Common Structural Rules for Bulk Carriers and Oil Tankers

Rule Change Notice 1 to 01 JAN 2018 version

Notes: (1) These Rule Changes enter into force on 1st July 2019.

COMMON STRUCTURAL RULES FOR BULK CARRIERS AND OIL TANKERS

RULE CHANGE NOTICE 1

This document contains amendments within the following Parts and Chapters of the Common Structural Rules for Bulk Carriers and Oil Tankers, 1 January 2018. The amendments are effective on 1st July 2019.

The technical background document containing explanation for the amendments in this document can be found in "Technical Background for Rule Change Notice 1 to 01 JAN 2018 version".

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PART 1 GENERAL RULE REQUIREMENTS

CHAPTER 2
GENERAL ARRANGEMENT DESIGN

SECTION 3 COMPARTMENT ARRANGEMENT

2 DOUBLE BOTTOM

2.3 Height of double bottom

2.3.1

Unless otherwise specified, the height of the double bottom is not to be less than the lesser of:

- For oil tankers: *B*/15 or 2 m, however not less than 1.0 m measured at right angles to the shell plating at any cross section.
- For bulk carriers: *B*/20 or 2 m, however not less than 0.76 m measured vertically from the plane parallel with keel line to inner bottom.

CHAPTER 3
STRUCTURAL DESIGN PRINCIPLES

SECTION 3 CORROSION ADDITIONS

Table 1 : Corrosion addition for one side of a structural member

Compartment type	Structural member		t_{c1} or t_{c2}		
			Oil tankers	*BC-A* or *BC-B* ships with $L \geq 150$ *m*	Other *BC* ships
Ballast water tank, bilge tank, drain storage tank, chain locker (1)	Face plate of PSM	Within 3m below top of tank (4)	2.0		
		Elsewhere	1.5		
	Other members (2) (3)	Within 3m below top of tank (4)	1.7		
		Elsewhere	1.2		
Cargo oil tank, slop tank	Face plate of PSM	Within 3m below top of tank (4)	1.7	N/A	
		Elsewhere	1.4		
	Inner-bottom plating/bottom of tank		2.1		

	Other members	Within 3m below top of tank [4]	1.7		
		Elsewhere	1.0		
Dry bulk cargo hold [5]	Transverse bulkhead	Upper part [6]	N/A	2.4	1.0
		Lower stool: sloping plate, vertical plate and top plate [7]		5.2	2.6
		Other parts		3.0	1.5
	Sloped plating of hopper tank, inner bottom plating			3.7	2.4
	Other members	Upper part [6]		1.8	1.0
		Webs and flanges of the upper end brackets of side frames of single side bulk carriers			
		Webs and flanges of lower brackets of side frames of single side bulk carriers		2.2	1.2
		Other parts		2.0	1.2
Exposed to atmosphere	Weather deck plating		1.7		
	Other members		1.0		
Exposed to seawater	Shell plating between the minimum design ballast draught waterline and the scantling draught waterline		1.5		
	Shell plating elsewhere		1.0		
Fuel and lube oil tank			0.7		
Fresh water tank			0.7		
Void spaces [8]	Spaces not normally accessed, e.g. access only via bolted manhole openings, pipe tunnels, inner surface of stool space not common with a dry bulk cargo hold or ballast cargo hold, etc.		0.7		
Dry spaces	Internals of machinery spaces, pump room, store rooms, steering gear space, etc.		0.5		

(1) 1.0 mm is to be added to the plate surface within 3m above the upper surface of the chain locker bottom.
(2) 0.5 mm is to be added to the plate surface exposed to ballast for the plate boundary between water ballast and heated cargo oil tanks/slop tanks. 0.3mm is to be added to each surface of the web and face plate of a stiffener in a ballast tank and attached to the boundary between water ballast and heated cargo oil tanks or heated fuel/lube oil tanks/slop tanks. Heated oil tanks are defined as tanks/slop tanks arranged with any form of heating capability (the most common type is heating coils).
(3) 0.7 mm is to be added to the plate surface exposed to ballast for the plate boundary between water ballast and heated fuel oil or lube oil tanks.
(4) Only applicable to cargo tanks/slop tanks and ballast tanks with weather deck as the tank top. The 3 m distance is measured vertically from and parallel to the top of the tank.
(5) Dry bulk cargo hold includes holds intended for the carriage of dry bulk cargoes, which may carry water ballast.
(6) Upper part of the cargo holds correspond to an area above the connection between the topside and the inner hull or side shell.
If there is no topside, the upper part corresponds to the upper one third of the cargo hold height (where a plane bulkhead is fitted in way of a dry bulk cargo hold, the upper part of the bulkhead is defined in the same manner).
(7) If there is no lower stool fitted (i.e. engine room bulkhead or fore peak bulkhead) or if a plane bulkhead is fitted, then this corrosion addition should be applied up to a height level with the opposing bulkhead stool in that hold. In the case where a stool is not fitted on the opposing bulkhead, the vertical extent of this zone is to be from the inner bottom to a height level with the top of the adjacent hopper sloping plate, but need not be taken as more than 3 m.
(8) For the determination of the corrosion addition of the outer shell plating, the pipe tunnel is considered as for a water ballast tank.

[RCN1 to 01 JAN 2014]

SECTION 6 STRUCTURAL DETAIL PRINCIPLES

3 Stiffeners

3.4 Sniped ends

3.4.1

Sniped ends may be used where dynamic loads are small, provided the net thickness of plating supported by the stiffener, t_p, is not less than:

$$t_p = c_1\sqrt{\left(1000l - \frac{s}{2}\right)\frac{sPk}{10^6}}$$

where:

P : Design pressure for the stiffener for the design load set being considered, in kN/m^2.

c_1 : Coefficient for the design load set being considered, to be taken as:

c_1 = 1.2 for acceptance criteria set AC-S.

c_1 = 1.1 for acceptance criteria set AC-SD.

Sniped stiffeners are not to be used on structures in the vicinity of engines or generators in the machinery space, propeller impulse zone in the stern area nor on the shell envelope.

3.4.2

Bracket toes and sniped stiffeners ends are to be terminated close to the adjacent member. The distance is not to exceed 40 mm unless the bracket or member is supported by another member on the opposite side of the plating. Tapering of the sniped end is not to be more than 30 deg, where it is not practical to comply with this requirement, alternative arrangements are specially considered. The depth of toe or sniped end is, generally, not to exceed the thickness of the bracket toe or sniped end member, but need not be less than 15 mm.

CHAPTER 7
DIRECT STRENGTH ANALYSIS

SECTION 3 LOCAL STRUCTURAL STRENGTH ANALYSIS

2 LOCAL AREAS TO BE ASSESSED BY FINE MESH ANALYSIS

2.1 List of mandatory structural details

2.1.1 List of structural details

In the midship cargo hold region, the following structural details are to be assessed according to the fine mesh analysis procedure defined in [1.1.3]:

a) Hopper knuckles for ship with double side as given in [2.1.2],
b) Side frame end brackets and lower hopper knuckle for single side bulk carrier as given in [2.1.3],
c) Large openings as given in [2.1.4],
d) Connections of deck and double bottom longitudinal stiffeners to transverse bulkhead as given in [2.1.5],
e) Connections of corrugated bulkhead to adjoining structure as given in [2.1.6].
f) Bracket at the heel of horizontal stringer as given in [2.1.7],

For each above mentioned structural detail, one fine mesh model is required within all the cargo hold models covering the midship cargo hold region. The selection of the location of this fine mesh model is to be based on requirements given from [2.1.2] to ~~[2.1.6]~~ [2.1.7] from all cargo hold analyses in the midship cargo hold region.

2.1.7 Bracket at the heel of horizontal stringer

Fine mesh analysis is to be carried out for the bracket at the heel of horizontal stringers. All structural elements adjacent to the heel including the inner hull, longitudinal and transverse bulkhead are to satisfy the stress acceptance criteria. The heel of horizontal stringer which, in the cargo hold analysis, has the maximum yield utilization factor, λ_y, is to be selected for the fine mesh analysis. Where there is a significant variation in the arrangement of the bracket at the heel and the horizontal stringer, analysis of additional locations may be required by the Society.

3 SCREENING PROCEDURE

3.2 List of structural details

3.2.2 Outside midship cargo hold region

The following structural details outside midship cargo hold region are to be evaluated by screening:
a) Hopper knuckle, as defined in [2.1.2] and [2.1.3],
b) Side frame end bracket, as defined in [2.1.3],
c) Large openings, as defined in [2.1.4],
d) Connections of corrugation to adjoining structure, as defined in [2.1.6],
e) Bracket at the heel of horizontal stringers in [2.1.7],

The connections of corrugation to adjoining structure and the bracket at the heel of horizontal stringers to be screened are to be similar in its geometry, its proportion and its relative location to the corresponding detail modelled in fine mesh in the midship cargo hold region.

When the connections of corrugation to adjoining structure and the bracket at the heel of horizontal stringers outside the midship cargo hold region are different from the corresponding detail modelled in fine mesh in the midship cargo hold region, a fine mesh analysis is to be performed for the detail located where the yield utilisation factor, λ_y, is maximum for structural details having the same geometry and the same relative location,

When it is deemed necessary, the Society may request a fine mesh analysis to be performed according to [1.1.3].

3.3 Screening criteria

3.3.1 Screening factors and permissible screening factors

The screening factors, λ_{sc}, and the permissible screening factors, λ_{scperm}, are given in Table 4 for the screening areas defined in [3.1].

Table 4 : Screening factors and permissible screening factors

Type of Details	Screening factors, λ_{sc}	Permissible screening factors, λ_{scperm}	
Within the whole cargo hold region		**S+D**	**S**
Openings for which their geometry is not required to be represented in the cargo hold model in accordance with Ch 7, Sec 2, [2.4.9] in way of webs of primary supporting members, such as transverse web frame as indicated in Table 1 and Table 2, horizontal stringers as indicated in Table 3, floors and longitudinal girders in double bottom.	Table 5	1.70	1.36
Manholes **(2)**	λ_y	0.85 λ_{yperm}	
Bracket toes on transverse web frames as indicated in Table 1 and Table 2, horizontal stringers and transverse plane bulkhead to double bottom connection or buttress structure specified in Table 3.	Table 6	1.50	1.20
Heels of transverse bulkhead horizontal stringers specified in Table 3.	Table 7	1.50	1.20
Connections of transverse lower stool to double bottom girders and longitudinal lower stool to double bottom floors as indicated in Figure 5. The connection of lower hopper to transverse lower stool structure as indicated in Figure 5. The connection of topside tank to inner side as indicated in Figure 6. The connection of corrugation and upper supporting structure to upper stool as indicated in Figure 7.	λ_y	0.75 λ_{yperm}	
Hatch corner area.	λ_y	0.95 λ_{yperm}	
Outside midship cargo hold region			
Hopper knuckle	λ_y	0.65 λ_{yperm}	
Side frame end bracket		0.85 λ_{yperm}	
Large openings **(2)**		0.85 λ_{yperm}	
Connections of corrugation to adjoining structure and bracket at the heel of horizontal stringer	$\lambda_{sc} = \frac{K_{sc} \cdot \sigma_c}{R_Y}$ **(1)**	1.50 f_f	1.20f_f

where:

λ_y : Coarse mesh yield utilisation factor, as defined in Ch 7, Sec 2, [5.2.4].

λ_{yperm} : Coarse mesh permissible yield utilisation factor, as defined in Ch 7, Sec 2, [5.2.4].

Ksc : Screening stress concentration factor, taken as:

$$K_{sc} = \frac{\sigma_{FM}}{\sigma_{CM}}$$

σ_{FM} : Von Mises fine mesh stress, in N/mm², for the considered detail calculated in the midship cargo hold region according to [2].

σ_{CM} : Von Mises coarse mesh stress, in N/mm², for the considered detail calculated in the midship cargo hold region according to Ch 7, Sec 2.

σ_c : Von Mises coarse mesh stress, in N/mm², for the area in way of considered detail.

ff : Fatigue factor defined in [6.2.1].

(1) For each screened detail, σ_{FM} and σ_{CM} are to be taken from the corresponding elements in the same plane position.

(2) The representative element which has maximum yield utilisation factor around the manhole and the large opening is to be verified against criterion.

CHAPTER 10
OTHER STRUCTURES

SECTION 1 FORE PART

3 STRUCTURE SUBJECTED TO IMPACT LOADS

3.2 BOTTOM SLAMMING

3.2.4 Shell plating

The net thickness of the hull envelope plating, t, in mm, except for the transversely stiffened bilge plating within the cylindrical part of the ship, is not to be less than:

$$t = \frac{0.0158\alpha_p b}{C_d}\sqrt{\frac{P_{SL}}{C_a R_{eH}}}$$

Where:

C_d : Plate capacity correction coefficient taken as:
C_d = 1.3.

C_a : Permissible bending stress coefficient taken as:
C_a = 1.0 for acceptance criteria set AC-I.

The transversely stiffened bilge plating within the cylindrical part of the ship is to comply with the requirement given in Pt 1, Ch 6, Sec 4, [2.2].

SECTION 3 AFT PART

3 STERN FRAMES

3.2 Propeller posts

3.2.1 Gross scantlings of propeller posts

The gross scantlings of propeller posts are not to be less than those obtained from the formulae in Table 1 for single screw ships and Table 2 for twin screw ships.

Scantlings and proportions of the propeller post which differ from ~~those above~~ Table 1 and Table 2 may be considered acceptable provided that the section modulus of the propeller post section about its longitudinal axis is not less than that calculated with the propeller post scantlings in Table 1 or Table 2, as applicable.

~~**3.2.2 Section modulus below the propeller shaft bossing**~~

~~In the case of a propeller post without a sole piece, the section modulus of the propeller post may be gradually reduced below the propeller shaft bossing down to 85% of the value calculated with the scantlings in Table 1 or Table 2, as applicable.~~

~~In any case, the thickness of the propeller posts are not to be less than those obtained from the formulae in the Table 1 and Table 2.~~

CHAPTER 12
CONSTRUCTION

SECTION 3 DESIGN OF WELD JOINTS

2 TEE OR CROSS JOINT

2.5 Weld size criteria

2.5.2

Table 1 Minimum leg size

Area	Type of space		Minimum length, in *mm*
Cargo hold region	Cargo tanks and holds	~~Welds w~~Within 3m below ~~top of compartment~~ tank (2)	6.5 (1)
		Elsewhere	6.0 (1)
	Water ballast ~~and fresh water~~ tanks	~~Welds w~~Within 3m below ~~top of compartment~~ tank (2)	6.5 (1)
		Elsewhere	6.0 (1)
	Dry spaces and voids		5.0
	Other tanks		6.0 (1)
Other areas	Water ballast ~~and fresh water~~ tanks	~~Welds w~~Within 3m below top of tank(2)	6.0 (1)
		Elsewhere	5.5 (1)
	Fuel oil, diesel oil, fresh water and other tanks	~~Welds within 3m below top of compartment~~	~~5.0~~
		~~Elsewhere~~	4.5
	Dry spaces and voids	~~Welds within 3m below top of compartment~~	~~4.5~~
		~~Elsewhere~~	4.0
	Superstructures and deckhouses		3.5

(1) If the as-built thickness of the element is less than 12mm, the minimum leg length may be reduced by 0.5mm.
(2) Only applicable to cargo tanks and ballast tanks with weather deck as the tank top. The 3m distance is measured vertically from and parallel to the top of the tank.

Table 2 : Weld factors for different structural members

Hull area	Connection				f_{weld}
	Of		To		
Deck	Strength deck	$t_{as\_built} \geq 13$	Side shell plating within 0.6*L* midship		PPW (3)
			Elsewhere		0.48
		$t_{as\_built} < 13$	Side shell plating		0.48
	Other deck		Side shell plating		0.38
			Stiffeners		0.20
	Hatch coamings		Deck plating	Longitudinal hatch coaming at ~~At~~ corners of hatchways ~~for~~ on a length of 15% of the hatch ~~length~~ coaming height	FPW (4) (1)
				Longitudinal hatch coaming on a length starting from 15% of the hatch coaming height from the corners of hatchways up to 15% of the hatch length	0.48
				Elsewhere	0.38
	Web stiffeners		Coaming webs		0.20 (2)
Bulkheads (5)	Non-watertight bulkhead		Boundaries	Swash bulkheads	0.24
	Stiffener		Bulkhead plating	At ends (25% of span), where no end brackets are fitted	0.48
….	….		….	….	….
Super-structure and deckhouse	External bulkhead (first and second tier erections)		Deck, external bulkhead		0.48
	External bulkhead and internal bulkheads		Elsewhere		0.20

(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].
(4) FPW: Full penetration welding in accordance with [2.4.2].
(5) Bulkheads of superstructure and deckhouse are to be considered in the row corresponding to "Superstructure and deck house".

(*Partial table shown only*)