RULES CHANGE NOTICE No.3

Part 1 Seagoing Ships

RULES FOR HULL

Volume II

April 2023

Jl. Yos Sudarso No. 38-40, Tanjung Priok
Jakarta 14320 - Indonesia
rules@bki.co.id
www.bki.co.id

Foreword

This Rules Change Notice (RCN) No.3 gives additions and amendments to the “Rules for Hull (Pt.1, Vol. II), 2022 Consolidated edition” along with the effective dates from which these changes are applicable.

Amendments to the preceding Edition are marked by strikethrough, red color and expanded text. These new addition and amendments are to be read in conjunction with the requirements given in the RCN No.1, RCN No.2 and 2022 consolidated edition of the Rules.

The summary of current amendments for each section including the implementation date are indicated in ***Table 1 - Amendments Incorporates in This Notice***.

This RCN is available to be downloaded at www.bki.co.id. Once downloaded, this RCN will be uncontrolled copy. Please check the latest version on the website.

Further queries or comments concerning this Rules are welcomed through communication to BKI Head Office.

Rules Changes Notice No. 3 – April 2023

Table 1 – Amendments Incorporates in This Notice

These amendments will come into force on 1 July 2023, except stated otherwise as indicated in the Table

Paragraph	Title/Subject	Status/Remark
Section 23 – Bulk Carriers, Ore Carriers and Ships with Strengthening's for Bulk Cargo and Heavy Cargo		
A.	Strengthenings for Bulk Cargo and Heavy Cargo	
A.1.4.1.	International convention(s) and / or code	Added new reference of IACS UR S1A Rev.6
B.	Bulk Carriers	
B.10.1.3		Added reference information and amendment requirements according to IACS UR S1A Rev.6
B.10.2		Added reference information and amendment requirements according to IACS UR S1A Rev.6
B.10.3	Condition of Approval of the loading instrument	Redaction amendment
B.10.4	Guidance for loading/unloading sequences[2]	Added new requirements regarding guidance for loading/unloading sequences of new and existing bulk carriers according to IACS UR S1A Rev.6
Fig. 23.4	Loading Sequence Summary Form	Added new figure for Loading Sequence Summary Form
D.2.2 –K.3		Renumbering figure
Section 36 – Subdivision and Stability		
B.	Intact Stability	
B.2.3	-	Amendment requirement according SOLAS II-1, B-1, 5-1.3
B.2.4	-	Amendment requirement according SOLAS II-1, B-1, 5-1.4
B.2.5		Amendment requirement according SOLAS II-1, B-1, 5-1.5
B .2.6		Renumbering and amendment requirement according to SOLAS II-1, B-1, 5-1.6.
B.2.7		Renumbering sub-section

Section 23 Bulk Carriers, Ore Carriers and Ships with Strengthenings for Bulk Cargo and Heavy Cargo

A. Strengthenings for Bulk Cargo and Heavy Cargo

1. General

1.4 References

1.4.1 International convention(s) and / or code(s)

Paragraphs of this section are based on the following international convention(s) and / or code(s):

IACS UR S1A Rev.6

IACS UR S12 Rev.5

IACS UR S17 Rev.10

IACS UR S18 Rev.10

IACS UR S19 Rev.5

IACS UR S20 Rev.6

IACS UR S22 Rev.3

IACS UR S28 Rev.3

At the end of each relevant paragraph, the corresponding paragraphs of the international convention(s) and/or code(s) are given in brackets.

---*end*---

B. Bulk Carriers

10. Loading information for Bulk Carriers, Ore Carriers and Combination Carriers

10.1 General, definitions

10.1.1 These requirements are additional to those specified in Section 5, A.4.3 and apply to Bulk Carriers, Ore Carriers and Combination Carriers of 150 m length and above, and are minimum requirements for loading information.

10.1.2 All ships falling into the category of this Section are to be provided with an approved loading manual and an approved computer-based loading instrument.

10.1.3 The following definition apply:

Loading manual is a document which in addition to the definition given in Section 5, A.4.1.3 describes:

– ~~for bulk carriers,~~ envelope results and permissible limits of still water bending moments and shear forces in the hold flooded condition according to 2.2.

– ~~which~~ the cargo hold(s) or combination of cargo holds might be empty at full draught. If no cargo hold is allowed to be empty at full draught, this is to be clearly stated in the loading manual.

- maximum allowable and minimum mass required of cargo and double bottom contents of each hold as a function of the draught at mid-hold position.
- maximum allowable and minimum required mass of cargo and double bottom contents of any two adjacent holds as a function of the mean draught in way of these holds. This mean draught may be calculated by averaging the draught of the two mid-hold positions.
- maximum allowable tank top loading together with specification of the nature of cargo for cargoes other than bulk cargoes.
- maximum allowable load on deck and hatch covers. If the ~~vessel~~ ship is not approved to carry load on deck or hatch covers, this is to be clearly stated in the loading manual.
- the maximum rate of ballast change together with the advice that a load plan is to be agreed with the terminal on the basis of the achievable rates of change of ballast.

Loading instrument is an approved computer system which in addition to the requirements given in Section 5, A.4.1.3 shall be capable to ascertain that:

- allowable mass of cargo and double bottom contents in way of each cargo hold as a function of the ship's draught at mid-hold position
- allowable mass of cargo and double bottom contents in any two adjacent cargo holds as a function of the mean draught in way of these holds, and
- the still water bending moments and shear forces in the hold flooded condition according to 2.2 ~~are within permissible values~~

are within permissible values.

(IACS UR S1A.2)

10.2 Conditions of approval of loading manuals

In addition to the requirements given in Section 5, A.4.2 the following loading conditions, subdivided into departure and arrival conditions as appropriate, are to be included in the Loading Manual:

- alternate light- and heavy cargo loading conditions at maximum draught, where applicable.
- homogeneous light and heavy cargo loading conditions at maximum draught.
- ballast conditions. ~~including those conditions, where~~ For ships having ballast holds ~~are filled when the~~ adjacent to topside wing-, hopper- and double bottom tanks ~~are empty~~, it shall be strengthwise acceptable that the ballast holds are filled when the topside wing, hopper and double bottom tanks are empty
- short voyage conditions where the vessel is to be loaded to maximum draught but with limited amount of bunkers.
- multiple port loading/unloading conditions.
- deck cargo conditions, where applicable.
- typical loading sequences where the vessel is loaded from commencement of cargo loading to reaching full dead weight capacity, for homogeneous conditions, the relevant part load conditions and alternate conditions, where applicable. Typical unloading sequences for these conditions shall also be included. The typical loading/unloading sequences shall also be developed to not exceed applicable strength limitations. The typical loading sequences shall also be developed paying due attention to loading rate and the deballasting capability~~[2]~~. Fig. 23.4 contains, as guidance only, an example of a loading sequence summary form.
- typical sequences for change of ballast at sea, where applicable.

(IACS UR S1A.3)

~~[2] Reference is made to IACS recommendation no. 83 (August 2003), "Note to Annexes to IACS unified Requirements S1A on Guidance for Loading/ Unloading Sequence for Bulk Carriers.~~

10.3 Condition of Approval of the loading instrument

For approval of the loading instrument see Guidelines for Certification of Loading Computer Systems (Pt.4, Vol.1).

10.4 Guidance for loading/unloading sequences[2]

10.4.1 The typical loading/unloading sequences shall be developed paying due attention to the loading/unloading rate, the ballasting/deballasting capacity and the applicable strength limitations.

10.4.2 The typical loading/unloading sequence is to be prepared and submitted for approval by shipyard:

10.4.3 The typical loading sequences as relevant shall include:

- alternate light and heavy cargo load condition
- homogeneous light and heavy cargo load condition
- short voyage condition where the ship is loaded to maximum draught but with limited bunkers
- multiple port loading/unloading condition
- deck cargo condition
- block loading.

10.4.4 The loading/unloading sequences may be port specific or typical.

10.4.5 The sequence shall be built up step by step from commencement of cargo loading to reach full deadweight capacity. Each time the loading equipment changes position to a new hold defines a step. Each step shall be documented and submitted to BKI. In addition to longitudinal strength, the local strength of each hold shall be considered.

10.4.6 For each loading condition, a summary of all steps shall be included. This summary shall highlight the essential information for each step, such as:

- how much cargo is filled in each hold during the different steps
- how much ballast is discharged from each ballast tank during the different steps
- the maximum still water bending moment and shear force at the end of each step
- the ship's trim and draught at the end of each step.

(IACS UR S1A.Annex 3)

[2] In addition, guidance for loading/unloading sequences of existing Bulk Carriers with length of 150 m and above, where one or more cargo holds are bounded by the side shell only, which were contracted for construction before 1st July 1998 refer to Annex 2 of IACS UR S1A.

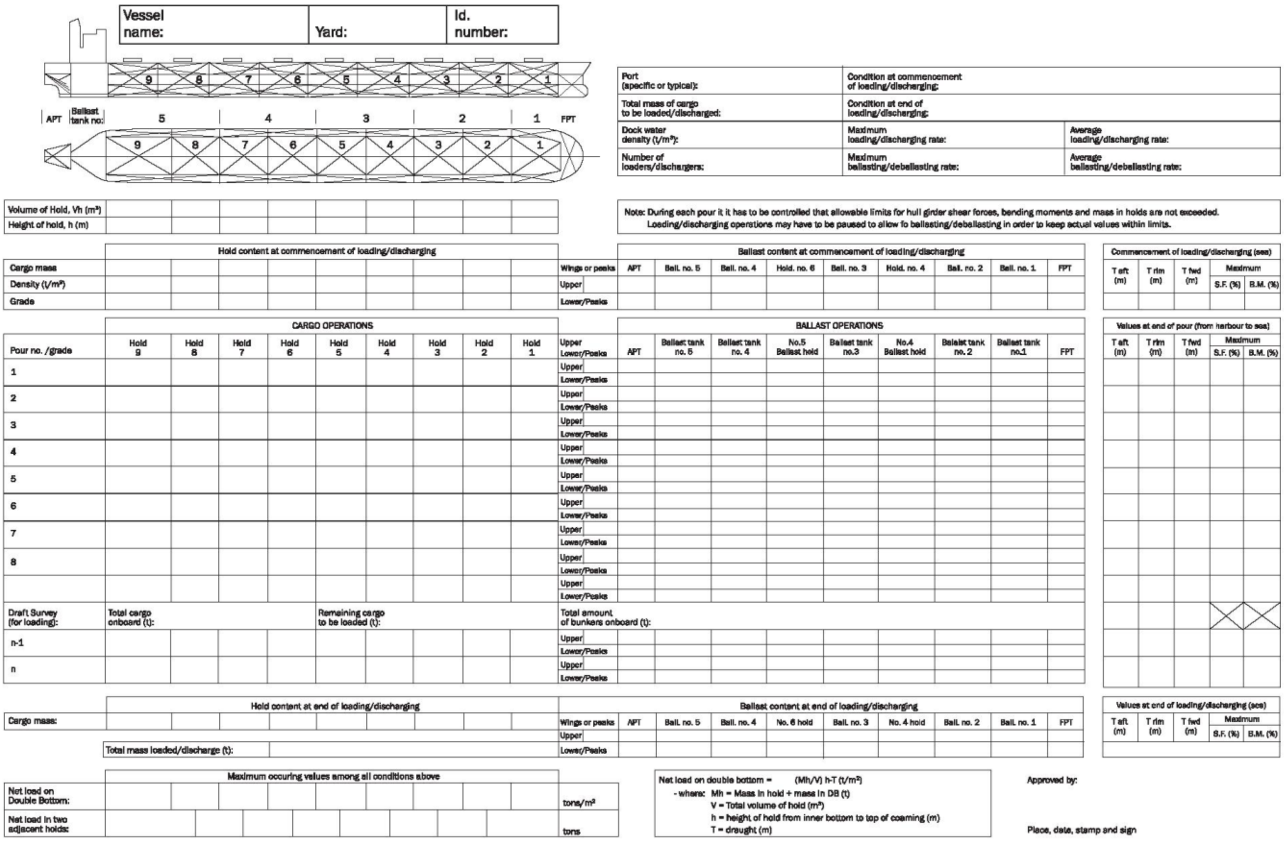


Fig. 23.4 Loading Sequence Summary Form

(IACS UR S1A.Annex 1)

-----end-----

D. Allowable hold loading, considering flooding

2. Load model

2.2 Inner bottom flooding head

The flooding head h_f (see Fig. 23.~~4~~5) is the distance [m], measured vertically with the ship in the upright position, from the inner bottom to a level located at a distance d_f [m], from the baseline:

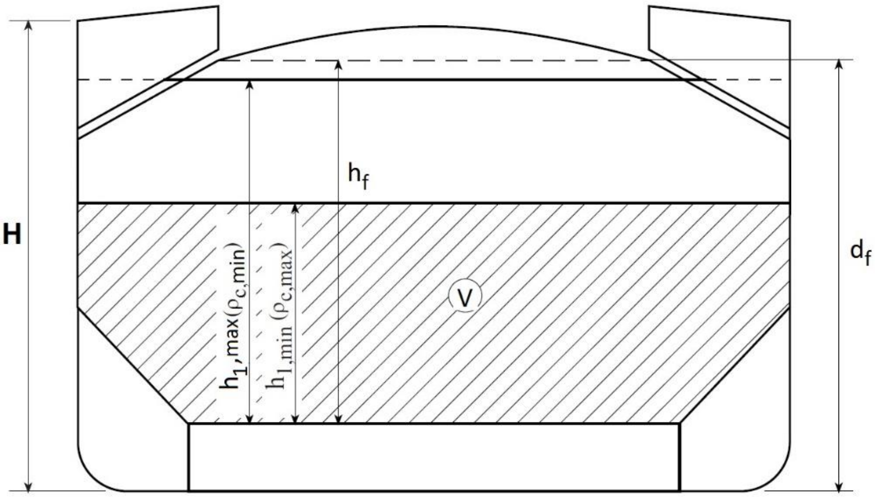
-----end-----

3. Shear capacity of the double bottom

The shear capacity C of the double bottom is defined as the sum of the shear strength at each end of:

- all floors adjacent to both hoppers, less one half of the strength of the two floors adjacent to each stool, or transverse bulkhead if no stool is fitted, see Fig. 23.~~5~~6
- all double bottom girders adjacent to both stools, or transverse bulkheads if no stool is fitted

-----end-----



V = Volume of cargo

Fig. 23.~~4~~5 Flooding head h_f of the inner bottom

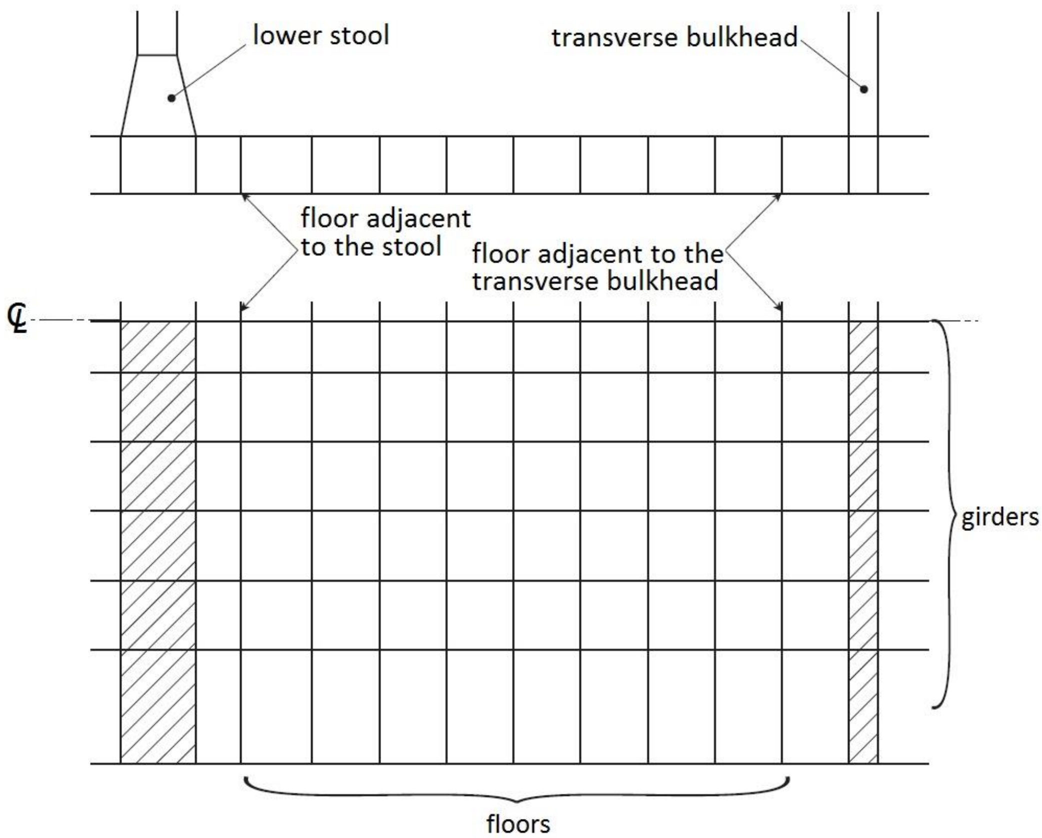


Fig. 23.~~5~~6 Girders and floors in the double bottom

--*end*---

4. Allowable hold loading

Calculating the allowable hold loading HL [t], the following condition are to be complied:

HL = the lesser of HL_1 and HL_2

HL_1 = $\frac{\rho_c \cdot V}{F}$

HL_2 = HL_{int}

HL_{int} = max. perm. hold loading for intact condition [t]

F = factor, defined as:

= 1,10 in general

= 1,05 for steel mill products

ρ_c = cargo density [t/m^3], for bulk cargoes see 2.1; for steel products, ρ_c is to be taken as the density of steel

V = volume [m^3], occupied by cargo assumed flattened at a level h_1

h_1 = cargo level [m] in hold, defined as:

= $\frac{X}{\rho_c \cdot g}$

For bulk cargoes, X is the lesser of X_1 and X_2 given by:

X_1 = $\frac{Z + \rho \cdot g \cdot (E - h_f)}{1 + \frac{\rho}{\rho_C}(perm - 1)}$

X_2 = $Z + \rho \cdot g \cdot (E - h_f \cdot perm)$

perm = cargo permeability, (i.e. the ratio between the voids within the cargo mass and the volume occupied by the cargo); need not be taken greater than 0,3.

For steel products, X may be taken as X_1 using a value for perm according to the type of products (pipes, flat bars, coils etc.) harmonized with BKI.

ρ = 1,025 [t/m^3], sea water density

g = 9,81 [m/s^2], gravitational acceleration

E = (nominal ship) immersion [m] for flooded hold condition

= $d_f - 0{,}1$ **H**

Z = the lesser of Z_1 and Z_2:

Z_1 = $\frac{C_h}{A_{DB,h}}$ [kN/m^2]

Z_2 = $\frac{C_e}{A_{DB,e}}$ [kN/m^2]

C_h = shear capacity of the double bottom [kN], as defined in 3., considering, for each floor, the lesser of the shear strengths S_{f1} and S_{f2} (see 3.1) and, for each girder, the lesser of the shear strengths S_{g1} and S_{g2} (see 3.2)

C_e = shear capacity of the double bottom [kN], as defined in 3., considering, for each floor, the shear strength S_{f1} (see 3.1) and, for each girder, the lesser of the shear strengths S_{g1} and S_{g2} (see 3.2)

$A_{DB,h}$ = relative load area [m²], defined as:

$$= \sum_{i=1}^{i=n} S_i \cdot B_{DB,i} \qquad [m^2]$$

$A_{DB,e}$ = relative load area [m²], defined as:

$$= \sum_{i=1}^{i=n} S_i \cdot \left(B_{DB,i} \cdot a_\ell\right) \qquad [m^2]$$

n = number of floors between stools (or transverse bulkheads, if no stool is fitted)

S_i = spacing of ith - floor [m]

$B_{DB,i}$ = breadth [m] of double bottom related to shear strength calculation of floor, defined as:

= $B_{DB} - a_\ell$ for floors whose shear strength is given by S_{f1}, see 3.1

= $B_{DB,h}$ for floors whose shear strength is given by S_{f2}, see 3.1

B_{DB} = breadth of double bottom [m] between hoppers, see Fig. 23.~~6~~7

$B_{DB,h}$ = distance [m] between the two considered openings, see Fig. 23.~~6~~7

a_ℓ = spacing [m], of double bottom longitudinals adjacent to hoppers.

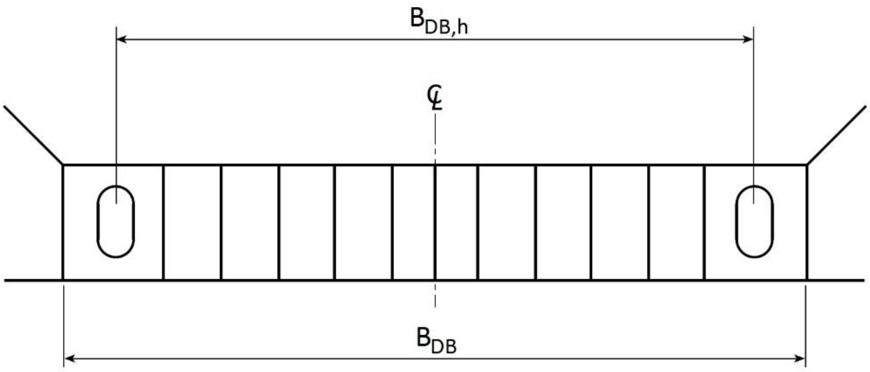


Fig. 23.~~6~~7 Effective distance B_{DB} and $B_{DB,h}$ for the calculation of shear capacity

---end---

E. Evaluation of Scantlings of Corrugated Transverse Watertight Bulkheads in Bulk Carriers Considering Hold Flooding

2. Load model

2.2 Bulkhead corrugation flooding head

The flooding head h_f (see Fig. 23.~~7~~8) is the distance [m], measured vertically with the ship in the upright position, from the calculation point to a level located at a distance d_f [m], from the baseline.

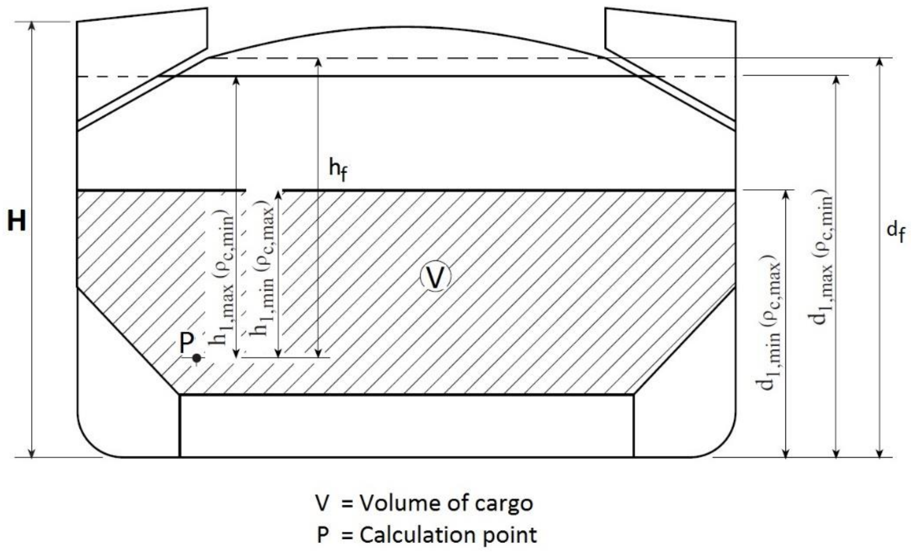


Fig. 23.~~7~~8 Flooding head h_f of a corrugated bulkhead

---*end*---

2.3 Pressure in the non-flooded bulk cargo loaded holds

At each point of the bulkhead, in way of length R according to Fig. 23.~~8~~9 and Fig. 23.~~9~~10 the pressure p_c [kN/m²], is given by:

$$p_c = \rho_c \cdot g \cdot h_1 \cdot n$$

ρ_c = bulk cargo density [t/m³]

g = 9,81 [m/s²], gravitational acceleration

h_1 = vertical distance [m], from the calculation point to the horizontal plane corresponding to the level height of the cargo (see Fig. 23.~~7~~8), located at a distance d_1 [m], from the baseline

n = $\tan^2\left(45^\circ - \frac{\gamma}{2}\right)$

γ = angle of repose of the cargo, that may generally be taken as 35° for iron ore and 25° for cement.

F_c = force [kN], acting on a corrugation is given by :

$$F_c = \rho_c \cdot g \cdot e_1 \cdot \frac{(d_1 - h_{DB} - h_{LS})^2}{2} \cdot n$$

e_1 = spacing of corrugations [m], see Fig. 23.~~8~~9

h_{LS} = mean height of the lower stool [m], from the inner bottom

h_{DB} = height of the double bottom [m]

---*end*---

3. Bending moment and shear force in the bulkhead corrugations

The bending moment M and the shear force Q in the bulkhead corrugations are obtained using the formulae given in 3.1 and 3.2. The M and Q values are to be used for the checks in 4.2.

3.1 Bending moment

The design bending moment M [kN · m], for the bulkhead corrugations is given by :

$$M = \frac{F \cdot \ell}{8}$$

F = resultant force [kN], as given in 2.5

ℓ = span [m] of the corrugation, to be taken according to Fig. 23.~~8~~9 and 23.~~9~~10

--*end*--

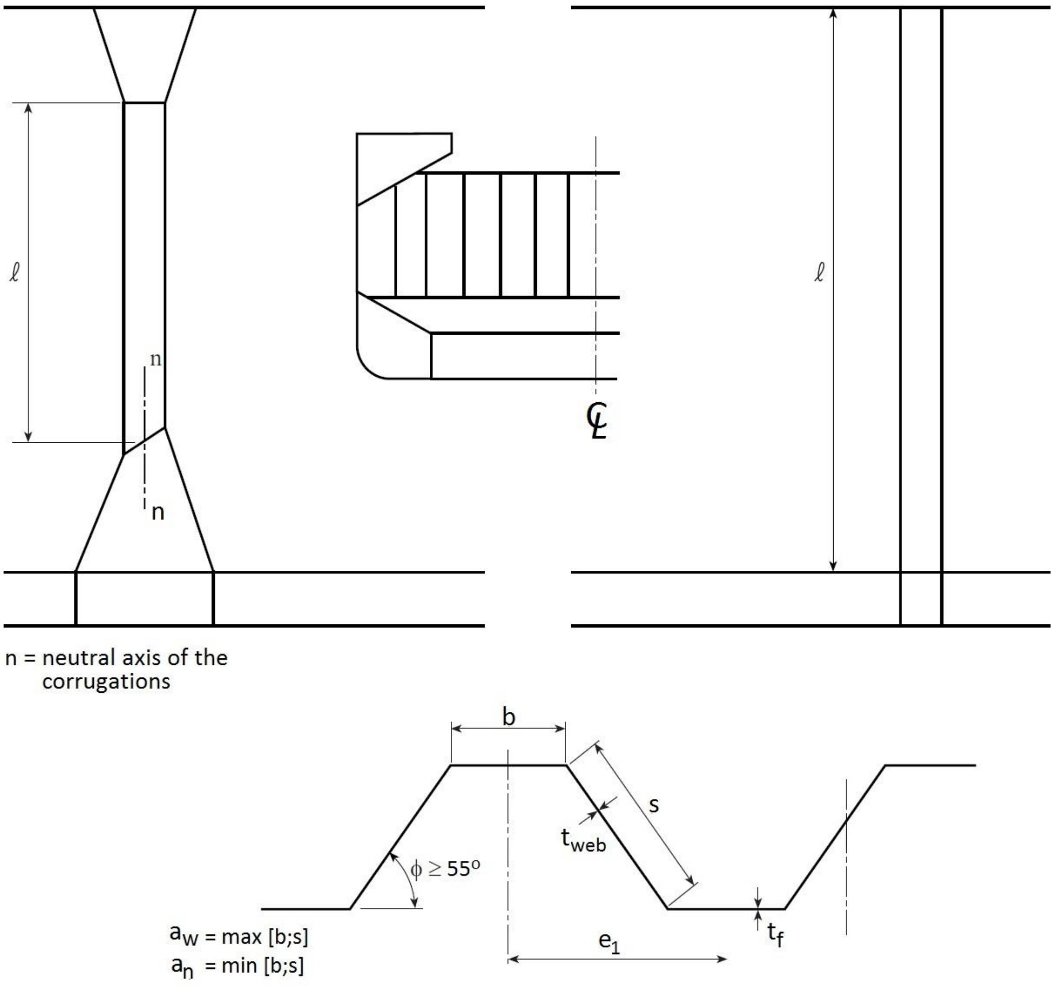
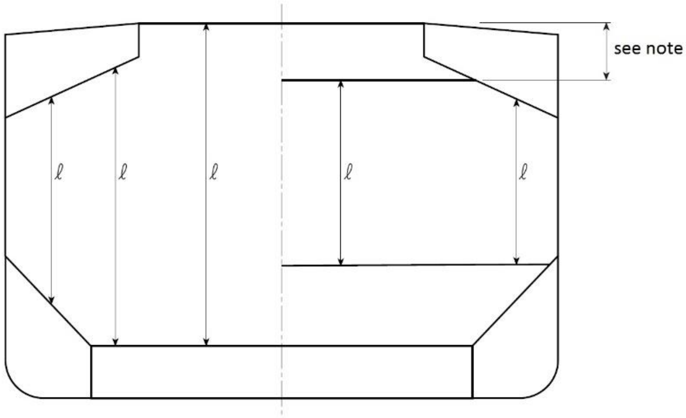


Fig. 23. 89 Span ℓ of the corrugation (longitudinal section)



Note :

For the definition of ℓ , the internal end of the upper stool is not to be taken more than a distance from the deck at the centre line equal to:

– *3 times the depth of corrugations, in general*

– *2 times the depth of corrugations, for rectangular stool*

Fig 23.~~9~~10 Span ℓ of the corrugation (transverse section)

---*end*---

4. Strength criteria

4.1 General

The following criteria are applicable to transverse bulkheads with vertical corrugations, see Fig. 23.~~8~~9. For ships of 190 m of length and above, these bulkheads are to be fitted with a lower stool, and generally with an upper stool below deck. For smaller ships, corrugations may extend from inner bottom to deck. However, if any stools are fitted, they are to comply with the requirements in 4.1.1 and 4.1.2. See also B.8.4.

The corrugation angle ϕ shown in Fig. 23.~~8~~9 is not to be less than 55°.

Requirements for local net plate thickness are given in 4.7.

In addition, the criteria as given in 4.2 and 4.5 are to be complied with.

The thicknesses of the lower part of corrugations considered in the application of 4.2 and 4.3 are to be maintained for a distance from the inner bottom (if no lower stool is fitted) or the top of the lower stool not less than $0{,}15 \cdot \ell$.

The thicknesses of the middle part of corrugations as considered in the application of 4.2 and 4.4 are to be maintained to a distance from the deck (if no upper stool is fitted) or the bottom of the upper stool not greater than $0{,}3 \cdot \ell$.

The section modulus of the corrugation in the remaining upper part of the bulkhead is not to be less than 75% of that required for the middle part, corrected for different yield stresses.

4.1.1 Lower stool

The height of the lower stool is generally to be not less than 3 times the depth of the corrugations. The thickness and material of the stool top plate is not to be less than those required for the bulkhead plating above. The thickness and material of the upper portion of vertical or sloping stool side plating within the depth equal to the corrugation flange width from the stool top is not to be less than the required flange plate thickness and material to meet the bulkhead stiffness requirement at lower end of corrugation. The thickness of the stool side plating and the section modulus of the stool side stiffeners is not to be less than those required according to Section 11, B. on the basis of the load model in 2. The ends of stool side vertical stiffeners are to be attached to brackets at the upper and lower ends of the stool.

The distance d from the edge of the stool top plate to the surface of the corrugation flange is to be not less than the corrugation flange plate thickness, measured from the intersection of the outer edge of corrugation flanges and the centre line of the stool top plate, see Fig. 23.~~12~~13. The stool bottom is to be installed in line with double bottom floors and is to have a width not less than 2,5 times the mean depth of the corrugation. The stool is to be fitted with diaphragms in line with the longitudinal double bottom girders for effective support of the corrugated bulkhead. Scallops in the brackets and diaphragms in way of the connections to the stool top plate are to be avoided.

Where corrugations are cut at the lower stool, corrugated bulkhead plating is to be connected to the stool top plate by full penetration welds. The stool side plating is to be connected to the stool top plate and the inner bottom plating by either full penetration or deep penetration welds, see Fig. 23.~~13~~14. The supporting floors are to be connected to the inner bottom by either full penetration or deep penetration welds, see Fig. 23.~~13~~14.

---*end*---

4.1.3 Alignment

At deck, if no stool is fitted, two transverse reinforced beams are to be fitted in line with the corrugation flanges.

At bottom, if no stool is fitted, the corrugation flanges are to be in line with the supporting floors. Corrugated bulkhead plating is to be connected to the inner bottom plating by full penetration welds. The plating of supporting floors is to be connected to the inner bottom by either full penetration or deep penetration welds, see Fig. 23.~~13~~14. The thickness and material properties of the supporting floors are to be at least equal to those provided for the corrugation flanges.

Moreover, the cut-outs for connections of the inner bottom longitudinals to double bottom floors are to be closed by collar plates. The supporting floors are to be connected to each other by suitably designed shear plates.

Stool side plating is to align with the corrugation flanges and stool side vertical stiffeners and their brackets in lower stool are to align with the inner bottom longitudinals to provide appropriate load transmission between these stiffening members. Stool side plating is not to be knuckled anywhere between the inner bottom plating and the stool top.

---*end*---

4.2 Bending capacity and shear stress τ

....

the section modulus W_{le} is to be taken not larger than the value W'_{le} which is to be determined by the following formula:

$$W'_{le} = W_g + 10^3 \cdot \frac{Q \cdot h_g - 0{,}5 \cdot h_g^2 \cdot e_1 \cdot p_g}{\sigma_a} \quad [cm^3]$$

W_g = section modulus of one half pitch corrugation [cm^3], of the corrugations calculated, according to 4.4, in way of the upper end of shedder or gusset plates, as applicable

Q = shear force [kN], as given in according to 3.2

h_g = height [m], of shedders or gusset plates, as applicable (see Fig. 23.~~10~~11 and 23.~~11~~12)

e_1 = as given in 2.3

p_g = resultant pressure [kN/m^2], as defined in 2.5, calculated in way of the middle of the shedders or gusset plates, as applicable

σ_a = allowable stress [N/mm^2], as given in according to 4.5

Stresses τ are obtained by dividing the shear force Q by the shear area. The shear area is to be reduced in order to account for possible non-perpendicularity 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 being the angle between the web and the flange (see Fig. 23.~~8~~9).

When calculating the section modulus and the shear area, the net plate thicknesses are to be used.

The section modulus of corrugations are to be calculated on the basis of the following requirements given in 4.3 and 4.4.

4.3 Section modulus at the lower end of corrugations

The section modulus is to be calculated with the compression flange having an effective flange width, b_{ef} , not larger than as given in 4.6.1.

If the corrugation webs are not supported by local brackets below the stool top (or below the inner bottom) in the lower part, the section modulus of the corrugations is to be calculated considering the corrugation webs 30 % effective.

a) Provided that effective shedder plates, as defined in 4.2, are fitted (see Fig. 23.~~10~~11), when calculating the section modulus of corrugations at the lower end (cross-section ① in Fig. 23.~~10~~11), the area of flange plates [cm^2], may be increased by :

$$\Delta A_f = 2{,}5 \cdot b \cdot \sqrt{t_f \cdot t_{sh}} \quad [cm^2] \qquad \text{(not to be taken greater than } 2{,}5 \cdot b \cdot t_f)$$

b = width [m], of the corrugation flange, see Fig. 23.~~8~~9

t_{sh} = net shedder plate thickness [mm]

t_f = net flange thickness [mm]

b) Provided that effective gusset plates, as defined in 4.2, are fitted (see Fig. 23.~~11~~12), when calculating the section modulus of corrugations at the lower end (cross-section ① in Fig. ~~11~~12), the area of flange plates [cm^2], may be increased by :

$$\Delta A_f = 7 \cdot h_g \cdot t_f \qquad [cm^2]$$

h_g = height of gusset plate [m], see Fig. 23. ~~11~~12, with :

$$h_g \leq \frac{10}{7} \cdot a_{gu}$$

a_{gu} = width of the gusset plates

$$a_{gu} = 2 \cdot e_1 - b \qquad [m]$$

t_f = net flange thickness [mm], based on the as built condition

c) If the corrugation webs are welded to a sloping stool top plate which has an angle not less than 45° with the horizontal plane, the section modulus of the corrugations may be calculated considering the corrugation webs fully effective. In case effective gusset plates are fitted, when calculating the section modulus of corrugations the area of flange plates may be increased as specified in b) above. No credit can be given to shedder plates only.

For angles less than 45°, the effectiveness of the web may be obtained by linear interpolation between 30% for 0° and 100% for 45°.

---*end*---

4.6 Effective compression flange width and shear buckling check

4.6.1 Effective width of the compression flange of corrugations

The effective width b_{ef}, of the corrugation flange is given by:

$$b_{ef} = C_e \cdot b$$

where:

$$C_e = \frac{2{,}25}{\beta} - \frac{1{,}25}{\beta^2} \qquad \text{for } \beta > 1{,}25$$

$$C_e = 1{,}0 \qquad \text{for } \beta \leq 1{,}25$$

$$\beta = 10^3 \cdot \frac{b}{t_f} \cdot \sqrt{\frac{R_{eH}}{E}}$$

t_f = net flange thickness, in mm

b = width, in m, of the corrugation flange (see Fig. 23.~~8~~9)

R_{eH} = minimum upper yield stress, in N/mm^2, of the material

E = modulus of elasticity of the material, in N/mm^2, to be assumed equal to $2{,}06 \times 10^5$ for steel

(IACS UR S18.4.6.1)

---*end*---

4.7 Local net plate thickness

The bulkhead local net plate thickness t_{net} [mm], is given by :

$$t_{net} = 14{,}9 \cdot a_w \cdot \sqrt{\frac{1{,}05 \cdot p}{R_{eH}}}$$

a_w = plate width [m], to be taken equal to the width of the corrugation flange or web, whichever is the greater, see Fig. 23.~~8~~9

p = resultant pressure [kN/m^2], as defined in 2.5, at the bottom of each strake of plating; in all cases, the net thickness of the lowest strake is to be determined using the resultant pressure at the top of the lower stool, or at the inner bottom, if no lower stool is fitted or at the top of shedders, if shedder or gusset/shedder plates are fitted

For built-up corrugation bulkheads, when the thicknesses of the flange and web are different, the net thickness of the narrower plating is to be not less than $t_{net,n}$ [mm], is to be determined by the following formula: given by :

$$t_{net,n} = 14{,}9 \cdot a_n \cdot \sqrt{\frac{1{,}05 \cdot p}{R_{eH}}}$$

a_n = the width [m], of the narrower plating, see Fig. 23.~~8~~9

The net thickness of the wider plating [mm], is not to be taken less than the maximum of the following values t_{w1} and t_{w2}:

$$t_{w1} = 14{,}9 \cdot a_w \sqrt{\frac{1{,}05 \cdot p}{R_{eH}}}$$

$$t_{w2} = \sqrt{\frac{440 \cdot a_w^2 \cdot 1{,}05 \cdot p}{R_{eH}} - t_{np}^2}$$

t_{np} are actual net thickness of the narrower plating, $t_{np} \le t_{w1}$.

---*end*--

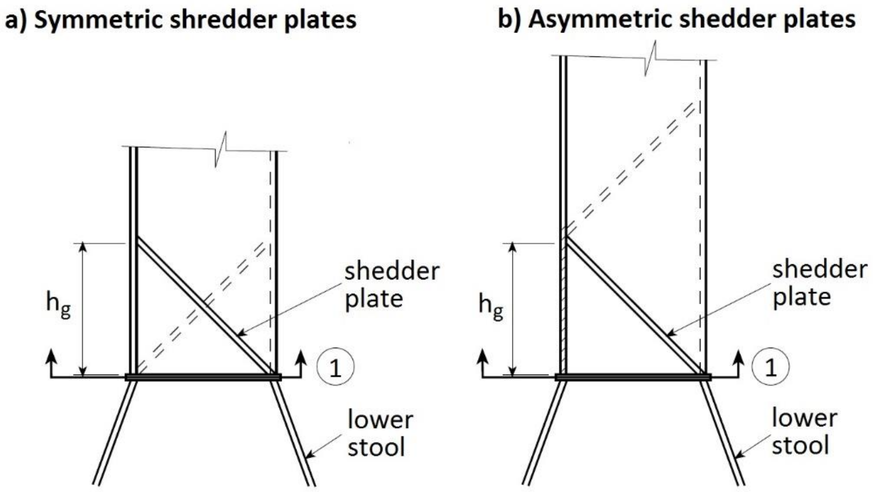


Fig. 23.~~10~~11 Shedder plates

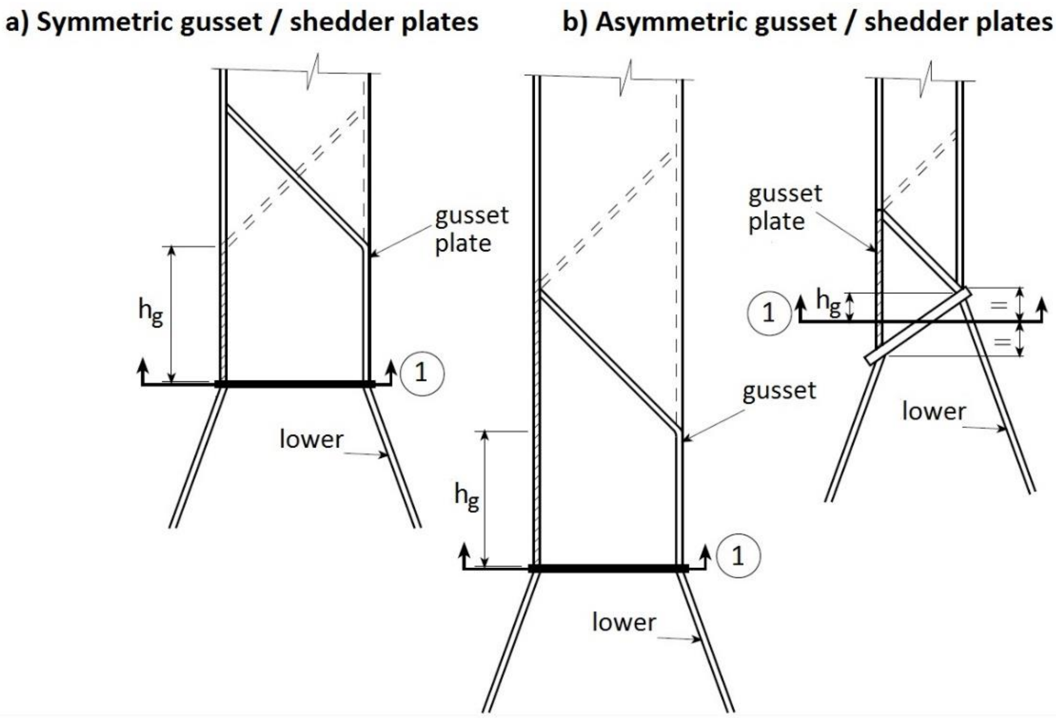


Fig. 23.~~11~~12 Gusset plates and shedder plates

---*end*---

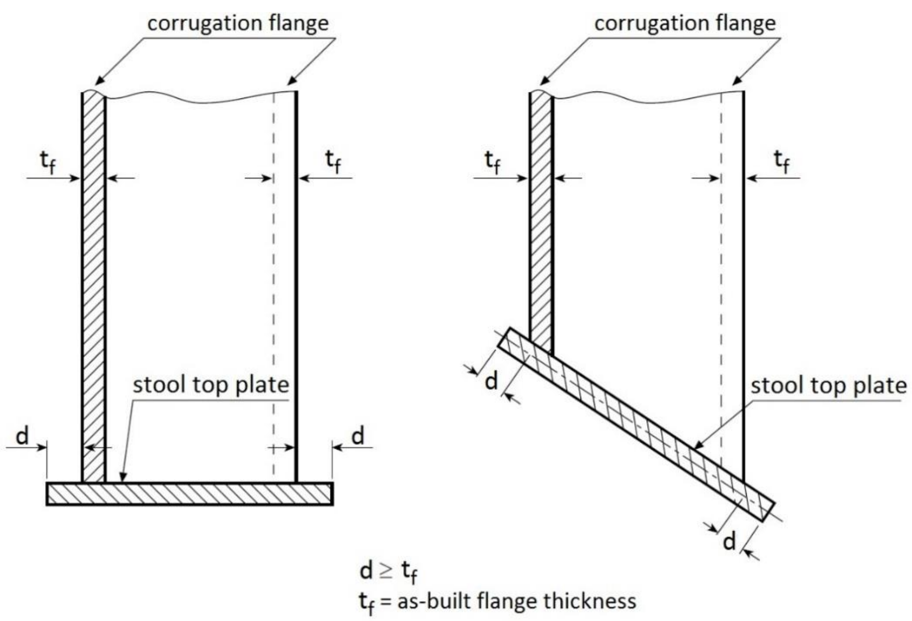


Fig. 23.~~12~~13 Excess end d of the stool top plate

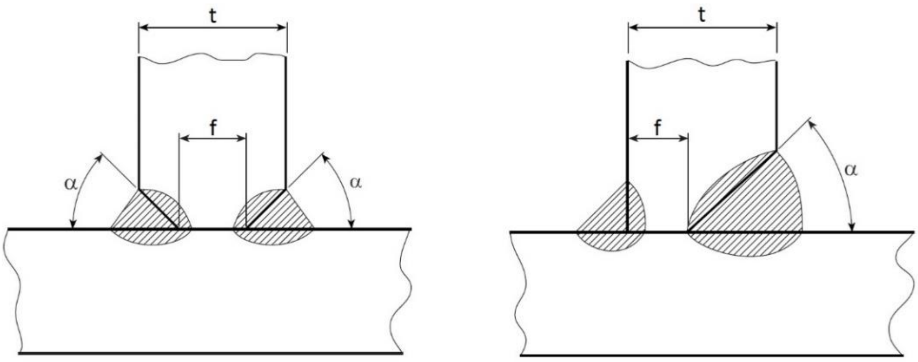


Fig. 23.~~13~~14 Connection by deep penetration welds

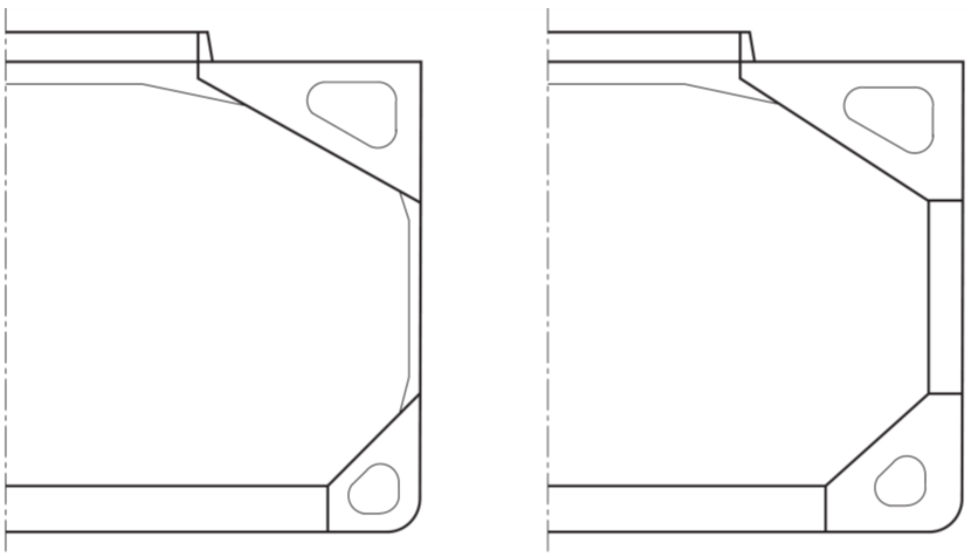


Fig. 23.~~14~~15 Single and double side skin bulk carrier

---*end*---

G. Fitting of Forecastle of Bulk Carrier, Ore Carriers and Combination Carriers

2. Dimensions

The forecastle is to be located on freeboard deck with its aft bulkhead fitted in way or aft of the forward bulkhead of the foremost hold (see Fig. 23.~~15~~16).

The forecastle height, H_F above the main deck is not to be less than the grater of :

– the standard height of a superstructure as specified in the ICLL, or

– $H_C + 0{,}5$ [m]

H_C = height [m] of the forward transverse hatch coaming of cargo hold No.1 [m]

In order to use the reduced design load for the forward transverse hatch coaming (see Section 17, B.2) and hatch cover stoppers (see Section 17, B.5.5) of the foremost cargo hold, the distances between all points of the aft edge of the forecastle deck and the hatch coaming plate, ℓ_F [m], are to comply with the following (see Fig. ~~15~~16) :

$$\ell_F = 5 \cdot \sqrt{H_F - H_C} \qquad [m]$$

A breakwater is not to be fitted on the forecastle deck for the purpose of protecting the hatch coaming or hatch covers. If fitted for other purposes, the distance between its upper edge at centre line and the aft edge of the forecastle deck, ℓ_B [m], is comply with the following (see Fig. 23.~~15~~16) :

$$\ell_B \geq 2{,}75 \cdot H_B \qquad [m]$$

H_B = is the water height of the breakwater above the forecastle.

(IACS UR S28.2)

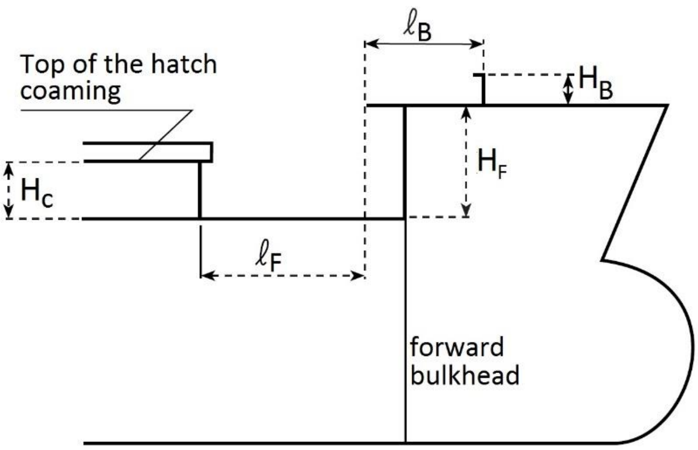


Fig. 23.~~15~~16 Dimensions of forecastle

---end---

H. Transport of Steel Coils in Multi-Purpose Dry Cargo Ships

2. Inner bottom plating

The plate thickness t of inner bottom is not to be less than determined by the following formula:

$$t = 1{,}15 \cdot K_1 \cdot \sqrt{\frac{p}{\sigma_{p\ell}}} + t_K \qquad [\mathrm{mm}]$$

K_1 = coefficient, defined as:

$$= \sqrt{\frac{1{,}7 \cdot a \cdot b \cdot K_2 - 0{,}73 \cdot a^2 \cdot K_2^2 - (b - c)^2}{2 \cdot c \cdot (2 \cdot a + 2 \cdot b \cdot K_2)}}$$

K_2 = coefficient, defined as:

$$= -\frac{a}{b} + \sqrt{\left(\frac{a}{b}\right)^2 + 1{,}37 \cdot \left(\frac{b}{a}\right)^2 \cdot \left(1 - \frac{c}{b}\right)^2 + 2{,}33}$$

c = distance [m] between outermost patch loads in a plate field, defined as:

$$= (n_2 - 1) \cdot \frac{\ell}{n_3} + c_d \cdot \ell_c \cdot (n_4 - 1)$$

n_1 = number of tiers of coils, defined as

= 1,4 for one tier, secured with key coils

n_2 = number of patch loads per plate field, see also Fig. 23.~~16~~17, defined as:

$$= n_3 \cdot \left(\frac{b}{\ell_c} - c_d \cdot (n_4 - 1)\right) \qquad \text{in general}$$

$$= n_3 \cdot n_4 \qquad \text{for} \quad (n_3 - 1) \cdot \frac{\ell}{n_3} < b - (1 + c_d) \cdot \ell_c \cdot (n_4 - 1)$$

n_2 has to be rounded up to the next integer

n_3 = number of dunnages per coil, see Fig. ~~16~~17

n_4 = number of coils per plate field, see Fig. 23.~~16~~17, where at

$$= \frac{b}{(1 + c_d) \cdot \ell_c}$$

n_4 has to be rounded up to the next integer

--end--

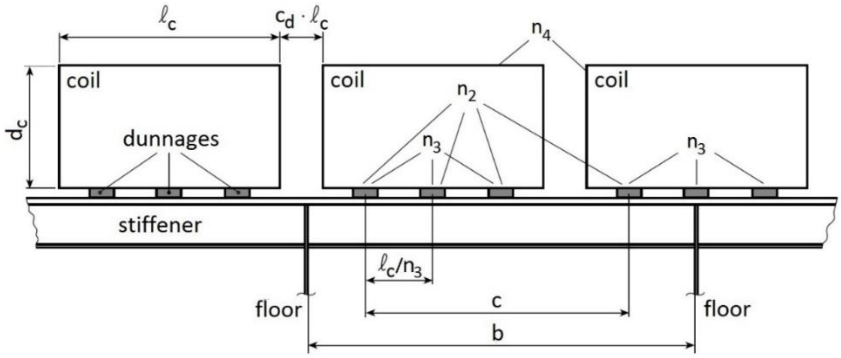


Fig. 23.~~16~~17 Exemplary arrangement for determination of n_2, n_3 and n_4

---end---

3. Plating of longitudinal bulkhead

The plate thickness of the longitudinal bulkhead at least to a height of one frame distance above the highest possible contact line with the steel coil loading is not to be less than determined by the following formula:

$$t = K_1 \cdot \sqrt{\frac{P^*}{\sigma_{P\ell}}} + t_k \quad [\text{mm}]$$

....

n_2 = number of patch loads per plate field according to 2

n_3 = number of dunnages per coil, see Fig. ~~16~~17

n_5 = number of coils in row athwardships, defined as:

$$= \frac{B_H}{d_c} + n_6$$

---end---

J. Evaluation of Scantlings of the Transverse Watertight Corrugated Bulkhead between Cargo Holds Nos. 1 and 2, with Cargo Hold No. 1 Flooded, for Existing Bulk Carriers2 Load model

2.2 Bulkhead corrugation flooding head

The flooding head h_f (see Fig. 23.~~7~~8) is the distance, in m, measured vertically with the ship in the upright position, from the calculation point to a level located at a distance d_f, in m, from the baseline equal to:

a) in general:

– H

b) for ships less than 50000 t deadweight with Type B freeboard:

– 0,95 · H

H being the distance, in m, from the baseline to the freeboard deck at side amidship (see Fig. 23. ~~7~~8).

c) for ships to be operated at an assigned load line draught T_r less than the permissible load line draught **T**, the flooding head defined in a) and b) above may be reduced by **T** - T_r

2.3 Pressure in the flooded hold

2.3.1 Bulk cargo loaded hold

Two cases are to be considered, depending on the values of d_1 and d_f, d_1 (see Fig. 23.~~7~~8) being a distance from the baseline given, in m, by:

--*end*--

4. Strength criteria

4.1 General

The following criteria are applicable to transverse bulkheads with vertical corrugations (see Fig. 23.~~8~~9).

Requirements for local net plate thickness are given in 4.7.

In addition, the criteria given in 4.2 and 4.5 are to be complied with.

Where the corrugation angle ϕ shown in Fig. 23.~~8~~9 if less than 50°, an horizontal row of staggered shedder plates is to be fitted at approximately mid depth of the corrugations (see Fig. 23.~~8~~9) to help preserve dimensional stability of the bulkhead under flooding loads. The shedder plates are to be welded to the corrugations by double continuous welding, but they are not to be welded to the side shell.

The thicknesses of the lower part of corrugations considered in the application of 4.2 and 4.3 are to be maintained for a distance from the inner bottom (if no lower stool is fitted) or the top of the lower stool not less than $0{,}15 \cdot \ell$

The thicknesses of the middle part of corrugations considered in the application of 4.2 and 4.4 are to be maintained to a distance from the deck (if no upper stool is fitted) or the bottom of the upper stool not greater than $0{,}3 \cdot \ell$

--*end*--

4.3 Section modulus at the lower end of corrugations

The section modulus is to be calculated with the compression flange having an effective flange width, b_{ef}, not larger than as given in 4.6.1.

a) Provided that effective shedder plates, as defined in 4.2, are fitted (see Fig.2.3.~~10~~11), when calculating the section modulus of corrugations at the lower end (cross-section ① in Fig. 23. ~~10~~11), the area of flange plates, in cm^2, may be increased by

$$\left(2{,}5 \cdot a \cdot \sqrt{t_f \cdot t_{sh}} \cdot \sqrt{\frac{\sigma_{Fsh}}{\sigma_{Ffl}}}\right) \qquad \text{(not to be taken greater than } 2{,}5 \cdot a \cdot t_f\text{)}$$

where:

a = width, in m, of the corrugation flange (see Fig. 23.~~8~~9)

t_{sh} = net shedder plate thickness, in mm

t_f = net flange thickness, in mm

σ_{Fsh} = minimum upper yield stress, in N/mm^2, of the material used for the shedder plates

σ_{Ffl} = minimum upper yield stress, in N/mm^2, of the material used for the corrugation flanges.

b) Provided that effective gusset plates, as defined in 9.4.2, are fitted (see Fig. 23.~~11~~12), when calculating the section modulus of corrugations at the lower end (cross-section ① in Fig. 23.~~11~~12), the area of flange plates, in cm^2, may be increased by $(7 \cdot h_g \cdot t_{gu})$ where:

h_g = height of gusset plate in m, see Fig. 23.~~11~~12, not to be taken greater than :

$$\left(\frac{10}{7} \cdot s_{gu}\right)$$

s_{gu} = width of the gusset plates, in m

t_{gu} = net gusset plate thickness, in mm, not to be taken greater than t_f

t_f = net flange thickness, in mm, based on the as built condition.

c) If the corrugation webs are welded to a sloping stool top plate, which is at an angle not less than 45° with the horizontal plane, the section modulus of the corrugations may be calculated considering the corrugation webs fully effective. In case effective gusset plates are fitted, when calculating the section modulus of corrugations the area of flange plates may be increased as specified in b) above. No credit can be given to shedder plates only.

For angles less than 45°, the effectiveness of the web may be obtained by linear interpolation between 30% for 0° and 100% for 45°.

---*end*---

K. Evaluation of Allowable Hold Loading of Cargo Hold No. 1 with Cargo Hold No. 1 Flooded, for Existing Bulk Carriers

3. Shear capacity of the double bottom of hold No. 1

The shear capacity C of the double bottom of hold No. 1 is defined as the sum of the shear strength at each end of:

– all floors adjacent to both hoppers, less one half of the strength of the two floors adjacent to each stool, or transverse bulkhead if no stool is fitted (see Fig. 23.~~5~~6),

– all double bottom girders adjacent to both stools, or transverse bulkheads if no stool is fitted.

The strength of girders or floors which run out and are not directly attached to the boundary stool or hopper girder is to be evaluated for the one end only.

---*end*---

Section 36 Subdivision and Stability

B. Intact Stability

2. Onboard Stability Information

2.3 ~~The stability information shall show the influence of various trims in cases where the operational trim range exceeds ± 0,5% of L_S~~. The intact and damage stability information required by 2.2 shall be presented as consolidated data and encompass the full operating range of draught and trim. Applied trim values shall coincide in all stability information intended for use on board. Information not required for determination of stability and trim limits should be excluded from this information.

(SOLAS II-1, B-1, 5-1.3)

2.4 ~~For ships which have to fulfil the stability requirements~~ If the damage stability is calculated in accordance with regulation 6 to regulation 7-3 and, if applicable, with regulations 8 and 9.8 of part B-1 of SOLAS as amended~~,~~ a stability limit curve is to be determined using linear interpolation between the minimum required GM assumed for each of the three draughts d_s, d_p and d_l. When additional subdivision indices are calculated for different trims, a single envelope curve based on the minimum values from these calculations shall be presented. When it is intended to develop curves of maximum permissible KG it shall be ensured that the resulting maximum KG curves correspond with a linear variation of GM ~~information referred to in paragraph 1. are determined from considerations related to the subdivision index, in the following manner:~~

~~Minimum required GM' values (or maximum permissible vertical positions of centre of gravity KG') for the three draughts d_S, d_P and d_L are equal to the GM' (or KG' values) of corresponding loading cases used for the calculation of survival factor s_i.~~

~~For intermediate draughts, values to be used shall be obtained by linear interpolation applied to the GM' value only between the deepest subdivision draught and the partial subdivision draught and between the partial load line and the light service draught respectively.~~

~~Intact stability criteria will also be taken into account by retaining for each draught the maximum among minimum required GM' values or the minimum of maximum permissible KG' values for both criteria. If the subdivision index is calculated for different trims, several required GM' curves will be established in the same way~~.

(SOLAS II-1, B-1, 5-1.4)

2.5 As an alternative to a single envelope curve, the calculations for additional trims may be carried out with one common GM for all of the trims assumed at each subdivision draught. The lowest values of each partial index A_s, A_p and A_l across these trims shall then be used in the summation of the attained subdivision index A according to regulation 7.1 of part B-1 of SOLAS as amended. This will result in one GM limit curve based on the GM used at each draught. A trim limit diagram showing the assumed trim range shall be developed.

(SOLAS II-1, B-1, 5-1.5)

2.~~5~~6 When curves or tables of minimum operational metacentric height GM' or maximum allowable KG versus draught are not ~~appropriate~~ provided, the master should ensure that the operating condition does not deviate from a studied loading condition, or verify by calculation that the stability criteria are satisfied for this loading condition.

(SOLAS II-1, B-1, 5-1.~~5~~6)

2.~~6~~7 The terms used in this Section are the same as those of SOLAS as amended.

--*end*--