RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

RULES

Part C Hull Construction and Equipment

2011 AMENDMENT NO.2

Rule No.82 1st November 2011

Resolved by Technical Committee on 7th July 2011

Approved by Board of Directors on 27th September 2011

Rule No.82 1st November 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 C HULL CONSTRUCTION AND EQUIPMETN

Amendment 2-1

Chapter 3 RUDDERS

3.7 Couplings between Rudder Stocks and Main Pieces

3.7.2 Cone Couplings

Paragraph 3.7.2 has been amended as follows.

1 Cone couplings that are mounted or dismounted without hydraulic arrangements (e.g. oil injection and hydraulic nut) are to be tapered 1:8～1:12 of the diameter. (*See* **Fig. C3.4**)

The taper length *l* of rudder stocks fitted into the rudder plate and secured by the slugging nut is generally not to be less than 1.5 *times* the rudder stock diameter d_0 at the top of the rudder. In this case, for couplings between stock and rudder, a key is to be provided. The scantling of the key is to be to the discretion of the Society.

2 The dimensions of the slugging nut as specified in **-1** are to be as follows (*See* **Fig. C3.4**):

External thread diameter: $d_g \geq 0.65 d_0$ (mm)

Length of nut: $h_n \geq 0.6 d_g$ (mm)

Outer diameter of nut: $dn \geq 1.2 d_e$ or $1.5 d_g$ (mm), whichever is greater

3 Notwithstanding the provisions in **-1** above, where a key is fitted to the couplings between stocks and rudders, and it is considered that rudder torque is transmitted by friction at the couplings, the scantlings of the key as well as the push-up force and push-up length are to be at the discretion of the Society.

~~3~~4 Cone couplings that are mounted or dismounted with hydraulic arrangements (e.g. oil injection and hydraulic nut) are to be tapered 1:12～1:20 of the diameter. (*See* **Fig. C3.4**)

The push-up force and the push-up length are to be to the discretion of the Society.

~~4~~5 The nuts fixing the rudder stocks are to be provided with efficient locking devices.

~~5~~6 Couplings of rudder stocks are to be properly protected from corrosion.

EFFECTIVE DATE AND APPLICATION (Amendment 2-1)

1. The effective date of the amendments is 1 November 2011.

Amendment 2-2

Chapter 27 EQUIPMENT

27.1 Anchors, Chain Cables and Ropes

Paragraph 27.1.7 has been amended as follow.

27.1.7 Chain Lockers

1 Chain lockers including spurling pipes are to be watertight up to the weather deck and to be provided with a means for drainage.

2 Chain lockers are to be subdivided by centre line screen walls.

3 Where a means of access is provided, it is to be closed by a substantial cover and secured by closely spaced bolts.

4 Where a means of access to spurling pipes or cable lockers is located below the weather deck, the access cover and its securing arrangements are to be to the satisfaction of the Society. Butterfly nuts and/or hinged bolts are prohibited as the securing mechanism for the access cover.

45 Spurling pipes through which anchor cables are led are to be provided with permanently attached closing appliances to minimize water ingress.

EFFECTIVE DATE AND APPLICATION (Amendment 2-2)

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.

Chapter 1 GENERAL

1.1 General

1.1.7 Materials

Sub-paragraph -2 has been amended as follows.

2 Where high tensile steel specified in **Chapter 3, Part K of the Rules** is used, the construction and scantlings of the ship are to comply with the following requirements in **(1)** to **(3)**:

(1) The section modulus of the transverse section of the hull is not to be less than the value obtained by multiplying the following coefficient with the value specified in **Chapter 15**. However, where special consideration is given to the type of high tensile steel used, this value may be different, subject to the approval of the Society, from the following coefficients. Moreover, the extent of high tensile steel use is to be at the discretion of the Society.

0.78: where high tensile steels *KA*32, *KD*32, *KE*32 or *KF*32 are used

0.72: where high tensile steels *KA*36, *KD*36, *KE*36 or *KF*36 are used

0.68: where high tensile steels *KA*40, *KD*40, *KE*40 or *KF*40 are used.

(2) With the exception of the requirements in **(1)**, details such as the thickness of decks and shell plating, and the section modulus of stiffeners and other scantlings are to be at the discretion of the Society.

(3) With the exception of the requirements in **(1)**, the construction and scantlings where high tensile steels are used are to be at the discretion of the Society.

1.1.13 Scantlings

Sub-paragraph -7 has been added as follows.

7 Scantlings of stiffeners based on requirements in this Part may be decided based on the concept of grouping designated sequentially placed stiffeners of equal scantlings. The scantling of the group is to be taken as the greater of the values obtained from the following requirements **(1)** and **(2)**. However, this requirement is not applicable to fatigue requirements as given in **1.1.23-4**.

(1) the average of the required scantling of all stiffeners within a group

(2) 90% of the maximum scantling required for any one stiffener within the group.

Chapter 32 CONTAINER CARRIERS

32.3 Double Bottom Construction

32.3.1 General

Sub-paragraphs -3 to -5 have been added as follows.

3 The thickness of girders, struts and their end brackets and bulkhead plates in double bottom spaces, the interior of which are used as deep tanks, are to be in accordance with the requirement of **14.1.4** according to the kind and size of the tank. However, in the application of the requirement in **14.1.4**, the thickness may be reduced by 1.0*mm* from the thickness prescribed in **Table 14.1**.
4 The thickness of bottom shell plating and inner bottom plating in the double bottom spaces for void spaces, fuel oil tanks, etc. which do not contain sea water in service conditions may be reduced by 0.5 *mm* from the thickness prescribed in **32.3**.
5 For bottom longitudinals, sufficient consideration is to be given for fatigue strength.

32.3.2 Longitudinals

Sub-paragraph -1 has been amended as follows.

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

$$\frac{100C}{24-15.5f_B}(d+0.026L')Sl^2$$

$$Z=\frac{90CK}{24-15.5f_BK}\left\{d+0.013L'\left(\frac{2}{B}y+1\right)+h_1\right\}Sl^2 \quad (cm^3)$$

C: Coefficient given below:
Where no strut specified in **32.3.3** is provided midway between floors C=1.0
Where a strut specified in **32.3.3** is provided midway between floors C=0.625
However, where the widths of the vertical stiffeners provided on floors and those of struts are especially large, the coefficient may be appropriately reduced.

h_1: As given in (I) or (II)

(I) For 0.3L from the fore end:

$$h_1=\frac{3}{2}(17-20C_b')(1-x)$$

C_b': Block coefficient

Where C_b exceeds 0.85, C_b' is to be taken as 0.85.

(II) For elsewhere:

0

x: As given by the following formula

$\frac{X}{0.3L}$

X: Distance (m) from the fore end for side shell plating. However, where X is less than that $0.1L$, X is to be taken as $0.1L$ and where X exceeds $0.3L$, X is to be taken as $0.3L$.

f_B: Ratio of the section modulus of the transverse section of the hull on the basis of mild steel required in **Chapter 15** to the actual section modulus of the transverse section of the hull at the bottom

K: Coefficient corresponding to the kind of steel
e.g. 1.0 for mild steel, the values specified in **1.1.7-2** for high tensile steel

L': Length of ship (m)
Where L exceeds 230 m, L' is to be taken as 230 m.

y: Horizontal distance (m) from the centre line of the ship to the longitudinals under consideration

l: Spacing of solid floors (m)

S: Spacing of longitudinals (m)

Sub-paragraph -2 has been amended as follows.

2 The section modulus Z of inner bottom longitudinals is not to be less than that obtained from the following formula. However, the section modulus is not to be less than 75% of that specified for the bottom longitudinals at the same place.

$$Z = 100 C_1 C_2 S h l^2 \quad (cm^3)$$

Where:

C_1: Coefficient given in the following formula, however, for h_2 and h_3, C_1 is to be taken as $\frac{K}{18}$

$$C_1 = \frac{K}{24 - \alpha K}$$, however, the value of C_1 is not to be less than $\frac{K}{18}$

α: As obtained from the following formula:

$$\alpha = 15.5 f_B \left(1 - \frac{z}{z_B}\right)$$

K and f_B: As specified in **-1** above

z: Vertical distance (m) from the top of the keel to the bottom of inner bottom plating

z_B: Vertical distance (m) from the top of the keel amidships to the horizontal neutral axis of the transverse section

C_2: As determined from **Table C32.1**

S: Spacing of stiffeners (m)

h: The following h_1, h_2 and h_3, however, where the double bottom space is void, h is to be taken as h_1

h_1: Vertical distance (m) from the mid point between the bottom of inner bottom plating and the upper end of the overflow pipe

h_2: As obtained from the following formula:

$h_2 = 0.85(h_1 + \Delta h)$ (m)

Δh: As obtained from the following formula:

$\Delta h = \frac{16}{L}(l_t - 10) + 0.25(b_t - 10)$ (m)

l_t: Tank length (m)

It is not to be less than 10m.

b_t: Tank breadth (m)

It is not to be less than 10m.

h_3: Value obtained by multiplying 0.7 by the vertical distance from the tank top plating to the point 2.0 m above the top of overflow pipe

l: Spacing of girders (m)

Table C32.1 to Table C32.3 have been renumbered to Table C32.2 to Table C32.4, and Table C32.1 has been added as follows.

Table C32.1 Value of C_2

Other end	One end		
	Rigid connection by bracket	Soft connection by bracket	Supported by girders or lug-connection
Rigid connection by bracket	0.70	1.15	0.85
Soft connection by bracket	1.15	0.85	1.30
Supported by girders or lug-connection	0.85	1.30	1.00

Notes:

1. "Rigid connection by bracket" is a connection by bracket of the stiffener to the double bottom or to a stiffener of equivalent strength attached to the face plates of adjacent members, or a connection of equivalent strength. (*see* **Fig.C13.1(a)** of the Rules)
2. "Soft connection by bracket" is a connection by bracket of the stiffener to transverse members such as beams, frames, or the equivalent thereto. (*see* **Fig.C13.1 (b)** of the Rules)

Paragraph 32.3.3 has been amended as follows.

32.3.3 Vertical Struts

Where vertical struts are provided, the sectional A area is not to be less than that obtained from the following formula:

~~$0.9CSb(d + 0.026L')$~~ $A = 0.9CKSb(d + 0.026L')$ (cm^2)

C: Coefficient obtained from the following formula, but C is not to be less than 1.43

~~$\frac{1}{1 - 0.5\frac{l_s}{k}}$~~ $C = \frac{1}{1 - 0.5\frac{l_s}{k\sqrt{K}}}$

K: As specified in **32.3.2-1.**

ls: Length of struts (m)

k: Minimum radius (cm) of gyration of struts obtained from the following formula:

$k = \sqrt{\frac{I}{A}}$

I : The least moment of inertia of struts (cm^4)

A : Sectional area of struts (cm^2)

S : Spacing of longitudinals (m)

b : Width (m) of the area supported by struts

Paragraph 32.3.4 has been amended as follows.

32.3.4 Thickness of Inner Bottom Plating

1 The thickness of inner bottom plating is to be in accordance with the requirement in **6.5.1-1**. However, in the application of the second formula in the requirement, h is to be obtained from the following formula:

$h = 1.13(d - d_0)$

Where:

d_0 : Height of centre girder (m)

2 Notwithstanding the requirement in **-1**, the thickness t of inner bottom plating is to be not less than obtained from the following formula.

$t = 3.6CS\sqrt{Kh} + 3.0$ (mm)

S: Spacing of stiffeners (m)

h: As specified in **32.3.2-2.**

K: As specified in **32.3.2-1.**

C: Coefficient given in the following formulae according to the stiffening system of inner bottom plating used, however, for h_2 and h_3, C is to be taken as 1.

(a) For transverse system

$$C = \frac{27.7}{\sqrt{767 - \alpha^2 K^2}}$$

α : As specified in **32.3.2-2.**

(b) For longitudinal system

$$C = \frac{3.72}{\sqrt{27.7 - \alpha K}}$$, However, C is not to be less than 1.0.

α : As specified in **32.3.2-2.**

~~2~~**3** The inner bottom plating with which the lower ends of corner fittings of containers are in contact is to be strengthened by means of doubling or by other appropriate means.

Paragraph 32.3.5 has been added as follows.

32.3.5 Bottom Shell Plating

1 The thickness t of bottom shell plating is not to be less than that obtained from the following formulae **(1)** and **(2)** or from the requirements in **6.5.5**, whichever is greater. However, in the application of the requirements in **6.5.5**, the thickness need not apply to the formulae in requirement of **16.3.4**.

(1) In ships with transverse framing, the thickness is not to be less than that obtained from the

following formula:

$$t = C_1 C_2 S \sqrt{d + 0.0175L'\left(\frac{2}{B}y + 1\right) + h_1} + 2.5 \quad (mm)$$

Where:

S : Spacing (m) of transverse frames

L', y, h_1: As specified in **32.3.2-1.**

C_1: Coefficient given below:

Where L is 230 *metres* and under: 1.0

Where L is 400 *metres* and over: 1.07

For intermediate values of L, C_1 is to be obtained by linear interpolation.

C_2: Coefficient given below:

$$C_2 = \frac{91}{\sqrt{576 - (15.5 f_B x)^2}}$$

x : As given by the following formula

$$\frac{X}{0.3L}$$

X : Distance (m) from the fore end for side shell plating afore the midship, or from the after end for side shell plating after the midship. However, where X is less than that $0.1L$, X is to be taken as $0.1L$ and where X exceeds $0.3L$, X is to be taken as $0.3L$.

(2) In ships with longitudinal framing, the thickness of side shell plating is not to be less than that obtained from the following formula:

$$t = C_1 C_2 S \sqrt{d + 0.0175L'\left(\frac{2}{B}y + 1\right) + h_1} + 2.5 \quad (mm)$$

Where:

S: Spacing (m) of longitudinal frames

L', C_1 and h_1: As given in **(1)**

C_2 : Coefficient given by the following formula, but it is not to be less than $3.78\sqrt{K}$

$$C_2 = 13\sqrt{\frac{K}{24 - 15.5 f_B K x}}$$

x: As given in **(1)**

2 Notwithstanding the requirement in **-1**, the thickness t of bottom shell plating is to be not less than obtained from the following formula.

$$t = \sqrt{KL'} \quad (mm)$$

L': Length (m) of ship

However, where L exceeds 330 m, L' is to be taken as 330 m.

K : As specified in **32.3.2-1**.

3 The breadth and thickness of plate keels are to be in accordance with the requirement of **16.2.1**. However, in the application of the requirement of **16.2.1-2,** "**16.3.4**" is to be read as "**32.3.5**".

32.4 Double Side Construction

Paragraph 32.4.1 has been amended as follows.

32.4.1 General

1 The side construction of holds is to be of double hull construction as far as practicable and is to be thoroughly stiffened by providing side transverse girders and side stringers within the double hull.

2 ~~Double side construction is to be in accordance with the requirements in **Chapter 13**, unless otherwise specified in **32.4**.~~ The construction of the double side construction in holds which are exclusively loaded with containers is to be in accordance with the requirements in **32.4**. Unless otherwise specified in **32.4**, such construction is also to be in accordance with the requirements in **Chapter 13**.

3 Double side shell structures, the interiors of which are used as deep tanks, are to be in accordance with the requirements in **Chapter 14** ~~in addition to those~~ unless otherwise specified in **32.4**.

4 The thickness of girders, struts and their end brackets and bulkhead plates in the double side spaces, the interior of which are used as deep tanks, are to be in accordance with the requirement of **14.1.4** according to the kind and size of the tank. However, in the application of the requirement in **14.1.4**, the thickness may be reduced by 1.0*mm* from the thickness prescribed in **Table 14.1**.

5 In the application of the requirements in **-2** to **-4,** the thickness of side shell plating and inner hull plating in double side spaces for void spaces, fuel oil tanks, etc. which do not contain sea water in service conditions may be reduced by 0.5 *mm* from the thickness prescribed in each respective applicable requirement.

~~**4**~~**6** Side stringers are to be spaced appropriately according to the depths of holds. Side transverse girders are to be provided at solid floors in double bottoms.

~~**5**~~**7** Where the width of the double side shell changes in the bilge part, the scantlings are to be at the discretion of the Society.

~~**6**~~**8** Where structures effectively support deck structures and side shell structures in the midway of holds, the requirements in **32.4** may be appropriately modified.

~~**7**~~**9** Where the height from the designed maximum load line to the strength deck is especially large, the scantlings are to be at the discretion of the Society.

~~**8**~~**10** Where the inner hull plating and the inner bottom plating are combined, considerations are to be made to their structural arrangement so as not to cause stress concentration.

~~**9**~~**11** At the fore and aft ends of the double side structure, sufficient considerations are to be made to the continuity of construction and strength.

12 For side longitudinals, sufficient consideration is to be given for fatigue strength.

Paragraph 32.4.2 has been amended as follows.

32.4.2 Side Transverse Girders and Side Stringers

1 The thickness of side transverse girders is not to be less than that obtained from the following formulae, whichever is the greatest: However, t_3 can be determined by other analytical measures against compressive buckling strength of the girder

~~$t_1 = 0.083 \frac{CSl_H}{d_1 - a}(d + 0.038L') + 2.5$~~ $t_1 = 0.083 \frac{CKSl_H}{d_1 - a}(d + 0.038L') + 2.5 \quad (mm)$

~~$t_2 = 8.6\sqrt[3]{\dfrac{d_1^2(t_1-2.5)}{k}} + 2.5$~~ $$t_2 = 8.6\sqrt[3]{\frac{d_1^2(t_1-2.5)}{kK}} + 2.5 \quad (mm)$$

~~$t_3 = 8.5S_2 + 2.5$~~ $$t_3 = \frac{8.5}{\sqrt{K}}S_2 + 2.5 \quad (mm)$$

Where:

C : As obtained from the following formula:

$C = (C_1 + \beta_T C_2)C_3$

C_1 and C_2 : As obtained from **Table C 32.~~1~~2** in accordance with the value of h / l_H

For intermediate values of h / l_H, the values of C_1 and C_2 are to be determined by linear interpolation.

h : Vertical distance (m) from the top of inner bottom to the strength deck at side

l_H : Length of hold (m)

β_T : As obtained from the following formula:

$$\beta_T = 1 + \frac{0.42\left(\frac{B}{D_s}\right)^2 - 0.5}{0.59\frac{D_s - \frac{d_0}{2}}{B - d_1}\left(\frac{d_0}{d_1}\right)^2 + 1.0}$$

d_0 : Height of centre girder (m)

d_1 : Depth of side transverse girder (m)

Where the depth of the web is divided by stiffeners attached in the direction of the length of the girder, d_1 in the formulae for t_2 and t_3 may be taken as the divided depth.

C_3 : As obtained from the following formula, but not to be less than 0.2:

$$C_3 = 1 - 1.8\frac{y}{h}$$

y : Distance (m) from the lower end of h to the location under consideration

K : As specified in **32.3.2-1**.

S : Width (m) of the area supported by the side transverse girders

a : Depth (m) of the openings at the location under consideration

L' : Length of ship (m).

However, where L exceeds 230 m, L' is to be taken as 230 m.

k : Coefficient obtained from **Table C 32.~~2~~3** in accordance with the ratio of the spacing S_1 (m) of the stiffeners provided on the web of side transverse girders in the direction of the depth of the girders and d_1

For intermediate values of S_1/d_1, the value of k is to be determined by linear interpolation.

S_2 : S_1 or d_1, whichever is smaller

However, t_3 can be determined by other analytical measures against compressive buckling strength of the girder

Table C32.~~1~~2 Coefficients, C_1 and C_2

h/l_H	0.50 and under	0.75	1.00	1.25	1.50	1.75 and above
C_1	0.18	0.21	0.24	0.25	0.26	0.27
C_2	0.05	0.08	0.09	0.10	0.11	0.12

Table C32.~~2~~3 Coefficient ***k***

S_1/d_1	0.3 and under	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.5	2.0 and above
k	60.0	40.0	26.8	20.0	16.4	14.4	13.0	12.3	11.1	10.2

2 The thickness of side stringers is not to be less than that obtained from the following formulae, whichever is the greatest:

~~$t_1 = 0.083\dfrac{CSl_H}{d_1 - a}(d + 0.038L') + 2.5$~~ $\quad t_1 = 0.083\dfrac{CKSl_H}{d_1 - a}(d + 0.038L') + 2.5 \quad (mm)$

~~$t_2 = 8.6\sqrt[3]{\dfrac{d_1^2(t_1 - 2.5)}{k}} + 2.5$~~ $\quad t_2 = 8.6\sqrt[3]{\dfrac{d_1^2(t_1 - 2.5)}{kK}} + 2.5 \quad (mm)$

~~$t_3 = 8.5S_2 + 2.5$~~ $\quad t_3 = \dfrac{8.5}{\sqrt{K}}S_2 + 2.5 \quad (mm)$

Where:

C : As obtained from the following formula:

$$C = (C_1 - \beta_L C_2)C_3$$

C_1 and C_2: As obtained from **Table C 32.~~3~~4**, in accordance with the value of h/l_H

For intermediate values of h/l_H, the values of C_1 and C_2 are to be determined by linear interpolation.

β_L : As obtained from the following formula:

$$\beta_L = 1 + \frac{0.18\left(\dfrac{B}{Ds}\right)^2 - 0.5}{0.59\dfrac{Ds - \dfrac{d_0}{2}}{B - d_1}\left(\dfrac{d_0}{d_1}\right)^2 + 1.0}$$

h , l_H , d_0 and L' : As specified in **-1** above

d_1: Depth of side stringers (m)

However, where the depth of the web is divided by stiffeners attached in the direction of the length of the stringer, d_1 in the formulae for t_2 and t_3 may be taken as the divided depth.

C_3 : As obtained from the following formula:

$$C_3 = \left|1 - \frac{2x}{l_H}\right|$$

x : Distance (m) from the end of l_H to the location under consideration

K : As specified in **32.3.2-1.**

S : Width (m) of the area supported by the side stringers

a : Depth (m) of the openings at the location under consideration

k : Coefficient obtained from **Table C32.~~2~~3** in accordance with the ratio of the spacing $S_1(m)$ of the stiffeners provided on the web of the side stringer in the direction of the depth of the stringer and d_1

For intermediate values of S_1/d_1, the value of k is to be determined by linear interpolation.

S_2 : S_1 or d_1, whichever is smaller

However, t_3 can be determined by other analytical measures against compressive buckling strength of the girder

Table C32.~~3~~4 Coefficients $\boldsymbol{C}_1$ and $\boldsymbol{C}_2$

h/l_H	0.50 and under	0.75	1.00	1.25	1.50 and above
C_1	0.20	0.24	0.26	0.26	0.26
C_2	0.07	0.05	0.03	0.01	0.00

Paragraph 32.4.3 has been amended as follows.

32.4.3 Inner Hull Construction

The thickness t of inner hull plating where the interior of the double side structure is used as deep water tanks, and the section modulus Z of longitudinal stiffeners are not to be less than those obtained from the following formulae, respectively:

(1) Thickness of inner hull plating

~~$3.6CS\sqrt{h}+3.0$~~ $t=3.6CS\sqrt{Kh}+2.0$ (mm)

Where:

S: Spacing of stiffeners (m)

K: As specified in **32.3.2-1.**

h: ~~Vertical distance (m) from the lower edge of the inner hull plating to the mid point between the tank top plating and the upper end of the overflow pipe~~

~~However, with respect to inner hull plating that composes a large tank, appropriate additional water pressure is to be taken into account.~~ The following h_1, h_2 and h_3, however, where the double bottom space is void, h is to be taken as h_1

h_1 : Vertical distance (m) from the lower edge of the bulkhead plating under consideration to the mid-point between the point on the tank top and the upper end of the overflow pipe

h_2 : As obtained from the following formula:

$h_2=0.85(h_1+\Delta h)$ (m)

Δh :As obtained from the following formula:

$\Delta h=\frac{16}{L}(l_t-10)+0.25(b_t-10)$ (m)

l_t :Tank length (m)

It is not to be less than 10m.

b_t : Tank breadth (m)

It is not to be less than 10m.

h_3 : Value obtained by multiplying 0.7 by the vertical distance from the lower edge of the bulkhead plating under consideration to the point 2.0 *m* above the top of overflow pipe

C : Coefficient given in the following formulae according to the stiffening system of inner hull plating used, however, for h_2 and h_3, C is to be taken as 1

(a) For transverse system

~~$\frac{27.7}{\sqrt{767-\alpha^2}}$~~ $C = \frac{27.7}{\sqrt{767-\alpha^2 K^2}}$

Where:

α : As obtained from the following formulae, whichever is greater:

~~$15.5 f_B \left(1-\frac{y}{y_B}\right) \cdots\cdots y \le y_B$~~ $\alpha = 15.5 f_B \left(1-\frac{z}{z_B}\right)$ where $z \le z_B$

~~$15.5 f_D \frac{y-y_B}{Y'} \cdots\cdots y_B < y$~~ $\alpha = 15.5 f_D \frac{z-z_B}{Z'}$ where $z_B < z$

~~$k\left(1-2\frac{d_1}{B}\right)$~~ $\alpha = \frac{1}{9.81}\frac{M_H}{I_H} y_H \times 10^5$

f_B : As specified in **32.3.2-1**.

~~y~~ z : Vertical distance (*m*) from the top of the keel to the lower edge of inner hull plating

~~y_B~~ z_B : ~~Vertical distance (*m*) from the top of the keel amidships to the horizontal neutral axis of the transverse section~~ As specified in **32.3.2-2.**

f_D : Ratio of the section modulus of the transverse section of hull on the basis of mild steel required in **Chapter 15** to the actual section modulus of the hull at the strength deck

~~Y'~~ Z' :The greater of the values specified in **15.2.3(5)(a)** or **(b)**

~~k : As specified in the following according to the value of L~~

~~For intermediate values of L, the values of k are to be determined by linear interpolation:~~

~~Where L is not greater than 230*m*: 6~~

~~Where L is not less than 400*m*: 10.5~~

~~d_1 : Width of double side shell (*m*)~~

M_H : As given by the following formula

$M_H = 0.45 C_1 L^2 d (C_b + 0.05) C_H$ (*kN-m*)

C_1 : As given by the following formula

$10.75 - \left(\frac{300-L_1}{100}\right)^{1.5}$ for $L_1 \le 300m$

10.75 for $300m < L_1 \le 350m$

$10.75 - \left(\frac{L_1-350}{150}\right)^{1.5}$ for $350m < L_1$

L_1 : Length (*m*) of ship specified in **2.1.2, Part A** or 0.97 *times* the length of ship on the designed maximum load line, whichever is smaller

C_H : Coefficient, as given in **Table C32.5**, based on the ratio of L to x, where x is the distance (*m*) from the aft end of L to the section under consideration

Intermediate values are to be determined by interpolation.

I_H : Moment of inertia (cm^4) of the cross section about the vertical neutral axis of the transverse section under consideration

y_H : Horizontal distance (m) from the vertical neutral axis to the evaluation position

(b) For longitudinal system

$$\frac{3.72}{\sqrt{27.7-\alpha}} \quad C=\frac{3.72}{\sqrt{27.7-\alpha K}}, \quad \text{However, } C \text{ is not to be less than 1.0.}$$

Where:

α: As specified in **(a)**

The thickness of inner hull plating which is not in contact with sea water in service conditions may be reduced by 0.5 *mm*.

(2) Section modulus Z of longitudinal stiffeners on inner hull plating

$$125C_1C_2C_3Shl^2 \quad Z=100C_1C_2Shl^2 \ (cm^3)$$

Where:

C_1: Coefficient determined according to the value of L as specified below:

C_1=1.0 where L is not greater than 230m

C_1=1.07 where L is not less than 400m

For intermediate values of L, the value of C_1 is to be obtained by linear interpolation

C_2: $\frac{1}{18}$, however, for h_1, C_2 is to be in accordance with the following:

$C_2=\frac{1}{24-\alpha}$, however, the value of C_2 is not to be less than $\frac{1}{18}$

α: As specified in **32.4.3(1)(a)**

C_1: Coefficient given in the following formula, however, for h_2 and h_3, C_1 is to be taken as $\frac{K}{18}$

$C_1=\frac{K}{24-\alpha K}$, however, the value of C_1 is not to be less than $\frac{K}{18}$

α: As specified in **(a)**

C_3 C_2: As determined from **Table C32.5** As specified in **32.3.2-2.**

S: Spacing of stiffeners (m)

h: The following h_1 and h_2 As specified in **(a)**

Where “the lower edge of the bulkhead plating under consideration” is to be construed as “the stiffener under consideration”

h_1: Vertical distance (m) from the mid point between the tank top plating and the upper end of the overflow pipe to the mid point between the stiffeners above and below the longitudinal stiffener under consideration

h_2: As obtained from the following formula:

$h_2=0.85(h_1+\Delta h) \ (m)$

Δh: As obtained from the following formula:

$$\Delta h=\frac{16}{L}(l_t-10)+0.25(b_t-10) \ (m)$$

l_t: Tank length (m)

It is not to be less than 10*m*.

b_t : Tank breadth (*m*)

It is not to be less than 10*m*.

l : Spacing of girders (*m*)

Table C32.5 has been amended as follows.

Table C32.5 Value of C_3

Other end	One end		
	Rigid connection by bracket	Soft connection by bracket	Supported by girders or lug-connection
Rigid connection by bracket	0.70	1.15	0.85
Soft connection by bracket	1.15	0.85	1.30
Supported by girders or lug-connection	0.85	1.30	1.00

Notes:

1. "Rigid connection by bracket" is a connection by bracket of the stiffener to the double bottom or to a stiffener of equivalent strength attached to the face plates of adjacent members, or a connection of equivalent strength. (*see* **Fig.C13.1 (a)** of the Rules)
2. "Soft connection by bracket" is a connection by bracket of the stiffener to transverse members such as beams, frames, or the equivalent thereto. (*see* **Fig.C13.1 (b)** of the Rules)

Table C32.5 Coefficient C_H

x/L	0.0	0.4	0.7	1.0
C_H	0.0	1.0	1.0	0.0

Paragraph 32.4.5 has been added as follows.

32.4.5 Side Shell plating

1 The side shell plating below the strength deck is to be in accordance with the requirements in **32.4.5**. Unless otherwise specified in **32.4.5**, such plating is also to be in accordance with the requirements in **Chapter 16**.

2 The thickness *t* of side shell plating other than the sheer strake specified in **16.3.3** is to be as required in the following **(1)** and **(2)** in addition to the requirements in **15.3.1** and **15.3.2**.

(1) In ships with transverse framing, the thickness of side shell plating is not to be less than that obtained from the following formula:

$$t = C_1 C_2 S \sqrt{d - z' + 0.05L' + h_1} + 2.0 \quad (mm)$$

Where:

S : Spacing (*m*) of transverse frames

L', C_1 and h_1: As specified in **32.3.5-1(1).**

z': Vertical distance (*m*) from the top of the keel to the upper turn of the bilge at midship. The upper turn of the bilge is a point of the end of curvature at upper turn of the bilge on the side shell.

C_2: Coefficient given below:

$$C_2 = 91\sqrt{\frac{K}{576 - \alpha^2 K^2 x^2}}$$

K: As specified in **32.3.2-1**

α: As given in following formulae, whichever is greater

$$\alpha = 15.5 f_B \left(1 - \frac{z}{z_B}\right)$$

$$\alpha = \frac{1}{9.81}\frac{M_H}{I_H} y_H \times 10^5$$

z_B: As specified in **32.3.2-2**

z: Vertical distance (m) from the top of keel to the lower edge of the side shell plating under consideration

f_B: As specified in **32.3.2-1**

M_H, I_H and y_H: As specified in **32.4.3(1)(a)**

x : As specified in **32.3.5-1(1)**

(2) In ships with longitudinal framing, the thickness of side shell plating is not to be less than that obtained from the following formula:

$$t = C_1 C_2 S\sqrt{d - z' + 0.05L' + h_1} + 2.0 \quad (mm)$$

Where:

S : Spacing (m) of longitudinal frames

z', L', C_1 and h_1: As specified in **(1)**

C_2: Coefficient given by the following formula, but it is not to be less than $3.78\sqrt{K}$

$$C_2 = 13\sqrt{\frac{K}{24 - \alpha K x}}$$

K, α and x : As specified in **(1)**

3 Notwithstanding the requirement in **-2**, the thickness t of side shell plating below the strength deck is to be not less than obtained from the formula in **32.3.5-2**.

Paragraph 32.4.6 has been added as follows.

32.4.6 Side Longitudinals

1 The section modulus Z of side longitudinals below the freeboard deck is not to be less than that obtained from the following formulae **(1)** and **(2)**, whichever is greater:

(1) $Z = 90CShl^2$ (cm^3)

Where:

S: Spacing (m) of longitudinals

l: Spacing of girders (m)

h: Vertical distance (m) from the side longitudinal concerned to a point $d + 0.038L' + h_1$ above the top of keel

h_1, K and L: As specified in **32.3.2-1**.

C: Coefficient given by the following formula:

$C = \frac{K}{24 - \alpha K}$, however, the value of C is not to be less than $\frac{K}{18}$

α : As obtained from the following formulae, whichever is greater:

$$\alpha = 15.5 f_B \left(1 - \frac{z}{z_B}\right) \text{ where } z \le z_B$$

$$\alpha = 15.5 f_D \frac{z - z_B}{Z'} \text{ where } z_B < z$$

$$\alpha = \frac{1}{9.81} \frac{M_H}{I_H} y_H \times 10^5$$

z: Vertical distance (m) from the top of keel to the longitudinal under consideration

z_B: As specified in **32.3.2-2**.

f_B, f_D and Z': As specified in **32.4.3(1)(a)**

M_H, I_H and y_H: As specified in **32.4.3(1)(a)**

(2) $Z = 2.9K\sqrt{L'}Sl^2$ ($cm3$)

K, L', S and l: As specified in **(2)**

2 The section modulus Z of side longitudinals where the interior of the double side structure is used as deep water tanks are to be in accordance with the requirement in **32.4.3(2)**.

32.6 Deck Construction

Paragraph 32.6.1 has been amended as follows.

32.6.1 Decks Inside the Line of Deck Openings

The scantlings of decks inside the line of deck openings in relation to bending in the deck plane are not to be less than those obtained from the following formulae. When calculating the section modulus and moment of inertia, the deck inside the line of deck openings is to be regarded as a web and the hatch end coaming as a flange. Where the construction is box-shaped or of similar construction, the second term of the formula for the thickness of deck plating is to be taken as 5.0.

(1) Thickness t of deck plating (including the bottom plate in case of box-shaped construction)

$$~~0.00417 C_1 \left(\frac{l_v^2 l_c}{w_c}\right) + 2.5~~ \quad t = 0.00417 C_1 K \left(\frac{l_v^2 l_c}{w_c}\right) + 2.5 \quad (mm)$$

Where:

K: As specified in **32.3.2-1**.

l_v: Distance (m) from the top of inner bottom plating to the bulkhead deck at the centre line of the ship

l_c: Width of hatchway (m)

Where two or more rows of hatchways are provided, the width of the widest hatchway is to be taken.

w_c: Width (m) of deck inside the line of deck openings

C_1: As obtained from **Table C 32.~~4~~6** in accordance with the value of α

For intermediate values of α, the values of C_1 are to be determined by linear interpolation.

α : As obtained from the following formula:

$$\alpha = 0.5 l_c \sqrt[4]{\frac{3}{4 S l_v^3} \frac{I_v}{I_c}}$$

S : Spacing (m) of vertical webs provided on transverse bulkheads

I_v : Moment of inertia (cm^4) of vertical webs provided on transverse bulkheads

I_c : Moment of inertia (cm^4) of decks inside the line of deck openings

(2) Section modulus Z

~~$1.43 C_2 l_v^2 l_c^2$~~ $Z = 1.43 C_2 K l_v^2 l_c^2$ (cm^3)

Where:

C_2 : As obtained from **Table C 32.~~4~~6** in accordance with the value of α

For intermediate values of α , the values of C_2 are to be determined by linear interpolation.

α , l_v and l_c : As specified in **(1)**

(3) Moment of inertia

$$I = 0.38 \frac{l_c^4}{S l_v^3} I_v \quad (cm^4)$$

Where:

S , l_c , l_v and I_v : As specified in **(1)**

Table C32.4 has been renumbered as follows.

Table C32.~~4~~6 Coefficients, C_1 and C_2

α	0.50 and under	1.50 and above
C_1	1.00	0.37
C_2	0.50	0.10

EFFECTIVE DATE AND APPLICATION (Amendment 2-3)

1. The effective date of the amendments is 1 May 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.

3. Notwithstanding the provision of preceding **2.**, the amendments to the Rules may apply to ships for which the application is submitted to the Society before the effective date upon request by the owner.

Amendment 2-4

Chapter 1 GENERAL

1.1 General

1.1.11 Application of Steels

Table C1.1(c) has been amended as follows.

Table C1.1(c) Application of Mild Steels for Various Structural Members (continued)

<table>
<tr><th rowspan="2">Structural member</th><th rowspan="2" colspan="2">Application</th><th colspan="6">Thickness of plate : t (mm)</th></tr>
<tr><th><i>t</i>≤15</th><th>15<<i>t</i>≤20</th><th>20<<i>t</i>≤25</th><th>25<<i>t</i>≤30</th><th>30<<i>t</i>≤40</th><th>40<<i>t</i>≤50</th></tr>
<tr><td colspan="9">Cargo Hatch</td></tr>
<tr><td rowspan="3">Face plate and web of cargo hatch coaming longitudinally extended on the strength deck</td><td rowspan="3">longitudinal members over 0.15L and end brackets and deck house transition</td><td>within 0.4L amidship</td><td colspan="4">D</td><td colspan="2">E</td></tr>
<tr><td>within 0.6L amidship excluding the above</td><td colspan="5">D</td><td>E</td></tr>
<tr><td>other than those mentioned above</td><td colspan="6">D</td></tr>
<tr><td><u>Hatch cover</u></td><td colspan="2"><u>—</u></td><td colspan="4"><u>A</u></td><td><u>B</u></td><td><u>D</u></td></tr>
<tr><td colspan="9">Stern</td></tr>
<tr><td>Stern frame, rudderhorn, shaft bracket</td><td colspan="2">—</td><td colspan="2">A</td><td>B</td><td colspan="2">D</td><td>E</td></tr>
<tr><td colspan="9">Rudder</td></tr>
<tr><td>Rudder plate</td><td colspan="2">—</td><td colspan="2">A</td><td>B</td><td colspan="2">D</td><td>E</td></tr>
<tr><td colspan="9">Other</td></tr>
<tr><td colspan="3">Other members than those mentioned above</td><td colspan="6">A*1*4</td></tr>
</table>

Notes:
(omitted)

Table C1.2(b) has been amended as follows.

Table C1.2(b) Application of High Tensile Steels for Various Structural Members (continued)

<table>
<tr><th rowspan="2">Structural member</th><th rowspan="2" colspan="2">Application</th><th colspan="6">Thickness of plate : t (mm)</th></tr>
<tr><th><i>t</i>≤15</th><th>15<<i>t</i>≤20</th><th>20<<i>t</i>≤25</th><th>25<<i>t</i>≤30</th><th>30<<i>t</i>≤40</th><th>40<<i>t</i>≤50</th></tr>
<tr><td colspan="9">Longitudinal bulkhead plate</td></tr>
<tr><td>Upper strake in longitudinal bulkhead adjoining to strength deck</td><td colspan="2">within 0.4L amidship</td><td colspan="3">AH</td><td colspan="2">DH</td><td>EH</td></tr>
<tr><td>Other than those mentioned above</td><td colspan="2">within 0.4L amidship</td><td colspan="5">AH</td><td>DH</td></tr>
<tr><td colspan="9">Longitudinals</td></tr>
<tr><td>Upper strake in sloping plate of topside tank adjoining to strength deck</td><td colspan="2">within 0.4L amidship</td><td colspan="3">AH</td><td colspan="2">DH</td><td>EH</td></tr>
<tr><td>Longitudinal members above strength deck including bracket and face plate of longitudinals</td><td colspan="2">within 0.4L amidship</td><td colspan="3">AH</td><td colspan="2">DH</td><td>EH</td></tr>
<tr><td colspan="9">Cargo Hatch</td></tr>
<tr><td rowspan="3">Face plate and web of
cargo hatch coaming longitudinally extended
on the strength deck</td><td>longitudinal members over 0.15L</td><td>within 0.4L amidship</td><td colspan="4">DH</td><td colspan="2">EH</td></tr>
<tr><td>and</td><td>within 0.6L amidship excluding the above</td><td colspan="5">DH</td><td>EH</td></tr>
<tr><td>end brackets and deck house transition</td><td>other than those mentioned above</td><td colspan="6">DH</td></tr>
<tr><td><u>Hatch cover</u></td><td colspan="2"><u>—</u></td><td colspan="5"><u>AH</u></td><td><u>DH</u></td></tr>
<tr><td colspan="9">Stern</td></tr>
<tr><td>Stern frame, rudderhorn, shaft bracket</td><td colspan="2">—</td><td colspan="3">AH</td><td colspan="2">DH</td><td>EH</td></tr>
<tr><td colspan="9">Rudder</td></tr>
<tr><td>Rudder plate</td><td colspan="2">—</td><td colspan="3">AH</td><td colspan="2">DH</td><td>EH</td></tr>
<tr><td colspan="9">Other</td></tr>
<tr><td colspan="3">Other members than those mentioned above</td><td colspan="6">AH</td></tr>
</table>

Notes:
(omitted)

Chapter 20 HATCHWAYS, MACHINERY SPACE OPENINGS AND OTHER DECK OPENINGS

20.1 General

Paragraph 20.1.3 has been amended as follows.

20.1.3 Renewal Thickness of Steel Hatchway Covers and Hatchway Coamings for Ships in Operation

Structural drawings for hatch covers and hatch coamings complying with the requirements of **20.2** are to indicate the renewal thickness ($t_{renewal}$) for each structural element given by the following formula in addition to the as built thickness ($t_{as\text{-}built}$). If the thickness for voluntary addition is included in the as built thicknesses, the value may be at the discretion of the Society.

$t_{renewal} = t_{as\text{-}built} - t_c + 0.5$ (mm)

t_c: Corrosion additions specified in **Table C20.1**~~ and 20.2.3-1~~

Where corrosion addition t_c is 1.0 (mm), renewal thickness may be given by the formula

$t_{renewal} = t_{as\text{-}built} - t_c$ (mm)

Section 20.2 has been amended as follows.

20.2 Hatchways

~~20.2.1 Application~~

~~(omitted)~~

~~20.2.2 Height of Hatchway Coamings~~

~~(omitted)~~

~~20.2.3 Construction of Hatchway Coamings~~

~~(omitted)~~

~~20.2.4 Portable Beams, Hatchway Covers, Steel Pontoon Covers and Steel Weathertight Covers~~

~~(omitted)~~

~~20.2.5 Additional Requirements for Steel Hatch Covers Carrying Cargoes~~

~~(omitted)~~

~~20.2.6 Special Requirements for Portable Beams, Hatchway Covers, Steel Pontoon Covers and Steel Weathertight Covers~~

~~(omitted)~~

~~20.2.7 Tarpaulins and Securing Arrangements for Hatchways Closed by Portable Covers~~

~~(omitted)~~

~~20.2.8 Steel Hatchway Covers for Container Carriers~~
~~(omitted)~~

~~20.2.9 Steel Hatchway Covers of Deep Tanks~~
~~(omitted)~~

~~20.2.10 Additional Requirement for Small Hatches Fitted on Exposed Fore Deck~~
~~(omitted)~~

~~Fig.C20.1 Example of Hatch Coaming Stay~~
~~(omitted)~~

~~Table C20.1 Corrosion addition~~
~~(omitted)~~

~~Table C20.2 Allowable Stresses~~
~~(omitted)~~

~~Table C20.3 Design Wave Load (*1)(*2) (kN/m^2)~~
~~(omitted)~~

~~Table C20.4 Coefficients k_1 and k_2~~
~~(omitted)~~

~~Table C20.5 Coefficient μ~~
~~(omitted)~~

~~Table C20.6 The value of m~~
~~(omitted)~~

~~Table C20.7 Coefficients C_1, C_2 and C_3~~
~~(omitted)~~

~~Table C20.8 Strength Requirements for Stoppers~~
~~(omitted)~~

20.2.1 Application
1 The construction and the means for closing of cargo and other hatchways are to comply with the requirements in **20.2**.
2 Notwithstanding the provisions in this paragraph, the construction and means for closing of cargo and other hatchways of bulk carriers defined in **1.3.1(13), Part B of the Rules** and ships intended to be registered as "bulk carriers" in accordance with **C31.1.1-1, Part C of the Guidance** are to comply with the relevant requirements in **Part CSR-B of the Rules**.
3 When the requirements for hatchways in **Part CSR-B of the Rules** apply to the hatchways of ships which are not subject to the application of **Part CSR-B of the Rules**, the corrosion additions

for hatch coamings may be taken as 1.5*mm*.

4 When the loading condition or the type of construction differs from that specified in this section, the calculation method used is to be as deemed appropriate by the Society.

20.2.2 General Requirement

1 Primary supporting members and secondary stiffeners of hatch covers are to be continuous over the breadth and length of hatch covers. When this is impractical, appropriate arrangements are to be adopted to ensure sufficient load carrying capacity and sniped end connections are not to be allowed.

2 The spacing of primary supporting members parallel to the direction of secondary stiffeners is not to exceed 1/3 of the span of the primary supporting members.

3 Secondary stiffeners of hatch coamings are to be continuous over the breadth and length of said hatch coamings.

20.2.3 Net Scantling Approach

1 Unless otherwise specified, the structural scantlings specified in this section are to be net scantlings which do not include any corrosion additions.

2 "Net scantlings" are the scantlings necessary to obtain the minimum net scantlings required by **20.2.5** and **20.2.9**.

3 Required gross scantlings are not to be less than the scantlings obtained from adding the corrosion addition t_c specified in **-4** below to the net scantlings obtained from the requirements in this section.

4 The corrosion addition t_c is to be taken as specified in **Table C20.1** according to ship type, the type of structure and structural members of steel hatchway covers, steel pontoon covers and steel weathertight covers (hereinafter referred to as "steel hatch covers").

5 Strength calculations using beam theory, grillage analysis or FEM are to be performed with net scantlings.

Table C20.1 Corrosion Additions

Type of ship	Type of structural member		Corrosion addition t_c (*mm*)
Container carriers and car carriers	Steel hatch covers		1.0
	Hatchway coamings		1.5
Ships other than those specified above and subject to the application of this section	Single plating type hatch cover		2.0
	Double plating type hatch cover	Top, side and bottom plating	1.5
		Internal structures	1.0
	Hatchway coamings		1.5

20.2.4 Design Loads

The design loads for steel hatchway covers, steel pontoon covers, steel weathertight covers, portable beams and hatchway coamings applying the requirements in **20.2** are specified in following **(1)** to **(5)**:

(1) Design vertical wave load P_V (kN/m^2) is not to be less than that obtained from **Table C20.2**. Design vertical wave loads need not to be combined with cargo loads according to **(3)** and **(4)** simultaneously.

Table C20.2 Design Vertical Wave Load P_V (*1) (*2) (kN/m^2)

		$L_f \leq 100m$	$L_f > 100m$
Position I	For 0.25 L_f forward	$\frac{9.81}{76}\left\{(4.28L_f + 28)\frac{x}{L_f} - 1.71L_f + 95\right\}$ (*3)	For type B ships according to ICLL(*4) : $9.81\left\{(0.0296L'_f + 3.04)\frac{x}{L_f} - 0.0222L'_f + 1.22\right\}$ For type B-60 and B-100 ships according to ICLL(*4) : $9.81\left\{(0.1452L'_f - 8.52)\frac{x}{L_f} - 0.1089L'_f + 9.89\right\}$
	Elsewhere	$\frac{9.81}{76}(1.5L_f + 116)$	9.81×3.5
Position II		$\frac{9.81}{76}(1.1L_f + 87.6)$	9.81×2.6 (*5)

Notes:

(*1) L_f: Length of ship for freeboard defined in **2.1.3**, **Part A** of the Rules (m)

L'_f : L_f (m), however, where L_f exceeds 340 m, L_f is to be taken as 340 m

x : Distance of the mid length of the hatch cover under examination from the aft end of L_f (m)

(*2) For exposed hatchways in positions other than Position I or II, the value of each design wave load will be specially considered.

(*3) Where a Position I hatchway is located at least one superstructure standard height higher than the freeboard deck, P_V may be taken as $\frac{9.81}{76}(1.5L_f + 116)$ (kN/m^2).

(*4) Where a Position I hatchway is located at least one superstructure standard height higher than the freeboard deck, P_V may be taken as 9.81×3.5 (kN/m^2).

(*5) Where a Position I hatchway is located at least one superstructure standard height higher than the Position II deck, P_V may be taken as 9.81×2.1 (kN/m^2).

(2) Design horizontal wave load P_H (kN/m^2) is not to be less than that obtained from the following formulae. However, P_H is not to be taken less than the minimum values given in **Table C20.3**.

$$P_H = ac(bC_1 - y)$$

a: As given by the following:

$20 + \frac{L'}{12}$ for unprotected front coamings and hatch cover skirt plates

$10 + \frac{L'}{12}$ for unprotected front coamings and hatch cover skirt plates, where the distance from the actual freeboard deck to the summer load line exceeds the minimum non-corrected tabular freeboard according to the ILCC by at least one superstructure standard height

$5 + \frac{L'}{15}$ for side and protected front coamings and hatch cover skirt plates

$7 + \frac{L'}{100} - 8\frac{x}{L_1}$ for aft ends of coamings and aft hatch cover skirt plates abaft amidships

$5 + \frac{L'}{100} - 4\frac{x}{L_1}$ for aft ends of coamings and aft hatch cover skirt plates forward of amidships

L': Length of ship L_1 (m). However, where L_1 exceeds 300m, L' is to be taken as 300m.

L_1: Length of ship specified in **2.1.2, Part A** of the Rules (m). However, L_1 need not to be greater than 97% of the total length on the summer load waterline.

C_1: As given by the following formulae:

$10.75-\left(\frac{300-L_1}{100}\right)^{1.5}$ for $L_1 \leq 300m$

10.75 for $300 < L_1 \leq 350m$

$10.75-\left(\frac{L_1-350}{150}\right)^{1.5}$ for $350 < L_1$

c_L: Coefficient to be taken as 1.0

b: As given by the following formulae:

$1.0+\left(\frac{0.45-\frac{x}{L_1}}{C_{b1}+0.2}\right)^2$ for $\frac{x}{L_1} < 0.45$

$1.0+1.5\left(\frac{\frac{x}{L_1}-0.45}{C_{b1}+0.2}\right)^2$ for $\frac{x}{L_1} \geq 0.45$

x: Distance (m) from the hatchway coamings or hatch cover skirt plates to after perpendicular, or distance from the mid-point of the side hatchway coaming or hatch cover skirt plates to after perpendicular. However, where the length of the side hatchway coaming or hatch cover skirt plates exceeds $0.15L_1$, the side hatchway coaming or hatch cover skirt plates are to be equally subdivided into spans not exceeding $0.15L_1$ and the distance from the mid-point of the subdivisions to the after perpendicular is to be taken.

C_{b1}: Block coefficient. However, where C_b is 0.6 or under, C_{b1} is to be taken as 0.6 and where C_b is 0.8 and over, C_{b1} is to be taken as 0.8. When determining scantlings of the aft ends of coamings and aft hatch cover skirt plates forward of amidships, C_{b1} does not need to be taken as less than 0.8.

c: As given by the following formula. However, where $\frac{b'}{B'}$ is less than 0.25, $\frac{b'}{B'}$ is to be taken as 0.25.

$0.3+0.7\frac{b'}{B'}$

b': Breadth (m) of hatchway coamings at the position under consideration

B': Breadth (m) of ship on the exposed weather deck at the position under consideration

y: Vertical distance (m) from the designed maximum load line to the mid-point of the span of stiffeners when determining the scantlings of stiffeners and to the mid-point of the plating when determining the thickness of plating

Table C20.3 Minimum Value of P_H (kN/m^2)

	Unprotected front coamings and hatch cover skirt plates	others
$L \le 250$	$25 + \frac{L_1}{10}$	$12.5 + \frac{L_1}{20}$
$L > 250$	50	25

(3) The load on hatch covers due to cargo loaded on said covers is to be obtained from the following **(a)** and **(b)**. Load cases with partial loading are also to be considered.

(a) Distributed load due to cargo load P_{cargo} (kN/m^2) resulting from heave and pitch is to be determined according to the following formula:

$$P_{cargo} = P_C(1 + a_V)$$

P_C: Static uniform cargo load (kN/m^2)

a_V: Acceleration addition given by the following formula:

$$a_V = \frac{0.11mV'}{\sqrt{L_1}}$$

m: As given by the following formulae:

$$m_0 - 5(m_0 - 1)\frac{x}{L_1} \quad \text{for } 0 \le \frac{x}{L_1} \le 0.2$$

$$1.0 \quad \text{for } 0.2 < \frac{x}{L_1} \le 0.7$$

$$1 + \frac{m_0 + 1}{0.3}\left(\frac{x}{L_1} - 0.7\right) \quad \text{for } 0.7 < \frac{x}{L_1} \le 1.0$$

m_0: As given by the following formula:

$$m_0 = 1.5 + \frac{0.11V'}{\sqrt{L_1}}$$

V': Speed of ship (*knots*) specified in **2.1.8, Part A** of the Rules. However, where V' is less than $\sqrt{L_1}$, V' is to be taken as $\sqrt{L_1}$.

x and L_1: As specified in **(2)** above

(b) Point load F_{cargo} (kN) due to a single force resulting from heave and pitch (e.g. in the case of containers) is to be determined by the following formula. When the load case of a partially loaded container is considered, the point load is at the discretion of the Society.

$$F_{cargo} = F_S(1 + a_V)$$

F_S: Static point load due to cargo (kN)

a_V: As specified in **(a)** above

(4) Where containers are stowed on hatch covers, cargo loads determined by following **(a)** and **(b)** are to be considered:

(a) Cargo loads (kN) due to heave, pitch and roll motion of the ship determined by the following formulae are to be considered (see **Fig. C20.1**). When the load case of a partially loaded container is considered, the cargo load is at the discretion of the Society.

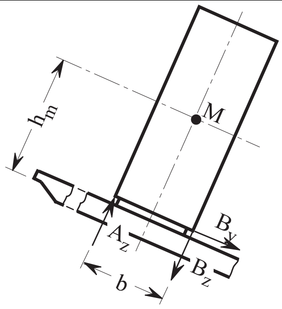
$$A_Z = 9.81\frac{M}{2}(1 + a_V)\left(0.45 - 0.42\frac{h_m}{b}\right)$$

$$B_Z = 9.81\frac{M}{2}(1+a_V)\left(0.45+0.42\frac{h_m}{b}\right)$$

$$B_Y = 2.4M$$

M: Maximum designed mass of container stack (t)
h_m: Design height of the centre of gravity of the stack above hatch cover supports (m)
b: Distance between foot points (m)
A_Z and B_Z: Support forces in vertical direction at the forward and aft stack corners (kN)
B_Y: Support force in transverse direction at the forward and aft stack corners (kN)
a_V: As specified in **(3)** above

Fig C20.1 Forces due to Container Loads



(b) Details of the application of **(a)** above are to be in accordance with the following:

i) For the maximum design mass of container stack M and the design height of the centre of gravity of the stack above hatch cover supports h_m, it is recommended to apply the values which are used for the calculations of cargo securing (container lashing). If different assumptions are made for M and h_m, sufficient data which show that the hatch cover structure is not loaded by less than the recommended values is to be submitted.

ii) When the strength of a hatch cover structure is assessed by FEM analysis using shell or plane strain elements, h_m may be taken as the design height of the centre of gravity of the stack above the hatch cover top plate.

iii) The values of M and h_m applied for the assessment of hatch cover strength are to be shown in the drawings of the hatch covers.

iv) In the case of container stacks secured to lashing bridges or carried in cell guides, the forces acting on the hatch covers may be specially considered by the Society.

v) Container loads may be applied based on accelerations calculated by an individual acceleration analysis for the lashing system being used as deemed appropriate by the Society.

(5) In addition to the loads specified in **(1)** to **(4)** above, when the load in the ship's transverse direction by forces due to elastic deformation of the ship's hull is acting on the hatch covers, the sum of stresses is to comply with the permissible values specified in **20.2.5-1(1)**.

20.2.5 Strength Criteria of Steel Hatch Covers and Hatch Beams

1 Permissible stresses and deflections

(1) The equivalent stress σ_E (N/mm^2) in steel hatchway covers and steel weathertight covers is to comply with the criteria in the following **(a)** and **(b)**:

(a) For beam element calculations and grillage analysis:

$$\sigma_E = \sqrt{\sigma^2 + 3\tau^2} \le 0.8\sigma_F$$

σ : Nominal stress (N/mm^2)

τ : Shear stress (N/mm^2)

σ_F :Minimum upper yield stress (N/mm^2) or proof stress (N/mm^2) of the material. However, when material with a σ_F of more than 355 N/mm^2 is used, the value for σ_F is to be as deemed appropriate by the Society.

(b) For FEM calculations, in cases where the calculations use shell or plane strain elements, the stresses are to be taken from centre of the individual element.

$\sigma_E = \sqrt{\sigma_x^2 - \sigma_x\sigma_y + \sigma_y^2 + 3\tau^2} \le 0.8\sigma_F$ when assessed using the design load specified in **20.2.4(1)**

$\sigma_E = \sqrt{\sigma_x^2 - \sigma_x\sigma_y + \sigma_y^2 + 3\tau^2} \le 0.9\sigma_F$ when assessed using any other design loads

σ_x : Normal stress (N/mm^2) in the x-direction

σ_y : Normal stress (N/mm^2) in the y-direction

τ : Shear stress (N/mm^2) in the x-y plane

x, y: Coordinates of a two dimensional Cartesian system in the plane of the considered structural element

σ_F : As specified in **(a)** above

(2) The equivalent stress σ_E (N/mm^2) in steel pontoon covers and hatch beams is not to be greater than $0.68\sigma_F$, where σ_F is as specified in **(1)** above.

(3) Deflection is to comply with following **(a)** and **(b)**:

(a) When the design vertical wave load specified in **20.2.4(1)** is acting on steel hatchway covers, steel pontoon covers, steel weathertight covers and portable beams, the vertical deflection of primary supporting members is not to be taken as more than that given by the following:

$0.0056l$ for steel hatchway covers and steel weathertight covers

$0.0044l$ for steel pontoon covers and hatch beams

l : Span of primary supporting members (m)

(b) Where steel hatch covers are arranged for carrying containers and mixed stowage is allowed, i.e., a 40-foot container is stowed on top of two 20-foot containers, particular attention is to be paid to the deflections of hatch covers. In addition the possible contact of deflected hatch covers with in hold cargo has to be observed.

2 Local net plate thickness of steel hatch covers

(1) The local net thickness t_{net} (mm) of steel hatch cover top plating is not to be less than that obtained from the following formula, and it is not to be less than 1% of the spacing of the stiffeners or 6 mm, whichever is greater:

$$t_{net} = 15.8 F_p S \sqrt{\frac{P_{HC}}{0.95\sigma_F}}$$

F_p: Coefficient given by the following formula:

$1.9\ \sigma/\sigma_a$ (for $\sigma/\sigma_a \ge 0.8$, for the attached plate flange of primary supporting members)

1.5 (for $\sigma/\sigma_a < 0.8$, for the attached plate flange of primary supporting members)

σ : Normal stress (N/mm^2) of the attached plate flange of primary supporting members. The normal σ may be determined at a distance S from the webs of adjacent primary supporting members perpendicular to secondary stiffeners and at a distance $S/2$ from the web of an adjacent primary supporting member parallel to secondary stiffeners, whichever is greater (see **Fig. C20.2**). The distribution of normal stress σ between two parallel girders is to be in accordance with **20.2.5-6.(3)(c)**.

σ_a :Permissible stress (N/mm^2) is to be as given by following formula:

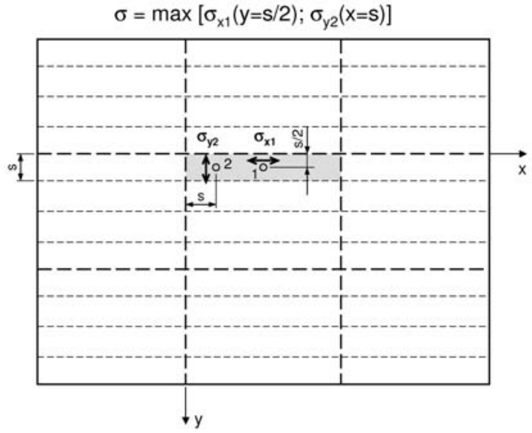
$$\sigma_a = 0.8\sigma_F$$

S: Stiffener spacing (m)

P_{HC}: Design load (kN/m^2) specified in **20.2.4(1)** and **20.2.4(3)(a)**

σ_F : Minimum upper yield stress (N/mm^2) or proof stress (N/mm^2) of the material

Fig.C20.2 Determination of the Normal Stress of Hatch Cover Plating



(2) The net thickness of double skin hatch covers and box girders is to be obtained in accordance with -**5** below taking into consideration of the permissible stresses specified in **20.2.5-1(1)**

(3) In addition to **(2)** above, when the lower plating of double skin hatch covers is taken into account as a strength member of the hatch cover, the net thickness t_{net} (mm) of the lower plating is not to be less than that obtained from following formulae:

$$t_{net} = 6.5S$$

$$t_{net} = 5$$

S : As specified in **(1)** above

(4) When lower plating is not considered to be a strength member of the hatch cover, the thickness of the lower plating is to be determined as deemed appropriate by the Society.

3 Net scantling of secondary stiffeners

(1) The net section modulus Z_{net} (cm^3) of the secondary stiffeners of hatch cover top plates, based on stiffener net member thickness, is not to be less than that obtained from the following formula. The net section modulus of the secondary stiffeners is to be determined based on an attached plate width that is assumed to be equal to the stiffener spacing.

$$Z_{net} = \frac{104 S P_{HC} l^2}{\sigma_F}$$

l : Secondary stiffener span (m) is to be taken as the spacing of primary supporting members or the distance between a primary supporting member and the edge support, as applicable.

S: Stiffener spacing (m)

P_{HC}: Design load (kN/m^2) as specified in **-2(1)** above

σ_F : Minimum upper yield stress (N/mm^2) or proof stress (N/mm^2) of the material

(2) The net shear sectional area A_{net} (cm^2) of the secondary stiffener webs of hatch cover top plates is not to be less than that obtained from the following formula:

$$A_{net} = \frac{10 S P_{HC} l}{\sigma_F}$$

l, S and P_{HC} : As specified in **(1)** above

(3) For flat bar secondary stiffeners and buckling stiffeners, the following formula is to be applied:

$$\frac{h}{t_{W,net}} \le 15\sqrt{k}$$

h: Height (mm) of the stiffener

$t_{W,net}$: Net thickness (mm) of the stiffener

$k = 235/\sigma_F$

σ_F : As specified in **(1)** above

(4) Stiffeners parallel to primary supporting members and arranged within the effective breadth according to **20.2.5-5(2)** are to be continuous at crossing primary supporting member and may be regarded for calculating the cross sectional properties of primary supporting members.

(5) The combined stress of those stiffeners induced by the bending of primary supporting members and lateral pressures is not to exceed the permissible stresses according to **20.2.5-1(1)**.

(6) For hatch cover stiffeners under compression, sufficient safety against lateral and torsional buckling according to **20.2.5-6(3)** is to be verified.

4 Primary supporting members of steel hatch covers and hatch beams

(1) Scantlings of the primary supporting members of steel hatch covers and hatch beams are to be determined according to **-5** below taking into consideration the permissible stresses specified in **20.2.5-1(1)**.

(2) Scantlings of the primary supporting members of steel hatch covers and hatch beam with variable cross-sections are to be not less than that obtained from the following formulae. For steel hatchway covers, S and l are to be read as b and S, respectively.

The net section modulus (cm^3) of hatch beams or primary supporting members at the mid-point

$Z_{net} = Z_{net\_cs}$

$Z_{net} = k_1 Z_{net\_cs}$

The net moment of inertia (cm^4) of hatch beams or primary supporting members at the mid-point

$I_{net} = I_{net\_cs}$

$I_{net} = k_2 I_{net\_cs}$

Z_{net_cs}: Net section modulus (cm^3) complying with requirement **(1)** above

I_{net_cs}: Net moment of inertia (cm^4) complying with requirement **(1)** above

S: Spacing (m) of portable beams or primary supporting members

l: Unsupported span (m) of portable beams or primary supporting members

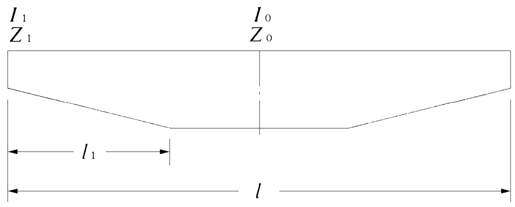
b: Width (m) of steel hatch covers

k_1 and k_2: Coefficients obtained from the formulae given in **Table C20.4**

Table C20.4 Coefficient k_1 and k_2

k_1	$1+\dfrac{3.2\alpha-\gamma-0.8}{7\gamma+0.4}$	k_1 is not to be taken as less than 1.0 $\alpha=\dfrac{l_1}{l}$ $\beta=\dfrac{I_1}{I_0}$ $\gamma=\dfrac{Z_1}{Z_0}$
k_2	$1+8\alpha^3\dfrac{1-\beta}{0.2+3\sqrt{\beta}}$	

l = Overall length of portable beam (m)
l_1 = Distance from the end of parallel part to the end of portable beam (m)
I_0 = Moment of inertia at mid-span (cm^4)
I_1 = Moment of inertia at ends (cm^4)
Z_0 = Section modulus at mid-span (cm^3)
Z_1 = Section modulus at ends (cm^3)



(3) In addition to **(1)** and **(2)** above, the scantlings of the primary supporting members of steel hatch covers are to comply with the requirements specified in **-6**.

(4) When biaxial compressed flange plates are considered, the effective width of flange plates is to comply with **20.2.5-6(3)**.

(5) In addition to **(1)** to **(4)** above, net thickness t_{net} (mm) of the webs of primary supporting members is not to be less than that obtained from the following formulae, whichever is greater:

$$t_{net}=6.5S$$

$$t_{net}=5$$

S : Stiffener spacing (m)

(6) In addition to **(1)** to **(5)** above, the net thickness t_{net} (mm) of edge girders exposed to sea wash is not to be less than that obtained from the following formulae, whichever is greater:

$$t_{net}=15.8S\sqrt{\frac{P_H}{0.95\sigma_F}}$$

$$t_{net}=8.5S$$

P_H: Design horizontal wave load (kN/m^2) as specified in **20.2.4(2)**
S: Stiffener spacing (m)
σ_F : Minimum upper yield stress (N/mm^2) or proof stress (N/mm^2) of the material

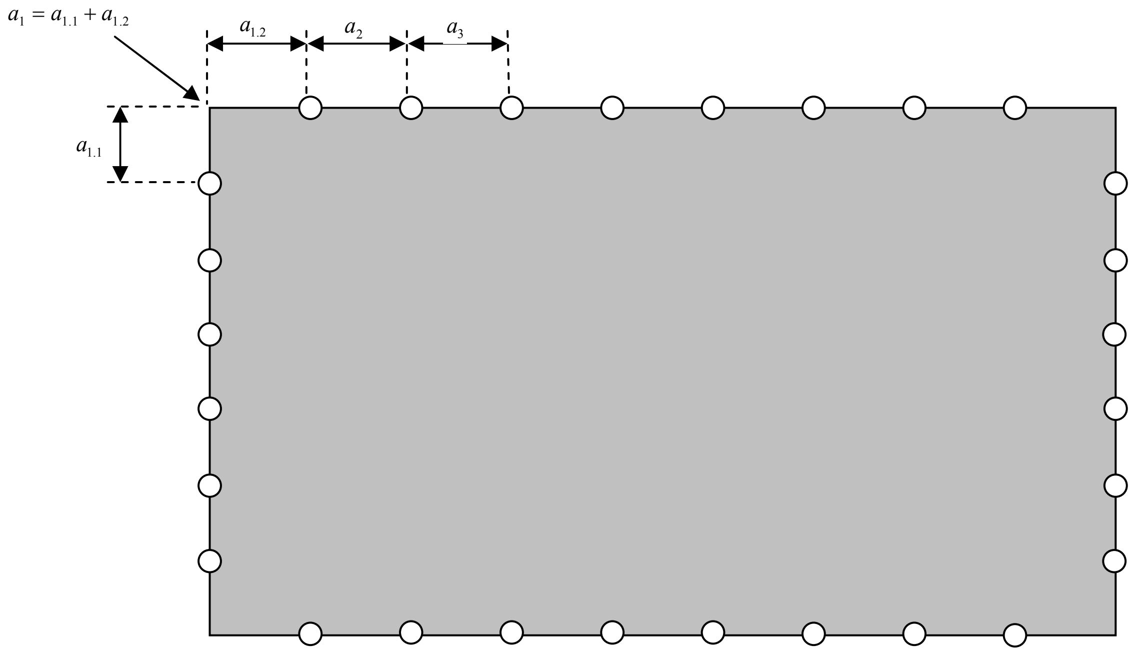
(7) The moment of inertia (cm^4) of the edge elements of hatch covers is not to be less than that obtained from the following formula:

$$I=6pa^4$$

a: Maximum of the distance (m), a_i, between two consecutive securing devices, measured along the hatch cover periphery, not to be taken as less than $2.5a_C$ (m), (see **Fig. C20.3**).
a_C : $\max(a_{1.1}, a_{1.2})$ (m) (see **Fig. C20.3**)
p: Packing line pressure (N/mm), minimum 5 N/mm
When calculating the actual gross moment of inertia of edge elements, the effective breadth of the attached plating of hatch covers is to be taken as equal to the lesser of the following values:
$0.165a$

Half the distance between the edge element and the adjacent primary member

Fig. C20.3 Distance between Securing Devices, Measured Along Hatch Cover Periphery



$a = \max(a_i, a_{i+1})$

$\bar{a} = (a_i + a_{i+1})/2$

5 Strength calculation

(1) Strength calculation for steel hatch covers may be carried out by either using beam theory, grillage analysis or FEM. Net scantlings are to be used for modeling.

(2) Effective cross-sectional properties for calculation by beam theory or grillage analysis are to be determined by the following **(a)** to **(e)**:

(a) The effective breadth of the attached plating e_m of the primary supporting members specified in **Table C20.5** according to the ratio of l and e is to be considered for the calculation of effective cross-sectional properties. For intermediate values of l/e, e_m is to be obtained by linear interpolation.

(b) Separate calculations may be required for determining the effective breadth of one-sided or non-symmetrical flanges.

(c) The effective cross sectional areas of plates is not to be less than the cross sectional area of the face plate.

(d) The cross sectional area of secondary stiffeners parallel to the primary supporting member under consideration within the effective breadth may be included in the calculations (see **Fig. C20.5**).

(e) For flange plates under compression with secondary stiffeners perpendicular to the web of the primary supporting member, the effective width is to be determined according to **20.2.5-6(3)**.

Table C20.5 Effective Breadth e_m of Plating of Primary Supporting Members

l/e	0	1	2	3	4	5	6	7	8 and over
e_{m1}/e	0	0.36	0.64	0.82	0.91	0.96	0.98	1.00	1.00
e_{m2}/e	0	0.20	0.37	0.52	0.65	0.75	0.84	0.89	0.90

(Notes)

e_{m1}: Effective breadth (*mm*) to be applied where primary supporting members are loaded by uniformly distributed loads or by not less than 6 equally spaced single loads

e_{m2}: Effective breadth (mm) to be applied where primary supporting members are loaded by 3 or less single loads

l: Length between zero-points of bending moment curve taken equal to:
For simply supported primary supporting members: l_0
For primary supporting members with both ends constant: $0.6l_0$

l_0: Unsupported length of the primary supporting members

e: Width of plating supported, measured from centre to centre of the adjacent unsupported fields

(3) General requirements for FEM are as follows:
(a) The structural model is to be able to reproduce the behaviour of the structure with the highest possible fidelity. Stiffeners and primary supporting members subject to pressure loads are to be included in the modelling. However, buckling stiffeners may be disregarded for stress calculation.
(b) Net scantlings which exclude corrosion additions are to be used for modeling.
(c) Element size is to be suitable to take effective breadth into account.
(d) In no case is element width to be larger than stiffener spacing. The ratio of element length to width is not to exceed 4.
(e) The element height of the webs of primary supporting members is not to exceed one-third of the web height.

6 Buckling strength of steel hatch covers

The buckling strength of the structural members of steel hatch covers is to be in accordance with the following **(1)** to **(3)**:

(1) The buckling strength of a single plate panel of the top and lower steel hatch cover plating is to comply with the following formulae:

$$\left(\frac{|\sigma_x|C_{sf}}{\kappa_x\sigma_F}\right)^{e_1}+\left(\frac{|\sigma_y|C_{sf}}{\kappa_y\sigma_F}\right)^{e_2}-B\left(\frac{\sigma_x\sigma_y C_{sf}^2}{\sigma_F^2}\right)+\left(\frac{|\tau|C_{sf}\sqrt{3}}{\kappa_\tau\sigma_F}\right)^{e_3}\leq 1.0$$

$$\left(\frac{\sigma_x C_{sf}}{\kappa_x\sigma_F}\right)^{e_1}\leq 1.0$$

$$\left(\frac{\sigma_y C_{sf}}{\kappa_y\sigma_F}\right)^{e_2}\leq 1.0$$

$$\left(\frac{|\tau|C_{sf}\sqrt{3}}{\kappa_\tau\sigma_F}\right)^{e_3}\leq 1.0$$

σ_x, σ_y: Membrane stress in the *x*-direction and the *y*-direction (N/mm^2). In cases where the stresses are obtained from FEM and already contain the Poisson-effect, the following modified stress values may be used. Both stresses σ_x^* and σ_y^* are to be compressive stress in order to apply stress reduction according to the following formulae:

$\sigma_x = \left(\sigma_x^* - 0.3\sigma_y^*\right)/0.91$

$\sigma_y = \left(\sigma_y^* - 0.3\sigma_x^*\right)/0.91$

σ_x^* and σ_y^*: Stresses containing the Poisson-effect. These values are to comply with the following formulae:

$\sigma_y = 0$ and $\sigma_x = \sigma_x^*$ for $\sigma_y^* < 0.3\sigma_x^*$

$\sigma_x = 0$ and $\sigma_y = \sigma_y^*$ for $\sigma_x^* < 0.3\sigma_y^*$

τ : Shear stress (N/mm^2) in x-y plane

σ_F : Minimum yield stress (N/mm^2) of the material.

Compressive and shear stresses are to be taken as positive values and tension stresses are to be taken as negative values.

C_{sf}: Safety factor taken as equal to:

C_{sf} = 1.25 for hatch covers when subjected to design vertical wave loads according to **20.2.4(1)**

C_{sf} = 1.10 for hatch covers when subjected to loads according to **20.2.4(2)** to **(5)**

F_1: Correction factor for the boundary condition of stiffeners on the longer side of elementary plate panels according to **Table C20.6**

e_1, e_2, e_3 and B: Coefficient obtained from **Table C20.7**

κ_x, κ_y and κ_τ : Reduction factor obtained from **Table C20.8**. However, these values are to comply with the following formulae:

$\kappa_x = 1.0$ for $\sigma_x \le 0$ (tension stress)

$\kappa_y = 1.0$ for $\sigma_y \le 0$ (tension stress)

a: Length (mm) of the longer side of the partial plate field (x-direction)

b: Length (mm) of the shorter side of the partial plate field (y-direction)

n: Number of the elementary plate panel breadths within the partial or total plate panel (see **Fig. C20.4**)

α :Aspect ratio of a single plate field obtained from the following formula:

$$\alpha = \frac{a}{b}$$

λ : Reference degree of slenderness, taken as equal to:

$$\lambda = \sqrt{\frac{\sigma_F}{K\sigma_e}}$$

K: Buckling factor according to **Table C20.8**

σ_e: Reference stress (N/mm^2), taken as equal to:

$$\sigma_e = 0.9E\left(\frac{t}{b}\right)^2$$

E: Modulus of elasticity (N/mm^2) of the material, taken as equal to:

$E = 2.06 \times 10^5$

t: Net thickness (mm) of plate under consideration

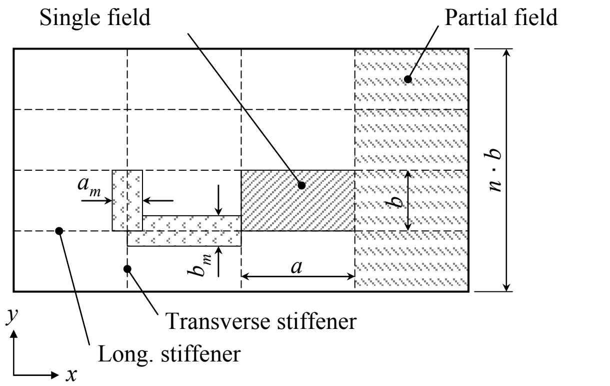
ψ : Edge stress ratio taken as equal to:

$$\psi = \frac{\sigma_2}{\sigma_1}$$

σ_1 : Maximum compressive stress (N/mm^2)

σ_2 : Minimum compressive stress or tension stress (N/mm^2)

Fig. C20.4 General Arrangement of Panels



Longitudinal : stiffener in the direction of the length a

Transverse : stiffener in the direction of the breath b

Table C20.6 Correction Factor F_1

Boundary condition	F_1 (2)	Edge stiffener
Stiffeners sniped at both ends	1.00	
Guidance value(1) where both ends are effectively connected to adjacent structures	1.05	Flat bars
	1.10	Bulb sections
	1.20	Angles and tee-sections
	1.30	U-type sections(3) and girders of high rigidity

(1) Exact values may be determined by direct calculations

(2) An average value of F_1 is to be used for plate panels having different edge stiffeners

(3) A higher value may be taken if it is verified by a buckling strength check of the partial plate field using non-linear FEA and deemed appropriate by the Society. However, such values are not to be greater than 2.0

Table C20.7 Coefficiente e_1, e_2, e_3 and B

Exponents e_1, e_2, e_3 and B		Plate panel
e_1		$1+\kappa_x^4$
e_2		$1+\kappa_y^4$
e_3		$1+\kappa_x\kappa_y\kappa_\tau^2$
B	For σ_x and σ_y positive (compressive stress)	$(\kappa_x\kappa_y)^5$
	For σ_x or σ_y negative (tension stress)	1

Table C20.8 Buckling and Reduction Factors for Plane Elementary Plate Panels

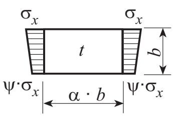
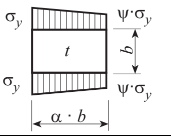
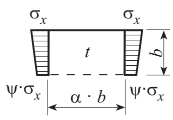
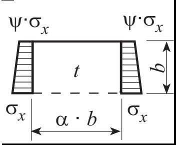
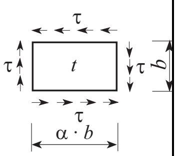
Load case	Edge stress ratio ψ	Aspect ratio $\alpha = a/b$	Buckling factor K	Reduction factor κ
1 	$1 \geq \psi \geq 0$	$\alpha \geq 1$	$K = \frac{8.4}{\psi + 1.1}$	$\kappa_x = 1$ for $\lambda \leq \lambda_c$ $\kappa_x = c\left(\frac{1}{\lambda} - \frac{0.22}{\lambda^2}\right)$ for $\lambda > \lambda_c$ $c = (1.25 - 0.12\psi) \leq 1.25$ $\lambda_c = \frac{c}{2}\left(1 + \sqrt{1 - \frac{0.88}{c}}\right)$
	$0 > \psi > -1$		$K = 7.63 - \psi(6.26 - 10\psi)$	
	$\psi \leq -1$		$K = 5.975(1 - \psi)^2$	
2 	$1 \geq \psi \geq 0$	$\alpha \geq 1$	$K = F_1\left(1 + \frac{1}{\alpha^2}\right)^2 \frac{2.1}{(\psi + 1.1)}$	$\kappa_y = c\left(\frac{1}{\lambda} - \frac{R + F^2(H - R)}{\lambda^2}\right)$ $c = (1.25 - 0.12\psi) \leq 1.25$ $R = \lambda\left(1 - \frac{\lambda}{c}\right)$ for $\lambda < \lambda_c$ $R = 0.22$ for $\lambda \geq \lambda_c$ $\lambda_c = \frac{c}{2}\left(1 + \sqrt{1 - \frac{0.88}{c}}\right)$ $F = \left(1 - \frac{\frac{K}{0.91} - 1}{\lambda_p^2}\right) c_1 \geq 0$ $\lambda_p^2 = \lambda^2 - 0.5$ for $1 \leq \lambda_p^2 \leq 3$ $c_1 = \left(1 - \frac{F_1}{\alpha}\right) \geq 0$ $H = \lambda - \frac{2\lambda}{c\left(T + \sqrt{T^2 - 4}\right)} \geq R$ $T = \lambda + \frac{14}{15\lambda} + \frac{1}{3}$
	$0 > \psi > -1$	$1 \leq \alpha \leq 1.5$	$K = F_1\left[\left(1 + \frac{1}{\alpha^2}\right)^2 \frac{2.1(1 + \psi)}{1.1} - \frac{\psi}{\alpha^2}(13.9 - 10\psi)\right]$	
		$\alpha > 1.5$	$K = F_1\left[\left(1 + \frac{1}{\alpha^2}\right)^2 \frac{2.1(1 + \psi)}{1.1} - \frac{\psi}{\alpha^2}\left(5.87 + 1.87\alpha^2 + \frac{8.6}{\alpha^2} - 10\psi\right)\right]$	
	$\psi \leq -1$	$1 \leq \alpha \leq \frac{3(1 - \psi)}{4}$	$K = 5.975 F_1\left(\frac{1 - \psi}{\alpha}\right)^2$	
		$\alpha > \frac{3(1 - \psi)}{4}$	$K = F_1\left[3.9675\left(\frac{1 - \psi}{\alpha}\right)^2 + 0.5375\left(\frac{1 - \psi}{\alpha}\right)^4 + 1.87\right]$	
3 	$1 \geq \psi \geq 0$	$\alpha > 0$	$K = \frac{4\left(0.425 + \frac{1}{\alpha^2}\right)}{3\psi + 1}$	$\kappa_x = 1$ for $\lambda \leq 0.7$ $\kappa_x = \frac{1}{\lambda^2 + 0.51}$ for $\lambda > 0.7$
	$0 > \psi > -1$		$K = 4\left(0.425 + \frac{1}{\alpha^2}\right)(1 + \psi) - 5\psi(1 - 3.42\psi)$	
4 	$1 \geq \psi \geq -1$	$\alpha > 0$	$K = \left(0.425 + \frac{1}{\alpha^2}\right)\frac{3 - \psi}{2}$	

Table C20.8 Buckling and Reduction Factors for Plane Elementary Plate Panels (continued)

Load case	Edge stress ratio ψ	Aspect ratio $\alpha = a/b$	Buckling factor K	Reduction factor κ
5 	-		$K = K_\tau \sqrt{3}$	$\kappa_\tau = 1$ for $\lambda \le 0.84$ $\kappa_\tau = \frac{0.84}{\lambda}$ for $\lambda > 0.84$
		$\alpha \ge 1$	$K_\tau = \left[5.34 + \frac{4}{\alpha^2}\right]$	
		$0 < \alpha < 1$	$K_\tau = \left[4 + \frac{5.34}{\alpha^2}\right]$	
Boundary condition - - - - - plate edge free ——— plate edge simple support				

(2) The buckling strength of non-stiffened webs and the flanges of primary supporting members are to be according to requirement of **(1)** above.

(3) The buckling strength of partial and total fields included in the structural members of steel hatch covers is to comply with the following **(a)** to **(e)**:

(a) The buckling strength of longitudinal and transverse secondary stiffeners is to comply with following **(d)** and **(e)**:

(b) When buckling calculation is carried out according to **(d)** and **(e)**, the effective breadth of steel hatch cover plating may be in accordance with following **i)** and **ii)**:

i) The effective breadth a_m or b_m of attached plating may be determined by the following formulae (see **Fig. C20.4**). However, the effective breadth of plating is not to be taken greater than the value obtained from **20.2.5-5**.

$b_m = \kappa_x b$ for longitudinal stiffeners

$a_m = \kappa_y a$ for transverse stiffeners

κ_x and κ_y : As obtained from **Table C20.8**

a and b: As specified **(1)** above

ii) The effective breadth e'_m of the stiffened flange plates of primary supporting members may be determined according to the following **1)** and **2)**. However, a_m and b_m for flange plates are in general to determined for $\psi = 1$.

1) Stiffening parallel to the webs of primary supporting members (see **Fig. C20.5**). For $b \ge e_m$, b and a have to be exchanged.

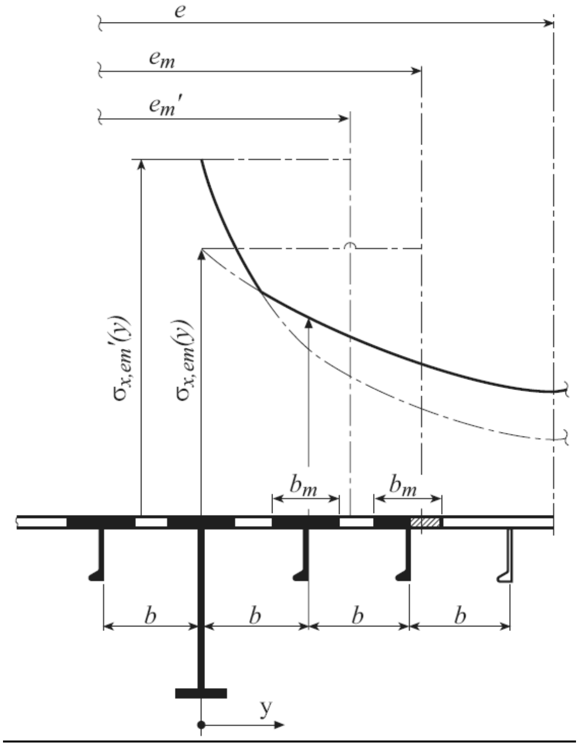
$b < e_m$

$e'_m = n b_m$

n : Integer number of stiffener spacing b inside the effective breadth e_m according to **20.2.5-5**, taken as equal to:

$$n = \text{int}\left(\frac{e_m}{b}\right)$$

Fig. C20.5 Stiffening Parallel to Web of Primary Supporting Member



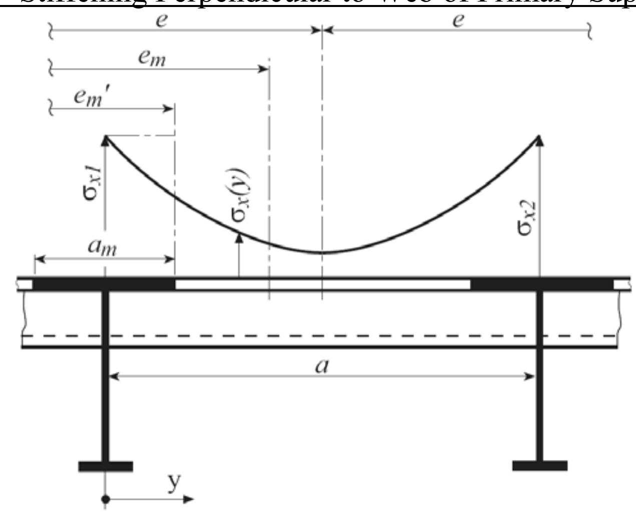
2) Stiffening perpendicular to the webs of primary supporting members (see **Fig. C20.6**). For $a < e_m$, a and b have to be exchanged.

$$a \geq e_m$$

$$e'_m = na_m < e_m$$

$$n = 2.7\frac{e_m}{a} \leq 1$$

Fig. C20.6 Stiffening Perpendicular to Web of Primary Supporting Member



(c) Stresses obtained from the calculation of the scantlings of plating and the stiffeners of steel hatch covers are to comply with the following:

i) The scantlings of plates and stiffeners are in general to be determined according to the maximum stresses $\sigma_x(y)$ at the webs of primary supporting members and stiffeners respectively.

ii) For stiffeners with spacing b under compression arranged parallel to primary supporting members, no value less than $0.25\sigma_F$ is to be inserted for $\sigma_x(y=b)$.

iii) The stress distribution between two primary supporting members may be obtained by the following formula:

$$\sigma_x(y) = \sigma_{x1}\left\{1 - \frac{y}{e}\left[3 + c_1 - 4c_2 - 2\frac{y}{e}\left(1 + c_1 - 2c_2\right)\right]\right\}$$

c_1: As given by the following formula:

$$c_1 = \frac{\sigma_{x1}}{\sigma_{x2}}$$, however $0 \le c_1 \le 1$

c_2: As given by the following formula:

$$c_2 = \frac{1.5}{e}\left(e''_{m1} + e''_{m2}\right) - 0.5$$

σ_{x1} and σ_{x2}: Normal stresses in the flange plates of adjacent primary supporting members 1 and 2 with spacing *e*, based on cross-sectional properties considering the effective breadth or effective width, as appropriate

e''_{m1}: Proportionate effective breadth e_{m1} or proportionate effective width e'_{m1} of primary supporting member 1 within the distance *e*, as appropriate

e''_{m2}: Proportionate effective breadth e_{m2} or proportionate effective width e'_{m2} of primary supporting member 2 within the distance e, as appropriate

iv) The shear stress distribution in flange plates may be assumed to be linear.

(d) For lateral buckling, longitudinal and transverse stiffeners are to comply with following **i) to iii)**:

i) Secondary stiffeners subject to lateral loads are to comply with the following criteria:

$$\frac{\sigma_a + \sigma_b}{\sigma_F} C_{sf} \le 1$$

σ_a: Uniformly distributed compressive stress (N/mm^2) in the direction of the stiffener axis, given by the following formula:

$\sigma_a = \sigma_x$ for longitudinal stiffeners

$\sigma_a = \sigma_y$ for transverse stiffeners

σ_b: Bending stress (N/mm^2) in the stiffeners, given by the following formula:

$$\sigma_b = \frac{M_0 + M_1}{Z_{st}10^3}$$ with $\sigma_x = \sigma_n$ and $\tau = \tau_{SF}$

M_0: Bending moment (*N-mm*) due to deformation *w* of stiffener, given by the following formula:

$$M_0 = F_{Ki}\frac{p_z w}{c_f - p_Z}$$ with $(c_f - p_z) > 0$

M_1: Bending moment (*N-mm*) due to lateral load *P* given by the following formula:

$$M_1 = \frac{Pba^2}{24 \cdot 10^3}$$ for longitudinal stiffeners

$$M_1 = \frac{P(nb)^2}{8c_S 10^3}$$ for transverse stiffeners. Where n is to be taken as equal to 1 for ordinary transverse stiffeners

Z_{st}: Section modulus of stiffener (cm^3), including the effective breadth of plating according to **20.2.5-6(3)**

c_S: Factor accounting for the boundary conditions of the transverse stiffener taken as equal to:

$c_S = 1.0$ for a stiffener that is simply supported stiffener

$c_S = 2.0$ for a stiffener that is partially constrained

P: Lateral load (kN/m^2) as specified in **20.2.4** according to the condition under consideration

F_{Ki}: Ideal buckling force (N) of the stiffener given by the following formula:

$$F_{Kix} = \frac{\pi^2}{a^2} EI_x 10^4$$ for longitudinal stiffeners

$$F_{Kiy} = \frac{\pi^2}{(nb)^2} EI_y 10^4$$ for transverse stiffeners

I_x, I_y: Net moments of inertia (cm^4) of the longitudinal or transverse stiffener, including the effective breadth of attached plating according to **20.2.5-6.(3)**. I_x and I_y, are to comply with the following criteria:

$$I_x \geq \frac{bt^3}{12 \cdot 10^4}$$

$$I_y \geq \frac{at^3}{12 \cdot 10^4}$$

p_z: Nominal lateral load (N/mm^2) of the stiffener due to σ_x, σ_y and τ

$$p_{zx} = \frac{t_a}{b}\left(\sigma_{xl}\left(\frac{\pi b}{a}\right)^2 + 2c_y\sigma_y + \tau_1\sqrt{2}\right)$$ for longitudinal stiffeners

$$p_{zy} = \frac{t_a}{b}\left(2c_x\sigma_{xl} + \sigma_y\left(\frac{\pi a}{nb}\right)^2\left(1 + \frac{A_y}{at_a}\right) + \tau_1\sqrt{2}\right)$$ for transverse stiffeners

t_a: Net thickness (mm) of attached plating

c_x and c_y: Factor taking into account the stresses vertical to the stiffener's axis and distributed variable along the stiffener's length taken as equal to:

$0.5(1+\psi)$ for $0 \leq \psi \leq 1$

$\frac{0.5}{1-\psi}$ for $\psi < 0$

A_x and A_y: Net sectional area (mm^2) of the longitudinal or transverse stiffener respectively without attached plating

$$\sigma_{xl} = \sigma_x \left(1 + \frac{A_x}{bt_a}\right)$$

$$\tau_1 = \left[\tau - t\sqrt{\sigma_F E\left(\frac{m_1}{a^2} + \frac{m_2}{b^2}\right)}\right] \geq 0$$

m_1 and m_2: Coefficient given by the following formulae:

For longitudinal stiffeners:

$m_1 = 1.47 \quad m_2 = 0.49$ for $\frac{a}{b} \geq 2.0$

$m_1 = 1.96 \quad m_2 = 0.37$ for $\frac{a}{b} < 2.0$

For transverse stiffeners:

$m_1 = 0.37 \quad m_2 = \frac{1.96}{n^2}$ for $\frac{a}{nb} \geq 0.5$

$m_1 = 0.49 \quad m_2 = \frac{1.47}{n^2}$ for $\frac{a}{nb} < 0.5$

$w = w_0 + w_1$

w_0: Assumed imperfection (*mm*) taken as equal to:

$w_0 = \min\left(\frac{a}{250}, \frac{b}{250}, 10\right)$ for longitudinal stiffeners

$w_0 = \min\left(\frac{a}{250}, \frac{nb}{250}, 10\right)$ for transverse stiffeners

For stiffeners sniped at both ends w_0 is not to be taken as less than the distance from the mid-point of attached plating to the neutral axis of the stiffener calculated with the effective width of its attached plating.

w_1: Deformation of stiffener (*mm*) at the mid-point of stiffener span due to lateral load *p*. In the case of uniformly distributed loads, the following values for w_1 may be used:

$w_1 = \frac{Pba^4}{384 \cdot 10^7 EI_x}$ for longitudinal stiffeners

$w_1 = \frac{5Pa(nb)^4}{384 \cdot 10^7 EI_y c_S^2}$ for transverse stiffeners

c_f : Elastic support (N/mm^2) provided by the stiffener taken as equal to:

For longitudinal stiffeners:

$$c_f = F_{Kix} \frac{\pi^2}{a^2}\left(1 + c_{px}\right)$$

$$c_{px} = \frac{1}{1 + \dfrac{0.91\left(\dfrac{12 \cdot 10^4 I_x}{t^3 b} - 1\right)}{c_{xa}}}$$

c_{xa}: Coefficient taken as equal to:

$$c_{xa} = \left[\frac{a}{2b} + \frac{2b}{a}\right]^2 \quad \text{for } a \geq 2b$$

$$c_{xa} = \left[1 + \left(\frac{a}{2b}\right)^2\right]^2 \quad \text{for } a < 2b$$

For transverse stiffeners:

$$c_f = c_S F_{Kiy} \frac{\pi^2}{(n \cdot b)^2}\left(1 + c_{py}\right)$$

$$c_{py} = \frac{1}{1 + \dfrac{0.91\left(\dfrac{12 \cdot 10^4 I_y}{t^3 b} - 1\right)}{c_{ya}}}$$

c_{ya}: Coefficient taken as equal to:

$$c_{ya} = \left[\frac{nb}{2a} + \frac{2a}{nb}\right]^2 \quad \text{for } nb \geq 2a$$

$$c_{ya} = \left[1 + \left(\frac{nb}{2a}\right)^2\right]^2 \quad \text{for } nb < 2a$$

ii) For stiffeners not subject to lateral loads, the bending moment σ_b is to be calculated at the mid-point of the stiffener.

iii) When lateral loads are acting, stress calculations are to be carried out for both fibres of the stiffener's cross sectional area (if necessary for the biaxial stress field at the plating side).

(e) For torsional buckling, longitudinal and transverse stiffeners are to comply with the following **i)** and **ii)**:

i) Longitudinal stiffeners are to comply with the following criteria:

$$\frac{\sigma_x}{\kappa_T \sigma_F} C_{sf} \leq 1.0$$

κ_T : Coefficient taken as equal to:

$$\kappa_T = 1.0 \quad \text{for } \lambda_T \leq 0.2$$

$$\kappa_T = \frac{1}{\Phi + \sqrt{\Phi^2 - \lambda_T^2}} \quad \text{for } \lambda_T > 0.2$$

$$\Phi = 0.5\left(1 + 0.21\left(\lambda_T - 0.2\right) + \lambda_T^2\right)$$

λ_T : Reference degree of slenderness taken as equal to:

$$\lambda_T = \sqrt{\frac{\sigma_F}{\sigma_{KiT}}}$$

$$\sigma_{KiT} = \frac{E}{I_P}\left(\frac{\pi^2 I_\omega 10^2}{a^2}\varepsilon + 0.385 I_T\right) \quad (N/mm^2)$$

I_P: Net polar moment of inertia of the stiffener (cm^4) defined in **Table C20.9**, and related to point C as shown in **Fig. C20.7**

I_T: Net St. Venant's moment of inertia of the stiffener (cm^4) defined in **Table C20.9**

I_ω: Net sectorial moment of inertia of the stiffener (cm^6) defined in **Table C20.9**, related to point C as shown in **Fig. C20.7**

ε: Degree of fixation taken as equal to:

$$\varepsilon = 1 + 10^{-3}\sqrt{\frac{a^4}{\frac{3}{4}\pi^4 I_w\left(\frac{b}{t^3} + \frac{4h_w}{3t_w^3}\right)}}$$

A_w: Net web area (mm^2) equal to:

$A_w = h_w t_w$

A_f: Net flange area (mm^2) equal to:

$A_f = b_f t_f$

$$e_f = h_w + \frac{t_f}{2} \quad (mm)$$

h_w, t_w, b_f and t_f: Dimensions of stiffener (mm) as specified in **Fig. C20.7**

Fig C20.7 Dimensions of Stiffener

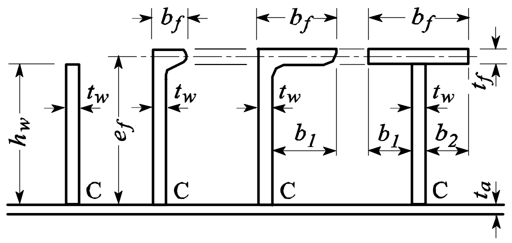


Table C20.9 Moments of Inertia

Section	I_P	I_T	I_ω
Flat bar	$\frac{h_w^3 t_w}{3\cdot 10^4}$	$\frac{h_w t_w^3}{3\cdot 10^4}\left(1 - 0.63\frac{t_w}{h_w}\right)$	$\frac{h_w^3 t_w^3}{36\cdot 10^6}$
Bulb, angle or tee sections	$\left(\frac{A_w h_w^2}{3} + A_f e_f^2\right)10^{-4}$	$\frac{h_w t_w^3}{3\cdot 10^4}\left(1 - 0.63\frac{t_w}{h_w}\right)$ $\pm$ $\frac{b_f t_f^3}{3\cdot 10^4}\left(1 - 0.63\frac{t_f}{b_f}\right)$	For bulb and angle sections: $\frac{A_f e_f^2 b_f^2}{12\cdot 10^6}\left(\frac{A_f + 2.6A_w}{A_f + A_w}\right)$ For tee-sections: $\frac{b_f^3 t_f e_f^2}{12\cdot 10^6}$

ii) For transverse secondary stiffeners loaded by compressive stress which are not supported by longitudinal stiffeners, sufficient torsional buckling strength is to be performed analogously in accordance with **i)** above.

20.2.6 Additional Requirements for Steel Hatch Covers Carrying Cargoes

1 Where concentrated loads, e.g. container loads, are acting on steel hatch covers, direct calculations deemed appropriate by the Society are required.

2 The scantlings of sub structures subject to concentrated loads acting on steel hatch covers are to be determined taking into consideration the design cargo loads and permissible stresses specified in this section.

3 The scantlings of top plates and stiffeners of steel hatch covers subject to wheel loads are determined by direct calculation or any other method which deemed appropriate by the Society.

20.2.7 Portable Beams, Hatchway Covers, Steel Pontoon Covers and Steel Weathertight Covers

1 Portable beams are to comply with the following **(1)** to **(7)**:

(1) The carriers and sockets for portable beams are to be of substantial construction, having a minimum beaming surface of 75 *mm*, and are to be provided with means for the efficient fitting and securing of the beams.

(2) Coamings are to be stiffened in way of carriers and sockets by providing stiffeners from these fittings to the deck or by equivalent strengthening.

(3) Where beams of a sliding type are used, the arrangement is to ensure that the beams remain properly in position when the hatchway is closed.

(4) The depth of portable beams and the width of their face plates are to be suitable to ensure the lateral stability of the beams. The depth of beams at their ends is not to be less than 0.40 *times* the depth at their mid-point or 150 *mm*, whichever is greater.

(5) The upper face plates of portable beams are to extend to the ends of the beams. The web plates are to be increased in thickness to at least twice that at the mid-point for at least 180 *mm* from each end or to be reinforced with doubling plates.

(6) Portable beams are to be provided with suitable gear for releasing them from slings without the need for personnel to get on the beam.

(7) Portable beams are to be clearly marked to indicate the deck, hatchway and position to which they belong.

2 Hatchway covers are to comply with the following **(1)** to **(5)**:

(1) Hatch rests are to be provided with at least a 65 *mm* bearing surface and are to be bevelled, if required, to suit the slope of the hatchways.

(2) Hatchway covers are to be provided with suitable hand grips according to their weight and size, except where such grips are unnecessary due to the cover's construction.

(3) Hatchway covers are to be clearly marked to indicate the deck, hatchway and position to which they belong.

(4) The wood for hatchway covers is to be of good quality, straight grained and reasonably free from knots, sap and shakes.

(5) The ends of all wood covers are to be protected by an encircling steel band.

3 Steel pontoon covers are to comply with the following **(1)** to **(3)**:

(1) The depth of steel pontoon covers at the supports is not to be less than one-third the depth at the mid-point or 150 *mm*, whichever is greater.

(2) The width of the bearing surfaces for steel pontoon covers is not to be less than 75 *mm*.

(3) Steel pontoon covers are to be clearly marked to indicate the deck, hatchway and position to which they belong.

4 Steel weathertight covers are to comply with the following **(1)** to **(4)**:

(1) The depth of steel weathertight covers at the supports is not to be less than one-third the depth at the mid-point or 150 *mm*, whichever is greater.

20.2.8 Tarpaulins and Securing Arrangements for Hatchways Closed by Portable Covers

1 At least two layers of tarpaulins of Grade A complying with the requirements in **Chapter 6, Part L** are to be provided for each exposed hatchway on the freeboard or superstructure decks and at least one layer of such a tarpaulin is to be provided for each exposed hatchway elsewhere.

2 Battens are to be efficient for securing the tarpaulins and not to be less than 65 *mm* in width and 9 *mm* in thickness.

3 Wedges are to be of tough wood or other equivalent materials. They are to have a taper not more than 1/6 and not to be less than 13 *mm* in thickness at the point.

4 Cleats are to be set to fit the taper of the wedges. They are to be at least 65 *mm* wide and to be spaced not more than 600 *mm* from centre to centre; the cleats along each side are to be arranged not more than 150 *mm* apart from the hatch corners.

5 For all hatchways in exposed freeboard and superstructure decks, steel bars or other equivalent means are to be provided in order to efficiently secure each section of the hatchway cover after the tarpaulins are battened down. Hatchway covers of more than 1.5 *metres* in length are to be secured by at least two such securing appliances. At all other hatchways in exposed positions on weather decks, ring bolts or other suitable fittings for lashing are to be provided.

20.2.9 Hatch Coaming Strength Criteria

1 Height of coamings is to comply with following **(1)** to **(3)**:

(1) Height of coamings above the upper surface of the deck is to be at least 600 *mm* in Position I and 450 *mm* in Position II.

(2) For hatchways closed by weathertight steel hatch covers, the height of coamings may be reduced from that prescribed in **(1)** or omitted entirely subject to the satisfaction of the Society.

(3) The height of hatchway coamings other than those provided in exposed portions of the freeboard or superstructure decks is to be to the satisfaction of the Society having regard to the position of hatchways or the degree of protection provided.

2 Scantlings of hatch coamings are to be in accordance with the followings.

(1) The local net plate thickness (*mm*) of the hatch coaming plating $t_{coam,net}$ is not to be less than that obtained from following formula:

$$t_{coam,net} = 14.2\,S\sqrt{\frac{P_H}{\sigma_{a,coam}}}$$, but not to be less than $6 + \frac{L'}{100}$

S: Secondary stiffener spacing (*m*)

P_H: As specified in **20.2.4(2)**

$\sigma_{a,coam} = 0.95\sigma_F$

σ_F : Minimum upper yield stress (N/mm^2) or proof stress (N/mm^2) of the material

L': Length of ship L_1 (*m*). However, where L' exceeds 300 *m*, L' is to be taken as 300 *m*.

(2) Where the hatch coaming secondary stiffener is snipped at both ends, the gross thickness $t_{coam,gross}$ (*mm*) of the coaming plate at the sniped stiffener end is not to be less than that obtained from the following formula:

$$t_{coam,gross} = 19.6\sqrt{\frac{P_H S(l - 0.5S)}{\sigma_F}}$$

l: secondary stiffener span (*m*) to be taken as the spacing of coaming stays

S, P_H and σ_F: As specified in **(1)** above

(3) The net section modulus Z_{net} (cm^3) and net shear area (cm^2) of hatch coaming secondary stiffeners are not to be less than that obtained from the following formula. For snipped stiffeners at coaming corners, section modulus and shear area at the fixed support are to be increased by 35%.

$$Z_{net} = \frac{83\, S l^2 P_H}{\sigma_F}$$

$$A_{net} = \frac{10\, S l P_H}{\sigma_F}$$

S, l, P_H and σ_F: As specified in **(2)** above

(4) Buckling strength assessment of hatch coaming is to be carried out by the method as deemed appropriate by the Society.

(5) The net scantlings of hatch coaming stays are to be in accordance with following **(a)** to **(d)**:

(a) The net section modulus Z_{net} (cm^3) of coaming stays with a height of less than 1.6 m is not to be less than that obtained from following formula:

$$Z_{net} = \frac{526 H_C^2 S P_H}{\sigma_F}$$

H_C: Hatch coaming stay height (m)

S: Hatch coaming stay spacing (m)

σ_F and P_H: As specified in **(1)** above

(b) The scantlings of hatch coaming stays with a height of 1.6 m and over are to be determined by direct calculations. The effective breadth of the coaming plate is to be in accordance with **20.2.5-5(2)** and stresses in hatch coaming stays are to comply with the criteria specified in **20.2.5-1**.

(c) For calculating the net section modulus of coaming stays, the area of their face plates is to be taken into account only when it is welded with full penetration welds to the deck plating and an adequate underdeck structure is fitted to support the stresses transmitted by them.

(d) The net scantling $t_{w,net}$ (mm) of hatch coaming stay webs is not to be less than that obtained from the following formula:

$$t_{w,net} = \frac{2 H_C S P_H}{\sigma_F\, h}$$

h: Hatch coaming stay depth (m)

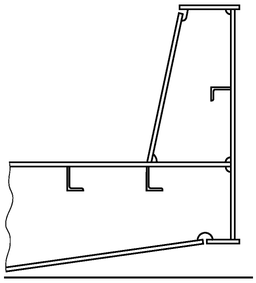
H_C, S, P_H and σ_F: As specified in **(a)** above

3 The coamings for hatchways in Position I or coamings of 760 mm or more in height for hatchways in Position II are to be stiffened in a suitable position below the upper edge by a horizontal stiffener; the breadth of the horizontal stiffener is not to be less than 180 mm.

4 Coamings are to be additionally supported by efficient brackets or stays provided from the horizontal stiffeners specified in **-3** to the deck at intervals of approximately 3 metres.

5 Coaming plates are to extend to the lower edge of the deck beams; moreover, they are to be flanged or fitted with face bars or half-round bars (see **Fig. C20.8**), except where specially approved by the Society.

Fig. C20.8 Example for the extension of coaming plates



6 Hatch coamings and hatch coaming stays are to comply with the following requirements:

(1) The local details of the structures are to be designed so as to transfer pressures on the hatch covers to the hatch coamings and, through them, to the deck structures below. Hatch coamings and supporting structures are to be adequately stiffened to accommodate the loading from hatch covers, in longitudinal, transverse and vertical directions.

(2) Underdeck structures are to be checked against the load transmitted by the stays.

(3) Double continuous welding is to be adopted for the connections of stay webs with deck plating and the weld throat is to be not less than $0.44t_{w,gross}$, where $t_{w,gross}$ is the gross thickness of the stay web.

(4) The toes of stay webs are to be connected to deck plating with deep penetration double bevel welds extending over a distance not less than 15% of the stay width.

(5) On ships carrying cargoes such as timber, coal or coke on deck, stays are to be spaced not more than 1.5 *m* apart.

(6) Hatch coaming stays are to be supported by appropriate substructures.

(7) For hatch coamings that transfer friction forces at hatch cover supports, special consideration is to be given to fatigue strength.

(8) Longitudinal hatch coamings with a length exceeding $0.1L_1$ are to be provided with tapered brackets or equivalent transitions and a corresponding substructure at both ends. At the end of the brackets, they are to be connected to the deck by full penetration welds of minimum 300 *mm* in length.

(9) Hatch coamings and horizontal stiffeners on hatch coamings may be considered as a part of the longitudinal hull structure when designed according to the requirements for longitudinal strength and verified in cases deemed appropriate by the Society.

(10) Unless otherwise specified, the material and welding requirements for hatch coamings are to comply with the provisions of other Parts of the Rules.

20.2.10 Closing Arrangements

1 Securing devices

(1) Securing devices between covers and coamings and at cross-joints are to ensure weathertightness.

(2) The means for securing and maintaining weathertightness by using gaskets and securing devices are to comply with the following **(a)** to **(f)**. The means for securing and maintaining weathertightness of weathertight covers are to be to the satisfaction of the Society. Arrangements are to ensure that weathertightness can be maintained in any sea condition.

(a) The weight of covers and any cargo stowed thereon are to be transmitted to the ship structure through steel to steel contact.

(b) Gaskets and compression flat bars or angles which are arranged between covers and the ship structure and cross-joint elements are to be in compliance with the following **i)** to **iii)**:

i) Compression bars or angles are to be well rounded where in contact with the gaskets and are to be made of corrosion-resistant materials.

ii) The gaskets are to be of relatively soft elastic materials. The material is to be of a quality suitable for all environmental conditions likely to be experienced by the ship, and is to be compatible with the cargoes carried.

iii) A continuous gasket is to be effectively secured to the cover. The material and form of gasket selected are to be considered in conjunction with the type of cover, the securing arrangement and the expected relative movement between the cover and ship structure.

(c) Securing devices attached to hatchway coamings, decks or covers are to be in compliance with the following **i)** to **v)**:

i) Arrangement and spacing of securing devices are to be determined with due attention to the effectiveness for weathertightness, depending upon the type and the size of hatch cover as well as to the stiffness of the cover edges between the securing devices.

ii) The gross sectional area (cm^2) of each securing device is not to be less than that obtained from the following formula. However, rods or bolts are to have a net diameter not less than 19 *mm* for hatchways exceeding 5 m^2 in area.

$$A = 0.28\bar{a}p / f$$

$\bar{a}$: Half the distance (*m*) between two adjacent securing devices, measured along the hatch cover periphery (see **Fig. C20.3**)

p: Packing line pressure (*N*/*mm*), minimum 5 *N*/*mm*

f: As obtained from the following formula:

$$f = (\sigma_F / 235)^e$$

σ_F: Minimum upper yield stress (N/mm^2) of the steel used for fabrication, but not to be taken greater than 70% of the ultimate tensile strength

e: Coefficient taken as equal to:

1.0 for $\sigma_F \leq 235$ N/mm^2

0.75 for $\sigma_F > 235$ N/mm^2

iii) Individual securing devices on each cover are to have approximately the same stiffness characteristics.

iv) Where rod cleats are fitted, resilient washers or cushions are to be incorporated.

v) Where hydraulic cleating is adopted, a positive means is to be provided to ensure that it remains mechanically locked in the closed position in the event of failure of the hydraulic system.

(d) A drainage arrangement equivalent to the standards specified in the following is to be provided.

i) Drainage is to be arranged inside the line of gaskets by means of a gutter bar or vertical extension of the hatch side and end coaming. If an application is made by the owner of a container carrier and the Society deems it to be appropriate, special consideration will be given to this requirement.

ii) Drain openings are to be arranged at the ends of drain channels and are to be provided with effective means such as non-return valves or the equivalent for preventing the ingress of water from outside.

iii) Cross-joints of multi-panel covers are to be arranged with a drainage channel for water from space above the gasket and a drainage channel below the gasket.

iv) If a continuous outer steel contact between cover and ship structure is arranged, drainage from the space between the steel contact and the gasket is also to be provided for.

(e) It is recommended that ships with steel weathertight covers are supplied with an operation and maintenance manual which includes the following **i)** to **v)**:

i) Opening and closing instructions

ii) Maintenance requirements for packing, securing devices and operating items

iii) Cleaning instructions for drainage systems

iv) Corrosion prevention instructions

v) List of spare parts

(f) Securing devices of special design in which significant bending or shear stresses occur may be designed as anti-lifting devices according to **-2** below.

2 The securing devices of hatch covers, on which cargo is to be lashed, are to be designed for a lifting force resulting from the loads according to **20.2.4(4)** (see **Fig. C20.9**). Unsymmetrical loading, which may occur in practice, is to be considered. Under such loading, the equivalent stress (N/mm^2) in securing devices is not to be greater than that obtained from the following formula. Anti-lifting devices may be dispensed with at the discretion of the Society.

$$\sigma_E = \frac{150}{k_l}$$

k_l: As obtained from the following formula:

$$k_l = \left(\frac{235}{\sigma_F}\right)^e$$

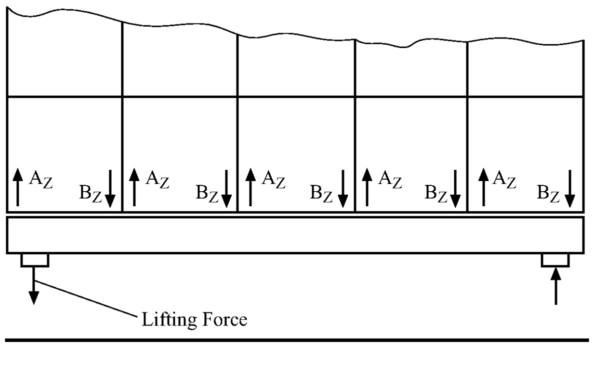
σ_F: Minimum upper yield stress (N/mm^2) or proof stress (N/mm^2) of the material

e: As given below:

0.75 for $\sigma_F > 235$

1.00 for $\sigma_F \leq 235$

Fig. C20.9 Lifting forces at a hatch cover



20.2.11 Hatch Cover Supports, Stoppers and Supporting Structures

Hatch cover supports, stoppers and supporting structures subject to the provisions of **20.2** are to comply with the following **(1)** to **(3)**:

(1) For the design of the securing devices for the prevention of shifting, the horizontal mass forces F obtained from the following formula are to be considered.

$F = ma$

m: Sum of mass of cargo lashed on the hatch cover and mass of hatch cover

a: Acceleration obtained from the following formula:

$a_X = 0.2g$ for longitudinal direction

$a_Y = 0.5g$ for transverse direction

(2) The design load for determining the scantlings of stoppers is not to be less than that obtained from **20.2.4(2)** and **(1)**, whichever is greater. Stress in the stoppers is to comply with the criteria specified in **20.2.5-1(1)**.

(3) The details of hatch cover supporting structures are to be in accordance with the following **(a)** to **(g)**:

(a) The nominal surface pressure (N/mm^2) of a hatch cover is not to be greater than that obtained from the following formula:

$p_{n\max} = dp_n$ in general

$p_{n\max} = 3p_n$ for metallic supporting surface not subjected to relative displacements

d: As given by the following formula. Where d exceeds 3, d is to be taken as 3.

$d = 3.75 - 0.015L_1$

$d_{\min} = 1.0$ in general

$d_{\min} = 2.0$ for partial loading conditions

L_1: Length of ship specified in **2.1.2, Part A** of the Rules (m). However, L_1 need not to be greater than 97% of the total length at the summer load waterline.

p_n: As obtained from **Table C20.10**

Table C20.10 Permissible nominal surface pressure p_n

Material	p_n when loaded by	
	Vertical force	Horizontal force
Hull structure steel	25	40
Hardened steel	35	50
Plastic materials in steel	50	-

(b) Where large relative displacements of the supporting surfaces are to be expected, the use of material having low wear and frictional properties is recommended.

(c) Drawings of the supports are to be submitted. In these drawings, the permitted maximum pressure given by the material manufacturer related to long time stress is to be specified.

(d) Sufficient abrasive strength may be shown by tests demonstrating an abrasion of support surfaces of not more than 0.3 *mm* per year in service at a total distance of shifting of 15,000 *m* per year when deemed necessary by the Society.

(e) Irrespective of the arrangement of stoppers, the supports are to be able to transmit the following force p_h in the longitudinal and transverse direction.

$$p_h = \mu \frac{p_v}{\sqrt{d}}$$

p_v: Vertical supporting force

μ: Friction coefficient generally to be taken as 0.5. For non-metallic or low-friction materials, the friction coefficient may be reduced as appropriate by the Society. However, in no case μ is to be less than 0.35.

(f) Stresses in supporting structures are to comply with the criteria specified in **20.2.5-1(1)**.

(g) For substructures and adjacent constructions of supports subjected to horizontal forces p_h, special consideration is to be given to fatigue strength.

20.2.12 Steel Hatchway Covers for Container Carriers

1 For container carriers with unusually large freeboards, gaskets and securing devices for steel hatchway covers may be suitably dispensed with at the discretion of the Society upon request by the applicant for classification.

2 Treatment of towage and segregation of containers containing dangerous goods is to be at the discretion of the Society.

20.2.13 Additional Requirement for Small Hatches Fitted on Exposed Fore Deck

Small hatches located on exposed decks forward of $0.25L_1$ are to be of sufficient strength and weathertightness to resist green sea force if the height of the exposed deck in way of those hatches is less than $0.1L_1$ or 22 *m* above the designed maximum load line, whichever is smaller. The length L_1 is specified in **15.2.1-1**.

EFFECTIVE DATE AND APPLICATION (Amendment 2-4)

1. The effective date of the amendments is 1 July 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 C Hull Construction and Equipment

GUIDANCE

2011 AMENDMENT NO.2

Notice No.90 1st November 2011

Resolved by Technical Committee on 7th July 2011

Notice No.90 1st November 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 C HULL CONSTRUCTION AND EQUIPMENT

Amendment 2-1

C3 RUDDERS

C3.7 Couplings Between Rudder Stocks and Main Pieces

C3.7.2 Cone Couplings

Sub-paragraph -3 has been added as follows.

3 "It is considered that rudder torque is transmitted by friction at the couplings" prescribed in **3.7.2-3, Part C** of the Rules refer to those cases in which 50% of the rudder torque is transmitted by friction at the coupling. In such cases, the value of the shear area of the key, the abutting surface area between the key and rudder stock or between the key and rudder body specified in **-2** above may be reduced to half respectively.

Appendix C1　REFERENCE DATA FOR DESIGN

1.2　Connection of Rudder Stock and Rudder Main Piece using Cone Coupling (3.7.2, Part C of the Rules)

Paragraph 1.2.2 has been amended as follows.

1.2.2

Where the rudder stock is connected to the main piece using the cone coupling with a slugging nut and key and all of the rudder torque is transmitted by the key, the necessary push-up force and the push-up length may be determined by applying the formulae mentioned in **1.2.1** above, taking μ_1 as 0.14 and f_{s1} as ~~1.5~~0.5.

Paragraph 1.2.3 has been added as follows.

1.2.3

Where the rudder stock is connected to the main piece using a cone coupling with a key and it is considered that 50% of the rudder torque is transmitted by friction at the coupling, the necessary push-up force and the push-up length may be determined by applying the formulae mentioned in **1.2.1** above, taking μ_1 and f_{s1} as follows according to the applied method for mounting and dismounting the coupling.

f_{s1} as 1.5: in the case of hydraulic arrangements (e.g. oil injection and hydraulic nut)

μ_1 as 0.14 and f_{s1} as 1.5: in the case of a slugging nut

Appendix C4 PERFORMANCE STANDARD FOR PROTECTIVE COATINGS FOR DEDICATED SEAWATER BALLAST TANKS IN ALL TYPES OF SHIPS AND DOUBLE-SIDE SKIN SPACES OF BULK CARRIERS (Resolution MSC.215(82) and IACS Unified Interpretations SC223)

Table 1 has been amended as follows.

Table 1 Basic coating system requirements for dedicated seawater ballast tanks of all type of ships and double-side skin spaces of bulk carriers of 150 *m* and upwards

	Characteristic/ Reference Standards	Requirement
	(Omitted)	
2 PSP (Primary Surface Preparation)		
.1	Blasting and Profile.[6, 7]	(Omitted)
.2	Water soluble salt limit equivalent to NaCl [8]	≤ 50 mg/m^2 of sodium chloride.
.3	Shop primer	(Omitted)
3 Secondary surface preparation		
.1	Steel condition[9]	(Omitted)
.2	Surface treatment[6]	(Omitted)
.3	Surface treatment after erection[6]	(Omitted)
.4	Profile requirements[7]	(Omitted)
.5	Dust[10]	(Omitted)
.6	Water soluble salts limit equivalent to NaCl after blasting/ grinding[8]	≤ 50 mg/m^2 of sodium chloride.
.7	Oil contamination	(Omitted)
	(Omitted)	

5 Type of gauge and calibration in accordance with SSPC-PA2: 2004. *Paint Application Specification No.2.*

6 Reference standard: *ISO* 8501-1: *1988/Suppl: 1994. Preparation of steel substrate before application of paints and related products – Visual assessment of surface cleanliness.*

7 Reference standard: *ISO* 8503-1/2: *1988. Preparation of steel substrate before application of paints and related products – Surface roughness characteristics of blast-cleaned steel substrates.*

8 Conductivity measured in accordance with the following standards:

.1 *ISO* 8502-9: *1998. Preparation of steel substrate before application of paints and related products – Test for the assessment of surface cleanliness*~~.~~ ; or

.2 *NACE SP*0508-2010 *Item no.*21134. *Standard practice methods of validating equivalence to ISO* 8502-9 *on measurement of the levels of soluble salts.*

9 Reference standard: *ISO* 8501-3: *2001 (grade P2). Preparation of steel substrate before application of paints and related products – Visual assessment of surface cleanliness.*

10 Reference standard: *ISO* 8502-3:*1993. Preparation of steel substrate before application of paints and related products – Test for the assessment of surface cleanliness.*

6 COATING INSPECTION REQUIREMENTS

6.1 General

6.1.1 To ensure compliance with this Standard, the following shall be carried out by qualified coating inspectors certified to NACE Coating Inspector Level 2, FROSIO Inspector Level III or equivalent as verified by the Administration.

6.1.2 Coating inspectors shall inspect surface preparation and coating application during the coating process by carrying out, as a minimum, those inspection items identified in section **6.2** to ensure compliance with this Standard. Emphasis shall be placed on initiation of each stage of surface preparation and coatings application as improper work is extremely difficult to correct later in the coating progress. Representative structural members shall be non-destructively examined for coating thickness. The inspector shall verify that appropriate collective measures have been carried out.

6.1.3 Results from the inspection shall be recorded by the inspector and shall be included in the CTF (refer to **annex 2** (Example of daily log and non-conformity report)).

****

Interpretation has been amended as follows.

Interpretation

Procedure for Assessment of Coating Inspectors' Qualifications

1 Coating inspectors required to carry out inspections in accordance with the PSPC 6 shall be qualified to NACE Coating Inspector Level 2, FROSIO Inspector Level III, or an equivalent qualification. Equivalent qualifications are described in 3 below.

2 (Omitted)

3 (Omitted)

4 Assistant to the coating ~~I~~inspectors

4.1 If the coating inspectors requires assistance from other persons to do the part of the inspections under the coating inspector's supervision, those persons shall be trained to the coating inspector's satisfaction.

4.2 Such training should be recorded and endorsed either by the inspector, the yard's training organization or inspection equipment manufacturer to confirm competence in using the measuring equipment and confirm knowledge of the measurements required by the PSPC.

4.3 Training records shall be available for verification if required.

****

EFFECTIVE DATE AND APPLICATION (Amendment 2-1)

1. The effective date of the amendments is 1 November 2011.

Amendment 2-2

C27 EQUIPMENT

C27.1 Anchors, Chain Cables and Ropes

Paragraph C27.1.7 has been added as follow.

C27.1.7 Chain Lockers

The wording "the access cover and its securing arrangements to the satisfaction of the Society" in **27.1.7-4, Part C of the Rules** means those which are in accordance with *JIS* F 2304, *JIS* F 2329, or *ISO* 5894:1999 or their equivalent.

EFFECTIVE DATE AND APPLICATION (Amendment 2-2)

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.
*"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.

Amendment 2-3

C1 GENERAL

C1.1 General

C1.1.23 Structural Details

Sub-paragraph -1 has been amended as follows.

1 In applying the requirements in **1.1.23-4**, **Part C** of the Rules, fatigue strength assessment of longitudinals in the midship part for tankers and, bulk carriers and container carriers is to be in accordance with the following items **(1)** and **(2)**to **(3)**.

(1) For ships not less than 150 *m* in length L_1, the fatigue strength assessment of longitudinals that do not penetrate structural members which constrain athwartship or vertical displacements of longitudinals (such as transverse bulkheads, swash bulkheads or floors) is to be carried out in accordance with the **Annex C1.1.23-1** "**GUIDANCE FOR THE FATIGUE STRENGTH ASSESSMENT OF LONGITUDINALS**." L_1 is the ship length specified in **15.2.1-1. Part C** of the Rules.

(2) Fatigue strength assessment of longitudinals that penetrate structural members which constrain athwartship or vertical displacements of longitudinals (such as transverse bulkheads, swash bulkheads or floors) is to be in accordance with the following **(a)** and **(b)**.

  (a) For ships not less than 150 *m* in length L_1, the fatigue assessment may be dispensed with where the scantlings of the longitudinals comply with the requirements in **(1)** above and soft brackets with sufficient fatigue strength are arranged on both sides of the structural members (bulkheads, etc.).

  (b) For ships that have or are intended to have the class notation "PS-FA" appended to the classification characters, the fatigue assessment is to be carried out on the structural members penetrated by the longitudinals in accordance with **Annex C1.1.23-1** "**GUIDANCE FOR THE FATIGUE STRENGTH ASSESSMENT OF LONGITUDINALS**."

(3) A fatigue strength assessment of longitudinals other than those at the midship part is to be carried out where deemed necessary by the Society.

Annex C1.1.7-1 GUIDANCE FOR HULL CONSTRUCTION CONTAINING HIGH TENSILE STEEL MEMBERS

1.2 Structural Members

1.2.1 General

Sub-paragraph -2 has been amended as follows.

2 Expressions

Unless specified otherwise, the expressions employed in this Guidance are to be as stipulated in **(1)** to **(4)** below.

(1) f_{DH} and f_{BH} are to be as follows:

$$f_{DH} = \frac{Z_{Mreq}}{Z_{DH\,ship}}$$

$$f_{BH} = \frac{Z_{Mreq}}{Z_{BH\,ship}}$$

Z_{Mreq}: Section modulus of hull determined according to the requirements in **Chapter 15, Part C** of the Rules when mild steel is used.

$Z_{DH\,ship}$ and $Z_{BH\,ship}$: Actual hull section moduli at strength deck and bottom respectively.

(2) K is the coefficient corresponding to the kind of steel. However, where special consideration is given to the type of high tensile steel used, this value may be different, subject to the approval of the Society, from the following coefficients:

0.78 (for *HT*32)
0.72 (for *HT*36)
0.68 (for *HT*40)

The values specified in **1.1.7-3, Part C** of the Rules (for stainless steel and stainless clad steel)

(3) Plate thickness t_M, section modulus Z_M and moment of inertia I_M are those required by the Rules for members and structures of mild steel, and t_H, Z_H and I_H are those for high tensile steel.

(4) Expressions not stipulated here are to be as defined in relevant provisions in **Part C** of the Rules.

1.2.2 Determination of Scantlings of Structural Members

Sub-paragraph -11 has been deleted.

~~**11** Container Carriers~~

~~The formulae in **Chapter 32, Part C** of the Rules, for the scantlings of members of Container Carriers are to be replaced by those in **Table 2.11(1)** and **Table 2.11(2)**~~

Table 2.11(1) and Table 2.11(2) have been deleted.

~~Table 2.11(1) Container Carriers~~

Members	Paragraph No.	Scantlings
Bottom longitudinals	**32.3.2-1**	Section modulus $\frac{100CK}{24-15.5f_{BH}K}(d+0.026L')Sl^2 \quad (cm^3)$
Vertical struts	**32.3.3**	Section area $0.9CKSb(d+0.026L') \quad (cm^2)$ C is to be 1.43 or the value obtained from the following formula, whichever is the greater. $\frac{1}{1-0.5\frac{l_s}{k\sqrt{K}}}$
Side transverse girders	**32.4.2-1**	Thickness of side transverse girders $t_1=0.083\frac{CKSl_H}{d_1-a}(d+0.038L')+2.5 \quad (mm)$ $t_2=8.6\sqrt[3]{\frac{d_1^{\,2}(t_1-2.5)}{kK}}+2.5 \quad (mm)$ $t_3=\frac{8.5}{\sqrt{K}}S_2+2.5 \quad (mm)$ However, t_3 can be determined by other analytical measures against compressive buckling strength of the girder
Side stringers	**32.4.2-2**	Thickness of side stringers $t_1=0.083\frac{CKSl_H}{d_1-a}(d+0.038L')+2.5 \quad (mm)$ $t_2=8.6\sqrt[3]{\frac{d_1^{\,2}(t_1-2.5)}{kK}}+2.5 \quad (mm)$ $t_3=\frac{8.5}{\sqrt{K}}S_2+2.5 \quad (mm)$ However, t_3 can be determined by other analytical measures against compressive buckling strength of the girder

Table 2.11(2) Container Carriers

Longitudinal bulkhead	**32.4.3(1)**	Thickness of longitudinal bulkhead $3.6CS\sqrt{Kh}+3.0\quad (mm)$ C as per the following formula (a) or (b) (a) Transverse framing system $\frac{27.7}{\sqrt{767-\alpha^2}}$ α is to be obtained from the following formulae according to the value of y, whichever is the greater $15.5 f_{BH} K\left(1-\frac{y}{y_B}\right)\cdots\cdots$ where $y \le y_B$ $15.5 f_{DH} K \frac{y-y_B}{Y'}\cdots\cdots$ where $y_B < y$ $k\left(1-2\frac{d_1}{B}\right)$ (b) Longitudinal framing system $\frac{3.72}{\sqrt{27.7-\alpha}}$ but not to be less than 1.0 α as specified in (a) above
Longitudinal stiffeners on inner hull plating	**32.4.3(2)**	Section modulus of longitudinal stiffeners $125C_1C'_2C_3Shl^2\quad (cm^3)$ C'_2 : $\frac{K}{18}$, however, C'_2 for h equal to h_1 is to be in accordance with the following: $C'_2=\frac{K}{24-\alpha}$, however, the value of C'_2 is not to be less than $\frac{K}{18}$
Decks inside the line of deck openings	**32.6.1(1)**	Thickness of deck plating $0.00417C_1K\left(\frac{l_v{}^2 l_c}{w_c}\right)+2.5\quad (mm)$
	32.6.1(2)	Section modulus $1.43C_2Kl_v{}^2l_c{}^2\quad (cm^3)$
	32.6.1(3)	Moment of inertia $0.38\frac{l_c{}^4}{Sl_v{}^3}I_v\quad (cm^4)$

Annex C1.1.23-1 GUIDANCE FOR THE FATIGUE STRENGTH ASSESSMENT OF LONGITUDINALS

1 General

1.1 General

Paragraph 1.1.3 has been amended as follows.

1.1.3 Navigating Conditions of the Ship

1 The navigating conditions of the ship are primarily classified into two conditions: full loading condition and ballast condition. However, for container carriers, ballast tanks are assumed to be full under both conditions.

2 Consideration will be given to the navigating condition of ships intended to navigate in any conditions other than those specified in paragraph **-1** above for a long period of time.

3 Notwithstanding the provisions of **-1,** a navigating condition other than those specified in **-1** may be used where deemed appropriate by the Society.

2 Stress Evaluation

2.1 Evaluation of Stress for Longitudinals which Penetrate Ordinary Transverse Members

2.1.2 Stress Due to Wave Load

Sub-paragraph -1 has been amended as follows.

1 Stress due to wave load σ_{wj} is given in **Table 3**.

The expressions used in the table are explained below.

C_1 : This value is calculated using the equations given in **Table 4**

L_1 : Length (m) of ship as specified in **2.1.2**, **Part A** of the Rules or 0.97 times the length of the ship on the designed maximum load line, whichever is smaller

d_i : Draft (m) amidships for the relevant loading condition

y_P : Transverse horizontal distance (m) from the centreline of the ship to the point being considered in the subject section

z_P : Vertical distance (m) from the bottom of the ship to the point being considered in the midship section

B : Breadth (m) as defined in **2.1.4**, **Part A** of the Rules

T_R : Natural period of roll (s) in condition being considered

Where the full load condition and ballast condition are considered and the natural period of roll corresponding to the respective conditions is not given beforehand, it may be calculated from the following equation.

$T_R = 1.15\dfrac{2K_{xx}}{\sqrt{GM}}$ (s) for tankers and bulk carriers

$T_R = 1.1\dfrac{2K_{xx}}{\sqrt{GM}}$ (s) for container carriers

K_{xx} : Roll radius (m) of gyration at the centre of gravity of the ship corresponding to the respective condition is given below.

For full load condition $K_{xx} = 0.35B$,

For ballast condition $K_{xx} = 0.40B$

For partial filling condition $K_{xx} = 0.40B$

GM : Metacenter height (m) is given below.

For Tanker:

GM=KM−KG

$$= \left\{0.42B\left(2-\frac{d_i}{d_f}\right)-7\left(1-\frac{d_i}{d_f}\right)\right\} - \left\{0.54D\left(0.2+0.8\frac{d_i}{d_f}\right)+3\left(1-\frac{d_i}{d_f}\right)+0.6\right\} \quad (m)$$

For Bulk Carrier:

GM=KM−KG

$$= \left\{ 0.42B\left(2-\frac{d_i}{d_f}\right)-7\left(1-\frac{d_i}{d_f}\right)\right\} - \left\{0.54D\left(0.4+0.6\frac{d_i}{d_f}\right)+3\left(1-\frac{d_i}{d_f}\right)+0.6\right\} \quad (m)$$

For Container Carrier:

GM=KM−KG

$$= \left\{ 0.52B+1.25\left(1-2.4\frac{d_i}{d_f}\right)\right\} - \left\{0.55D\left(0.45+0.55\frac{d_i}{d_f}\right)-1.95\left(1-2.8\frac{d_i}{d_f}\right)\right\} \quad (m)$$

It is not to be less than 0.06*B*.

D : Depth (m) of ship defined in **2.1.6**, **Part A** of the Rules

ϕ : Rolling angle (*radians*): obtained from the following formula:

$\phi = \frac{4}{T_R\sqrt{B}}H_j$ for tankers and bulk carriers

$\phi = \frac{4}{T_E\sqrt{B}}H_j$ for container carriers

T_E : As given by the following

$$T_E = 0.5\left(T_R + \sqrt{T_R^2 - \frac{2\pi}{g}VT_R}\right) \quad \text{for } T_R > \frac{2\pi}{g}V$$

$$T_E = T_R \quad T_R \le \frac{2\pi}{g}V$$

Where,

V : Ship speed (*knots*) as defined in **2.1.8**, **Part A** of the Rules

C : Distribution coefficient in the longitudinal direction of the ship is based on the equation given below.

Where the cross section being considered is positioned forward of amidship:

$$C = 1 + \frac{6}{C_b}\left(3 - \frac{|4y'|}{B}\right)\left(\frac{x_l}{L}\right)^3$$

Where the considered cross section is positioned afterward of amidship:

$$C = 1 + \frac{12}{C_b}\left(1 - \sqrt{\frac{|2y'|}{B}}\right)\left(\frac{x_l}{L}\right)^3$$

x_l : Longitudinal distance (m) from the midship section to the cross section being considered

y' : Transverse horizontal distance (m) from the centreline of the ship to the point being considered in the subject section

C_c, Z, S, C_{cor}, l and g are determined according to the provision in **2.1.1**.

Paragraph 2.1.3 has been amended as follows.

2.1.3 Stress Due to Acceleration of Ship

Stress due to acceleration of liquid in the tanks and bulk cargo in the holds induced by acceleration of the ship σ_{Tj} is according to the equations given in **Table 6** using the acceleration of the centre of gravity of the ship is given in **Table 5**.

The expressions used in **Table 5** and **Table 6** are explained below.

V : Ship speed (*knots*) as defined in **2.1.8**, **Part A** of the Rules

C_b : Block coefficient as defined in **2.1.14**, **Part A** of the Rules

Sgn: Indicates use of either a plus or minus sign

A "plus" sign indicates that the longitudinals are inside the subject tank being assessed, while a "minus" sign is used in cases where the longitudinals are outside (are affixed to the exterior surface of) the subject tank being assessed.

$B, g, s, l, Z,\ C_{cor},\ d_i,\ d_f, L,\ C_c,\ \rho_c,\ C_P$ and T_R are determined according to **2.1.1**.

T_P: As given by the following

$$T_P = \sqrt{\frac{2\pi\left\{0.6\left(1+\frac{d_i}{d_f}\right)\right\}L}{g}}\quad (s)$$ for tankers and bulk carriers

$$T_P = \sqrt{\frac{2\pi\left\{0.5\left(1+{d_i}/{d_f}\right)\right\}L}{g}}$$ for container carriers

$H_1,\ H_3,\ H_4$: Wave height (m) corresponding to the design condition of L-180, R and P, respectively, as given in **Table 3**

x_g : Longitudinal distance (m) from A.P. to the rotation centre of pitch motion (=0.45L)

x_t : Longitudinal distance (m) from A.P. to the centre of gravity of the tank being considered

y_t : Transverse horizontal distance (m) from the centreline of the ship to the centre of gravity of the tank being considered

y_c : Transverse horizontal distance (m) from the centre of gravity in the breadth of the tank to the longitudinal being considered

z_c : Vertical distance (m) from the tank top to the longitudinal being considered

Table 3 has been amended as follows.

Table 3 Stress Range Due to Wave Load

<table>
<tr><th colspan="2">Design Condition</th><th>Design wave height H_j (m)</th><th>Wave pressure P_{Wj} (kN/m^2)</th><th>Stress σ_{Wj} (N/mm^2)</th></tr>
<tr><td>1</td><td>L-180</td><td>For tankers and bulk carriers
$0.6175C_1\sqrt{(1.6+\frac{0.6d_i}{d_f})-\frac{25}{L}}$
For container carriers
$0.6175C_1\sqrt{\left(1.5+\frac{0.5d_i}{d_f}\right)-\frac{25}{L}}$</td><td>$2.3C\left(\frac{z_p}{d_i}+\frac{\lvert 2y_p\rvert}{B}+1\right)H_j$</td><td rowspan="4">$1000C_C\frac{P_{Wj}Sl^2}{12ZC_{cor}}$</td></tr>
<tr><td>2</td><td>L-0</td><td>For tankers and bulk carriers
$0.6175C_1\sqrt{(1.6+\frac{0.4d_i}{d_f})-\frac{25}{L}}$
For container carriers
$0.6175C_1\sqrt{\left(1.5+\frac{d_i}{3d_f}\right)-\frac{25}{L}}$</td><td>$2.3\left(\frac{z_p}{d_i}+\frac{\lvert 2y_p\rvert}{B}+1\right)H_j$</td></tr>
<tr><td>3</td><td>R</td><td>For tankers and bulk carriers
$0.399C_1\sqrt{1+\frac{gT_R^{\ 2}}{2\pi L}-\frac{25}{L}}$
For container carriers
$0.399C_1\sqrt{1+\frac{gT_E^{\ 2}}{2\pi L}-\frac{25}{L}}$</td><td>$10y'\sin\phi+\left(\frac{\lvert 2y'\rvert}{B}+1\right)H_j$</td></tr>
<tr><td>4</td><td>P</td><td>For tankers and bulk carriers
$0.665C_1\sqrt{(1.2+\frac{0.4d_i}{d_f})-\frac{25}{L}}$
For container carriers
$0.665C_1\sqrt{\left(1.2+\frac{0.15d_i}{d_f}\right)-\frac{25}{L}}$</td><td>For tankers and bulk carriers
$3\left(\frac{2z_p}{d_i}+\frac{3\lvert 2y'\rvert}{B}\right)H_j$
For container carriers
$2.4\left(\frac{2z_p}{d_i}+\frac{3\lvert 2y'\rvert}{B}\right)H_j$</td></tr>
</table>

Table 5 has been amended as follows.

Table 5 Acceleration of the Centre of Gravity of Ship

Heave (m/s^2)	Roll ($rad./s^2$)	Pitch ($rad./s^2$)
$a_h = \frac{3g(V+5)^{0.2}}{B^{0.6}L^{0.6}\sqrt{C_b}}H_4$	For tankers and bulk carriers $a_r = \frac{4H_3}{T_R\sqrt{B}}\left(\frac{2\pi}{T_R}\right)^2$ For container carriers $a_r = \frac{4H_3}{T_E\sqrt{B}}\left(\frac{2\pi}{T_R}\right)^2$	$a_p = \frac{3(V+5)^{0.2}H_1}{L^{1.2}\sqrt{C_b}}\left(\frac{2\pi}{T_p}\right)^2$

Table 6 has been amended as follows.

Table 6 Stress Due to Acceleration of Liquid in Tanks and Bulk Cargo in Holds

Design Condition		Load due to acceleration of liquid in tanks and bulk cargo in holds P_{Tj} (kN/m^2)		Stress σ_{Tj} (N/mm^2)
1	L-180	Liquid: $\rho_c\left(\frac{d_i}{d_f}a_h + \lvert x_t - x_g\rvert a_p\right)z_c$	Bulk Cargo: $0.75C_P\rho_c\left(\frac{d_i}{d_f}a_h + \lvert x_t - x_g\rvert a_p\right)z_c$	$\mathrm{sgn}\left(1000\frac{C_C P_{Tj} S l^2}{12ZC_{cor}}\right)$
2	R	For tankers and bulk carriers Liquid: $\rho_c\left\{\left(\frac{\sqrt{L}}{40}a_h + y_t a_r\right)z_c + \left(\frac{4gH_3}{T_R\sqrt{B}}\right)y_c\right\}$ For container carriers Liquid: $\rho_c\left[\left\{\left(0.7-0.6\frac{d_i}{d_f}\right)a_h + y_t a_r\right\}z_c + \left(\frac{4gH_3}{T_E\sqrt{B}}\right)y_c\right]$	Bulk Cargo $\rho_c\left\{0.75C_P\left(\frac{\sqrt{L}}{40}a_h + y_t a_r\right)z_c + 0.25\left(\frac{4gH_3}{T_R\sqrt{B}}\right)y_c\right\}$	
3	P	For tankers and bulk carriers Liquid: $\rho_c\left\{(a_h + 0.5y_t a_r)z_c + 0.5\left(\frac{4gH_3}{T_R\sqrt{B}}\right)y_c\right\}$ For container carriers Liquid: $\rho_c\left\{(a_h + 0.5y_t a_r)z_c + 0.5\left(\frac{4gH_3}{T_E\sqrt{B}}\right)y_c\right\}$	Bulk Cargo: $\rho_c\left\{0.75C_P(a_h + 0.5y_t a_r)z_c + 0.25\left(0.5\frac{4gH_3}{T_R\sqrt{B}}\right)y_c\right\}$	

3 Fatigue Strength Assessment

3.1 Calculation of Cumulative Fatigue Damage

3.1.3 Calculation of Cumulative Fatigue Damage

Table 9 has been amended as follows.

Table 9 Correction Coefficient

Type of Ship		Hull part where the longitudinal is fitted	η_v
Tanker		Side shell and bottom shell	0.5
		Other than the above	0.4
Bulk Carrier	$L \geq 200$ m	Side shell and bottom shell	0.55
		Other than the above	0.45
	$L < 200$ m	The value is determined at the discretion of the Society	
Container Carrier	Over Panamax	Side shell and bottom shell	0.5
		Other than the above	0.4
	Panamax	Side shell and bottom shell	0.35
		Other than the above	0.3
	Feeder	Side shell and bottom shell	0.3
		Other than the above	0.25

EFFECTIVE DATE AND APPLICATION (Amendment 2-3)

1. The effective date of the amendments is 1 May 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.

3. Notwithstanding the provision of preceding **2.**, the amendments to the Guidance may apply to ships for which the application is submitted to the Society before the effective date upon request by the owner.

Amendment 2-4

C20 HATCHWAYS, MACHINERY SPACE OPENINGS AND OTHER DECK OPENINGS

Section 20.2 has been amended as follows

C20.2 Hatchways

~~**C20.2.2 Height of Hatchway Coamings**~~
~~(omitted)~~

~~**C20.2.3 Construction of Hatchway Coamings**~~
~~(omitted)~~

~~**C20.2.4 Portable Beams, Hatchway Covers, Steel Pontoon Covers and Steel Weathertight Covers**~~
~~(omitted)~~

~~**C20.2.5 Additional Requirements for Steel Hatch Covers Carrying Cargoes**~~
~~(omitted)~~

~~**C20.2.6 Special Requirements for Portable Beams, Hatchway Covers, Steel Pontoon Covers and Steel Weathertight Covers**~~
~~(omitted)~~

~~**C20.2.7 Tarpaulins and Securing Arrangements for Hatchways Closed by Portable Covers**~~
~~(omitted)~~

~~**C20.2.8 Steel Hatchway Covers for Container Carriers**~~
~~(omitted)~~

~~**C20.2.9 Steel Hatchway Covers for Deep Tanks**~~
~~(omitted)~~

~~**C20.2.10 Additional Requirement for Small Hatchways Fitted on Exposed Fore Deck**~~
~~(omitted)~~

~~Table C20.2.3-1 Height of Small Hatchway Coamings (*mm*)~~
~~(omitted)~~

~~Fig. C20.2.3-1 Example of Hatch Coaming Stay~~
~~(omitted)~~

~~Fig. C20.2.5-1~~
~~(omitted)~~

~~Table C20.2.5-1 Allowable Values~~
~~(omitted)~~

~~Fig.C20.2.6 Distance between Securing Devices, Measured Along Hatch Cover Periphery~~
~~(omitted)~~

~~Table C20.2.6 Design pressure for stopper~~
~~(omitted)~~

~~Fig. C20.2.8 Arrangement of Labyrinth (Example)~~
~~(omitted)~~

~~Fig. C20.2.9-1 How to measure h'~~
~~(omitted)~~

~~Table C20.2.9-1 Coefficients C_1, C_2 and C_3~~
~~(omitted)~~

~~Table C20.2.10-1 Scantlings for Small Steel Hatch Covers on the Fore Deck~~
~~(omitted)~~

~~Fig. C20.2.10-1 Arrangement of Stiffeners~~
~~(omitted)~~

~~Fig. C20.2.10-2 Example of a Primary Securing Method~~
~~(omitted)~~

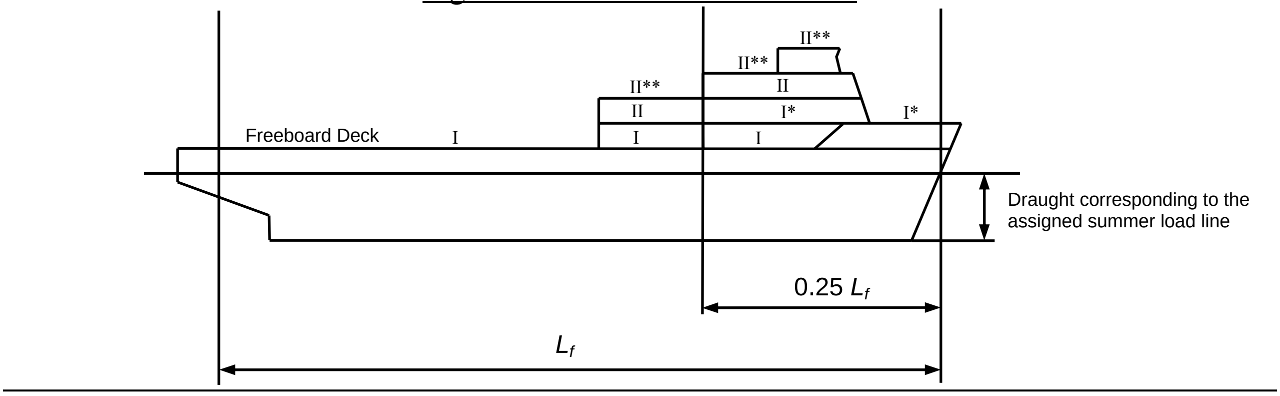
C20.2.4 Design Load

1 Design vertical wave load P_V as specified in **20.2.4(1), Part C** of the Rules is to comply with the following requirements.

(1) Positions I and II may be determined in accordance with Fig. **C20.2.4-1** and **-2**.

(2) Where an increased freeboard is assigned, the design load for hatch covers according to **20.2.4(1), Part C** of the Rules on the actual freeboard deck may be as required for a superstructure deck, provided the summer freeboard is such that the resulting draught will not be greater than that corresponding to the minimum freeboard calculated from an assumed freeboard deck situated at a distance at least equal to one superstructure standard height (as per Regulation 33 of the "*International Convention on Load Lines,* 1966 *and Protocol of* 1988 *relating to the International Convention on Load Lines,* 1966") below the actual freeboard deck (see **Fig. C20.2.4-2**).

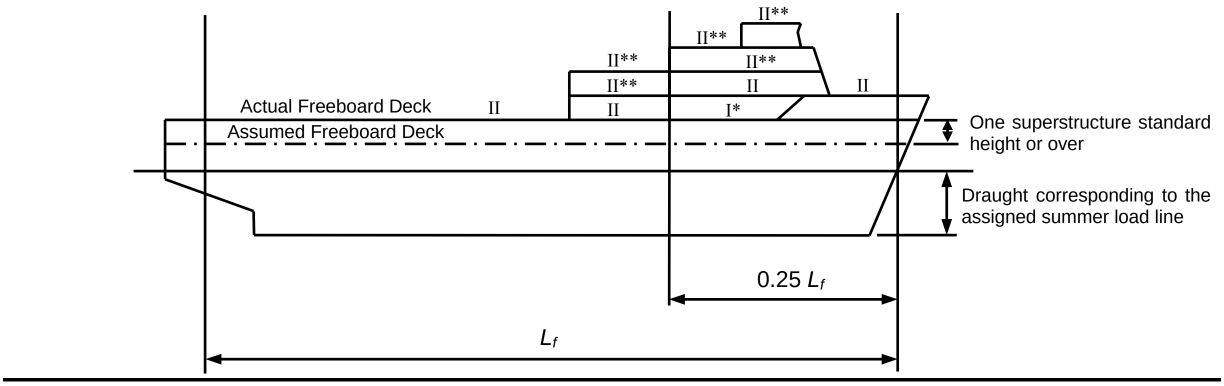
Fig. C20.2.4-1 Position I and II



* Exposed superstructure decks located at least one superstructure standard height above the freeboard deck

** Exposed superstructure decks of vessels having length L_f of greater than 100m located at least one superstructure standard height above the lowest Position II deck

Fig. C20.2.4-2 Position I and II for an increased freeboard

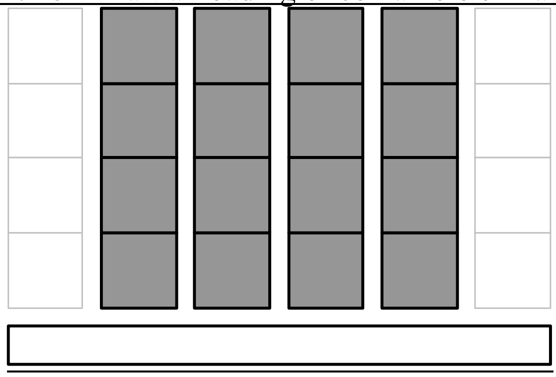


* Exposed superstructure decks located at least one superstructure standard height above the freeboard deck

** Exposed superstructure decks of ships having length L_f of greater than 100m located at least one superstructure standard height above the lowest Position II deck

2 In the application of the requirements of **20.2.4(3)** and **(4)**, **Part C** of the Rules, load cases with the partial loading of containers on hatch covers may be evaluated using a simplified approach, in cases where the hatch cover is loaded without the outermost stacks (see **Fig. C20.2.4-3**).

Fig. C20.2.4-3 Partial loading of containers on hatch covers



C20.2.5 Strength Criteria of Steel Hatch Covers and Hatch Beams

1 Where scantlings of structural members of steel hatch covers are determined based upon direct calculations, the following requirements are to be applied. Those not specified in this paragraph are to comply with the requirements in **Annex C1.1.22-1** "**GUIDANCE FOR DIRECT CALCULATIONS**."

(1) Loads

The design wave loads imposed on steel hatch covers are to be P_V specified in **20.2.4(1), Part C** of the Rules.

(2) Modelling of structures

(a) The structural model is to be able to reproduce the behaviour of the structure with the highest possible fidelity. Stiffeners and primary supporting members subject to pressure loads are to be included in the modelling. However, buckling stiffeners may be disregarded for stress calculation.

(b) Net scantlings which do not include corrosion additions are to be used for modelling.

(c) In no case is element width to be larger than stiffener spacing. The ratio of element length to width is not to exceed 4. The element height of the webs of primary supporting members is not to exceed one-third of the web height.

(d) The structural model is to be supported by pads. If the arrangement of pads differs from the arrangement of stiffeners, the edge elements of steel hatch covers are also to be modelled.

(3) Permissible value

When the loads specified in **(1)** act on the structural model specified in **(2)**, the net scantlings are to be determined so that the stress and deflection generated in each structural member satisfy the allowable values specified in **20.2.5-1**, **Part C** of the Rules.

(4) Miscellaneous

(a) The thickness of the top plating of steel hatch covers is to comply with the requirements in **20.2.5-2**, **Part C** of the Rules.

(b) The scantlings of the secondary stiffeners of steel hatch covers are to comply with the requirements in **20.2.5-3**, **Part C** of the Rules.

(c) The buckling strength for the structural members forming steel hatch covers is to comply with the requirements in **20.2.5-6**, **Part C** of the Rules.

C20.2.6 Additional Requirements for Steel Hatch Covers Carrying Cargoes

1 "Direct calculations deemed appropriate by the Society" in **20.2.6-1**, **Part C** of the Rules refers to calculations that comply with the following requirements. Those not specified in this paragraph are to comply with the requirements in **Annex C1.1.22-1** "**GUIDANCE FOR DIRECT**

CALCULATIONS".

(1) Loads

(a) The loads acting on steel hatch covers are to be according to **20.2.4, Part C** of the Rules based on the type of load and loading condition. Except as deemed necessary by the Society, no loads are to be assumed to act jointly.

(b) No dynamic loads due to ship motion are to be assumed as the wheel loads from wheeled vehicles only used for loading/unloading while in port.

(2) Modelling of Structures

(a) The structural model is to be able to reproduce the behaviour of the structure with the highest possible fidelity. Stiffeners and primary supporting members subject to pressure loads are to be included in the modelling. However, buckling stiffeners may be disregarded for stress calculation.

(b) Net scantlings which do not include corrosion additions are to be used for modelling.

(c) In no case is element width to be larger than stiffener spacing. The ratio of element length to width is not to exceed 4. The element height of the webs of primary supporting members is not to exceed one-third of the web height.

(d) The structural model is to be supported by pads. If the arrangement of pads differs from the arrangement of stiffeners, the edge elements of steel hatch covers are also to be modelled.

(3) Permissible values

When the loads specified in **(1)** act on the structural model specified in **(2)**, the net scantlings are to be determined so that the stress and deflection generated in each structural member satisfy the allowable values specified in **20.2.5-1**, **Part C** of the Rules.

2 The details for steel hatch covers carrying cargoes are to comply with the following **(1)** to **(4)**:

(1) To prevent damage to hatch covers and the ship structure, the location of stoppers is to be compatible with the relative movements between hatch covers and the ship structure.

(2) Hatchway covers and supporting structures are to be adequately stiffened to accommodate the load from hatch covers.

(3) At the cross-joints of multi-panel covers, vertical guides (male/female) are to be fitted to prevent excessive relative vertical deflections between loaded/unloaded panels.

(4) The construction and scantlings of hatchways on exposed parts or on the lower deck are to comply with the following requirements in addition to those of **20.2, Part C** of the Rules.

(a) The loading arrangement is to be clearly shown in drawings submitted for approval. In the case of freight containers, the type and location are to be additionally described.

(b) Girders or stiffeners are to be provided for reinforcement beneath the corner fittings of freight containers.

(c) The top plates of hatch covers, upon which wheeled vehicles are loaded, are to comply with the following:

i) The thickness of hatch cover top plating may be determined by direct calculation or in accordance with **C17.3.5**.

ii) The scantlings of the stiffeners of hatch covers may be determined by direct calculation or in accordance with **C10.9.1**.

C20.2.10 Closing Arrangements

"At the discretion of the Society" prescribed in **20.2.10-2, Part C** of the Rules refers to the following case:

(1) The case in which the height h_E (*mm*) of the transverse cover guides above the hatch cover supports is not less than that obtained from the following formula (see **Fig. C20.2.10-1**):

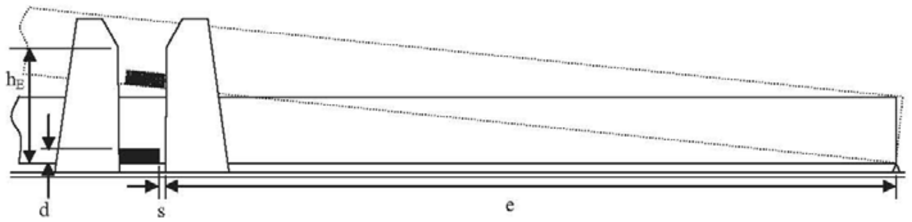
$h_E = 1.75\sqrt{2se + d^2} - 0.75d$, however, in no case is h_E to be less than the height of the cover edge plate plus 150 *mm*.

e: Largest distance (*mm*) from the inner edges of the transverse cover guides to the ends of the cover edge plate

s: Total clearance (*mm)* within the transverse cover guide, with $10 \leq s \leq 40$

d: Distance between the upper edge of transverse stopper and the hatch cover supports

Fig. C20.2.10-1 Height of transverse cover guides



C20.2.12 Steel Hatchway Covers for Container Carriers

1 In the application of the requirements of **20.2.12**, **Part C** of the Rules, the height of coamings above the upper surface of the deck where the hatchway covers are fitted is to be at least 600 *mm* in Position II.

2 In the application of the requirements of **20.2.12-1, Part C** of the Rules, the following requirements **(1)** through **(4)** are to be complied with:

(1) The hatchway covers concerned may be fitted to hatchways located on weatherdecks which are at least two standard superstructure heights (as per Regulation 33 of the "*International Convention on Load Lines*, 1966") above an actual freeboard deck or an assumed freeboard deck from which the freeboard can be calculated which will result in a draught not less than that corresponding to the freeboard actually assigned. Where any part of a hatchway is forward of a point located one quarter of the ship's length ($0.25L_f$) from the forward perpendicular, that hatchway is to be located on a weatherdeck at least three standard superstructure heights above the actual or assumed freeboard deck.

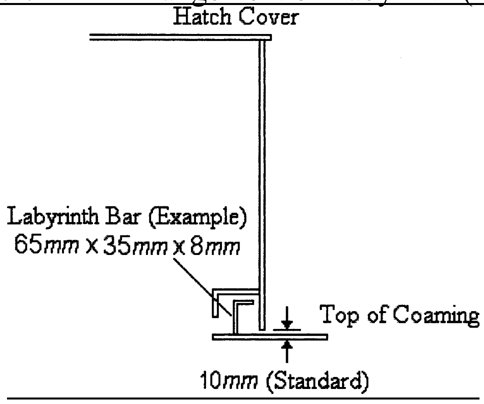
(2) The non-weathertight gaps between hatch cover panels are to be considered as unprotected openings in the application of **Part U** and **Chapter 4, Part C** of the Rules. They are to be as small as possible commensurate with the capacity of the bilge system and expected water ingress, and the capacity and operational effectiveness of the fixed gas fire-extinguishing system required in **Part R** of the Rules, and are not to be more than 50 *mm*.

(3) Labyrinths, gutter bars, or other equivalent means are to be fitted close to the edges of each panel in way of the gaps to minimize the amount of water that can enter the container hold from the top surface of each panel. In general, the height of such means is not to be less than 65 *mm* from the top of the coaming and gutter bars or from the top of the panel, and the gaps between hatch covers and the top of the coaming are not to exceed 10 *mm*. (See **Fig. C20.2.12-1**)

(4) Bilge alarms are to be provided in each hold fitted with non-weathertight covers.

3 In the application of **20.2.12-2**, **Part C** of the Rules, relevant requirements specified in MSC/Circ.1087 may be applied.

Fig. C20.2.12-1 Arrangement of Labyrinth (Example)



C20.2.13 Additional Requirement for Small Hatchways Fitted on Exposed Fore Decks

1 General

(1) The strength of, and securing devices for, small hatchways fitted on the exposed fore deck in **20.2.13**, **Part C** of the Rules are to comply with the requirements of this paragraph.

(2) Small hatchways in the context of this requirement are hatchways designed for access to spaces below the deck and are capable of being closed weathertight or watertight, as applicable. Their opening is normally 2.5 m^2 or less.

(3) Notwithstanding the provisions of **(1)** above, hatchways designed for emergency escape need not comply with the requirements of **-3(1)(a)**, **-3(1)(b)**, **-4(3)** and **-5**.

(4) The securing devices of the hatchways for emergency escape are to be of a quick-acting type (e.g., one action wheel handles are provided as central locking devices for latching/unlatching of hatch cover) operable from both sides of the hatch cover.

2 Strength

(1) For small rectangular steel hatch covers, plate thickness, stiffener arrangement and scantlings are to be in accordance with **Table C20.2.13-1** and **Fig. C20.2.13-1**. Stiffeners, where fitted, are to be aligned with the metal-to-metal contact points, required in **-4(1)**. Primary stiffeners are to be continuous. All stiffeners are to be welded to the inner edge stiffener. (See **Fig. C20.2.13-2**)

(2) For rectangular hatchways, the upper edge of hatchway coamings is to be suitably reinforced by a horizontal section, normally not more than 170 to 190 *mm* from the upper edge of the coamings.

(3) For small hatch covers of a circular or similar shape, the cover plate thickness and reinforcement is to be according to the requirements of the Society.

(4) For small hatch covers constructed of materials other than steel, the required scantlings are to provide equivalent strength.

Table C20.2.13-1 Scantlings for Small Steel Hatch Covers on the Fore Deck

Nominal size (*mm* × *mm*)	Cover plate thickness (*mm*)	Primary stiffeners	Secondary stiffeners
		Flat Bar (*mm* × *mm*); number	
630 × 630	8	-	-
630 × 830	8	100 × 8 ; 1	-
830 × 630	8	100 × 8 ; 1	-
830 × 830	8	100 × 10 ; 1	-
1030 × 1030	8	120 × 12 ; 1	80 × 8 ; 2
1330 × 1330	8	150 × 12 ; 2	100 × 10 ; 2

Fig. C20.2.13-1 Arrangement of Stiffeners

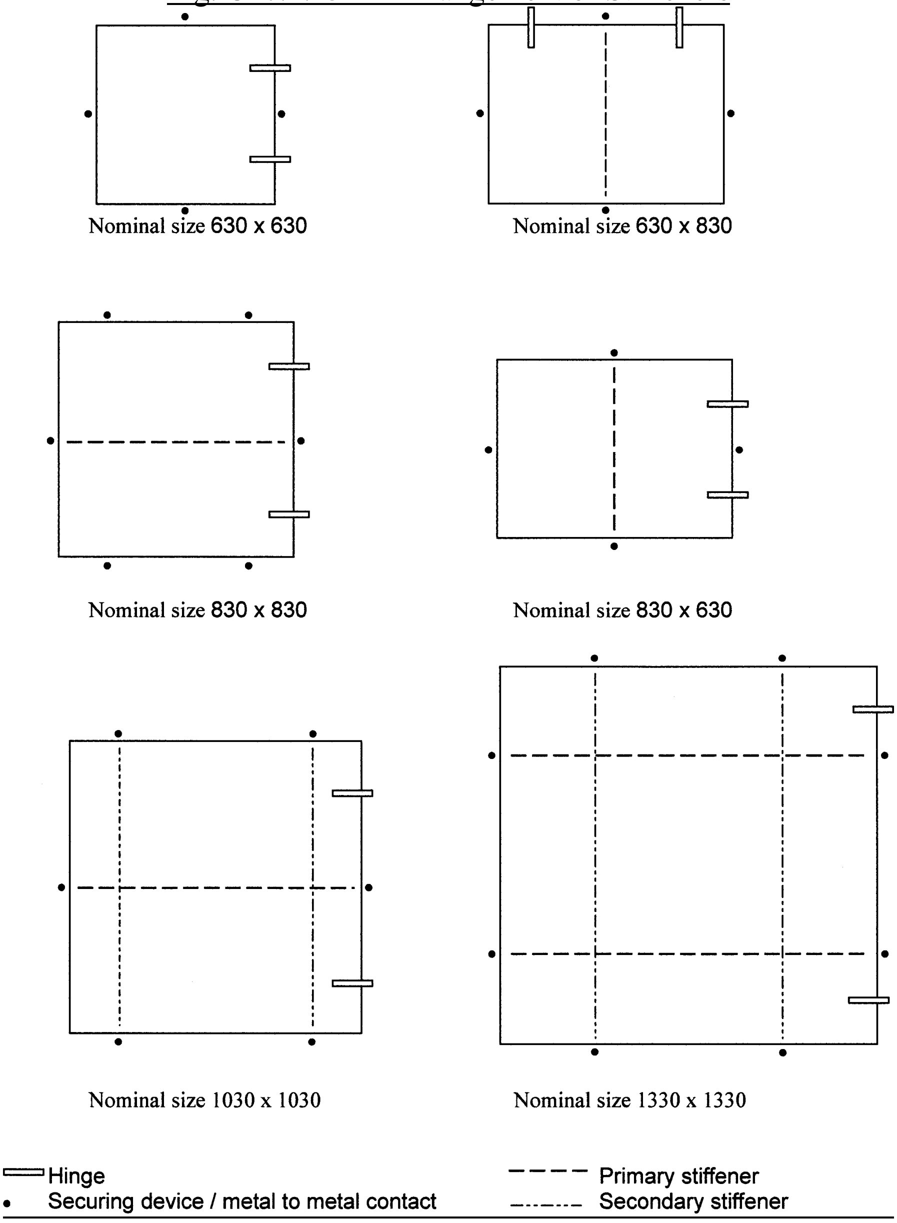
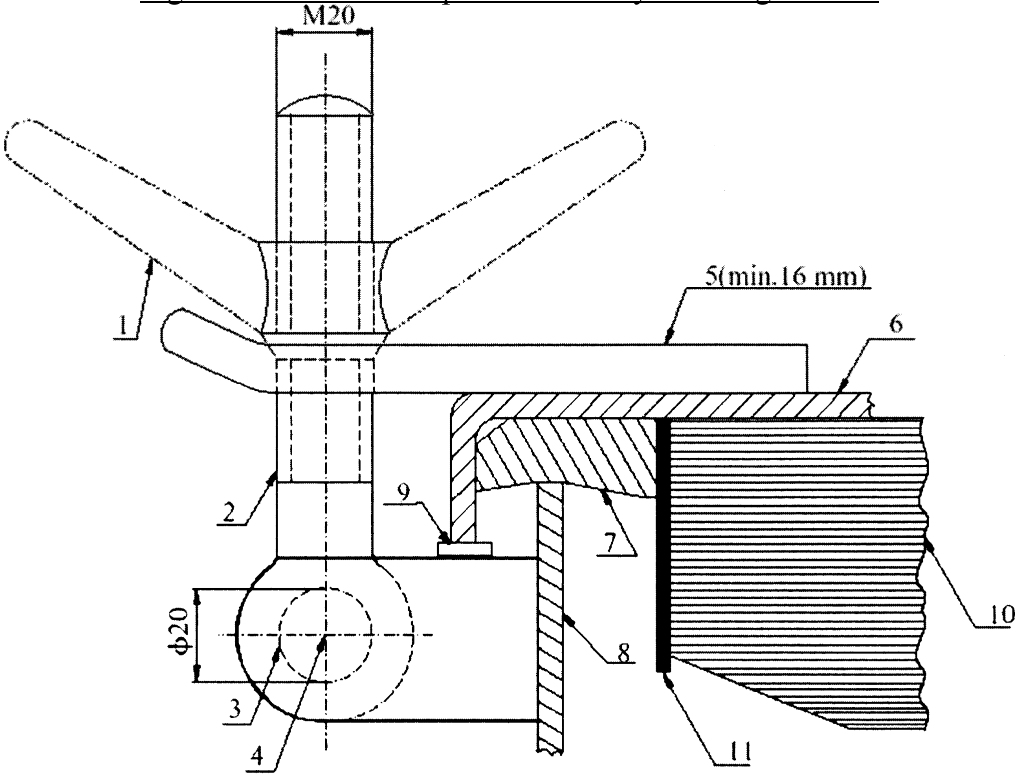


Fig. C20.2.13-2 Example of a Primary Securing Method



(Note : Dimensions in millimeters)

1. Butterfly nut
2. Toggle Bolt
3. Toggle bolt pin
4. Center of toggle bolt pin
5. Fork(clamp) plate
6. Hatch cover
7. Gasket
8. Hatch coaming
9. Bearing pad welded on the bracket of a toggle bolt for metal to metal contact
10. Stiffener
11. Inner edge stiffener

3 Primary Securing Devices

(1) Small hatchways located on an exposed fore deck subject to the application of this requirement are to be fitted with primary securing devices such that their hatch covers can be secured in place and weathertight by means of a mechanism employing any one of the following methods:

(a) Butterfly nuts tightening onto forks (clamps)

(b) Quick acting cleats

(c) Central locking device

(2) Dogs (twist tightening handles) with wedges are not acceptable.

4 Requirements for Primary Securing Devices

(1) Hatch covers are to be fitted with a gasket of elastic material. This is to be designed to allow metal-to-metal contact at a designed compression and to prevent over compression of the gasket by green sea forces that may cause the securing devices to be loosened or dislodged. (See item 9 of **Fig.C20.2.13-2**) The metal-to-metal contacts are to be arranged close to each securing device in accordance with **Fig.C20.2.13-1**, and of sufficient capacity to withstand the bearing force.

(2) The primary securing device is to be designed and manufactured such that the designed

compression pressure is achieved by one person without the need of any tools.

(3) For a primary securing device that uses butterfly nuts, the forks (clamps) are to be of a robust design. They are to be designed to minimize the risk of the butterfly nuts being dislodged while in use; by means of curving the forks upward, a raised surface on the free end, or a similar method. The plate thickness of unstiffened steel forks is not to be less than 16 *mm*. An example arrangement is shown in **Fig.C20.2.13-2**.

(4) For small hatch covers located on an exposed deck forward of the foremost cargo hatch, the hinges are to be fitted such that the predominant direction of green sea force will cause the cover to close, which means that the hinges are normally to be located on the fore edge.

(5) On small hatchways located between the main hatchways, for example between Nos. 1 and 2, the hinges are to be placed on the fore edge or outboard edge, whichever is practicable for protection from green sea force in beam seas and bow quartering conditions.

5 Secondary Securing Device

Small hatchways on the fore deck are to be fitted with an independent secondary securing device (e.g. by means of a sliding bolt, a hasp or a backing bar of slack fit) which is capable of keeping the hatch cover in place, even in the event that the primary securing device becomes loosened or dislodged. It is to be fitted on the side opposite to the hatch cover hinges

EFFECTIVE DATE AND APPLICATION (Amendment 2-4)

1. The effective date of the amendments is 1 July 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.
*"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.