RUSSIAN MARITIME REGISTER OF SHIPPING

CIRCULAR LETTER **No. 314-27-1703c** dated 14.02.2022

Re:
amendments to the Common Structural Rules for Bulk Carriers and Oil Tankers in accordance with Corrigenda 1 to CSR 01 Jan 2021 version

Item(s) of supervision:
bulk carriers and oil tankers under construction and in service

Entry-into-force date:
01.07.2021

~~Cancels / amends / adds Circular Letter No.~~ ~~dated~~

Number of pages: 1 + 35

Appendices:
Appendix 1: information on amendments introduced by the Circular Letter
Appendix 2: text of Corrigenda 1

Director General Konstantin G. Palnikov

Text of CL:
We hereby inform that Corrigenda 1 to CSR 01 Jan 2021, containing the list of editorial amendments to the IACS Common Structural Rules for Bulk Carriers and Oil Tankers, 01 January 2021 version, was posted on the official IACS website (https://iacs.org.uk/).

The document will be fully introduced to the IACS CSR upon the re-publication in 2022.

It is necessary to do the following:

1. Bring the content of the Circular Letter to the notice of the RS surveyors, as well as interested organizations and persons in the area of the RS Branch Offices' activity.
2. Apply the provisions of the Circular Letter during review and approval of the technical documentation on equipment installed on board the ships contracted for construction or conversion on or after 01.07.2021*, in the absence of a contract for construction, according to 5.10 of Part II "Technical Documentation" of the Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships, starting from 01.07.2021.

* The definition of "date of contract for construction of a ship (series of ships)" is set out in 1.1.2 of Part I "Classification" of the Rules for Classification and Construction of Sea-Going Ships.

List of the amended and/or introduced paras/chapters/sections:
Common Structural Rules for Bulk Carriers and Oil Tankers

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Appendix 1 to Circular Letter
No. 314-27-1703c dated 14.02.2022

Information on amendments introduced by the Circular Letter
(for inclusion in the Revision History to the RS Publication)

Nos.	Amended paras/chapters/sections	Information on amendments	Number and date of the Circular Letter	Entry-into-force date
1	Common Structural Rules for Bulk Carriers and Oil Tankers	Amendments in accordance with Corrigenda 1 to CSR 01 Jan 2021 version	314-27-1703c of 14.02.2022	

Common Structural Rules for Bulk Carriers and Oil Tankers

Corrigenda 1 to 01 January 2021 version

Notes: (1) This Corrigenda enters into force on 1st July 2021

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PART 1 GENERAL HULL REQUIREMENTS

CHAPTER 1
RULE GENERAL PRINCIPLES

SECTION 3
VERIFICATION OF COMPLIANCE

2 DOCUMENTS TO BE SUBMITTED

2.2 Submission of plans and supporting calculations

2.2.1 Plans and supporting calculations are to be submitted for approval

Table 1: Plans and supporting calculation to be submitted for approval

Plan or supporting calculation	Containing also information on
[Omitted]	[Omitted]
Sea chests, stabiliser recesses, etc	-
~~Plan of manholes~~	-
Plan of access to and escape from spaces	-
[Omitted]	[Omitted]

2.2.2 Plans to be submitted for information

In addition to those in [2.2.1], the following plans are to be submitted to the Society for information:

a) General arrangement.

b) Capacity plan, indicating the volume and position of the centre of gravity of all compartments and tanks.

c) Lines plan, when deemed necessary by the Society.

d) Hydrostatic curves.

e) Lightweight distribution.

f) Docking plan.

g) Arrangement of lifting appliances

h) Plan of manholes

SECTION 4
SYMBOLS AND DEFINITIONS

2 SYMBOLS

2.1 Ship's main data

2.1.1

Table 2: Ship's main data

Terms	Definition	Units
[Omitted]	[Omitted]	[Omitted]

T_{BAL-H}	Heavy ballast draught at midship	m
T_{BAL-E}	Emergency ballast draught or gale ballast draught at midship	m
[Omitted]	[Omitted]	[Omitted]

Table 7: Definition of terms

Terms	Definition
[Omitted]	[Omitted]
Corrugation	- Plating arranged in a corrugated fashion, shedder and gusset plates excluded.
[Omitted]	[Omitted]

3 DEFINITIONS

3.1 Principal Particulars

3.1.9 Lightweight

The lightweight is the ship displacement, in t, complete in all respects, but without cargo, consumable, stores, ~~passengers and~~ crew and their effects, and without any liquids on board except that machinery and piping fluids, such as lubricants and hydraulics, are at operating levels

CHAPTER 2
GENERAL ARRANGEMENT DESIGN

SECTION 3
COMPARTMENT ARRANGEMENT

7 BALLAST TANKS

7.1 Capacity and disposition of ballast tanks

7.1.1

[Omitted]

- In addition, for oil tankers, the moulded draught amidships, T_{mid}, excluding any hogging or sagging correction, is not to be less than:
  $T_{mid} = 2.0 + 0.02$ ~~L~~ L_{LL}, in m

[Omitted]

CHAPTER 3
STRUCTURAL DESIGN PRINCIPLES

SECTION 1
MATERIALS

2 Hull structural steel

2.3 Steel grades

Table 5: Minimum material grades for ships with length exceeding 250 m

Structural member category (1)	**Material grade**
~~Shear~~ Sheer strake at strength deck	Grade E/EH within 0.4 *L* amidships
Stringer plate in strength deck	Grade E/EH within 0.4 *L* amidships
Bilge strake	Grade D/DH within 0.4 *L* amidships
(1) Single strakes required to be of Grade D/DH or Grade E/EH as shown in the above table and within 0.4 *L* amidships are to have breadths not less than 800+5 *L* (mm), need not be greater than 1800 (mm), unless limited by the geometry of the ship's design.	

SECTION 6
STRUCTURAL DETAIL PRINCIPLES

2 GENERAL PRINCIPLES

2.3 Connection of longitudinal members not contributing to the hull girder longitudinal strength

2.3.1

Where the hull girder stress at the strength deck or at the bottom as defined in Ch 5, Sec 1, [2.2.2] is higher than the permissible stress as defined in Ch 5, Sec 1, [2.2.1] for normal strength steel, longitudinal members not contributing to the hull girder longitudinal strength and welded to the strength deck or bottom plating and ~~bilge strake~~ bilge plating, such as longitudinal hatch coamings, gutter bars, strengthening of deck openings, bilge keel, are to be made of steel with the same specified minimum yield stress as the strength deck or bottom structure steel.

3 STIFFENERS

3.2 Bracketed end connection of non-continuous stiffeners

3.2.5 Brackets at the ends of non-continuous stiffeners

[Omitted]

For connections similar to item (b) in Figure 3, but not lapped, the bracket arm length is to comply with

$l_{bkt} \geq 2.0\ h_{stf}$

[Omitted]

5 INTERSECTION OF STIFFENERS AND PRIMARY SUPPORTING MEMBERS

5.2 Connection of stiffeners to PSM

5.2.7

Where the web stiffener of the PSM is parallel to the web of the intersecting stiffener, but not connected to it, the offset PSM web stiffener is to be located in close proximity to the slot edge as shown in Figure 10. The ends of the offset web stiffeners are to be suitably tapered and softened.

~~Locations where the web stiffener of the PSM are not connected to the intersecting stiffeners as well as the detail arrangements are to be specially considered on the basis of their ability to transmit load with equivalent effectiveness to that of [5.2.2] through [5.2.7]. Details of calculations made and/or testing procedures and results are to be submitted.~~

7 DOUBLE BOTTOM STRUCTURE

7.5 Bilge keel

7.5.3 Ground bars

Bilge keels are not to be welded directly to the shell plating. A ground bar, or doubler, is to be fitted on the shell plating as shown in Figure 18 and Figure 19. In general, the ground bar is to be continuous.
The gross thickness of the ground bar is not to be less than the gross thickness of the ~~bilge strake~~ bilge plating or 14 mm, whichever is the lesser.

10 BULKHEAD STRUCTURE

10.5 Non-tight bulkheads

10.5.2 Non-tight bulkheads not acting as pillars

In general, the maximum spacing of stiffeners fitted on non-tight bulkheads not acting as pillars is to be:
- 0.9 m, for transverse bulkheads.
- Two frame spacings, with a maximum of 1.5 m, for longitudinal bulkheads.

The net thickness of bulkhead stiffener, in mm, is not to be less than:
$t = 3 + 0.015\, L_2$
The depth of bulkhead stiffener of flat bar type is in general not to be less than 1/12 of stiffener length.
A smaller depth of stiffener may be accepted based on calculations showing compliance with ~~Ch 6, Sec 5~~ Ch 10, Sec 4, [2.2] and Ch 8.

SECTION 7
STRUCTURAL IDEALISATION

Symbols

φ_w : Angle, in deg, between the stiffener or primary supporting member web and the attached plating, see Figure 14. φ_w is to be taken equal to 90 deg if the angle is ~~greater than or equal to~~ between 75 and 105 deg including 75 and 105 deg.

1 STRUCTURAL IDEALISATION OF STIFFENERS AND PRIMARY SUPPORTING MEMBERS

1.4 Geometrical properties of stiffeners and primary supporting members

1.4.3 Effective shear depth of stiffeners

The effective shear depth of stiffeners, d_{shr}, in mm, is to be taken as:

$d_{shr}=(h_{stf} - 0.5t_{c\text{-}stf} + t_p + 0.5t_{c\text{-}pl}) \sin\varphi_w$

where:

h_{stf} : Height of stiffener, in mm, as defined in Ch 3, Sec 2, Figure 2.

t_p : Net thickness of the stiffener attached plating, in mm, as defined in Ch 3, Sec 2, Figure 2.

t_{c_stf} :Corrosion addition, in mm, of considered stiffener as given in Ch 3, Sec 3.

t_{c_pl} : Corrosion addition, in mm, of attached plate of the stiffener considered as given in Ch 3, Sec 3.

~~φ_w : Angle, in deg, as defined in Figure 14. φ_w is to be taken as 90 degrees if the angle is greater than or equal to 75 degrees.~~

1.4.4 Elastic net section modulus and net moment of inertia of stiffeners

The elastic net section modulus, Z , in cm^3 and the net moment of inertia, I, in cm^4 of stiffeners, is to be taken as:

$Z = Z_{stf} \sin \varphi_w$

$I = I_{st} \sin^2 \varphi_w$

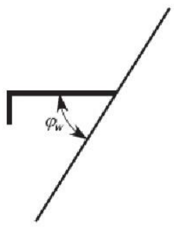
where:

Z_{stf} : Net section modulus of the stiffener, in cm^3, considered perpendicular to its attached plate, i.e. with φ_w = 90 deg.

I_{st} : Net moment of inertia of the stiffener, in cm^4, considered perpendicular to its attached plate, i.e. with φ_w = 90 deg.

~~φ_w : Angle, in deg, as defined in Figure 14. φ_w is to be taken as 90 degrees if the angle is greater than or equal to 75 degrees.~~

Figure14: Angle between stiffener web and attached plating



1.4.6 Effective net plastic section modulus of stiffeners

The effective net plastic section modulus, Z_{pl}, of stiffeners, in cm^3, which is used for assessment against impact loads, is to be taken as:

$$Z_{pl} = \frac{f_w h_w^{2} t_w}{2000} + \frac{(2\gamma - 1) A_f h_{f-ctr}}{1000}$$ for 75° ≤ φ_w ≤ ~~90~~105°

$$Z_{pl} = \frac{f_w h_w^{2} t_w \sin\phi_w}{2000} + \frac{(2\gamma - 1) A_f \left(h_{f-ctr} \sin\phi_w - b_{f-ctr} \left|\cos\phi_w\right|\right)}{1000}$$ for φ_w< 75° or φ_w> 105°

where:

[Omitted]

t_f : Net flange thickness, in mm.

- t_f = 0 for flat bar stiffeners.
- For bulb profiles t_f is defined in [1.4.1].

1.4.7 Primary supporting member web not perpendicular to attached plating

Where the primary supporting member web is not perpendicular to the attached plating, the actual net shear area, in cm², and the actual net section modulus, in cm³, can be obtained from the following formulae:

- Actual net shear area:

  $A_{sh-n50} = A_{sh-0-n50}\sin\varphi_w$ ~~for $\varphi_w < 75°$~~

  ~~$A_{sh-n50} = A_{sh-0-n50}$ for $75° \leq \varphi_w \leq 90°$~~

- Actual net section modulus:

  $Z_{n50} = Z_{perp-n50}\sin\varphi_w$ ~~for $\varphi_w < 75°$~~

  ~~$Z_{n50} = Z_{perp-n50}$ for $75° \leq \varphi_w \leq 90°$~~

where:

$A_{sh-0-n50}$: Actual net shear area, in cm², of the primary supporting member assumed to be perpendicular to the attached plating, to be taken equal to:

~~$$A_{sh-0-n50} = (h_w + t_{f-n50} + t_{p-n50})t_{w-n50}10^{-2}$$~~

$$A_{sh-0-n50} = (h_{eff} + t_{f-n50} + t_{p-n50})t_{w-n50}10^{-2}$$

$Z_{perp-n50}$: Actual section modulus, in cm³, with its attached plating of the primary supporting member assumed to be perpendicular to the attached plating.

3 STIFFENERS

3.2 Load calculation points

3.2.2 LCP for hull girder bending stress

The load calculation point for the hull girder bending stresses is defined as follows:

- For prescriptive yielding verification according to Ch 6 and Ch 10, Sec 4:
  - At the middle of the full length, ℓ, of the considered stiffener.
  - At the reference point given in Figure 23.

[Omitted]

CHAPTER 4
LOADS

SECTION 4
HULL GIRDER LOADS

2 VERTICAL STILL WATER HULL GIRDER LOADS

2.3 Vertical still water shear force

2.3.2 Minimum still water shear force in harbour/sheltered water conditions for oil tankers

[Omitted]
b) For oil tankers with two cargo tanks across the breadth of the ship:
~~Q_{sw-min}~~ $Q_{sw-p-min} = \pm 0.45 \rho g B_{local} \ell_{tk} T_{SC}$
and is to be taken as maximum value of $Q_{sw-p-min}$ calculated for cargo/ballast tanks forward and aft of the transverse bulkhead.

SECTION 6
INTERNAL LOADS

1 PRESSURE DUE TO LIQUID

1.5 Dynamic pressure in flooded conditions

1.5.1 Dynamic pressure in flooded compartment

The dynamic pressure, P_{fd}, in kN/m^2, for watertight boundaries of flooded compartments is to be taken as:
[Omitted]
f_{ull-l}, f_{ull-t}: Longitudinal and transverse correction factors:

When z_{FD} ~~$>$~~ $\leq z_0$, *full-l* and *full-t* are to be taken as defined in [1.3.1].

When z_{FD} ~~$\leq$~~ $\geq z_0$, *full-l* = 1.0 and *full-t* = 1.0.

6 SLOSHING PRESSURES IN TANKS

6.3 Sloshing pressures due to longitudinal liquid motion

6.3.2 Effective sloshing length

The effective sloshing length, ℓ_{slh}, in m, is to be taken as defined in Table 11.

Table 11: (omitted)

where:
α_{WT}: Transverse wash bulkhead coefficient, to be taken as (see Figure 11)

$\alpha_T = \frac{A_{OWT}}{A_{tk-t-h}}$

For tanks with changing shape along the length and/or with wash bulkhead of different shape the transverse wash bulkhead coefficient, α_{WT}, may be taken as the weighted average of all wash bulkhead locations in the tank given as:

$$\alpha_{WT} = \frac{\sum_{i=1}^{n_{WT}} \frac{A_{OWT_i}}{A_{tk-t-h_i}}}{n_{WT}}$$

[Omitted]

6.4 Sloshing pressures due to transverse liquid motion

6.4.2 Effective sloshing breadth

The effective sloshing breadth, b_{slh}, in m, is to be taken as in Table 12, but not less than 0.3B.

Table 12: (omitted)

Where:

n_{WL}: Number of longitudinal wash bulkheads in the tank.

α_{WL}: Longitudinal wash bulkhead coefficient:

$\alpha_{WL} = \frac{A_{OWL}}{A_{tk-L-h}}$

For tanks with changing shape along the breadth and/or with wash bulkhead of different shape the longitudinal wash bulkhead coefficient, α_{WL}, may be taken as the weighted average of all wash bulkhead locations in the tank given as:

$$\alpha_{WL} = \frac{\sum_{i=1}^{n_{WL}} \frac{A_{OWL_i}}{A_{tk-L-h_i}}}{n_{WL}}$$

α_{grd}: Girder coefficient, to be taken as:

$\alpha_{grd} = \frac{A_{O-grd-h}}{A_{tk-L-h}}$

For tanks with changing shape along the breadth and/or with girder of different shape the girder coefficient, α_{grd}, may be taken as the weighted average of all girder locations in the tank given as:

$$\alpha_{grd} = \frac{\sum_{i=1}^{n_{grd}} \frac{A_{O-grd-h_i}}{A_{tk-L-h_i}}}{n_{grd}}$$

[omitted]

7 DESIGN PRESSURE FOR TANK TESTING

7.1 Definition

Table 13 : Design testing load height z_{ST}

Compartment	z_{ST}
Double bottom tanks(1)	The greater of the following: $z_{ST} = z_{top} + h_{air}$ $z_{ST} = z_{bd}$
Hopper side tanks, topside tanks, double side tanks, fore and after peaks used as tank	The greater of the following: $z_{ST} = z_{top} + h_{air}$ $z_{ST} = z_{top} + 2.4$

Tank bulkheads, deep tanks, fuel oil bunkers	The greater of the following: $z_{ST} = z_{top} + h_{air}$ $z_{ST} = z_{top} + 2.4$ $z_{ST} = z_{top} + 0.1P_{PV}$
Ballast hold	$z_{ST} = z_h + 0.9$
Chain locker ~~(if aft of collision bulkhead)~~	$z_{ST} = z_C$
Independent tanks	The greater of the following: $z_{ST} = z_{top} + h_{air}$ $z_{ST} = z_{top} + 0.9$
Ballast ducts	Testing load height corresponding to ballast pump maximum pressure
where: z_{bd} : *Z* coordinate, in m, of the bulkhead deck. z_h : *Z* coordinate, in m, of the top of hatch coaming. z_C : *Z* coordinate, in m, of the top of the chain pipe. **(1)** For double bottom tanks connected with hopper side tanks, topside tanks or double side tanks, z_{ST} corresponding to "Hopper side tanks, topside tanks, double side tanks, fore and aft peaks used as tank, cofferdams" is applicable.	

SECTION 8
LOADING CONDITIONS

4 BULK CARRIERS

4.1 Specific design loading condition

4.1.4 Cargo loading condition for BC-A

As required for BC-B, plus:

At least one cargo loaded condition with specified holds empty, with cargo density 3.0 t/m³, and the same filling ratio (cargo mass/hold cubic capacity) in all loaded cargo holds at scantling draught with all ballast tanks empty.

The combination of specified empty holds is to be indicated with the additional service feature {~~h~~Holds a, b, … may be empty}.

In such cases where the design cargo density applied is different from 3.0 t/m³, the maximum density of the cargo that the ship is allowed to carry is to be indicated in the loading manual. If the maximum density is less than 3.0 t/m³ then the additional service feature {~~h~~Holds a, b, … may be empty with maximum cargo density x.y t/m³} is to be indicated as defined in Ch 1, Sec 1, [3.2.1].

4.2 Design load combinations for direct strength analysis

4.2.1 Application general loading patterns

The following loading patterns are to be applied:

a) Any cargo hold carrying M_{Full} with fuel oil tanks in way of the cargo hold, if any, being 100% full and ballast water tanks in the double bottom in way of the cargo hold being empty, at scantling draught.
b) Any cargo hold carrying minimum 50% of M_H, with all double bottom tanks <u>and all fuel oil tanks</u> in way of the cargo hold being empty, at scantling draught.
c) Any cargo hold taken empty, with all double bottom tanks <u>and all fuel oil tanks</u> in way of the cargo hold being empty, at the deepest ballast draught. Where a topside and double bottom tank are permanently connected as a common tank, the following conditions are to be considered:

[omitted]

4.2.2 Multiport conditions

The following multiport conditions are applicable to all types of bulk carriers except when the service feature {no MP} is assigned:

a) Any cargo hold carrying M_{Full} with fuel oil tanks in way of the cargo hold, if any, being 100% full and ballast water tanks in the double bottom in way of the cargo hold being empty, at 67% of scantling draught.
b) Any cargo hold taken empty with all double bottom tanks and all fuel oil tanks in way of the cargo hold being empty, at 83% of scantling draught.
c) Any two adjacent cargo holds carrying M_{Full} with the next holds being empty, with fuel oil tanks in way of the cargo hold, if any, being 100% full and ballast water tanks in the double bottom in way of the cargo hold being empty, at 67% of the scantling draught. This requirement to the mass of the cargo and fuel oil ~~in double bottom~~ tanks in way of the cargo hold applies also to the condition where the adjacent hold is filled with ballast.
d) Any two adjacent cargo holds being empty with the next holds being full, with all double bottom tanks and fuel oil tanks in way of the cargo hold being empty, at 75% of scantling draught.

4.2.3 Alternate conditions

The following alternate conditions are applicable to BC-A only:

a) Cargo holds which are intended to be empty at scantling draught, being empty with all double bottom tanks and fuel oil tanks in way of the cargo hold also being empty.

[omitted]

4.2.4 Heavy ballast condition

The following condition applies to ballast holds only:

- Cargo holds which are designed as ballast water holds, being 100% full of ballast water including hatchways, with all double bottom tanks and fuel oil tanks in way of the cargo hold being 100% full, at any heavy ballast draught. For ballast holds adjacent to topside wing, hopper and double bottom tanks, it shall be strengthwise acceptable that the ballast holds are filled when the topside wing, hopper, stool, and double bottom tanks are empty.

4.2.5 Additional harbour condition for all bulk carriers

The following additional harbour conditions apply to all bulk carriers:

a) At reduced draught during loading and unloading in harbour, the maximum allowable mass in a cargo hold may be increased by 15% of the maximum mass allowed at the scantling draught in seagoing condition, but is not to exceed the mass allowed at scantling draught in the seagoing condition. The minimum required mass may be reduced by the same amount.

b) Any single cargo hold holding the maximum allowable seagoing mass at 67% of scantling draught, in harbour condition~~.~~ with fuel oil tanks in way of the cargo hold, if any, being 100% full and ballast water tanks in the double bottom in way of the cargo hold being empty.

Any two adjacent cargo holds carrying M_{Full} with the next holds being empty, with fuel oil tanks ~~in the double bottom~~ in way of the cargo hold, if any, being 100% full and ballast water tanks in the double bottom in way of the cargo hold being empty, at 67% of scantling draught, in harbour condition.

CHAPTER 5
HULL GIRDER STRENGTH

SECTION 1 HULL GIRDER YIELDING STRENGTH

3 HULL GIRDER SHEAR STRENGTH ASSESSMENT

3.4 Effective net thickness for longitudinal bulkheads between cargo tanks of oil tankers

3.4.6 Equivalent net thickness of corrugation

The equivalent net thickness, in mm, of the corrugation of vertical and horizontal corrugated bulkheads, $t_{cor-n50}$, to be used for the calculation of the effective net shear area of A_{3-n50} in Table 7 and for the unit shear flow, is given as follows:

$$t_{cor-n50} = \frac{t_{w-gr} + t_{f-gr}}{2} \cdot \frac{S_c}{c+a} - 0.5t_c$$

where:

t_{w-gr} : Gross corrugation web thickness, in mm.
t_{f-gr} : Gross corrugation flange thickness, in mm.
S_c : Projected length of one corrugation, in mm, as defined in Ch 3, Sec 6, Figure 21.
c : Breadth of corrugation web, in mm, as defined in Ch 3, Sec 6, Figure 21.
a : Breadth of corrugation flange, in mm, as defined in Ch 3, Sec 6, Figure 21.

CHAPTER 6
HULL LOCAL SCANTLING

SECTION 4
PLATING

1 PLATING SUBJECTED TO LATERAL PRESSURE

1.2 Plating of corrugated bulkheads

1.2.1 Cold, hot formed and built-up corrugations

The net thicknesses, t in mm, of the web and flange plates of corrugated bulkheads are not to be taken less than the greatest value calculated for all applicable design load sets, as defined in Ch 6, Sec 2, [2.1.3], given by:

$$t = 0.0158 b_p \sqrt{\frac{|P|}{C_{CB} R_{eH}}}$$

where:

b_p : Breadth of plane corrugation plating:

b_p = ~~a~~ $\underline{b_{f\text{-}cg}}$ for flange plating, in mm, as defined in Ch 3, Sec 6, Figure 21.

b_p = ~~c~~ $\underline{b_{w\text{-}cg}}$ for web plating, in mm, as defined in Ch 3, Sec 6, Figure 21.

C_{CB} : Permissible bending stress coefficient for corrugated bulkhead plating taken equal to:

[omitted]

2 SPECIAL REQUIREMENTS

2.2 Bilge plating

2.2.1 Definition of bilge ~~area~~ plating

The definition of bilge ~~area~~ plating is given in Ch 1, Sec 4, [3.8.1].

2.4 Sheer strake

2.4.2 Welded Sheer strake

The net thickness of a welded sheer strake is not to be less than the offered net thickness of the adjacent ~~2 m width~~ side plating, provided this adjacent side plating is located entirely within the top wing tank or double side tank as the case may be.

CHAPTER 7
DIRECT STRENGTH ANALYSIS

SECTION 2
CARGO HOLD STRUCTURAL STRENGTH ANALYSIS

4 LOAD APPLICATION

4.4 Procedure to adjust hull girder shear forces and bending moments

4.4.7 Method 2 for vertical shear force adjustment at both bulkheads

[Omitted]

Table 8 : Formulae for calculation of vertical loads for adjusting vertical shear forces

$\delta w_1 = \dfrac{\Delta Q_{aft}(2l - l_2 - l_3) + \Delta Q_{fwd}(l_2 + l_3)}{(n_1 - 1)(2l - l_1 - 2l_2 - l_3)} + \delta w_1'$
$\delta w_2 = \dfrac{(W1 + W3)}{(n_2 - 1)} = \dfrac{(\Delta Q_{aft} - \Delta Q_{fwd})}{(n_2 - 1)}$
$\delta w_3 = \dfrac{-\Delta Q_{fwd}(2l - l_1 - l_2) - \Delta Q_{aft}(l_1 + l_2)}{(n_3 - 1)(2l - l_1 - 2l_2 - l_3)} - \delta w_3'$
[OMITTED]
[OMITTED]

[Omitted]

CHAPTER 8
BUCKLING

SECTION 1 GENERAL

3 DEFINITION

3.2 Buckling utilization factor

3.2.2.

For combined loads, the utilisation factor, η_{act}, is to be defined as the ratio of the equivalent applied ~~equivalent~~ stress and the corresponding buckling capacity, as shown in Figure 1, and is to be taken as:

$$\eta_{act} = \frac{W_{act}}{W_u} = \frac{1}{\gamma_c}$$

Where:

W_{act} : Equivalent applied ~~equivalent~~ stress, in N/mm^2~~:~~, the actual applied stress are given in Sec 3 and Sec 4 respectively for buckling assessment by prescriptive and direct strength analysis.

~~$W_{act} = \sqrt{\sigma_x^2 + \sigma_y^2 + \tau^2}$ for plate~~

~~$W_{act} = \sigma_a + \sigma_b + \sigma_w$ for stiffener~~

W_u : Equivalent buckling capacity, in N/mm^2, ~~to be taken as:~~ for plates and stiffeners, their respective buckling or ultimate capacities are given in Sec 5.

~~$W_u = \sqrt{\sigma_{cx}^2 + \sigma_{cy}^2 + \tau_c^2}$ for plate~~

~~$W_u = \frac{R_{eH-S}}{S}$ for stiffener~~

γ_c : Stress multiplier factor at failure

For each typical failure mode, the corresponding capacity of the panel is calculated by applying the actual stress combination and then increasing or decreasing the stresses proportionally until collapse.
Figure 1 illustrates the buckling capacity and the buckling utilisation factor of a structural member subject to σ_x and σ_y stresses.

SECTION 2 SLENDERNESS REQUIREMENTS

3 STIFFENERS

3.1 Proportions of stiffeners

3.1.3 Bending stiffness of stiffeners

The net moment of inertia, in cm^4, of the stiffener with the effective width of attached plate, s_{eff}, about the neutral axis parallel to the attached plating, is not to be less than the minimum value given by:

[Omitted]

5 BRACKETS

5.1 Tripping brackets

5.1.1 Unsupported flange length

…

$S_{b\text{-}min}$: Minimum unsupported flange length taken as:

$S_{b\text{-}min}$ = 3.0 m for ~~the cargo tank/hold region, on~~ tank/hold boundaries or ~~the~~ hull envelope including external decks.

$S_{b\text{-}min}$ = 4.0 m for other areas.

6 OTHER STRUCTURES

6.2 Edge reinforcement in way of openings

6.2.1 Depth of edge stiffener

When fitted as shown in Figure 2, the depth of web, h_w in mm, of edge stiffeners in way of openings is not to be less than:

$h_w = C\ell\sqrt{\frac{R_{eH}}{235}}$ or 50 mm, whichever is greater.

Where:

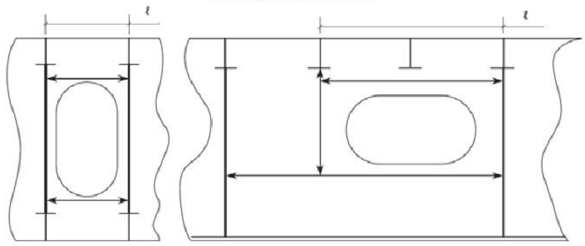
C : Slenderness coefficient taken as:

$C = 50$

R_{eH} : Specified minimum yield stress of the edge stiffener material, in N/mm².

ℓ : Length of edge stiffener in way of opening, in m, as defined in Figure 2.

Figure 2 : Typical edge reinforcements



SECTION 3 PRESCRIPTIVE BUCKLING REQUIREMENT

1 GENERAL

1.1 Scope

1.1.1

This section applies to plate panels including curved plate panels and stiffeners subject to hull girder compression and shear stresses. In addition the following structural members subject to compressive stresses are to be checked:

~~• Corrugation of transverse vertically corrugated bulkhead.~~

• Corrugation of longitudinal corrugated bulkhead.

• Strut.

• Pillar.

• Cross tie.

3 BUCKLING CRITERIA

3.4 Vertically corrugated ~~transverse and~~ longitudinal bulkheads

3.4.1

The shear buckling strength of vertically corrugated ~~transverse and~~ longitudinal bulkheads is to satisfy the following criterion:

$\eta_{Shear} \leq \eta_{all}$

where:

[Omitted]

τ_{bhd}: Hull girder ~~S~~shear stress, in N/mm^2, in the longitudinal bulkhead ~~taken~~ as defined in [2.1.2]

~~· For longitudinal bulkheads: hull girder shear stress defined in [2.1.2]~~

~~· For transverse bulkheads: shear stress in the corrugation defined in Pt 2, Ch 1, Sec 3, [3.2.1].~~

[Omitted]

SECTION 4 BUCKLING REQUIREMENTS FOR DIRECT STRENGTH ANALYSIS

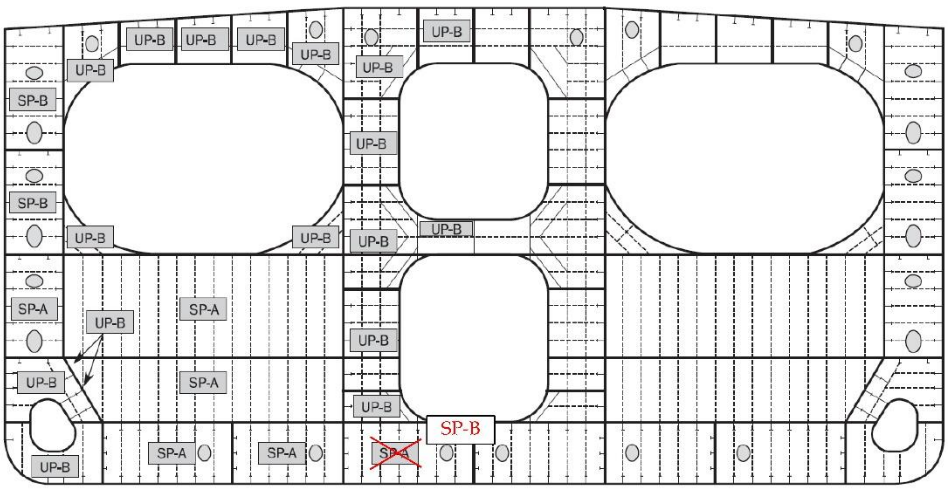
2 STIFFENED AND UNSTIFFENED PANELS

2.2 Stiffened panels

2.2.2

[Omitted]

Figure 4 : Cross tie



3 CORRUGATED BULKHEAD

3.2 Reference stress

3.2.4

Where more than one plate thicknesses are used for flange or web panel, maximum stress is to be obtained for each thickness range and to be checked with the buckling criteria for each thickness.

SECTION 5 BUCKLING CAPACITY

2 BUCKLING CAPACITY OF PLATES AND STIFFENERS

2.1 Overall stiffened panel capacity

2.1.2

The stress multiplier factor $\gamma_{GEB,bi}$ for the stiffened panel subjected to biaxial loads is taken as:

$$\gamma_{GEB,bi} = \frac{\pi^2}{L_{B1}^2 L_{B2}^2} \frac{[D_{11} L_{B2}^4 + 2(D_{12} + D_{33}) n^2 L_{B1}^2 L_{B2}^2 + n^4 D_{22} L_{B1}^4]}{L_{B2}^2 N_x + n^2 L_{B1}^2 K_{tran} N_y}$$

where:

[Omitted]

$\sigma_{x,av}$: Average stress, in N/mm^2, for both plate and stiffener with Poisson correction, taken as:

$\sigma_{x,av} = \sigma_x - \nu c \sigma_y A_s/(A_p + A_s) \geq 0$ for $\sigma_x > 0$ and $\sigma_y > 0$

$\sigma_{x,av} = \sigma_x$ for $\sigma_x \leq 0$ or $\sigma_y \leq 0$

[Omitted]

2.1.3

[Omitted]

where:

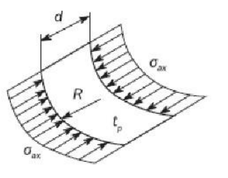
$N_{xy} = \tau t_p$

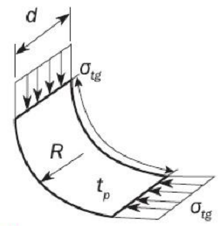
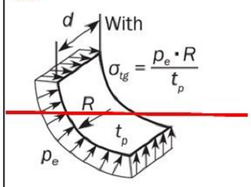
2.2 Plate capacity

2.2.6 Curved plate panels

[Omitted]

Table 4: Buckling and reduction factor for curved plate panel with R/t_p ≤ 2500

Case	Aspect Ratio	Buckling factor K	Reduction factor C
1 	$\frac{d}{R} \leq 0.5 \sqrt{\frac{R}{t_p}}$	$K = 1 + \frac{2}{3} \frac{d^2}{Rt_p}$	For general application: $C_{ax} = 1$ for $\lambda \leq 0.25$ $C_{ax} = 1.233 - 0.933\lambda$ for $0.25 < \lambda \leq 1$ $C_{ax} = 0.3/\lambda^3$ for $1 < \lambda \leq 1.5$ $C_{ax} = 0.2/\lambda^2$ for $\lambda > 1.5$ For curved single fields, e.g. ~~bilge strake~~ bilge plating, which are bounded by plane
	$\frac{d}{R} > 1.63 \sqrt{\frac{R}{t_p}}$	$K = 0.267 \frac{d^2}{RRt_p} \left[3 - \frac{d}{R} \sqrt{\frac{t_p}{R}}\right] \geq 0.4 \frac{d^2}{Rt_p}$	

			panels as shown in Ch 6, Sec 4, Figure 1: $C_{tg} = \frac{0.65}{\lambda^2} \le 1.0$
2~~a~~  ~~2b~~  p_e = external pressure in [N/mm²]	$\frac{d}{R} \le 1.63\sqrt{\frac{R}{t_p}}$	$K = \frac{d}{\sqrt{Rt_p}} + 3\frac{(Rt_p)^{0.175}}{d^{0.35}}$	For general application: $C_{tg} = 1$ for $\lambda \le 0.4$ $C_{tg} = 1.274 - 0.686\lambda$ for $0.4 < \lambda \le 1.2$ $C_{tg} = \frac{0.65}{\lambda^2}$ for $\lambda > 1.2$ For curved single fields, e.g. ~~bilge strake~~ bilge plating, which are bounded by plane panels as shown in Ch 6, Sec 4, Figure 1: $C_{tg} = \frac{0.8}{\lambda^2} \le 1.0$
	$\frac{d}{R} > 1.63\sqrt{\frac{R}{t_p}}$	$K = 0.3\frac{d^2}{R^2} + 2.25\left(\frac{R^2}{dt_p}\right)^2$	
[Omitted]			

2.2.7 Applied normal and shear stresses to plate panels

The normal stresses, σ_x and σ_y, in N/mm², to be applied for the overall stiffened panel capacity and the plate panel capacity calculations, as given in [2.1.1] and [2.2.1] respectively, are to be taken as follows:

- For FE analysis, the reference stresses as defined in Ch 8, Sec 4, [2.4].
- For prescriptive assessment of the overall stiffened panel capacity and the plate panel capacity, the axial or transverse compressive stresses calculated according to Ch 8, Sec 3, [2.2.1], at load calculation points of the considered stiffener or the considered elementary plate panel, as defined in Ch 3, Sec 7, [3] and [2], respectively. However, in case of transverse stiffening arrangement, the transverse compressive stress used for the assessment of the overall stiffened panel capacity is to be taken as the compressive stress calculated at load calculation points of the stiffener attached plating, as defined in Ch 3, Sec 7, [2].
- For grillage analysis where the stresses are obtained based on beam theory, the stress taken as:

  $$\sigma_x = \frac{\sigma_{xb} + \upsilon\sigma_{yb}}{1 - \upsilon^2}$$

  $$\sigma_y = \frac{\sigma_{yb} + \upsilon\sigma_{xb}}{1 - \nu^2}$$

  where

  σ_{xb}, σ_{xb}: Stress, in N/mm², from grillage beam analysis respectively along x or y axis of the ~~attached~~ plate attached to the PSM web~~of girders~~.

[Omitted]

- For grillage beam analysis, $\tau = 0$ in the ~~attached~~ plate attached to the PSM web~~of girders~~.

APPENDIX 1 STRESS BASED REFERENCE STRESSES

2 REFERENCE STRESSES

2.1 Regular Panel

2.1.2 Transverse stress

[Omitted]

The unknown coefficients ~~C and D~~ A and B must yield zero first partial derivatives, ∂Π with respect to ~~C and D~~ A and B, respectively.

CHAPTER 10
OTHER STRUCTURES

SECTION 1
FORE PART

3 STRUCTURE SUBJECTED TO IMPACT LOADS

3.3 Bow impact

3.3.6 Primary supporting members

[Omitted]

g) The net web thickness of each primary supporting member, tw, in mm including decks/bulkheads ~~in way of~~ directly welded to the side shell is not to be less than:

[Omitted]

SECTION 3
AFT PART

3 STREN FRAMES

3.1 General

3.1.2

Cast steel and fabricated stern frames are to be strengthened by adequately spaced horizontal plates with gross thickness not less than 80% of required thickness for stern frames, t_1, as defined in Table 1 or Table 2. Abrupt changes of section are to be avoided in castings; all sections are to have adequate tapering radius.

CHAPTER 12
CONSTRUCTION

SECTION 3
DESIGN OF WELD JOINTS

2 TEE OR CROSS JOINT

2.4 Partial or full penetration welds

2.4.6 Locations required for partial penetration welding

Partial penetration welding as defined in [2.4.2], is to be used in the following locations (see examples in Figure 3):

a) Connection of hopper sloping plate to longitudinal bulkhead (inner hull) or horizontal girder in double side space.

b) Longitudinal/transverse bulkhead primary supporting member end connections to the double bottom.

c) Corrugated bulkhead lower stool supporting floors to inner bottom.

d) Corrugated bulkhead gusset and shedder plates.

e) Lower 15% of the length of built-up corrugation of vertical corrugated bulkheads

f) Structural elements in double bottom below bulkhead primary supporting members and stool plates, except in way of [2.4.5] i).

g) Lower hopper plate to inner bottom.

h) Horizontal stringers on bulkheads in way of their bracket toe and the heel.

2.5 Weld size criteria

[Omitted]

Table 2 : Weld factors for different structural members

Hull area	**Connection**			f_{weld}
	Of		**To**	
[Omitted]				
Deck	Strength deck	$t_{as\_built} \geq 13$	Side shell plating within 0.6L midship	PPW (3)
			Elsewhere	0.48
		$t_{as\_built} < 13$	Side shell plating	0.48
[Omitted]				
Machinery Space	Centre girder		Keel and inner bottom	0.48
	Floor		Centre girder and engine foundation girder	0.48
	Engine foundation girders		Top plate ~~and primary hull structure~~ of main engine bed and inner bottom plate, where applicable	PPW (3)
	Floors and girders		Inner bottom and shell plate	0.38

(1)	f_{weld} = 0.43 for hatch coaming other than in cargo holds.
(2)	Continuous welding.
(3)	PPW: Partial penetration welding in accordance with [2.4.2]. When one side partial penetration weld is adopted, f_{weld} = 0.48 is to be used for the fillet.
(4)	FPW: Full penetration welding in accordance with [2.4.2].
(5)	Bulkheads of superstructure and deckhouses are to be considered in the row corresponding to "Superstructure and deck house".

Table 3 : Weld Factors for Miscellaneous Fittings and Equipment

Item		Connection to	f_{weld}
Hatch cover	Primary supporting members	~~Watertight/oil tight joints~~ At ends(10% of span) of PSM	0.48 [(1)]
		Elsewhere	0.24
	Stiffeners	At ends ~~of stiffeners~~	0.38 [(2)]
		Elsewhere	0.20
Mast, derrick post, crane pedestal, etc.		Deck / Underdeck reinforced structure	0.43
Deck machinery seat		Deck	0.24
Mooring equipment seat		Deck	0.43
Ring for access hole type cover		Anywhere	0.43
Stiffening of side shell doors and weathertight doors		Anywhere	0.24
Frames of shell and weathertight doors		Anywhere	0.43
Coaming of ventilator and air pipe		Deck	0.43
Ventilators, etc., fittings		Anywhere	0.24
~~Ventilators, air pipes, etc., coaming to deck~~		~~Deck~~	~~0.43~~
Scupper and discharge		Deck	0.55
Bulwark stay		Deck	0.24
Bulwark plating		Deck	0.43
Guard rail, stanchion		Deck	0.43
Cleats and fittings		Hatch coaming and hatch cover	0.60 [(3)]

(1) For bulk carrier hatch covers f_{weld} = 0.38 ~~for watertight joints~~

(2) For bulk carrier hatch covers f_{weld} = 0.24 at ends of stiffeners

(3) Minimum weld factor. Where $t_{as\text{-}built}$ >11.5 mm, ℓ_{leg} need not exceed $0.62t_{as\text{-}built}$. Penetration welding may be require depending on design.

CHAPTER 13
SHIP IN OPERATION – RENEWAL CRITERIA

SECTION 2
ACCEPTANCE CRITERIA

1 GENERAL

1.2 Definition

1.2.1 Deck zone

The deck zone includes all the following items contributing to the hull girder strength:

…

- For oil tankers: elements above or crossed by the 0.9D level line above the baseline such as:
  - Strength deck plating.
  - Deck stringer.
  - Sheer strake.
  - Inner hull and other plane longitudinal bulkheads upper most strake.
  - Topside tank sloped plating, including horizontal and vertical strakes.
  - Longitudinal upper stool.
  - Longitudinal stiffeners, girders and stringers connected to the above mentioned plating.

1.2.2 Bottom zone

The bottom zone includes the following items contributing to the hull girder strength:

- For bulk carriers: elements up to the upper level of the hopper sloping plating or up to and including the inner bottom plating if there is no hopper tank:
  - Keel plate.
  - Bottom plating.
  - Bilge plating.
  - Bottom girders.
  - Inner bottom plating.
  - Hopper tank sloping plating, and horizontal plating, if any.
  - ~~Longitudinal stiffeners connected to the above mentioned plating.~~
  - Side shell plating.
  - Plane longitudinal bulkheads lower strake.
  - Longitudinal stiffeners connected to the above mentioned plating.
- For oil tankers: elements up to the upper level of the hopper sloping plating or up to and including the inner bottom plating if there is no hopper tank
  - Keel plate.
  - Bottom plating.
  - Bilge plating.
  - Plane longitudinal bulkheads lower strake.

- Bottom girders
- ~~Longitudinal stiffeners connected to the above mentioned plating.~~
- Inner bottom plating.
- Hopper tank sloping plating, and horizontal plating, if any.
- Side shell plating.
- Longitudinal lower stool.
- Longitudinal stiffeners connected to the above mentioned plating.

PART 2 SHIP TYPES

CHAPTER 1
BULK CARRIERS

SECTION 3 HULL LOCAL SCANTLINGS

SYMBOLS

[Omitted]

s_{cw} : Plate width, in mm, taken as the width of the corrugation flange ~~a~~b_{f-cg} or the web ~~c~~b_{w-cg}, whichever is greater, see Pt 1, Ch 3, Sec 6, Figure 21.

~~s_C~~s_{cg} : Half pitch, in mm, of the corrugation flange as defined in Pt 1, Ch 3, Sec 6, Figure 21.

3 TRANSVERSE VERTICALLY CORRUGATED WATERTIGHT BULKHEADS SEPARATING CARGO HOLDS IN FLOODED CONDITION

3.2 Bending, shear and buckling check

3.2.1 Bending capacity and shear capacity

[Omitted]

A_{shr} : Net shear area, in cm^2, of one half pitch corrugation. The calculated net shear area is to consider possible reduced shear efficiency due to non-straight angles between the corrugation webs and flanges. In general, the reduced shear area may be obtained by multiplying the web sectional area by sin ~~φ~~ϕ.

~~φ~~ϕ : Angle between the web and the flange, see Pt 1, Ch 3, Sec 6, Figure 21.

[Omitted]

3.2.2 Shear buckling check of the bulkhead corrugation webs

[Omitted]

τ_E : Euler shear buckling stress, in N/mm^2, to be taken as:

$$\tau_E = 0.9\,k_t\,E\left(\frac{t_w}{\cancel{c}\;b_{w-cg}}\right)^2$$

[Omitted]

~~c~~b_{w-cg}: Width, in mm, of the corrugation webs as shown in Pt 1, Ch 3, Sec 6, Figure 21.

3.3 Net section modulus ~~at the lower end~~ of the corrugations

3.3.1 Effective flange width

The net section modulus ~~at the lower end~~ of the corrugations is to be calculated with the compression flange having an effective flange width b_{eff} not larger than the following formula:

$b_{eff} = C_E$ ~~a~~b_{f-cg}

[omitted]

B : Coefficient to be taken equal to:

$$\beta = \frac{\cancel{a}\;b_{f-cg}}{t_f}\sqrt{\frac{R_{eH}}{E}}$$

~~a~~ b_{f-cg} : Width, in mm, of the corrugation flange as shown in Pt 1, Ch 3, Sec 6, Figure 21.

t_f : Net flange thickness, in mm.

3.3.3 Effective shedder plates

Provided that effective shedder plates are fitted as shown in Figure 4, when calculating the section modulus at the lower end of the corrugations (Sections '1' in Figure 4), the net area, in cm^2, of flange plates may be increased by I_{SH} to be taken as:

$$I_{SH} = 2.5 \cdot 10^{-3} \sout{a}\ \underline{b_{f\text{-}cg}} \sqrt{t_f\, t_{SH}}$$ without being taken greater than $2.5\ \sout{a}\ \underline{b_{f\text{-}cg}}\ t_f\ 10^{-3}$

Where:

~~a~~ $\underline{b_{f\text{-}cg}}$: Width, in mm, of the corrugation flange as shown in Pt 1, Ch 3, Sec 6, Figure 21.

[omitted]

4 ALLOWABLE HOLD LOADING FOR BC-A & BC-B SHIPS IN FLOODED CONDITIONS

4.1 Evaluation of double bottom capacity and allowable hold loading

4.1.4 Allowable hold loading

[Omitted]

h_B : Level of cargo, in m, to be taken as:

$$h_B = \frac{P}{\rho_C g}$$

[Omitted]

z_F : Flooded level, in m, as defined in Pt 1, Ch 4, Sec 6, ~~[3.1.3]~~[3.2.3].

[Omitted]

SECTION 4
HULL LOCAL SCANTLING FOR BULK CARRIERS L < 150M

SYMBOLS

[Omitted]

ϕ : ~~Major diameter~~ Depth of the openings in parallel to web depth of primary support members, in m.

[Omitted]

3 TRANSVERSE CORRUGATED BULKHEADS OF BALLAST HOLDS

3.2 Net section modulus

3.2.1

The net section modulus Z, in cm^3, of corrugated bulkhead of ballast holds, subjected to lateral pressure are not to be less than the values obtained from the following formula:

$$Z = K \frac{P\ \sout{s_C}\ \underline{s_{cg}}\ \ell^2}{f_{bdg}\ C_s\ R_Y}$$

where:

[Omitted]

~~s_C~~ $\underline{s_{cg}}$: Half pitch length, in mm, of the corrugation, as defined in Pt 1, Ch 3, Sec 6, Figure 21.

[Omitted]

4 PRIMARY SUPPORTING MEMBERS

4.2 Design load sets

4.2.2 Loading conditions

Table 3: Design load sets for primary supporting members in cargo hold region

Item	Design load set	Load component	Draught	Design load	Loading condition
Bulk cargo hold assigned as ballast hold	WB-4	$P_{in} - P_{ex}$ (1)	T_{BAL-H} ~~(3)~~	S+D	Heavy ballast condition
	WB-6	P_{in}	-	S	Harbour/test condition
Bulk cargo hold	BC-11	$P_{in} - P_{ex}$ (1)	T_{SC}	S+D	Cargo loading condition
	BC-12	$P_{in} - P_{ex}$ (1)	-	S	Harbour condition
Compartments not carrying liquids	FD-1 (2)	P_{in}	T_{SC}	S+D	Flooded condition
	FD-2 (2)	P_{in}		S	Flooded condition

(1) P_{ex} is to be considered for external shell only

(2) FD-1 and FD-2 are not applicable to external shell

~~(3) Minimum draught among heavy ballast conditions is to be used.~~

SECTION 5
CARGO HATCH COVERS

2 ARRANGEMENTS

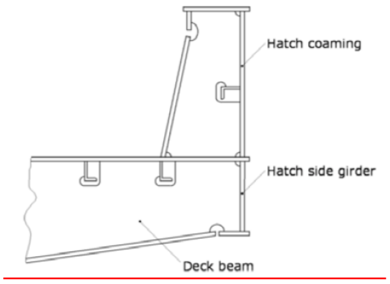
2.3 Hatch coamings

2.3.3

Longitudinal coamings are to be vertically extended at least to the lower edge of deck beams or hatch side girders below deck are to be fitted in line with longitudinal coamings. Extended coaming plates are to be flanged or fitted with face bars or half-round bars at the level of lower edge of the deck beams. Figure 1 gives an example.

- Where they are not part of continuous deck girders, the lower edge of longitudinal coamings including below deck structure as an extension measure above are to extend for at least two frame spaces beyond the end of the hatch openings.
- Where ~~longitudinal coamings~~ they are part of continuous deck girders, their scantlings are to be as required in Pt 1, Ch 6, Sec 6 and Pt 1, Ch 8, Sec 3.

Figure 1: Example of extension to lower edge of deck beams of longitudinal coaming by fitting a hatch side girder



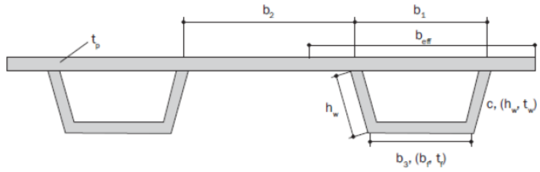
5 STRENGTH CHECK

5.1 Stiffeners

5.1.1 Net Section modulus and net shear sectional area

[Omitted]

Figure ~~1~~ 2: Example of hatch cover fitted with U type stiffener



5.3 Stiffeners

5.3.3 Net Section modulus and net shear sectional area

The net section modulus Z, in cm^3, and the net shear sectional area A_{shr}, in cm^2, of a stiffener subject to lateral pressure are to be taken not less than given by the following formulae:

$$Z = \frac{(F_S\,P_S + F_W\,P_W)\,s\cdot\ell_s^2}{f_{bc}\,\sigma_a}$$ ~~10^{-3}~~

$$A_{shr} = \frac{5(F_S\,P_S + F_W\,P_W)\,s\,\ell_s}{\tau_a}\,10^{-3}$$

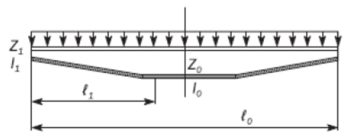
[Omitted]

5.5 Stiffeners

5.5.1

[Omitted]

Figure ~~2~~ 3: Variable cross section stiffener



6 HATCH COAMING

6.3 Scantlings

6.3.3 Coaming stays

[Omitted]

Figure ~~3~~ 4 : Coaming stay (example 1)

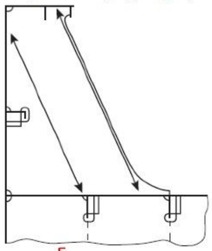
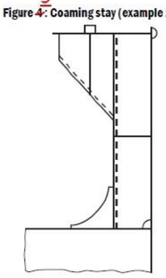


Figure ~~4~~ 5 : Coaming stay (example 2)



[Omitted]

Figure ~~5~~ 6 : Coaming stay (example 3)

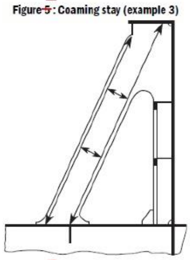
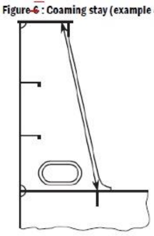


Figure ~~6~~ 7 : Coaming stay (example 4)



CHAPTER 2
OIL TANKERS

SECTION 2 STRUCTURE DESIGN PRINCIPLES

1 CORROSION PROTECTION

1.2 Internal cathodic protection systems

1.2.2

Permanent magnesium or magnesium alloy anodes in tanks ~~made of, or alloyed with magnesium~~ are not acceptable, except in tanks solely intended for water ballast that are not adjacent to cargo tanks.

[Omitted]

SECTION 4 HULL OUTFITTING

1 SUPPORTING STRUCTURES FOR COMPONENTS USED IN EMERGENCY

1.6 Scantling requirements

1.6.3 Permissible stresses

For the design load given in [1.5.2], the shear stresses and normal stresses, including bending stresses induced in the supporting structure and welds, in way of strong-points and fairleads, are not to be exceed the permissible values given below based on the gross thickness of the structure:

- Normal stress, 1.00 R_{eH}.
- Shear stress, 0.58 R_{eH}.

Allowable buckling utilization factor is to be used as given in Ch 8, Sec 1, Table 1, for static and dynamic load scenario, S+D. Buckling assessment method is to be used according to Pt 1, Ch 8, Sec 4, [2].