RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

Part CSR-T Common Structural Rules for Double Hull Oil Tankers

Rules for the Survey and Construction of Steel Ships
Part CSR-T 2010 AMENDMENT NO.1

Rule No.24 15th April 2010
Resolved by Technical Committee on 5th February 2010
Approved by Board of Directors on 23rd February 2010

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Rule No.24 15th April 2010
AMENDMENT TO THE RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

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

Part CSR-T COMMON STRUCTURAL RULES FOR DOUBLE HULL OIL TANKERS

Section 2 RULE PRINCIPLES

2. General Assumptions

2.1 General

2.1.2 Classification Societies

Paragraph 2.1.2.1 has been amended as follows.

2.1.2.1 ~~Classification Societies develop and publish the standards for the hull structure and essential engineering systems. Classification Societies undertake an audit during design, construction and operation of a ship to confirm compliance with the classification requirements and the applicable international regulations when authorised by a National Administration.~~ Classification Societies develop and publish the standards for the hull structure and essential engineering systems. Classification Societies verify compliance with the classification requirements and the applicable international regulations when authorised by a National Administration during design, construction and operation of a ship.

Section 4 BASIC INFORMATION

1. Definitions

1.8 Glossary

1.8.1 Definitions of terms

1.8.1.1 The terms in **Table 4.1.1** are used within this Part to describe the items which their respective definitions describe.

Table 4.1.1 has been amended as follows. (part only shown)

Table 4.1.1 Definitions of Terms

Terms	Definition
Deck house	~~A structure on the freeboard or superstructure deck not extending from side to side of the ship~~ A decked structure other than a superstructure, located on the freeboard deck or above
Superstructure	~~A decked structure on the freeboard deck extending for at least 92% of the breadth of the ship~~ A decked structure on the freeboard deck, extending from side to side of the ship or with the side plating not being inboard of the shell plating more than 0.04B

Section 6 MATERIALS AND WELDING

2. Corrosion Protection Including Coatings

2.1 Hull Protection

2.1.2 Internal cathodic protection systems

Paragraph 2.1.2.2 has been amended as follows.

2.1.2.2 Permanent 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. Impressed current systems are not to be used in cargo tanks due to the development of chlorine and hydrogen that can result in an explosion. Aluminium anodes are accepted, however, in tanks with liquid cargo with flash point below 60°C and in adjacent ballast tanks, aluminium anodes are to be located so a kinetic energy of not more than 275*J* is developed in the event of their loosening and becoming detached.

3. Corrosion Additions

3.3 Application of Corrosion Additions

3.3.4 Application of corrosion additions for scantling strength assessment of primary support members

Paragraph 3.3.4.3 has been amended as follows.

3.3.4.3 The required minimum gross thickness of primary support members is calculated by adding the full corrosion addition, i.e. $+1.0t_{corr}$, to the minimum net thickness requirement given in **Section 8/2.1.6.1, 8/3.1.4.1, 8/4.1.5.1, 8/5.1.4.1, 8/6.3.7.5, 8/6.4.5.4** and **10/2.3**.

5. Weld Design and Dimensions

5.4 Lapped Joints

5.4.1 General

Paragraph 5.4.1.3 has been amended as follows.

5.4.1.3 The overlaps for lugs and collars in way of cut-outs for the passage of stiffeners through webs and bulkhead plating are not to be less than three *times* the gross thickness of the lug but need not be greater than 50*mm*. The joints are to be positioned to allow adequate access for completion of sound welds.

5.7 Determination of the Size of Welds

5.7.4 Welding of end connections of primary support members

Paragraph 5.7.4.1 has been amended as follows.

5.7.4.1 Welding of end connections of primary support members (i.e. transverse frames and girders) is to be such that the weld area, A_{weld}, is to be equivalent to the Rule gross cross-sectional area of the member. In terms of weld leg length, l_{leg}, this is to be taken as by:

$$l_{leg} = 1.41 f_{yd} \frac{h_w t_{p-grs}}{l_{dep}} \qquad (mm)$$

Where:

h_w : web height of primary support member, in *mm*, see **Fig. 6.5.10**
$t_{p\text{-}grs}$: rule gross thickness of the primary support member, in *mm*
l_{dep} : total length of deposit of weld metal, in *mm*. Generally this can be taken as twice l_{weld} shown in **Fig. 6.5.10** for a double continuous fillet weld
f_{yd} : correction factor taking into account the yield strength of the weld deposit, as defined in **5.7.1.2**

In no case is the size of weld to be less than that calculated in accordance with **5.7.1.2**, using a minimum weld factor, ~~f_l~~ $\underline{f_{weld}}$, of 0.48 in tanks or 0.38 elsewhere.

Table 6.5.4 has been amended as follows.

Table 6.5.4 Connection of Primary Support Members

Primary Support Member gross face area, in cm^2		Position [1]	Weld factor, f_{weld}			
			In tanks		In dry spaces	
Greater than	Not greater than		To face plate	To plating	To face plate	To plating
	30.0	At ends Remainder	0.20 0.12	0.26 0.20	0.20 0.12	0.20 0.15
30.0	65.0	At ends Remainder	0.20 0.12	0.38 0.26	0.20 0.12	0.20 0.15
65.0	95.0	At ends Remainder	0.42 0.30 [2]	0.59 [3] 0.42	0.20 0.15	0.30 0.20
95.0	130.0	At ends Remainder	0.42 0.30 [2]	0.59 [3] 0.42	0.30 0.20	0.42 0.30
130.0		At ends Remainder	0.59 [3] 0.42	0.59 [3] 0.42	0.42 0.30	0.59 [3] 0.42

Note

1. The weld factors ‘at ends’ are to be applied for 0.2 *times* the overall length of the member from each end, but at least beyond the toe of the member end brackets. On vertical webs, the increased welding may be omitted at the top, but is to extend at least 0.3 *times* overall length from the bottom.
2. Weld factor 0.38 to be used for cargo tanks.
3. Where the web plate thickness is increased locally to meet shear stress requirements, the weld size may be based on the gross web thickness clear of the increased area, but is to be not less than weld factor of 0.42 based on the increased gross thickness.
4. In regions of high stress, see **5.3.4**, **5.7.4** and **5.8**.

Section 8 SCANTLING REQUIREMENTS

1. Longitudinal Strength

1.1 Loading Guidance

1.1.2 Loading Manual

Paragraph 1.1.2.2 has been amended as follows.

1.1.2.2 The following loading conditions and design loading and ballast conditions upon which the approval of the hull scantlings is based are, as a minimum, to be included in the Loading Manual:
(a) Seagoing conditions including both departure and arrival conditions

- homogeneous loading conditions including a condition at the scantling draft
  (homogeneous loading conditions shall not include filling of dry and clean ballast tanks)
- a normal ballast condition where:
  the ballast tanks may be full, partially full or empty. Where partially full options are exercised, the conditions in **1.1.2.5** are to be complied with
  all cargo tanks are to be empty including cargo tanks suitable for the carriage of water ballast at sea
  the propeller is to be fully immersed, and
  the trim is to be by the stern and is not to exceed $0.015L_{CSR\text{-}T}$, where $L_{CSR\text{-}T}$ is as defined in **Section 4/1.1.1**
- a heavy ballast condition where:
  the draught at the forward perpendicular is not to be less than that for the normal ballast condition
  ballast tanks in the cargo tank region or aft of the cargo tank region may be full, partially full or empty. Where the partially full options are exercised, the conditions in **1.1.2.5** are to be complied with
  the fore peak water ballast tank is to be full. If upper and lower fore peak <u>water ballast</u> tanks are fitted, the lower is required to be full. The upper fore peak tank may be full, partially full or empty. <u>If upper and lower fore peak tanks are fitted and only one of them is designated as water ballast tank, the other may be empty.</u>
  all cargo tanks are to be empty including cargo tanks suitable for the carriage of water ballast at sea
  the propeller is to be fully immersed
  the trim is to be by the stern and is not to exceed $0.015L_{CSR\text{-}T}$, where $L_{CSR\text{-}T}$ is as defined in **Section 4/1.1.1**
  any specified non-uniform distribution of loading
  conditions with high density cargo including the maximum design cargo density, when applicable
  mid-voyage conditions relating to tank cleaning or other operations where these differ significantly from the ballast conditions
  conditions covering ballast water exchange procedures with the calculations of the intermediate condition just before and just after ballasting and/or deballasting any ballast tank

(b) Harbour/sheltered water conditions

- conditions representing typical complete loading and unloading operations
- docking condition afloat
- propeller inspection afloat condition, in which the propeller shaft centre line is at least $D_{prop}/4$ above the waterline in way of the propeller, where D_{prop} is the propeller diameter

(c) Additional design conditions

- a design ballast condition in which all segregated ballast tanks in the cargo tank region are full and all other tanks are empty including fuel oil and fresh water tanks.

Guidance Note

The design condition specified in **(c)** is for assessment of hull strength and is not intended for ship operation. This condition will also be covered by the **IMO 73/78 SBT** condition provided the corresponding condition in the Loading Manual only includes ballast in segregated ballast tanks in the cargo tank region.

6. Evaluation of Structure for Sloshing and Impact Loads

6.2 Sloshing in Tanks

6.2.2 Application of sloshing pressure

Paragraph 6.2.2.5 has been amended as follows.

6.2.2.5 The design sloshing pressure due to transverse liquid motion, P_{shl-t}, as defined in **Section 7/4.2.3.1**, is to be applied to the following members as shown in **Fig. 8.6.2**:

(a) longitudinal tight bulkhead
(b) longitudinal wash bulkhead
(c) horizontal stringers ~~and vertical webs~~ on longitudinal tight and wash bulkheads
(d) plating and stiffeners on the transverse tight bulkheads including stringers and deck which are between the longitudinal bulkhead and the first girder from the bulkhead or the bulkhead and $0.25b_{slh}$ whichever is lesser.

Paragraph 6.2.3 has been amended as follows.

6.2.3 Sloshing assessment of plating forming tank boundaries <u>and wash bulkheads</u>

6.2.3.1 The net thickness of plating forming tank boundaries <u>and wash bulkheads</u>, t_{net}, subjected to sloshing pressures is not to be less than:

$$t_{net} = 0.0158\alpha_p\, s\sqrt{\frac{P_{slh}}{C_a \sigma_{yd}}} \qquad (mm)$$

Where:

α_p : correction factor for the panel aspect ratio

$= 1.2 - \frac{s}{2100 l_p}$ but not to be taken as greater than 1.0

s : stiffener spacing, in *mm*, as defined in **Section 4/2.2**

l_p : length of plate panel, to be taken as the spacing of primary support members, *S*, unless carlings are fitted, in *m*

P_{slh} : the greater of $P_{slh-lng}$, P_{slh-t} or $P_{slh-min}$ as specified in **6.2.2**

C_a : permissible plate bending stress coefficient as given in **Table 8.6.1**

σ_{yd} : specified minimum yield stress of the material, in N/mm^2

Paragraph 6.2.4 has been amended as follows.

6.2.4 Sloshing assessment of stiffeners on tank boundaries <u>and wash bulkheads</u>

6.2.4.1 The net section modulus, Z_{net}, of stiffeners on tank boundaries <u>and wash bulkheads</u> subjected to sloshing pressures is not to be less than:

$$Z_{net} = \frac{P_{slh}\, s\, l_{bdg}^{\,2}}{f_{bdg} C_s\, \sigma_{yd}} \qquad (cm^3)$$

Where:

l_{bdg} : effective bending span, of stiffener, as defined in **Section 4/2.1**, in *m*

C_s : permissible bending stress coefficient as given in **Table 8.6.2**

P_{slh} : the greater of $P_{slh-lng}$, P_{slh-t} or $P_{slh-min}$ as specified in **6.2.2**

s : stiffener spacing, in *mm*, as defined in **Section 4/2.2**

σ_{yd} : specified minimum yield stress of the material, in N/mm^2

f_{bdg} : bending moment factor

= 12 for stiffeners fixed against rotation at each end. This is generally to be applied for scantlings of all continuous stiffeners

= 8 for stiffeners with one or both ends not fixed against rotation. This is generally to be applied to discontinuous stiffeners for other configurations the bending moment factor may be taken as given in **Table 8.3.5**

6.2.5 Sloshing assessment of primary support members

Paragraph 6.2.5.4 bis has been added as follows.

6.2.5.4 bis The effective breadth of the attached plate to be used for calculating the section modulus of the tripping bracket supporting primary support members is to be taken as 1/3 the length of the tripping bracket, l_{trip}, as given in **8/6.2.5.4**.

6.4 Bow Impact

6.4.7 Primary support members

Paragraph 6.4.7.5 has been amended as follows.

6.4.7.5 The net section modulus of each primary support member, Z_{net50}, is not to be less than:

$$Z_{net50} = 1000 \frac{f_{bdg-pt} P_{im}\, b_{slm} f_{slm} l_{bdg}^{2}}{f_{bdg} C_s \sigma_{yd}} \qquad (cm^3)$$

Where:

f_{bdg-pt} : correction factor for the bending moment at the ends and considering the patch load

$= 3 f_{slm}^{3} - 8 f_{slm}^{2} + 6 f_{slm}$

f_{slm} : patch load modification factor

$= \frac{l_{slm}}{l_{bdg}}$

l_{slm} : extent of bow impact load area along the span

$= \sqrt{A_{slm}}$ (m), but not to be taken as greater than l_{bdg}

A_{slm} : bow impact load area, in m^2, as defined in **6.4.6.1**

l_{bdg} : effective bending span, as defined in **Section 4/2.1.4**, in m

P_{im} : bow impact pressure as given in **Section 7/4.4** and calculated at the load calculation point defined in **Section 3/5.3.3**, in kN/m^2

b_{slm} : breadth of impact load area supported by the primary support member, to be taken as the spacing between primary support members as defined in **Section 4/2.2.2**, but not to be taken as greater than l_{slm}, in m

f_{bdg} : bending moment factor

= 12 for primary support members with end fixed continuous face plates, stiffeners or where stiffeners are bracketed in accordance with **Section 4/3.3** at both ends

C_s : permissible bending stress coefficient

= 0.8 ~~for acceptance criteria set AC3~~

σ_{yd} : specified minimum yield stress of the material, in N/mm^2

Section 11 GENERAL REQUIREMENTS

1. Hull Openings and Closing Arrangements

1.1 Shell and Deck Openings

1.1.6 Small hatches on the exposed fore deck

Paragraph 1.1.6.15 has been added as follows.

1.1.6.15 For small hatch covers located on the exposed deck within the forward $0.25L_{CSR-T}$ from the F.P., the hinges are to be fitted such that the predominant direction of green sea will cause the cover to close, which means that the hinges are normally to be located on the fore edge.

1.3 Air Pipes

Table 11.1.5 has been amended as follows.

Table 11.1.5 Thickness and Bracket Standards for 760*mm* High Air Pipes

Nominal pipe size	Minimum fitted gross thickness, in *mm*	Maximum projected area of head, in cm^2	Height (1) of brackets, in *mm*
65A	6.0	-	~~-~~480
80A	6.3	-	~~480~~460
100A	7.0	-	~~460~~380
125A	7.8	-	~~380~~300
150A	8.5	-	300
175A	8.5	-	300
200A	8.5 (2)	1900	300 (2)
250A	8.5 (2)	2500	300 (2)
300A	8.5 (2)	3200	300 (2)
350A	8.5 (2)	3800	300 (2)
400A	8.5 (2)	4500	300 (2)

Note

: Brackets (see **1.3.3.2**) need not extend over the joint flange for the head.

: Brackets are required where the gross thickness of the pipe section is less than 10.5*mm*, or where the tabulated projected head area is exceeded.

3. Support Structure and Structural Appendages

3.1 Support Structure for Deck Equipment

3.1.3 Supporting structure for mooring winches

Paragraph 3.1.3.7 has been amended as follows.

3.1.3.7 These requirements are to be assessed using a simplified engineering analysis based on elastic beam theory, two-dimensional grillage or finite-element analysis using ~~gross~~ net scantlings.

5. Testing Procedures

Table 11.5.1 has been amended as follows.

Table 11.5.1 Testing Requirements for Tanks and Boundaries

	Structures to be tested	Type of testing	Hydrostatic testing head or pressure	Remarks
1	Double Bottom Tanks	Structural(1)	The greater of - to the top of overflow, or - to the bulkhead deck	Tank boundaries tested from at least one side
2	Double Side Tanks	Structural(1)	The greater of - to the top of overflow, or - to 2.4*m* above top of tank(2)	Tank boundaries tested from at least one side
3	Cargo Tanks	Structural(1)	The greatest of - to the top of overflow, - to 2.4*m* above top of tank(2), or - to the top of tank(2) plus setting of any pressure relief valve	Tank boundaries tested from at least one side
	Fuel Oil Bunkers	Structural		
4	Cofferdams	Structural(3)	The greater of - to the top of overflow, or - to 2.4*m* above top of cofferdam	
5a	Peak Tanks	Structural	The greater of - to the top of overflow, or - to 2.4*m* above top of tank(2)	Aft peak tank test to be carried out after installation of stern tube.
5b	Fore Peak not used as a tank	Refer to *SOLAS II.1 Reg.14*		
5c	Aft Peak not used as a tank	Leak		
6	Watertight Bulkheads in way of dry space	Hose(4)		Including steps and recesses
7	Watertight Doors below freeboard or bulkhead deck	Hose		For testing before installation(5)
8	~~Double Plate Rudder~~(void)	~~Structural(1), (6)~~	~~2.4*m* head of water. Rudder is to be tested while laid on its side~~	
9	Watertight hatch covers of tanks on combination carriers	Structural testing	The greater of: - to 2.4*m* above the top of hatch cover, or - setting pressure of the pressure relief valve	At least every second hatch cover is to be tested
10	Weathertight Hatch Covers, Doors and other Closing Appliances	Hose(4)		
11	Shell plating in way of pump room	Visual examination		To be carefully examined with the vessel afloat

Table 11.5.1 (Continued) Testing Requirements for Tanks and Boundaries

	Structures to be tested	Type of testing	Hydrostatic testing head or pressure	Remarks
12	Chain Locker (aft Collision Bulkhead)	Structural	To the top of chain locker spurling pipe	
13	Independent Tanks	Structural	The greater of - to the top of overflow, or - to 0.9 *m* above top of tank	
14	Ballast Ducts	Structural	Ballast pump maximum pressure or setting of any relief valve for the ballast duct if that is less	
15	Hawse Pipes	Hose		

Note :

1. Leak or hydropneumatic testing may be accepted under the conditions specified in **5.1.5**, provided that at least one tank for each type is structurally tested, and selected in connection with the approval of the design. In general, the structural testing need not be repeated for subsequent vessels of a series of identical new buildings unless the Surveyor deems the repetition necessary. The structural testing of cargo space boundaries and tanks for segregated cargoes or pollutants on subsequent vessels of a series of identical new buildings are to be in accordance with the requirements of the Society.
2. Top of tank is defined as the deck forming the top of the tank excluding hatchways.
3. Leak testing in accordance with **5.1.5** may be accepted, except that hydropneumatic testing may be required in consideration of the construction techniques and welding procedures employed.
4. Where hose testing is impractical due to the stage of outfitting (machinery, cables, switchboard, insulation etc.), it may be replaced at the Society's discretion, by a careful visual examination of all the crossings and welded joints. A dye penetrant test, leak test or ultrasonic leak test may be required.
5. Before installation (i.e. normally at manufacture) the watertight access doors or hatches are to be hydrostatically tested with a head of water equivalent to the bulkhead deck at centre, from the side which is most prone to leakage. The acceptance criteria are as follows:
   no leakage for doors or hatches with gaskets
   a maximum water leakage of one litre per minute for doors or hatches with metallic sealing.
6. If leak or hydropneumatic testing is carried out, arrangements are to be made to ensure that no pressure in excess of 0.30 *bar* is applied.

Appendix B STRUCTURAL STRENGTH ASSESSMENT

3. Local Fine Mesh Structural Strength Analysis

Table B.3.1 has been amended as follows.

Table B.3.1 Fine Mesh Analysis Screening Criteria for Openings in Primary Support Members

A fine mesh finite element analysis is to be carried out where:

$\lambda_y > 1.7$ (load combination S + D)

$\lambda_y > 1.36$ (load combination S)

Where:

λ_y	: yield utilisation factor	
	$= 0.85 C_h \left(\lvert \sigma_x + \sigma_y \rvert + \left(2 + \left(\frac{l_0}{2r} \right)^{0.74} + \left(\frac{h_0}{2r} \right)^{0.74} \right) \lvert \tau_{xy} \rvert \right) \frac{k}{235}$	
C_h	$= 1.0 - 0.23 \left(\frac{h_0}{h} \right) + 2.12 \left(\frac{h_0}{h} \right)^2$	for openings in vertical web and horizontal girder of wing ballast tank, double bottom floor and girder and horizontal stringer of transverse bulkhead
	= 1.0	for opening in web of main bracket and buttress (see figures below)
r	: radius of opening, in *mm*	
h_0	: height of opening parallel to depth of web, in *mm*	
l_0	: length of opening parallel to girder web direction, in *mm*	
h	: height of web of girder in way of opening, in *mm*	
σ_x	: axial stress in element x direction determined from cargo tank FE analysis according to the coordinate system shown, in N/mm^2	
σ_y	: axial stress in element y direction determined from cargo tank FE analysis according to the coordinate system shown, in N/mm^2	
τ_{xy}	: element shear stress determined from cargo tank FE analysis, in N/mm^2, [(2)]	
k	: higher strength steel factor, as defined in **Section 6/1.1.4** but not to be taken as less than 0.78 for load combination S + D	

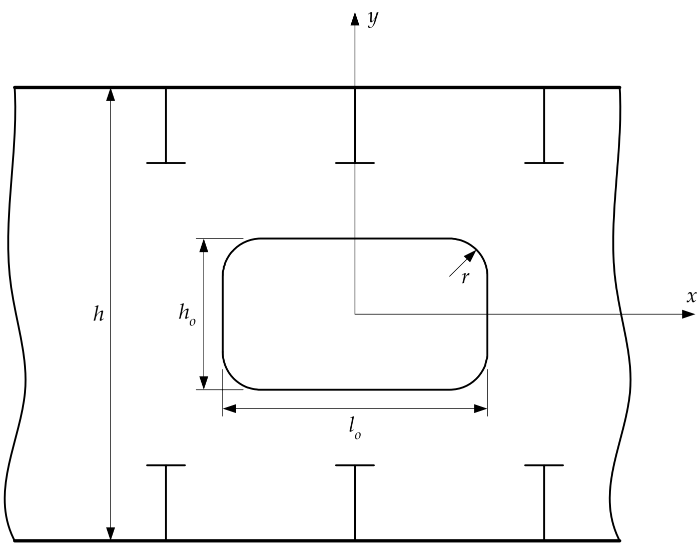
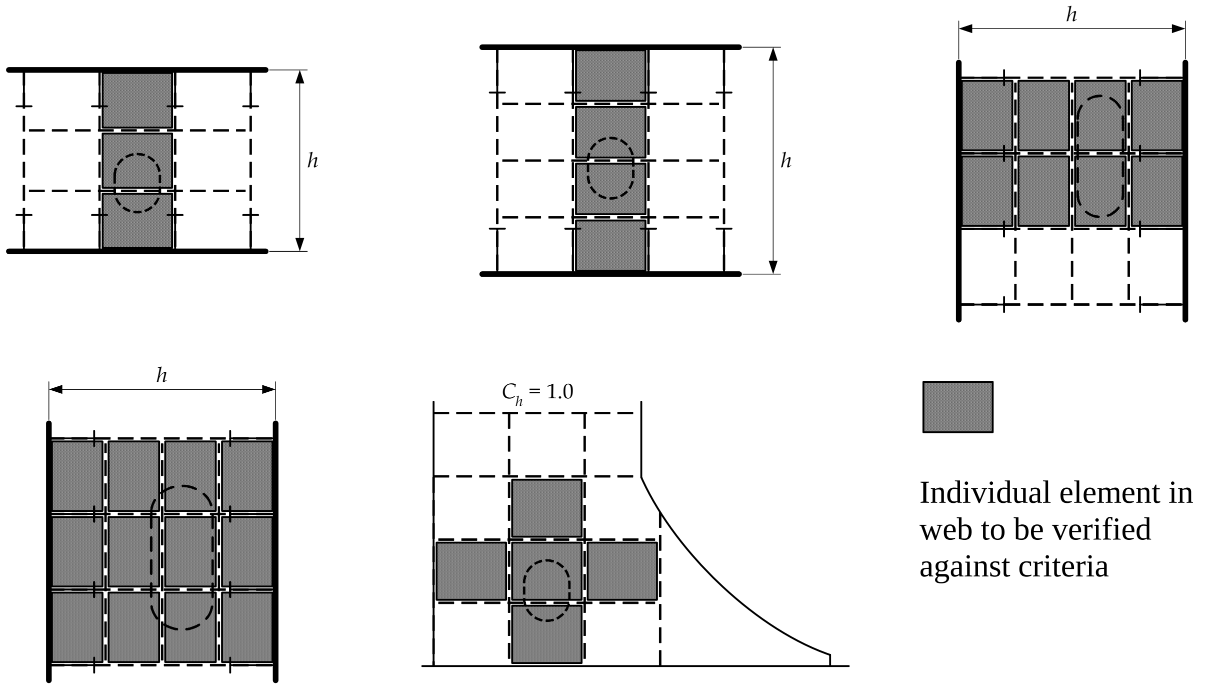


Table B.3.1 (Continued) Fine Mesh Analysis Screening Criteria for Openings in Primary Support Members



Notes:

1. ~~Screening criteria only applicable to opening where its geometry is not required to be represented in the cargo tank FE model in accordance with **Table B.2.2**. Where the geometry of the opening is required to be modelled in accordance with **Table B.2.2**, fine mesh FE analysis is to be carried out to determine the stress level.~~
   For opening where the modelled shear area in way of the opening is different from the actual net shear area the element shear stress is to be adjusted using the formula given in B.2.7.2.4 prior to the evaluation of yield utilisation factor for verification against the screening criteria.
2. ~~Where the modelled thickness of the web in way of the opening is reduced in accordance with **Table B.2.2**, the element shear stress is to be adjusted by the ratio of the actual net web thickness (i.e. calculated by deducting 0.5t_{corr} from the gross thickness) to the modelled reduced mean thickness (i.e. $t_{1-net50}$ or $t_{2-net50}$ defined in **Table B.2.2**) prior to the evaluation of yield utilisation factor for verification against the screening criteria.~~
   Where the geometry of the opening is required to be modelled in accordance with Table B.2.2, fine mesh FE analysis is to be carried out to determine the stress level. The screening criteria given in this table are not applicable.
3. Screening criteria is only valid if the cargo tank finite element analysis and the derivation of element stresses is carried out in accordance with **B/2**.

Appendix C FATIGUE STRENGTH ASSESSMENT

1. Nominal Stress Approach

1.4 Fatigue Damage Calculation

1.4.5 Selection of S-N curves

Paragraph 1.4.5.11 has been amended as follows.

1.4.5.11 The total stress range considering the mean stress effect is to be taken as follows:

$S_{Ri} = \sigma_{tensile} - 0.6\,\sigma_{compressive}$ *if* $\sigma_{compressive} < 0$ *and* $\sigma_{tensile} > 0$

$S_{Ri} = S$ *if* $\sigma_{compressive} \geq 0$

$S_{Ri} = 0.6S$ *if* $\sigma_{tensile} \leq 0$

Where:

$\sigma_{tensile}$: mean stress plus half stress range, in N/mm^2
$= \sigma_{mean} + S/2$

$\sigma_{compressive}$: mean stress minus half stress range, in N/mm^2
$= \sigma_{mean} - S/2$

σ_{mean} : mean stress due to static load components in the full load condition or ballast condition as appropriate, in N/mm^2, see **1.3.2**

For the nominal stress approach, S and σ_{mean} are to be calculated as follows:

S : total combined stress range, in N/mm^2, as defined in **1.4.4.19**
$= \sigma_{tensile} - \sigma_{compressive}$

σ_{mean} $= \sigma_{hg} + \sigma_{ex} + \sigma_{in}$

σ_{hg} : mean stress due to hull girder bending, to be derived using σ_v from **1.4.4.6** with $M_{wv\text{-}v\text{-}amp}$ taken as the actual SWBM for the full load condition or ballast condition as appropriate, see **1.3.2**.

σ_{ex} : mean local bending stress due to external static sea pressure, if applicable. σ_{ex} is to be derived using σ_{2A} from **1.4.4.11** with P calculated based on the actual draught for the full load condition or ballast condition as appropriate, see **1.3.2**, where $P = P_{hys}$, see **Section 7/2.2.2.1**.

σ_{in} : mean local bending stress due to internal static tank pressure, if applicable. σ_{in} is to be derived using σ_{2A} from **1.4.4.11** with P calculated based on the head to the top of tank and the tank contents for the full load condition or ballast condition as appropriate, see **1.3.2**, where $P = P_{in\text{-}tk}$, see **Section 7/2.2.3.1**.

Notes:

1. P is to be taken as negative when the pressure is acting on the plate side and positive when acting on the stiffener side. This gives compressive stress with a negative sign

2. Where the stiffener is on the boundary between two cargo tanks, then the mean stress is to be taken as the net stress acting on the stiffener.
3. It is to be assumed that water ballast and cargo tanks are 100% full. The fluid density is to be taken in accordance with **Section 7/2.2.3.1**, where cargo density is not to be less than 0.9 *tonnes/m*^{3}

For the hot spot stress approach in *Sub* **Section 2**, the mean stress, σ_{mean}, is to be calculated by applying the applicable static loads to the FE model for the full load condition or ballast condition as appropriate. Alternatively, in lieu of applying the static loads to the FE model, the total stress range is to be calculated in accordance with **2.4.2.8.**

2. Hot Spot Stress (FE Based) Approach

2.4. Fatigue Damage Calculation

2.4.2 Stresses to be used

Paragraph 2.4.2.6 has been amended as follows.

2.4.2.6 The hot spot stress is defined as the surface stress at 0.5*t* away from the weld toe location, as shown in **Fig. C.2.1**. The hot spot stress is to be obtained by linear interpolation in the ship's transverse direction using the respective stress at the 1st and 2nd element from the structure intersection.

EFFECTIVE DATE AND APPLICATION

1. The effective date of the amendments is 1 July 2010.

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

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

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

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

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

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

Notes:
This Procedural Requirement applies from 1 July 2009.