in the ice belt.

(4) If the weather deck in any part of the ship is situated below the upper limit of the ice belt, the bulwark and the construction of the freeing ports are to be given at least the same strength as is required for the shell in the ice belt.

Table I5.6 has been amended as follows.

Table I5.6 Vertical Extension of the Ice Belt

~~Ice Class~~	~~Above the *UIWL*~~	~~Below the *LIWL*~~
~~I*A Super*~~	~~0.6*m*~~	~~0.75*m*~~
~~I*A*~~	~~0.5*m*~~	~~0.6*m*~~
~~I*B*~~	~~0.4*m*~~	~~0.5*m*~~
~~I*C*~~	~~0.4*m*~~	~~0.5*m*~~
~~I*D*~~	~~0.4*m*~~	~~0.5*m*~~

Ice Class	Hull region	Above the *UIWL*	Below the *LIWL*
I*A Super*	Bow	0.6*m*	1.20*m*
	Midbody		
	Stern		1.0*m*
I*A*	Bow	0.5*m*	0.90*m*
	Midbody		0.75*m*
	Stern		
I*B* I*C*	Bow	0.4*m*	0.70*m*
	Midbody		0.60*m*
	Stern		
I*D*	Bow	0.4*m*	0.70*m*

Sub-paragraph -2 has been amended as follows.

2 The thickness of shell plating in the ice belt is not to be less than that obtained from the following formula according to the type of framing.

For the transverse framing: $667s\sqrt{\frac{f_1 p_{PL}}{\sigma_y}} + t_c \quad (mm)$

For the longitudinal framing: $\cancel{667s\sqrt{\frac{p_{PL}}{f_2\sigma_y}} + t_c}$ $\underline{667s\sqrt{\frac{p}{f_2\sigma_y}} + t_C}$ (mm)

where

s: Frame spacing (m)

p_{PL}: $0.75p$ (MPa)

p: As specified in **5.2.1-1**

f_1: As given in the following formula. Where, however, f_1 is greater than 1.0, f_1 is to be taken as 1.0.

$$1.3 - \frac{4.2}{(h/s+1.8)^2}$$

f_2: As given in the following formula depending on the value of h/s

where $h/s < 1.0$: $0.6 + \frac{0.4}{h/s}$

where $1.0 \le h/s < 1.8$: $1.4 - 0.4\,(h/s)$

h : As specified in **5.2.1-2**

σ_y : Yield stress of the materials (N/mm^2),

for which the following values are to be used

235 N/mm^2 for normal-strength hull structural steel
315 N/mm^2 for high-strength hull structural steel
However, if steels with different yield stresses than those given above are used, the value is to be at the discretion of the Society.

t_c: 2*mm*: If special surface coating, by experience shown capable to withstand the abrasion of ice, is applied and maintained, lower values may be approved.

5.3.2 General Requirements for Frames

Sub-paragraph -1 has been amended as follows.

1 The vertical extension of the ice strengthening of the framing is to be at least as given in **Table I5.7** according to the respective ice classes and regions. Where an upper ~~forward~~bow ice belt is required in **5.3.1-1**, the ice strengthening part of the framing is to be extended at least to the top of this ice belt. Where the ice strengthening would go beyond a deck or a tank top by no more than 250*mm*, it can be terminated at that deck or tank top.

Table I5.7 has been amended as follows.

Table I5.7 Vertical Extension of the Ice Strengthening of Framing

~~Ice Class~~	~~Region~~		~~Above the *UIWL* (*m*)~~	~~Below the *LIWL* (*m*)~~
~~I*A Super*~~	~~forward~~	~~from stem to 0.3*L* abaft it~~	~~1.2~~	~~to double bottom or below top of floors~~
		~~abaft 0.3*L* from stem~~	~~1.2~~	~~1.6~~
	~~midship~~		~~1.2~~	~~1.6~~
	~~aft~~		~~1.2~~	~~1.2~~
~~I*A*~~ ~~I*B*~~ ~~I*C*~~	~~forward~~	~~from stem to 0.3*L* abaft it~~	~~1.0~~	~~1.6~~
		~~abaft 0.3*L* from stem~~	~~1.0~~	~~1.3~~
	~~midship~~		~~1.0~~	~~1.3~~
	~~aft~~		~~1.0~~	~~1.0~~
~~I*D*~~	~~forward~~	~~from stem to 0.3*L* abaft it~~	~~1.0~~	~~1.6~~
		~~abaft 0.3*L* from stem~~	~~1.0~~	~~1.3~~

Ice Class	Hull region	Above the *UIWL*	Below the *LIWL*
I*A Super*	Bow	1.2 *m*	Down to double bottom or below top of the floors
	Midbody		2.0*m*
	Stern		1.6*m*
I*A* I*B* I*C*	Bow	1.0 *m*	1.6*m*
	Midbody		1.3*m*
	Stern		1.0*m*
I*D*	Bow	1.0 *m*	1.6*m*

Sub-paragraph -3 has been amended as follows.

3 In all regions for I*A Super* ice class ships, in the ~~forward~~bow and ~~midship~~midbody regions for I*A* ice class ships and in the ~~forward~~bow regions for I*B*, I*C* and I*D* ice class ships, the following~~s~~ are to apply in the ice strengthening area~~.~~:

~~(1) Frames which are at a small angle to the shell, are to be supported against tripping by brackets, intercostals, stringers or similar at a distance preferably not exceeding 1,300*mm*.~~

(~~2~~1) The frames are to be attached to the shell by double continuous welds. No scalloping is allowed except when crossing shell plate butts.

(~~3~~2) The web thickness of the frames is not to be ~~at least one half of the thickness of the shell plating and at least 9*mm*~~ less than the greatest of the following **(a)** to **(d)**.

(a) $\dfrac{h_w\sqrt{\sigma_y}}{C}$

h_w: web height

C: 805 for profiles

282 for flat bars

σ_y: As specified in **5.3.1-2**

(b) 2.5% of the frame spacing for transverse frames

(c) Half of the net thickness of the shell plating $t-t_c$. For the purpose of calculating the web thickness of frames, the required thickness of the shell plating is to be calculated according to **5.3.1-2** using the yield strength σ_y of the frames

(d) 9 *mm*

(~~4~~3) Where there is a deck, tank top or bulkhead in lieu of a frame, the plate thickness of this is to be as per the preceding **(~~3~~2)**, to a depth corresponding to the height of adjacent frames.

(4) Frames that are not normal to the plating or the profile is unsymmetrical, and the span exceeds 4.0 *m*, are to be supported against tripping by brackets, intercostals, stringers or similar at a distance not exceeding 1.3 *m*. If the span is less than 4.0 *m*, the supports against tripping are required for unsymmetrical profiles and stiffeners for webs which are not normal to plating.

5.3.3 Transverse Frames

Sub-paragraph -1 has been amended as follows.

1 The section modulus and the effective shear area of a main or intermediate transverse frame specified in **5.3.2-1** are to be not less than that obtained from the following formula:

Section modulus: $\dfrac{pshl}{m_t\sigma_y}\times 10^6 \quad (cm^3)$

Effective shear area: $\dfrac{\sqrt{3}f_3phs}{2\sigma_y}\times 10^4 \quad (cm^2)$

where

p : As specified in **5.2.1-1**

s : Frame spacing (m) (See the note to **Table I5.4**)

h : As specified in **5.2.1-2**

l : Span of the frame (m) (See the note to **Table I5.4**)

m_t : As given by the following formula

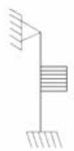
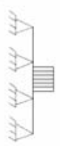
$$\frac{7m_0}{7-5h/l}$$

m_0 : As specified in **Table I5.8**

<u>f_3 : Factor which takes into account the maximum shear force versus the load location and the shear stress distribution, taken as 1.2</u>

σ_y : As specified in **5.3.1-2**.

Table I5.8 Value of m_0

Boundary condition	m_0	Example
	7.0	Frames in a bulk carrier with top side tanks
	6.0	Frames extending from the tank top to a single deck
	5.7	Continuous frames between Several decks or stringers
	5.0	Frames extending between two decks only

Note:
The boundary conditions are those for the main and intermediate frames. Load is applied at mid span.

Sub-paragraph -3 has been amended as follows.

3 The upper end of the strengthening part of a main frame and of an intermediate frame are to be attached to a deck or an ice stringer as specified in **5.3.5**. Where a frame terminates above a deck or a stringer (hereinafter, referred to as the lower deck in this section) which is situated at or above the upper limit of the ice belt, the part of the frame above the lower deck is to be in accordance with the followings:

(1) the part of the main frame and the intermediate frame may have the scantlings required by the ordinary frame; and

(2) the upper end of the main frame and the intermediate frame is to be connected to a deck which situated above the lower deck (hereinafter, referred to as the higher deck in this section). However, the upper end of the intermediate frame may be connected to the adjacent main frames by a horizontal stiffener having the same scantlings as the main frame. ~~Where an intermediate frame is outside the forward region and the higher deck is situated more than 1.8*m* above the ice belt, an upper termination of such an intermediate frame may be decided as appropriately.~~

Paragraph 5.3.4 has been amended as follows.

5.3.4 Longitudinal Frames

~~**1** The spacing of longitudinal frames in the extension specified in **5.3.2-1** is not to exceed 0.35*m* for I*4 Super* and I*4* ice class ships and is to be in no case exceed 0.45*m*. Where deemed as necessary by the Society, larger frame spacing may be permitted.~~

~~**2**~~<u>**1**</u> The section modulus and <u>effective</u> shear area of a longitudinal frame in the extension specified in **5.3.2-1** are not to be less than those obtained by the following formulae<u>. However, in calculating the actual shear area of the frames, the area of the brackets is not to be taken into account</u>:

Section modulus: $\cancel{\dfrac{f_3 f_4 phl^2}{m\sigma_y}\times 10^6}$ $\underline{\dfrac{f_4 phl^2}{m\sigma_y}\times 10^6}$ (cm^3)

~~S~~<u>Effective s</u>hear area: $\cancel{\dfrac{\sqrt{3} f_3 phl}{2\sigma_y}\times 10^4}$ $\underline{\dfrac{\sqrt{3} f_4 f_5 phl}{2\sigma_y}\times 10^4}$ (cm^2)

~~f_3~~ <u>f_4</u>: Factor which takes account of the load distribution to adjacent frames as given by the following formula.
$(1-0.2h/s)$

<u>f_5: Factor which takes into account the pressure definition and maximum shear force versus load location and also the shear stress distribution, taken as 2.16</u>

h : As specified in **5.2.1-2**

s : Frame spacing (*m*) (See the note to **Table I5.4**)

~~f_4 : Factor which takes account of the concentration of load to the point of support is to be taken as 0.6.~~

p : As specified in **5.2.1-1**

l : Span of the longitudinal frame (*m*) (See the note to **Table I5.4**)

m : Boundary condition factor is to be taken as 13.3. Where the boundary conditions deviate significantly from those of a continuous beam, a smaller boundary factor is to be adapted. <u>For frames without brackets, the boundary condition factor is to be taken as 11.0.</u>

σ_y : As specified in **5.3.1-2**

Paragraph 5.3.5 has been amended as follows.

5.3.5 Ice Stringers

1 The section modulus and <u>effective</u> shear area of a stringer situated within the ice belt are not to be less than those obtained by the following formulae:

Section modulus : $\cancel{\dfrac{f_5 phl^2}{m\ \sigma_y}\times 10^6}$ $\underline{\dfrac{f_6 f_7 phl^2}{m\ \sigma_y}\times 10^6}$ (cm^3)

~~S~~<u>Effective s</u>hear area : $\cancel{\dfrac{\sqrt{3} f_5 phl}{2\sigma_y}\times 10^4}$ $\underline{\dfrac{\sqrt{3} f_6 f_7 f_8 phl}{2\sigma_y}\times 10^4}$ (cm^2)

~~f_5~~ <u>f_6</u>: Factor which takes account of the distribution of load to the transverse frames is to be taken as 0.9.

<u>f_7: Safety factor of stringers is to be taken as 1.8.</u>

<u>f_8: Factor which takes into account the maximum shear force versus load location and the shear stress distribution, taken as 1.2.</u>

p : As specified in **5.2.1-1**

h : As specified in **5.2.1-2**

However, the product of p and h is not to be taken as less than ~~0.30~~ 0.15

l : Span of the stringer (m)

m : Boundary condition factor as defined in **5.3.4-~~2~~1**

σ_y : As specified in **5.3.1-2**

2 The section modulus and effective shear area of a stringer situated outside the ice belt but supporting ice strengthened frames are not to be less than those obtained by the following formulae:

Section modulus: $\cancel{\frac{f_6 phl^2}{m\ \sigma_y}(1-h_s/l_s)\times 10^6}\ \frac{f_9 f_{10} phl^2}{m\ \sigma_y}(1-h_s/l_s)\times 10^6 \quad (cm^3)$

~~S~~Effective shear area: $\cancel{\frac{\sqrt{3} f_6 phl}{2\sigma_y}(1-h_s/l_s)\times 10^4}\ \frac{\sqrt{3} f_9 f_{10} f_{11} phl}{2\sigma_y}(1-h_s/l_s)\times 10^4 \quad (cm^2)$

$\cancel{f_6}$ f_9: Factor which takes account of load to the transverse frames is to be taken as ~~0.95~~0.8.

f_{10}: Safety factor of stringers is to be taken as 1.8.

f_{11}: Factor which takes into account the maximum shear force versus load location and the shear stress distribution, taken as 1.2.

p: As specified in **5.2.1-1**

h: As specified in **5.2.1-2**

However, the product of p and h is not to be taken as less than ~~0.30~~ 0.15

l: Span (m) of the stringer

h_s: The distance to the ice belt

l_s: The distance (m) to the adjacent ice stringer (m)

m: Boundary condition factor as defined in **5.3.4-~~2~~1**

σ_y : As specified in **5.3.1-2**

3 Narrow deck strips abreast of hatches and serving as ice stringers are to comply with the section modulus and shear area requirements in the preceding **-1** and **-2** respectively. In the case of very long hatches, the product p and h may ~~by~~be taken as less than ~~0.30~~ 0.15 but in no case less than ~~0.20~~0.10. Regard is to be paid to the deflection of the ship's sides due to ice pressure in way of very long (more than B/2) hatch openings, when designing weather deck, hatch covers and their fittings.

Paragraph 5.3.6 has been amended as follows.

5.3.6 Web Frames

1 The load ~~(F)~~ transferred to a web frame from an ice stringer or from longitudinal framing is not to be less than that obtained by the following formula:

$\cancel{phs}$ $f_{12}phS$ (MN)

f_{12}: Safety factor of web frames is to be taken as 1.8.

p : Ice pressure (MPa) as specified in **5.2.1-1**, in calculating C_a however, l_a is to be taken as 2$\cancel{s}S$.

h : As specified in **5.2.1-2**

However, the product of p and h is not to be taken as less than ~~0.30~~ 0.15

$\cancel{s}S$: Distance (m) between web frames

2 Notwithstanding the provisions specified in **-1** above, in case the supported stringer is outside the ice belt, the force ~~(F)~~ may be reduced to that obtained by the following formula:

$\cancel{phs(1-h_s/l_s)}\ f_{12}phS(1-h_s/l_s) \quad (MN)$

h_s and l_s : As specified in **5.3.5-2**

3 ~~When a web frame is represented by the structure model shown in **Fig. I5.2**, t~~The section modulus and effective shear area are to be calculated by the following formulae:

~~S~~Effective shear area: $\cancel{\frac{\sqrt{3}\alpha Q}{\sigma_y}\times 10^4}$ $\frac{\sqrt{3}\alpha f_{13} Q}{\sigma_y}\times 10^4 \quad (cm^2)$

Section modulus: $\frac{M}{\sigma_y}\sqrt{\frac{1}{1-(\gamma A/A_a)^2}}\times 10^6 \quad (cm^3)$

f_{13}: Factor which takes into account the shear force distribution is to be taken as 1.1.

Q : Maximum calculated shear force under the load ~~(F)~~ transferred to a web frame from an ice stringer or from longitudinal framing as specified in **-1** or **-2**, as given in the following formula:

$\cancel{Q = k_1 F}$ $Q = F$

M: Maximum calculated bending moment under the load ~~(F)~~ transferred to a web frame from an ice stringer or from longitudinal framing as specified in **-1** or **-2**, as given in the following formula:

$\cancel{M = k_2 Fl}$ $M = 0.193Fl$

~~k_1 : The value is not to be less than those obtained from the following formulae, whichever is greater. For the lower part of the web frame the smallest l_F within the ice belt is to be used. For the upper part of the biggest l_f within the ice belt is to be taken.~~

$\cancel{1+0.5(l_F/l)^3-1.5(l_F/l)^2}$

$\cancel{1.5(l_F/l)^2-0.5(l_F/l)^3}$

~~k_2: As given by the following formula:~~

$\cancel{0.5(l_f/l)^3-1.5(l_f/l)^2+(l_f/l)}$

~~F : As specified in **-1** or **-2**~~

l : Span (m) of the web frame

~~l_F: Distance (m) from the lowest support of the web frame to the stringer or longitudinal in question~~

α and γ :As given in Table I5.9. For intermediate values of A_f/A_w is to be obtained by linear interpolation.

A : Required shear area (cm^2) ~~obtained by using k_1 obtained by the following formula:~~

$\cancel{1+0.5(l_F/l)^3-1.5(l_F/l)^2}$

A_a : Actual cross sectional area (cm^2) of the web frame, as given in the following formula:

$A_a = A_f + A_w$

A_f : ~~C~~Actual cross sectional area (cm^2) of free flange

A_w : ~~C~~Actual effective cross sectional area (cm^2) of web plate

σ_y : As specified in **5.3.1-2**

4 ~~For other web frame configurations and boundary condition than specified in the preceding **-3**, a direct stress calculation is to be carried out. The concentrated load on the web frame is specified in the preceding **-1.** The point of application is in each case to be chosen in relation to the arrangement of stringers and longitudinal frames so as to obtain the maximum shear and bending moments. Allowable stresses are specified in **Table I5.10**.~~ The scantlings of web frames may be calculated by direct analysis where deemed appropriate by the Society. In this case, the following are to be complied with:

(1) The pressure to be used is 1.8p (MPa) where p is determined according to **5.2.1-1,** and the

load patch is to be applied at locations where the capacity of the structure under the combined effects of bending and shear are minimized.

(2) The structure is to be checked with load centred at the *UIWL*, 0.5 h_0 (m) below the *LIWL*, and positioned several vertical locations in between. Several horizontal locations which are the locations centred at the mid-span or spacing are to be checked. If the load length l_a cannot be determined directly from the arrangement of the structure, several values of l_a may be checked using corresponding values for C_a.

(3) Acceptance criterion for designs is that the combined stresses from bending and shear, using the von Mises yield criterion, is to be lower than the σ_y as specified in **5.3.1-2.** When the direct analysis is using beam theory, the allowable shear stress is not to be greater than 0.9 τ_y, where $\tau_y = \sigma_y / \sqrt{3}$

Fig. I5.2 has been deleted.

~~Fig. I5.2 Structural Model of Web Frame~~

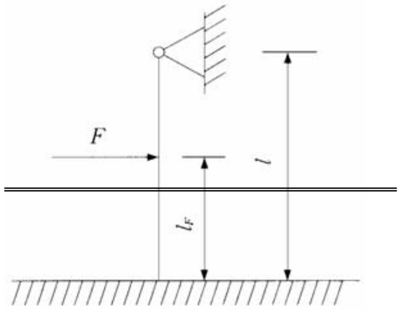


Table I5.10 has been deleted.

~~Table I5.10 Allowable stresses~~

~~Stress~~	~~Allowable stress~~
~~Shear stress (τ)~~	~~$\sigma_y / \sqrt{3}$~~
~~Bending stress (σ_b)~~	~~σ_y~~
~~Equivalent stress ($\sigma_e = \sqrt{\sigma_b^2 + 3\tau^2}$)~~	~~σ_y~~

~~Note:~~

~~σ_y : As specified in **5.3.1-2**~~

Paragraph 5.3.7 has been amended as follows.

5.3.7 Stem

1 ~~A sharp edged stem as given by **Fig. I5.3** improves the maneuverability of the ship in ice and is recommended particularly for smaller ships with length below 150 *metres*.~~ A stem is recommended to be similar to the structure shown in **Fig. I5.3.**

2 The plate thickness of a shaped plate stem and in the case of a blunt bow, any part of the shell ~~which forms an angle of 30 *degrees* or more to the centre line in a horizontal plane~~ where angle α and ψ as specified in **5.4.2-1** are respectively not less than 30 *degrees* and 75 *degrees*, is to be obtained from the formula in **5.3.1-2**

where

s : Spacing (m) of elements supporting the plate

p_{PL} : ~~P~~Ice pressure (MPa) as specified in **5.2.1-1**

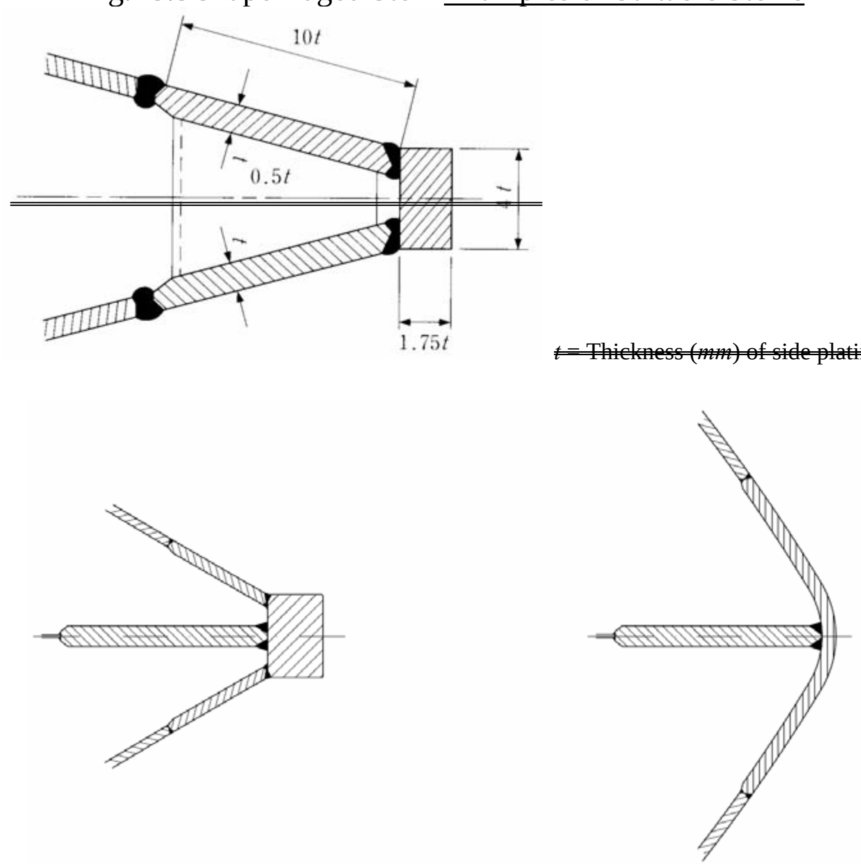
l_a : Spacing (m) of vertical supporting elements

3 The stem and the part of a blunt bow specified in the preceding **-2**~~.~~ is to be supported by floors or brackets spaced not more than 0.6m apart and having a thickness of at least half the plate thickness.

4 The reinforcement of the stem is to be extended from the keel to a point 0.75m above *ULWL* or, in case an upper ~~forward~~bow ice belt is required in **5.3.1-1** to the upper limit of this.

Fig. I5.3 has been amended as follows.

Fig. I5.3 ~~Shape Edged Stem~~ Examples of Suitable Stems



~~t = Thickness (mm) of side plating~~

Paragraph 5.3.8 has been amended as follows.

5.3.8 Arrangements for Towing

~~**1** A mooring pipe with an opening not less than 250 by 300*mm*, a length of at least 150*mm* and an inner surface radius of at least 100*mm* is to be fitted in the bow bulwark at the centre line.~~

~~**2** A bitt or other means for securing a towline, dimensioned to stand the breaking force of the towline of the ship is to be fitted.~~

~~**3** On ships with a displacement not exceeding 30,000 *tons* the part of the bow which extends to a height of at least 5 *metres* above the *UIWL* and at least 3 *metres* back from the stem, is to be strengthened to take the stresses caused by fork towing. For this purpose intermediate frames is to be fitted and the framing is to be supported by stringers or decks.~~

Special consideration is to be given to the strength and installation of towing arrangements.

Paragraph 5.3.9 has been amended as follows.

5.3.9 Stern

1 The clearance between the propeller blade tip and hull, including the stern frame, is not to be ~~sufficient~~less than h_0 as specified in **5.1.2-6** to prevent from occurring high loads on the blade tip.

2 On twin and triple screw ships, the ice strengthening of the shell and framing are to be extended to the double bottom for 1.5 *metres* forward and aft of the side propellers.

3 On twin and triple screw ships, the shafting and stern tubes of side propellers are to be normally enclosed within plated bossings. If detached struts are used, their design, strength and attachment to the hull is to be duly considered.

~~**4** A wide transom stern extending below the *UIWL* will seriously impede the capability of the ship to back in ice. Therefore a transom stern is not to be extended below the *UIWL* if this can be avoided. If unavoidable, the part of the transom stern below the *UIWL* is to be kept as narrow as possible. The part of a transom stern situated within the ice belt is to be strengthened as for the midship region.~~

~~**5**~~**4** The introduction of new propulsion arrangements with azimuthing thrusters or podded propellers, which provide an improved maneuverability, will result in increased ice loading of the ~~aft~~stern region and the stern area. This fact is to be considered in the design of the aft/stern structure.

Paragraph 5.3.10 has been amended as follows.

5.3.10 Bilge Keel

~~**1** The connection of bilge keels to the hull is to be so designed, that the risk of damage to the hull, in case a bilge keel is ripped off, is minimized.~~

~~**2** It is recommended that bilge keels are cut up into several shorter independent lengths.~~

Special consideration is to be given to the design of bilge keels.

5.4 Fundamental Requirements of Machinery

Table I5.11 to Table I5.15 have been renumbered to Table I5.10 to Table I5.14 respectively.

Table I5.12 has been amended as follows.

Table I5.~~13~~12 Value of f_1, f_2, f_3, f_4, g_1, g_2, g_3, C_3, C_4, C_5

f_1:	10.3 (N/m^2)	g_1:	1,530 (N)	C_3:	~~845~~460 (N/m^3)
f_2:	45.8 (N/m)	g_2:	170 (N/m)	C_4:	~~42~~18.7 (N/m^3)
f_3:	2.94 (N/m)	g_3:	400 ($N/m^{1.5}$)	C_5:	825 (N/m)
f_4:	5.8 (N/m^2)				

Paragraph 5.4.3 has been amended as follows.

5.4.3 Rudders and Steering Arrangements

1 The rudder scantlings of rudder post, rudder stock, pintles, steering gear etc. are to comply with requirements in **Chapter 3** of ~~this Part~~ **Part C** and **Chapter 15, Part D**. In this case, the maximum service speed of the ship to be used in these calculations is not to be taken less than that given in the **Table I5.~~15~~14**.

2 The local scantlings of rudders are to be determined assuming that the whole rudder belongs to the ice belt. The rudder plating and frames are to be designed using the ice pressure for the plating and frames in the midbody region.

~~2~~3 For I*A Super* and I*A* ice class ships, the rudder stock and the upper ~~edge~~part of the rudder are to be protected ~~against ice pressure by an ice knife or equivalent means~~ from direct contact with intact ice by either an ice knife that extends blew the *LIWL* or by equivalent means. Special consideration is to be given to the design of the rudder and the ice knife for ships with flap-type rudders.

~~3~~4 For I*A Super* and I*A* ice class ships, the rudders and steering arrangements are to be designed as follows to endure the loads that work on the rudders by the ice when backing into an ice ridge.

(1) Relief valves for hydraulic pressure are to be ~~effective~~installed.

(2) The components of the steering gear are to be dimensioned to stand the yield torque of the rudder stock.

(3) ~~Where possible, rudder stoppers working on the blade or rudder stock are to be fitted~~Suitable arrangements such as rudder stoppers are to be installed.

5.5 Design Loads of Propulsion Units

Table I5.16 to Table I5.24 have been renumbered to Table I5.15 to Table I5.23 respectively.

5.6 Design of Propellers and Propulsion Shafting Systems

Table I5.25 to Table I5.27 have been renumbered to Table I5.24 to Table I5.26 respectively.

EFFECTIVE DATE AND APPLICATION (Amendment 1-1)

1. The effective date of the amendments is 1 January 2012.

2. Notwithstanding the amendments to the Rules, the current requirements may apply to ships for which the date of contract for construction is before the effective date.

Amendment 1-2

Chapter 2 MATERIALS AND WELDING

2.1 Material

2.1.2 Material Classes and Grades

Table I2.2 has been amended as follows.

Table I2.2 Material Classes for Structural Members of Polar Class Ships

Structural Members	Material Class
Shell plating within the Bow and Bow Intermediate Icebelt hull areas (B, B_{Ii})	II
All weather and sea exposed Secondary and Primary, as defined in **Table I2.1-1**, structural members outside 0.4 *L* amidships	I
Plating materials for stem and stern frames, rudder hone, rudder, propeller nozzle, shaft brackets, ice skeg, ice knife and other appendages subject to ice impact loads	II
All inboard framing members attached to the weather and sea-exposed plating, including any contiguous inboard member within 600 *mm* of the ~~shell~~ plating	I
Weather-exposed plating and attached framing in cargo holds of ships which by nature of their trade have their cargo hold hatches open during cold weather operations	I
All weather and sea exposed Special, as defined in **Table I2.1-1**, structural members within 0.2*L* from *FP*	II

2.3 Corrosion/Abrasion Additions

2.3.2 Corrosion/Abrasion Additions

Table I2.6 has been amended as follows.

Table I2.6 Corrosion/Abrasion Additions for Shell Plating

Hull Area	Additional Thickness t_s (*mm*)					
	With Effective Protection[(1)]			Without Effective Protection		
	*PC*1 - *PC*3	*PC*4&*PC*5	*PC*6&*PC*7	*PC*1 - *PC*3	*PC*4&*PC*5	*PC*6&*PC*7
Bow ~~Icebelt~~ area, Bow Intermediate Icebelt area	3.5	2.5	2.0	7.0	5.0	4.0
Bow Intermediate Lower area, Midbody Icebelt area, Stern Icebelt area	2.5	2.0	2.0	5.0	4.0	3.0
Midbody Lower area, Stern Lower area, Bottom area	2.0	2.0	2.0	4.0	3.0	2.5
~~Other Arias~~	~~2.0~~	~~2.0~~	~~2.0~~	~~3.5~~	~~2.5~~	~~2.0~~

Notes:

(1) "With Effective Protection" refers to coating the ship with paints such as ice strengthening paint that takes into account use in polar waters or equivalent measures which are deemed appropriate by the Society.

(2) Steel renewal for ice strengthened structures is required when the gauged thickness is less than t_{net}+0.5 *mm*.

Chapter 3 HULL STRUCTURE

3.4 Design Ice Load

3.4.2 Bow Area

Sub-paragraph -3 has been amended as follows.

3 Shape coefficient fa_i is to be taken as the minimum value obtained from the following two formulas. However, when the shape coefficient fa_i is 0.6 or more, it is taken to be 0.6.

$$fa_{i,1} = \left\{ 0.097 - 0.68 \left(\frac{x}{L'} - 0.15 \right)^2 \right\} \frac{\alpha_i}{\sqrt{\beta_i'}}$$

$$fa_{i,2} = \frac{1.2 CF_F}{\sin(\beta_i') CF_C \left(\frac{\Delta_1}{1000} \right)^{0.64}}$$

where

i: sub-region considered

L': ship length (m) measured ~~at~~on the *UIWL* from the forward side of the stem to the after side of the rudder post, or the centre of the rudder stock if there is no rudder post. L' is tobe not less than 96% and need not exceed 97% of the extreme length on the *UIWL*.

x: distance (m) from the forward perpendicular to station under consideration

α: waterline angle (deg), see **Fig. I1.3**

β' : normal frame angle (deg), see **Fig. I3.1**

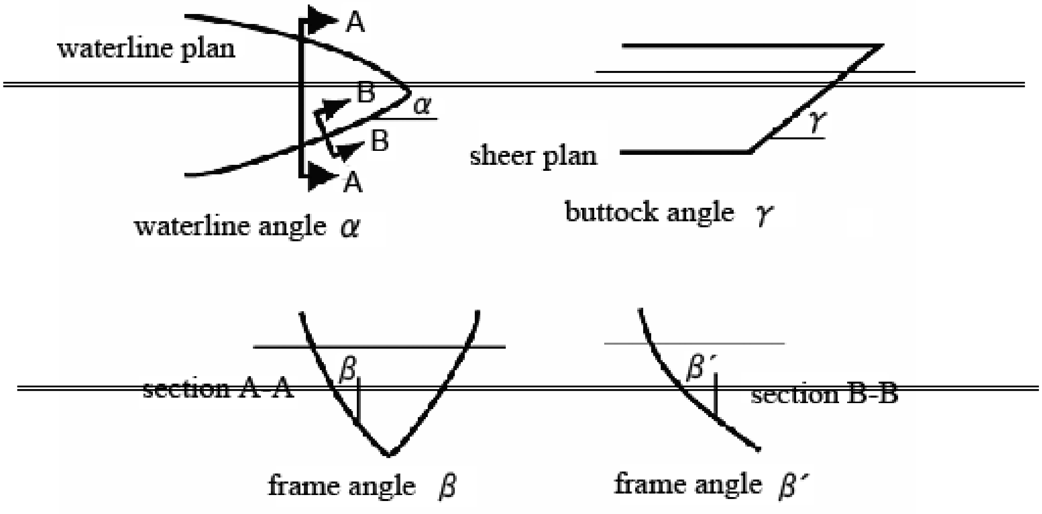
Δ_1 : ship displacement (t) at the *UIWL*, not to be taken as less than 5,000t

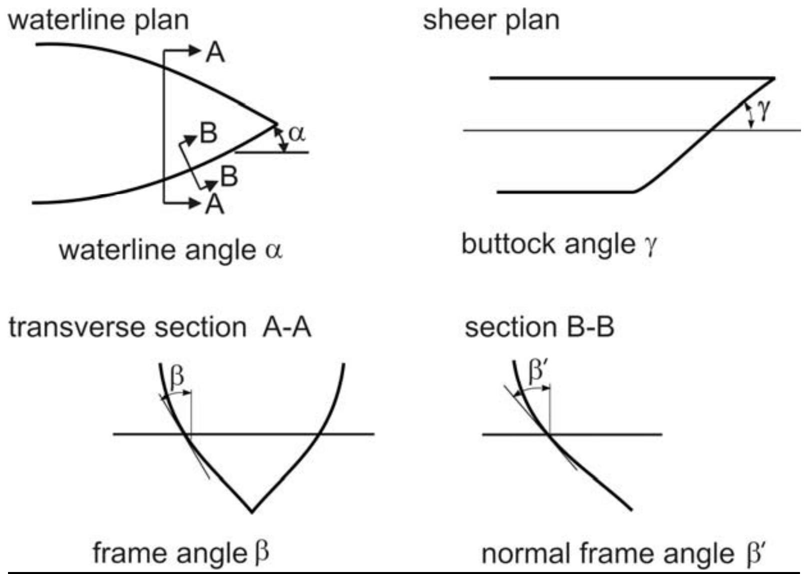
CF_C: Crushing Failure Class Factor from **Table I3.1**

CF_F: Flexural Failure Class Factor from **Table I3.1**

Fig. I3.1 has been amended as follows.

Fig. I3.1 Definition of Hull Angles





Note :

β' : normal frame angle (*deg*) at the *UIWL*

α : upper ice waterline angle (*deg*)

γ : buttock angle (*deg*) at the *UIWL* (angle of buttock line measured from horizontal)

$\tan(\beta) = \tan(\alpha)/\tan(\gamma)$

$\tan(\beta') = \tan(\beta)\cos(\alpha)$

Sub-paragraph -8 has been amended as follows.

8 In the Bow area, and the Bow Intermediate Icebelt area for *PC*6 and *PC*7polar class ships, the design load patch has dimensions of width, w_{Bow}, and height, b_{Bow}, defined as follows:

$w_{Bow} = F_{Bow} / Q_{Bow}$ (m)

$b_{Bow} = Q_{Bow} / P_{Bow}$ (m)

where

F_{Bow} : maximum force F_i (kN) in the Bow area from **-4**

Q_{Bow} : maximum line load Q_i (kN/m) in the Bow area from **-6**

P_{Bow} : maximum pressure P_i (kN/m^2) in the Bow area from **-7**

3.5 Local Strength

3.5.2 Framing

Sub-paragraph -3 has been amended as follows.

3 The actual net effective shear area, A_w, of a framing member is given by:

$$A_w = \frac{h t_{wn} \sin \varphi_w}{100} \quad (cm^2)$$

where

h : height of stiffener (mm), see **Fig. I3.3**

t_{wn} : net web thickness (mm), $t_{wn} = t_w - t_c$

t_w : as built web thickness (mm), see **Fig. I3.3**

t_c : corrosion deduction (mm) to be subtracted from the web and flange thickness (as specified by other Parts , but not less than t_s as required by **2.3.3**).

φ_w : smallest angle (deg) between shell plate and stiffener web, measured at the mid-span of the stiffener, see **Fig. I3.3**. The angle φ_w may be taken as 90 degrees provided the smallest angle is not less than 75 degrees.

(1) When the cross-sectional area of the attached plate flange exceeds the cross-sectional area of the local frame, the actual net effective plastic section modulus, Z_p, is given by:

$$Z_p = \frac{A_{pn} t_{pn}}{20} + \frac{h_w^2 t_{wn} \sin \varphi_w}{2000} + \frac{A_{fn}(h_{fc} \sin \varphi_w - b_w \cos \varphi_w)}{10} \quad (cm^3)$$

where

s: frame spacing (m)

A_{pn}: net cross-sectional area (cm^2) of the local frame ~~attached plate (A_{pn}=10 $t_{pn}s$, but not to be taken greater than the net cross-sectional area of the local frame)~~

t_{pn}: fitted net shell plate thickness (mm) (is to comply with t_{net} as required by **3.5.1-2**)

h_w: height (mm) of local frame web, see **Fig. I3.5**

A_{fn}: net cross-sectional area (cm^2) of local frame flange

h_{fc}: height (mm) of local frame measured to centre of the flange area, see **Fig. I3.5**

b_w : distance (mm) from mid thickness plane of local frame web to the centre of the flange area, see **Fig. I3.5**

(2) When the cross-sectional area of the local frame exceeds the cross-sectional area of the attached plate flange, the plastic neutral axis is located a distance z_{na} above the attached shell plate, given by:

$$Z_{na} = \frac{100A_{fn} + h_w t_{wn} - 1000 t_{pn} s}{2t_{wn}} \quad (mm)$$

where

s : frame spacing (m)

The net effective plastic section modulus, Z_p, is given by:

$$\cancel{Z_p = t_{pn} s z_{na} \sin\varphi_w + \left(\frac{((h_w - z_{na})^2 + z_{na}^2) t_{wn} \sin\varphi_w}{2000} + \frac{A_{fn}\left((h_{fc} - z_{na})\sin\varphi_w - b_w \cos\varphi_w\right)}{10} \right)}$$

$$Z_p = t_{pn} s \left(z_{na} + \frac{t_{pn}}{2} \right) \sin\varphi_w + \left(\frac{((h_w - z_{na})^2 + z_{na}^2) t_{wn} \sin\varphi_w}{2000} + \frac{A_{fn}\left((h_{fc} - z_{na})\sin\varphi_w - b_w \cos\varphi_w\right)}{10} \right)$$

(cm^3)

3.5.6 Structural Stability

Sub-paragraph -2(b) has been amended as follows.

(b) $t_{wn} = 0.35 t_{pn} \sqrt{\frac{\sigma_y}{235}} \quad (mm)$

where

σ_y : minimum upper yield stress of the ~~material~~ shell plate in way of the framing member (N/mm^2)

t_{wn} : net thickness (mm) of the web

t_{pn} : net thickness (mm) of the shell plate in way of the framing member

3.6 Longitudinal Strength

Paragraph 3.6.2 has been amended as follows.

3.6.2 Design Vertical Ice Force at the Bow

The design vertical ice force at the bow F_{IB} is to be taken the minimum value of following $F_{IB,1}$ and $F_{IB,2}$.

$$F_{IB,1} = 1000 \times 0.534 K_I^{0.15} \sin^{0.2}(\gamma_{stem}) \sqrt{\frac{\Delta_2}{1000}\frac{K_h}{1000}} C F_L \quad (kN)$$

$$F_{IB,2} = 1000 \times 1.20 C F_F \quad (kN)$$

where

K_I : indentation parameter, $K_I = 1000 \dfrac{K_f}{K_h}$

where

(a) for the case of a blunt bow form

$$K_f = \left(\frac{2CB^{1-e_b}}{1+e_b} \right)^{0.9} \tan(\gamma_{stem})^{-0.9(1+e_b)}$$

(b) for the case of wedge bow form (α_{stem} < 80 *deg*), e_b =1 and above simplifies to:

$$K_f = \left(\frac{\tan(\alpha_{stem})}{\tan^2(\gamma_{stem})} \right)^{0.9}$$

$$K_h = 10 A_{WP} \quad (kN/m)$$

CF_L: Longitudinal Strength Class Factor from **Table I3.1**

e_b: bow shape exponent which best describes the waterplane, see **Fig. I3.5** and **Fig. I3.6**

e_b = 1.0 for a simple wedge bow form

e_b = 0.4 to 0.6 for a spoon bow form

e_b = 0 for a landing craft bow form

An approximate e_b determined by a simple fit is acceptable

γ_{stem}: stem angle (*deg*) to be measured between the horizontal axis and the stem tangent at the *UIWL* (buttock angle (*deg*) as per **Fig. I3.1** measured on the centreline)

α_{stem}: waterline angle (*deg*) measured in way of the stem at the *UIWL*, see **Fig. I3.5**

$$C = \frac{1}{2\left(\frac{L_B}{B} \right)^{e_b}}$$

B: ship moulded breadth (*m*)

L_B: bow length (*m*), see **Fig. I3.5** and **Fig. I3.6**.

Δ_2 : ship displacement (*t*), not to be taken less than 10,000*t*

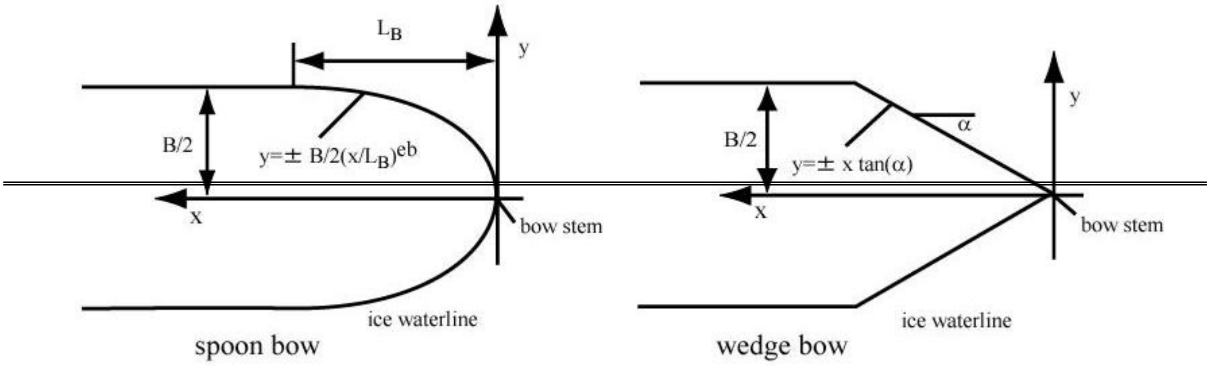
A_{wp}: ship waterplane area (m^2)

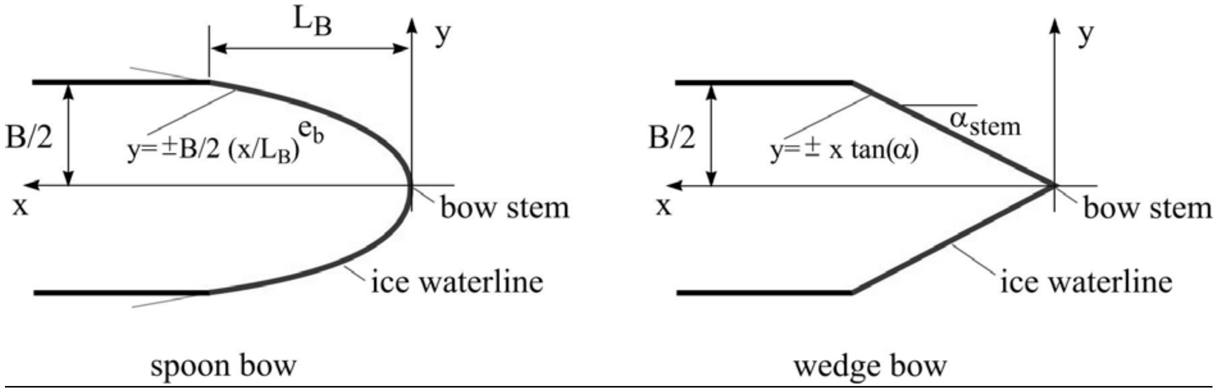
CF_F: Flexural Failure Class Factor from **Table I3.1**

Where applicable, draught dependent quantities are to be determined at the waterline corresponding to the loading condition under consideration.

Fig. I3.5 has been amended as follows.

Fig. I3.5 Bow Shape Definition





3.6.4 Design Vertical Ice Bending Moment

Sub-paragraph -1 has been amended as follows.

1 The design vertical ice bending moment M_I along the hull girder is to be taken as:

$$\cancel{M_I = 0.1C_m L \sin^{-0.2}(\gamma_{stem})F_{IB}}$$

$$\underline{M_I = 0.1C_m L' \sin^{-0.2}(\gamma_{stem})F_{IB}} \quad (kNm)$$

where

~~L~~ L': ship length (m)~~, Rule Length as defined in **2.1.2, Part A**.~~ measured on the *UIWL* from the forward side of the stem to the after side of the rudder post, or the centre of the rudder stock if there is no rudder post. L' is tobe not less than 96% and need not exceed 97% of the extreme length on the *UIWL*.

γ_{stem}: as given in **3.6.2**

F_{IB}: design vertical ice force (kN) at the bow, see **3.6.2**

C_m: longitudinal distribution factor for design vertical ice bending moment to be taken as follows:
C_m = 0.0 at the aft end of L
C_m = 1.0 between 0.5 L and 0.7L from aft

C_m = 0.3 at 0.95L from aft

C_m = 0.0 at the forward end of L

Intermediate values are to be determined by linear interpolation.

Where applicable, draught dependent quantities are to be determined at the waterline corresponding to the loading condition under consideration.

EFFECTIVE DATE AND APPLICATION (Amendment 1-2)

1. The effective date of the amendments is 1 January 2012.

2. Notwithstanding the amendments to the Rules, the current requirements may apply to ships for which the date of contract for construction* is before the effective date.
*"contract for construction" is defined in the latest version of IACS Procedural Requirement(PR) No.29.

IACS PR No.29 (Rev.0, July 2009)

1. The date of "contract for construction" of a vessel is the date on which the contract to build the vessel is signed between the prospective owner and the shipbuilder. This date and the construction numbers (i.e. hull numbers) of all the vessels included in the contract are to be declared to the classification society by the party applying for the assignment of class to a newbuilding.

2. The date of "contract for construction" of a series of vessels, including specified optional vessels for which the option is ultimately exercised, is the date on which the contract to build the series is signed between the prospective owner and the shipbuilder.
For the purpose of this Procedural Requirement, vessels built under a single contract for construction are considered a "series of vessels" if they are built to the same approved plans for classification purposes. However, vessels within a series may have design alterations from the original design provided:
(1) such alterations do not affect matters related to classification, or
(2) If the alterations are subject to classification requirements, these alterations are to comply with the classification requirements in effect on the date on which the alterations are contracted between the prospective owner and the shipbuilder or, in the absence of the alteration contract, comply with the classification requirements in effect on the date on which the alterations are submitted to the Society for approval.
The optional vessels will be considered part of the same series of vessels if the option is exercised not later than 1 year after the contract to build the series was signed.

3. If a contract for construction is later amended to include additional vessels or additional options, the date of "contract for construction" for such vessels is the date on which the amendment to the contract, is signed between the prospective owner and the shipbuilder. The amendment to the contract is to be considered as a "new contract" to which **1.** and **2.** above apply.

4. If a contract for construction is amended to change the ship type, the date of "contract for construction" of this modified vessel, or vessels, is the date on which revised contract or new contract is signed between the Owner, or Owners, and the shipbuilder.

Notes:
This Procedural Requirement applies from 1 July 2009.

GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

Part I Polar Class Ships and Ice Class Ships

GUIDANCE

2011 AMENDMENT NO.1

Notice No.41 30th June 2011

Resolved by Technical Committee on 3rd February 2011

Notice No.41 30th June 2011
AMENDMENT TO THE GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

“Guidance for the survey and construction of steel ships” has been partly amended as follows:

Part I POLAR CLASS SHIPS AND ICE CLASS SHIPS

I1 GENERAL APPLICATION

I1.2 Definitions

I1.2.3 Classification of Ice Strengthening

Sub-paragraph -1 has been amended as follows.

1 The correspondence of ice classes specified in **1.2.3, Part I of the Rules** with those in the *Finnish-Swedish Ice Class Rules* ~~2008~~*2010* is as given in **Table I1.2.3-1**.

Table I1.2.3-1 has been amended as follows.

Table I1.2.3-1 The Correspondence of Ice Classes between the Rules and the *Finnish-Swedish Ice Class Rules* ~~2008~~*2010*

Ice Class of the *Finnish-Swedish Ice Class Rules* ~~2008~~*2010*	Ice Class of the Rules
I*A Super*	~~NS*(Class~~ I*A Super* ~~Ice Strengthening)~~ ~~NS (Class IA Super Ice Strengthening)~~
I*A*	~~NS*(Class~~ I*A* ~~Ice Strengthening)~~ ~~NS (Class IA Ice Strengthening)~~
I*B*	~~NS*(Class~~ I*B* ~~Ice Strengthening)~~ ~~NS (Class IB Ice Strengthening)~~
I*C*	~~NS*(Class~~ I*C* ~~Ice Strengthening)~~ ~~NS (Class IC Ice Strengthening)~~
II	~~NS*(Class~~ I*D* ~~Ice Strengthening)~~ ~~NS (Class ID Ice Strengthening)~~ ~~NS*~~ ~~NS~~No ice class

I5 ICE CLASS SHIPS

I5.1 General

I5.1.1 Application

Sub-paragraph -1 has been amended as follows.

1 For ice class ships trading in the Northern Baltic in the winter under the control of the regulation "*Finnish-Swedish Ice Class Rules* ~~2008~~*2010*", ~~the~~ regard needs to be paid to the followings~~s~~ as extracted from ~~that regulation~~ "*Guidelines for the Application of the Finnish-Swedish Ice Class Rules*".

(1) The administrations of Sweden and Finland ~~(hereafter the administrations)~~ provide icebreaker assistance to ice class ships bound for ports in respective countries in the winter season. Depending on the ice conditions, restrictions in regard to the size and ice class of ships entitled to icebreaker assistance are enforced.

~~(2) Ice class ships entitled to assistance under these restrictions are requested to follow the instructions by the icebreaker when operating in icebound waters and will receive assistance when such is needed.~~

~~(3) The administrations can not take responsibility for the safety of ice class ships which enter ice bound waters ignoring the size and ice class restrictions or any instructions by the icebreakers.~~

(~~4~~2) Merely the compliance with these regulations must not be assumed to guarantee any certain degree of capability to advance in ice without icebreaker assistance nor to withstand heavy ice jamming.

(~~5~~3) It should be noted that small ice class ships will have somewhat less ice going capability as compared with larger ice class ships having the same ice class.

~~(6) If a ship because of very unconventional proportions, hull from or propulsion arrangements, or any other characteristics, in practice turns out to have exceptionally poor ice going capability the administrations may lower its ice class.~~

(~~7~~4) It shall be noted that for ice class ships of moderate size (displacement not exceeding 30,000 *tons*) ~~fork~~notch towing in many situations is the most efficient way of assisting in ice.

(~~8~~5) Ice class ships with a bulb protruding more than 2.5*m* forward of the forward perpendicular, ice class ships with too blunt of a bow shape and ice class ships with an ice knife fitted above the bulb are often difficult ~~to tow in this way~~ for notch towing.

(6) When the bow is too high in the ballast condition, ice class ships may be trimmed to get the bow down.

(~~9~~7) An ice strengthened ship is assumed to operate in open sea conditions corresponding to a level ice thickness not exceeding h_0. The design height (h) of the area actually under ice pressure at any particular point of time is, however, assumed to be only a fraction of the ice thickness. The values for h_0 and h are given in **Table I5.1.1-1**.

I5.3 Hull Structures and Equipments

I5.3.2 General Requirements for Frames

Sub-paragraphs -2 and -3 have been deleted.

~~**2** With respect to the provisions of **5.3.2-2, Part I of the Rules**, for longitudinal frames, where deemed as unavoidable by the Society, no end brackets may be accepted. In this case, for facilitating transmission of the ice load to main hull structures, the web of such frames is to be attached to web frames by double lugs and web frame stiffeners, welded to the flange of the frame, fitted in way of every frame support, and effective support structures at frame terminations. In the application of the formula specified in **5.3.4-2, Part I of the Rules**, value of *m* is not to be taken larger than 11.~~

~~**3** Where larger spacing is adopted for longitudinals according to the conditional clause in **5.3.4-1, Part I of the Rules**, web thickness of the frames specified in **5.3.2-3(3), Part I of the Rules** need not to exceed one half of the required shell plating thickness as required for frame spacing of 0.45*m* assuming the yield stress of the plate not more than that used for the frame.~~

Paragraph I5.3.4 has been amended as follows.

I5.3.4 Longitudinal Frames

1 With respect to the provisions of **5.3.4, Part I of the Rules**, vertical extension of ice strengthening of longitudinal framing may be limited to longitudinal frames within the ice belt specified in **5.3.1-1, Part I of the Rules** and those just above and below the edge of the ice belt, except where deemed necessary by the Society. <u>In this case, the spacing of longitudinal frames just above and below the edge of the ice belt is to be the same as the frame spacing in the ice belt.</u> Notwithstanding the above, the longitudinal frames just above and below the edges of the ice belt are closer than 50% of s to the upper and lower edges of the ice belt respectively, where s is the <u>frame </u>spacing <u>in the ice belt</u>~~specified in **5.3.4-1, Part I of the Rules**, the same frame spacing of~~ s is to be extended to the second longitudinal frame~~s~~ above and below the ice belt.

2 With respect to the provisions of **5.3.4-~~2~~<u>1</u>, Part I of the Rules**, boundary condition factor m for frames in conditions deviating from those of continuous beam is to be determined in accordance with the following~~s~~:

(1) For conditions deemed as those fixed at both ends: $m = 12$

(2) For conditions deemed as those simple supported at both ends: $m = 8$

(3) For conditions other than **(1)** or **(2)**, boundary condition factor m is to be determined by calculation using simple beam theory, but in no case that m is not to be greater than 13.3.

Paragraph I5.3.8 has been added as follows.

I5.3.8 Arrangements for Towing

The wording "special consideration" specified in **5.3.8, Part I of the Rules** refers to the following:

(1) The towing arrangement uses a thick wire which is split into two slightly thinner wires as shown in **Fig.I5.3.8-1.**

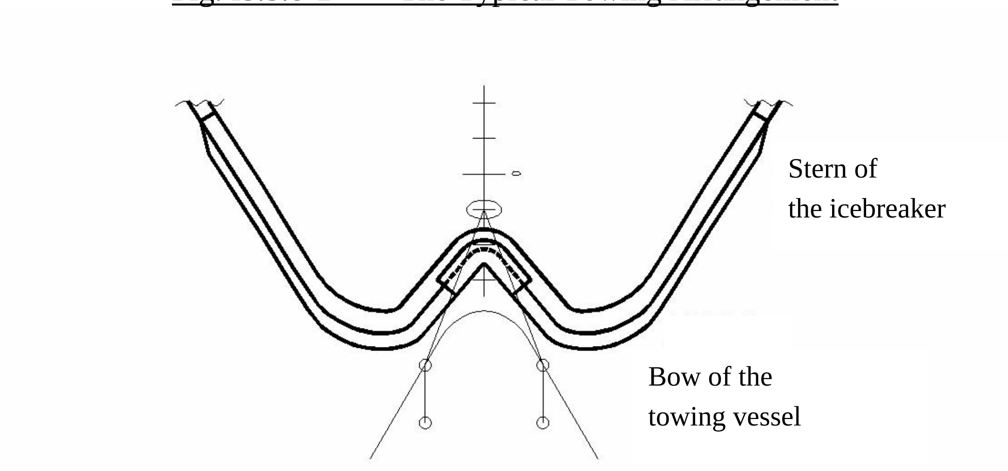
(2) Two fairleads are to be fitted symmetrically off the centreline with one bollard each.

(3) The distance of the bollards from the centreline is approximately 3 *m.* The bollards are to be aligned with the fairleads allowing the towlines to be fastened straight onto them.

(4) Bollards or other means for securing towlines are structurally designed to withstand the breaking force of the towline of the ship.

Fig. I5.3.8-1 has been added as follows.

Fig. I5.3.8-1 The Typical Towing Arrangement



Paragraph I5.3.9 has been added as follows.

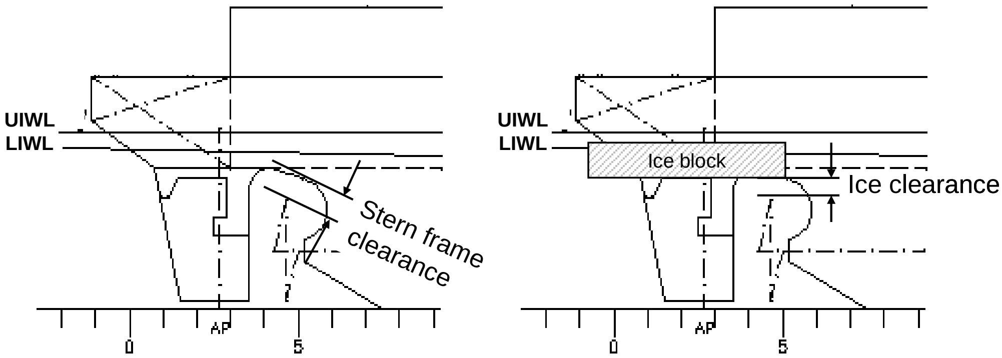
I5.3.9 Stern

1 The clearance between the propeller blade tip and the stern frame is not to be less than 0.5*m* to prevent high loads from occurring on the blade tip. The ice clearance between the propeller blade tip and the bottom of the level ice sheet is to be positive when the level ice thickness is taken as specified in **Table I5.1.** (See **Fig. I5.3.9-1**)

2 A wide transom stern extending below the *UIWL* will seriously impede the capability of the ship to astern in ice. Therefore, a transom stern is not to be extended below the *UIWL* if this can be avoided. If unavoidable, the part of the transom stern below the *UIWL* is to be kept as narrow as possible. The part of a transom stern situated within the ice belt is to be strengthened at least as for the midbody region.

Fig. I5.3.9-1 has been added as follows.

Fig. I5.3.9-1 The Clearance between the Stern Frame and the Propeller (left) and the Ice Sheet and the Propeller when the Ship is at *LIWL* (right)



Paragraph I5.3.10 has been added as follows.

I5.3.10 Bilge Keel

The wording "special consideration" specified in **5.3.10, Part I of the Rules** refers to the following:

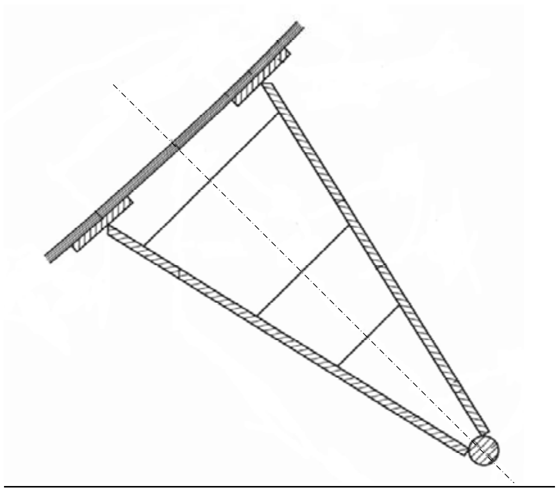
(1) The connection of bilge keels to the hull is to be so designed that the risk of damage to the hull, in case a bilge keel is ripped off, is minimized.

(2) Bilge keels are recommended to be constructed as shown in **Fig. I5.3.10-1.**

(3) It is recommended that bilge keels are cut up into several shorter independent lengths.

Fig. I5.3.10-1 has been added as follows.

Fig. I5.3.10-1 An Example of Bilge Keel Construction



Paragraph I5.4.3 has been added as follows.

I5.4.3 Rudders and Steering Arrangements

The wording "Ice knife" specified in **5.4.3-3, Part I of the Rules** refers to the following and special consideration is to be given to the strength and proper shape of the ice knife.

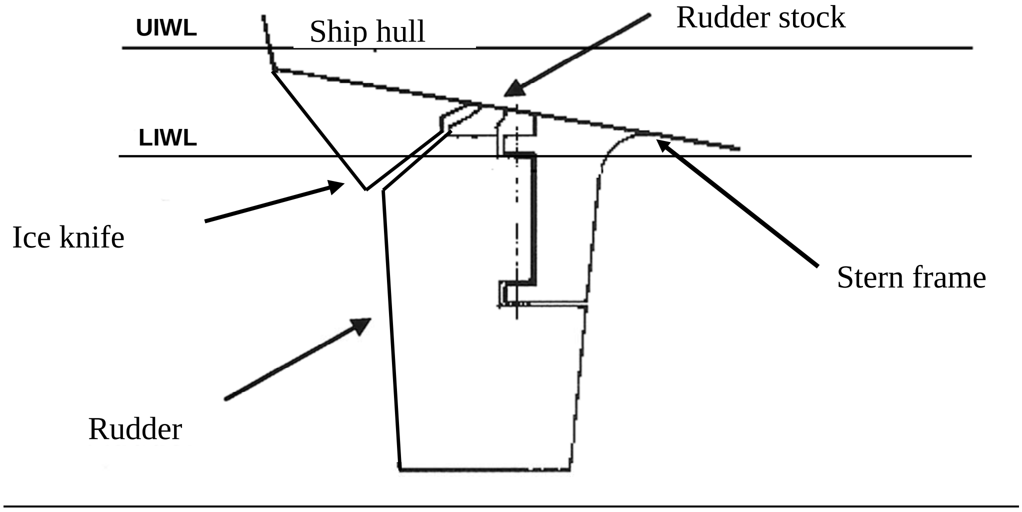
(1) The ice knife bottom is to be below water in all draughts

(2) Where the ship is not intended to go astern in ice at some draught, a smaller ice knife may be used.

(3) An ice knife is recommended to be installed on all ships with ice class I*A Super* or I*A*.

Fig. I5.4.3-1 has been added as follows.

Fig. I5.4.3-1 An Example of an Adequate Ice Knife Design



EFFECTIVE DATE AND APPLICATION

1. The effective date of the amendments is 1 January 2012.
2. Notwithstanding the amendments to the Guidance, the current requirements may apply to ships for which the date of contract for construction is before the effective date.