06-392

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 2007 AMENDMENT NO.1

Rule No.12 1st February 2007
Resolved by Technical Committee on 17th November 2006
Approved by Board of Directors on 19th December 2006

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Rule No.12 1st February 2007
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

Amendment 1-1

Section 1 INTRODUCTION

1. Introduction to Common Structural Rules for Oil Tankers

1.1 General

1.1.1 Applicability

The following sentence has been added after the end of sub-paragraph 1.1.1.1.

The definition of the rule length, *L* is given in **Section 4/1.1.1.1**.

Section 2 RULE PRINCIPLES

3. Design Basis

3.1 General

3.1.7 External environment

Sub-paragraph 3.1.7.4 has been amended as follows:

3.1.7.4 The Rules assume that the structural assessment of hull strength members is valid for the following design temperatures:
(a) lowest daily mean temperature in air is -15 ℃
(b) lowest daily mean temperature in sea water is 0 ℃
Ships operating for long periods in areas with lower daily mean air temperature may be subject to additional requirements as specified by the individual Classification Society.

3.1.8 Internal environment (cargo and water ballast tanks)

In sub-paragraph 3.1.8.5, the wording" corrosion margins" has been amended to "corrosion additions".

5. Application of Principles

5.4 Load-capacity Based Requirements

5.4.1 General

Sub-paragraph 5.4.1.8(a) has been amended as follows:

(a) repeated yield

5.4.3 Design loads for fatigue requirements

The following sentence has been added after the end of sub-paragraph 5.4.3.3(b):

> The proportion of the ship's sailing life in the full load condition is 50% and in ballast 50%. It is assumed that 15% of the ships' life is in harbour/sheltered water. It is consequently assumed that the ship will be sailing in open waters in full load condition for 42.5% of the ship's life and in the ballast condition for 42.5% of the ship's life.

5.5 Materials

5.5.1 General

In sub-paragraph 5.5.1.1, "and low service temperatures" has been deleted.

5.6 Application of Rule Requirements

5.6.6 Relationship between the prescriptive scantling requirements and the strength assessment (FEM)

Sub-paragraph 5.6.6.2 has been amended as follows:

5.6.6.2 The section modulus and/or shear area of a primary support member and/or the cross sectional area of a primary support member cross tie may be reduced to 85% of the prescriptive requirements provided that the reduced scantlings comply with the strength assessment (FEM).

Section 3 RULE APPLICATION

2. Documentation, Plans and Data Requirements

2.2 Submission of Plans and Supporting Calculations

Sub-paragraph 2.2.2.2(f) has been deleted.

4. Equivalence Procedure

4.1 General

4.1.1 Rule applications

In sub-paragraph 4.1.1.3(g), the wording" corrosion margins" has been amended to "corrosion additions".

5. Calculation and Evaluation of Scantling Requirements

5.2 Determination of Scantlings of Stiffeners

5.2.5 Shear area requirements of stiffeners

Sub-paragraph 5.2.5.3 has been amended as follows:

5.2.5.3 The requirements in **Section 8** are to be evaluated against the actual shear area of the stiffener, based on the effective shear height of the stiffener as given in **Section 4/2.4.2** and based on the specified minimum yield of the stiffener.

5.3 Calculation and Evaluation of Scantling Requirements for Primary Support Members

5.3.2 Shear requirements of primary support members

Sub-paragraph 5.3.2.3 has been amended as follows:

5.3.2.3 These requirements are to be evaluated against the actual shear area and the specified minimum yield of the web plate of the primary support member. The actual shear area of the primary support member is defined in **Section 4/2.5.1**. The effect of brackets may be included in the calculation of effective span, but are not to be included in the calculation of actual shear area.

5.3.3 Bending requirements of primary support members

Sub-paragraph 5.3.3.1 has been amended as follows:

5.3.3.1 Requirements for section modulus and moment of inertia of primary support members are given in **Section 8** and **Section 10**, respectively.

Sub-paragraph 5.3.3.4 has been amended as follows:

5.3.3.4 Where it is impracticable to fit a primary support member with the required web depth, then it is permissible to fit a member with reduced depth provided that the fitted member has equivalent inertia to the required member. The required equivalent inertia is to be based on an equivalent section given by the effective width of plating at mid span with required plate thickness, web of required depth and thickness and face plate of sufficient width and thickness to satisfy the required mild steel section modulus. All other rule requirements, such as minimum thicknesses, slenderness (*s/t*) ratio, section modulus and shear area, are to be satisfied for the member of reduced depth.

Section 4 BASIC INFORMATION

1. Definition

1.1 Principal Particulars

1.1.8 Maximum Service Speed

Sub-paragraph 1.1.8.1 has been amended as follows:

1.1.8.1 V, the maximum ahead service speed, in *knots*, means the greatest speed which the ship is designed to maintain in service at her deepest sea-going draught at the maximum propeller RPM and corresponding engine MCR (Maximum Continuous Rating).

2. Structural Idealisation

2.3 Effective Breadth of Plating

2.3.2 Effective breadth of attached plate and flanges of primary support members for strength evaluation

In sub-paragraph 2.3.2.2, the wording" the section modulus of a primary support member" has been amended to "the section modulus and/or moment of inertia of a primary support member".

In sub-paragraph 2.3.2.3, the wording" the section modulus of a primary support member" has been amended to "the section modulus and/or moment of inertia of a primary support member".

In sub-paragraph 2.3.2.3, the formula" $b_{eff} = S\sin\left[\frac{\pi}{6}\left(\frac{l_{bdg}}{S\sqrt{3}}\right)\right]$ " has been amended to "$b_{eff} = S\sin\left[\frac{\pi}{18}\left(\frac{l_{bdg}}{S\sqrt{3}}\right)\right]$".

2.3.3 Effective breadth of attached plate of local support members for fatigue strength evaluation

In sub-paragraph 2.3.3.3, the formula" $b_{eff} = S \sin\left[\frac{\pi}{6}\left(\frac{l_{bdg}}{S\sqrt{3}}\right)\right]$ " has been amended to "$b_{eff} = S \sin\left[\frac{\pi}{18}\left(\frac{l_{bdg}}{S\sqrt{3}}\right)\right]$".

2.4 Geometrical Properties of Local Support Members

2.4.1 Calculation of net section properties for local support members

Sub-paragraph 2.4.1.1 has been amended as follows:

2.4.1.1 The net section modulus, moment of inertia and shear area properties of local support members are to be calculated using the net thicknesses of the attached plate, web and flange.

2.4.2 Effective elastic sectional properties of local support members

In sub-paragraph 2.4.2.2, the wording" web depth" has been amended to "shear depth".

2.4.3 Effective plastic section modulus and shear area of stiffeners

In sub-paragraph 2.3.3.3, the formula" $Z_{pl-net} = \frac{f_w\, d_w{}^2\, t_{w-net} \sin_w}{2000} + \frac{(2\gamma - 1) A_{f-net}\left(h_{f-ctr} \sin_w - b_{f-ctr} \cos_w\right)}{1000}$" has been amended to "$Z_{pl-net} = \frac{f_w\, d_w{}^2\, t_{w-net} \sin\varphi_w}{2000} + \frac{(2\gamma - 1) A_{f-net}\left(h_{f-ctr} \sin\varphi_w - b_{f-ctr} \cos\varphi_w\right)}{1000}$"

2.5 Geometrical Properties of Primary Support Members

The title of Sub-paragraph 2.5.1 has been amended as follows:

2.5.1 Effective shear area of primary support members

Sub-paragraph 2.5.1.2(c) has been amended as follows:

(c) $h_{n1} + h_{n2} + h_{n4}$

3. Structure Design Details

3.2 Termination of Local Support Members

3.2.3 Bracketed connections

In sub-paragraph 3.2.3.4, the wording" see **Figure 4.3.1**" have been amended to "see **Figure 4.3.1(a), (b) and (d)**"

3.4 Intersections of Continuous Local Support Members and Primary Support Members

3.4.3 Connection between primary support members and intersecting stiffeners (local support members)

In sub-paragraph 3.4.3.3, the definition of "$t_{c\text{-net}}$" has been amended as follows:

$t_{c\text{-net}}$ net thickness of lug or collar plate, not to be taken greater than the net thickness of the adjacent primary support member web, in *mm*

Table 4.3.1 has been amended as follows:

Table 4.3.1 Permissible Stresses for Connection between Stiffeners and Primary Support Members

Item	Direct Stress, σ_{perm}, in N/mm^2			Shear Stress, τ_{perm}, in N/mm^2		
	Acceptance Criteria Set See **3.4.3.2**			Acceptance Criteria Set See **3.4.3.2**		
	AC1	AC2	AC3	AC1	AC2	AC3
Primary support member web stiffener	$0.83\,\sigma_{yd}$ (3)	σ_{yd}	σ_{yd}	-	-	-
Primary support member web stiffener to intersecting stiffener in way of weld connection:						
double continuous fillet	$0.58\,\sigma_{yd}$ (3)	$0.70\,\sigma_{yd}$ (3)	σ_{yd}	-	-	-
partial penetration weld	$0.83\,\sigma_{yd}$ (2)(3)	σ_{yd} (2)	σ_{yd}	-	-	-
Primary support member stiffener to intersecting stiffener in way of lapped welding	$0.50\,\sigma_{yd}$	$0.60\,\sigma_{yd}$	σ_{yd}	-	-	-
Shear connection including lugs or collar plates:						
single sided connection	-	-	-	$0.71\,\tau_{yd}$	$0.85\,\tau_{yd}$	τ_{yd}
double sided connection	-	-	-	$0.83\,\tau_{yd}$	τ_{yd}	τ_{yd}
Where:						

τ_{perm}	permissible shear stress, in N/mm^2
σ_{perm}	permissible direct stress, in N/mm^2
σ_{yd}	minimum specified material yield stress, in N/mm^2
τ_{yd}	$\frac{\sigma_{yd}}{\sqrt{3}}$, in N/mm^2

Note

The stress computation on plate type members is to be performed on the basis of net thicknesses, whereas gross values are to be used in weld strength assessments, see **3.4.3.11**.

The root face is not to be greater than one third of the gross thickness of the primary support member stiffener.

Allowable stresses may be increased by 5 percent where a soft heel is provided in way of the heel of the primary support member web stiffener.

Table 4.3.2 has been amended as follows:

Table 4.3.2
Weld Factors for Connection between Stiffeners and Primary Support Members

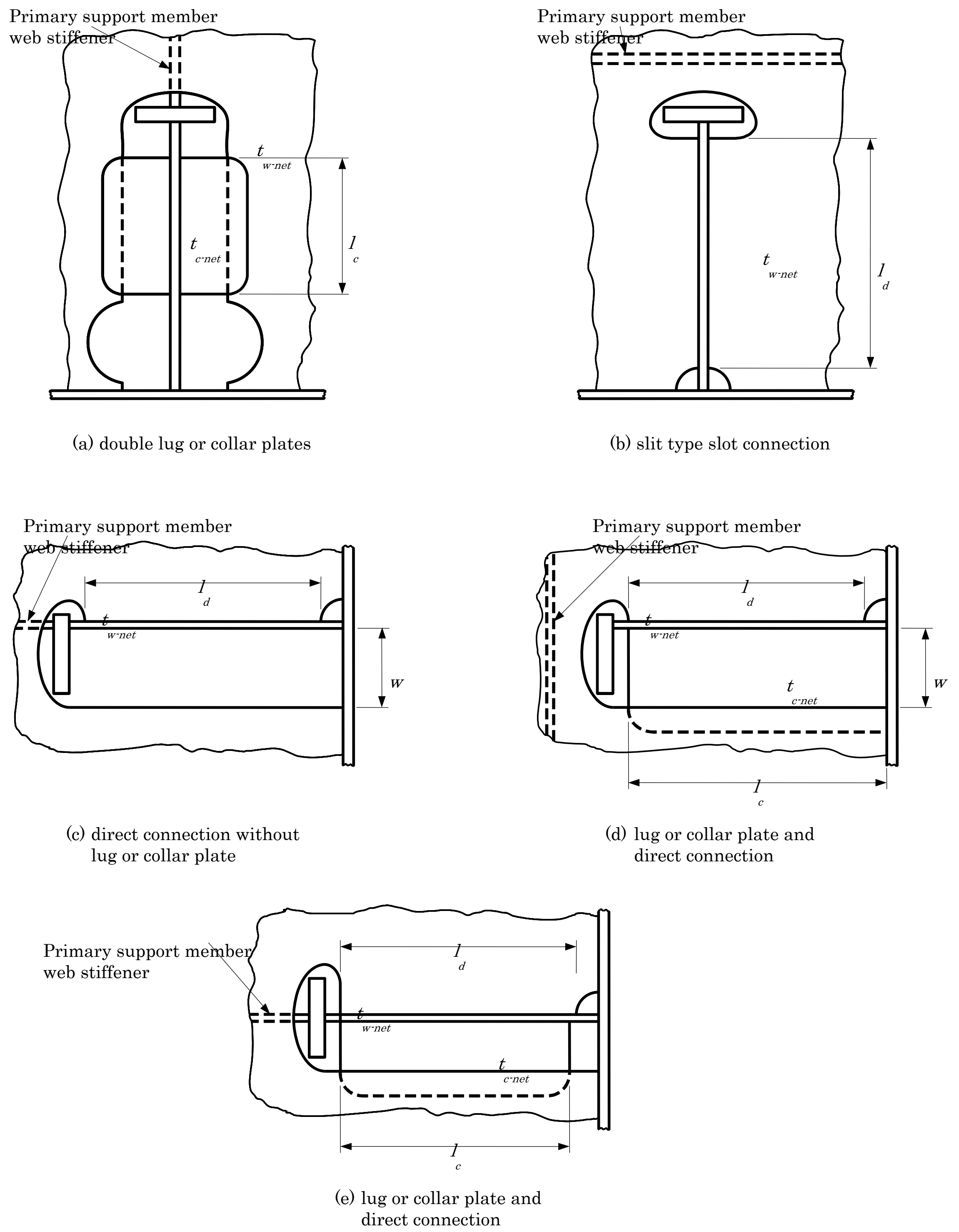
Item	Weld factor
Primary support member stiffener to intersecting stiffener	0.6 $\sigma_{wc}/\sigma_{perm}$ not to be less than 0.38
Shear connection inclusive lug or collar plate	0.38
Shear connection inclusive lug or collar plate, where the web stiffener of the primary support member is not connected to the intersection stiffener	0.6 τ_w/τ_{perm} not to be less than 0.44

Where:

τ_w	shear stress, as defined in **3.4.3.5**
σ_w	as defined in **3.4.3.5**
τ_{perm}	permissible shear stress, in N/mm^2, see **Table 4.3.1**
σ_{perm}	permissible direct stress, in N/mm^2 see **Table 4.3.1**

Figure 4.3.5 has been amended as follows:

Figure 4.3.5 Symmetric and Asymmetric Cut outs



a

Note

The details shown in this figure are only used to illustrate symbols and definitions and are not intended to represent design guidance or recommendations.

3.5 Openings

3.5.4 Manholes and lightening holes requiring reinforcement

Sub-paragraph 3.5.4.1 has been amended as follows:

3.5.4.1 Manholes and lightening holes are to be stiffened as required by **3.5.4.2** and **3.5.4.3**. The stiffening requirements of **3.5.4.2** and **3.5.4.3** may be modified where alternative arrangements are demonstrated as satisfactory with regards to stress and stability, in accordance with analysis methods described in **Section 9/2**.

In sub-paragraph 3.5.4.2, the wording” specially” has been deleted.

Section 5 STRUCTURAL ARRANGEMENT

1 General

1.1 Introduction

1.1.1 Scope

Sub-paragraph 1.1.1.1 has been amended as follows:

1.1.1.1 This section covers the general structural arrangement requirements for the ship, which are based on or derived from National and International regulations, see *Sections* **2/2.1.1** and **3/3.3**.

Section 6 MATERIALS AND WELDING

3. Corrosion Additions

3.3 Application of Corrosion Additions

3.3.3 Application for scantling assessment of plates and local support members

Sub-paragraph 3.3.3.1 and 3.3.3.2 have been amended as follows:

3.3.3.1 The required gross thickness for plates and local support members are calculated by adding the full corrosion addition, i.e. $+1.0t_{corr}$, to the net thickness required in accordance with the scantling requirements in **Sections 4/3.4** and **8/2** to **8/7**.

3.3.3.2 The net sectional properties of local support members are calculated by deducting the full corrosion margin, i.e. $-1.0t_{corr}$, from the web, flange and attached plate gross thicknesses as described in **Section 4/2.4.1** and are to comply with required section modulus, moment of inertia and shear area as given in **Sections 4/3.4** and **8/2** to **8/7**.

4. Fabrication

4.3 Hot Forming

4.3.1 Temperature requirements

The following sentence has been added after the end of sub-paragraph 4.3.1.1

Where curve forming or fairing, by line or spot heating, is carried out in accordance with **4.3.2.1** these mechanical tests are not required.

Sub-paragraph 4.3.1.2 has been amended as follows:

4.4.1.2 Confirmation is required to demonstrate the mechanical properties after further heating meet the requirements specified by a procedure test using representative material, when considering further heating other than in **4.3.1.1** of thermo-mechanically controlled steels (TMCP plates) for forming and stress relieving.

4.4 Welding

4.4.1 General

Sub-paragraph 4.4.1.1 has been amended as follows:

4.4.1.1 All welding is to be carried out by approved welders, in accordance with approved welding procedures, using approved welding consumables and is to comply with the Rules for Materials of the individual Classification Society.

5. Weld Design and Dimensions

5.1 General

5.1.3 Tolerance requirements

Sub-paragraph 5.1.3.1 has been amended as follows:

5.1.3.1 The gaps between the faying surfaces of members being joined are to be kept to a minimum or in accordance with approved specification.

5.4 Lapped Joints

5.4.1 General

Sub-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 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.

Sub-paragraph 5.4.1.4 has been added as follows:

5.4.1.4 The faying surfaces of lap joints are to be in close contact and both edges of the overlap are to have continuous fillet welds.

5.4.2 Overlapped end connections

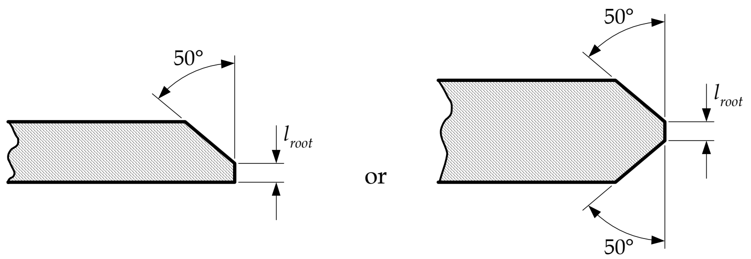
Sub-paragraph 5.4.2.1 has been amended as follows:

5.4.2.1 Lapped end connections, where accepted by the Rules, are to have continuous welds on each edge with leg length, l_{leg}, as shown in **Figure 6.5.6**, such that the sum of the two leg lengths is not less than 1.5 times the gross thickness of the thinner plate.

5.7 Determination of the Size of Welds

Table 6.5.3 has been amended as follows:

Table 6.5.3 Weld Connection of Strength Deck Plating to Sheer Strake

<table>
<tr><td>Stringer
gross plate thickness,
in mm</td><td>Weld type</td></tr>
<tr><td>$t_{p\text{-}grs} < 15$</td><td>Double continuous fillet weld with a leg size of 0.60 $t_{p\text{-}grs}$ + 2.0mm</td></tr>
<tr><td>$15 < t_{p\text{-}grs} < 20$</td><td>Single vee preparation to provide included angle of 50° with root face length $l_{root} < t_{p\text{-}grs}/3$ in conjunction with a continuous fillet weld with a weld factor of 0.35
or
Double vee preparation to provide included angle of 50° with root face length $l_{root} < t_{p\text{-}grs}/3$</td></tr>
<tr><td>$t_{p\text{-}grs} > 20$</td><td>Double vee preparation to provide included angle of 50° with root face length $l_{root} < t_{p\text{-}grs}/3$, but not to be greater than 10mm</td></tr>
<tr><td colspan="2">Where $t_{p\text{-}grs}$ = gross thickness of stringer plate, in mm


single vee preparation double vee preparation</td></tr>
<tr><td colspan="2">Note
Welding procedure, including joint preparation, is to be specified and approved for individual builders.
Where structural members pass through the boundary of a tank a leak stopper is to be arranged in accordance with 4.4.4.
Alternative connections will be specially considered.</td></tr>
</table>

Section 7 LOADS

2. Static Load Components

2.1 Static Hull Girder Loads

2.1.1 Permissible hull girder still water bending moment

In sub-paragraph 2.1.1.5, the wording" in 2.1.2.1"has been amended to "in 2.1.2.1 and 2.1.2.2"

In sub-paragraph 2.1.1.6, the wording" in 2.1.2.2"has been amended to "in 2.1.2.3"

4. Sloshing and Impact Loads

4.2 Sloshing Pressure in Tanks

4.2.1 Application and limitations

Sub-paragraph 4.2.1.2 has been amended as follows:

4.2.1.2 The given pressures do not include the effect of impact pressures due to high velocity impacts with tank boundaries or internal structures. For tanks with a maximum effective sloshing breadth, b_{slh}, greater than $0.56B$ or a maximum effective sloshing length, l_{slh}, greater than $0.13L$ at any filling height from $0.05h_{max}$ to $0.95h_{max}$, an additional impact assessment is to be carried out in accordance with the individual Classification Society procedures. The effective sloshing lengths and breadths, l_{slh} and b_{slh}, are calculated using the equations in **4.2.2.1** and **4.2.3.1** respectively.

4.2.2 Sloshing pressure due to longitudinal liquid motion

In sub-paragraph 4.2.2.2, the wording" $0.70h_{max}$" has been amended to "$0.05h_{max}$"

In sub-paragraph 4.2.2.2, Guidance note has been deleted.

4.2.3 Sloshing pressure due to transverse liquid motion

In sub-paragraph 4.2.3.2, the wording” $0.70h_{max}$” has been amended to “$0.05h_{max}$”

In sub-paragraph 4.2.2.2, Guidance note has been deleted.

4.3 Bottom Slamming Loads

4.3.2 Slamming pressure

In sub-paragraph 4.3.2.1, the wording ” in 4.3.2.2”and “in 4.3.2.3” have been amended to “in 4.3.2.3”and “in 4.3.2.4” respectively.

4.4 Bow Impact Loads

4.4.2 Bow impact pressure

In sub-paragraph 4.4.2.1, the definition of “T_{bal}” has been amended as follows:

T_{bal} minimum design ballast draught, in *m*, for the normal ballast condition as defined in **Section 4/1.1.5.2**

6. Combination of Loads

6.3 Application of Dynamic loads

6.3.5 Dynamic wave pressure distribution for a considered dynamic load case

Sub-paragraph 6.3.5.2 has been amended as follows:

6.3.5.2 The simultaneously acting dynamic wave pressure for the port and starboard side outside the cargo region, $P_{wv\text{-}dyn}$, for a considered dynamic load case is to be obtained by linear interpolation between P_{ctr} and P_{WL}, but not to be taken less than $-\rho_{sw} g(T_{LC} - z)$ below still waterline or less than 0 above still waterline.

$P_{wv-dyn} = P_{ctr} + \frac{z}{T_{LC}}(P_{WL} - P_{ctr})$ between bottom centreline and still waterline

$P_{wv-dyn} = P_{WL} - 10(z - T_{LC})$ above still waterline

Where:

P_{ctr}	dynamic wave pressure at bottom centreline, and is to be taken as: $f_{ctr} P_{ex-\max}$ *kN/m*^{2}
P_{WL}	dynamic wave pressure at still waterline, and is to be taken as: $f_{WL} P_{ex-\max}$ *kN/m*^{2}
$P_{ex\text{-}max}$	envelope maximum dynamic wave pressure, in *kN/m*^{2}, as defined in **3.5.2.2**
f_{WL}	dynamic load combination factor for dynamic wave pressure at still waterline for considered dynamic load case, see **6.3.1.2**
f_{ctr}	dynamic load combination factor for dynamic wave pressure at centreline for considered dynamic load case, see **6.3.1.2**
T_{LC}	draught in the loading condition being considered, in *m*
z	vertical coordinate, in *m*
ρ_{sw}	density of sea water, 1.025*tonnes/m*^{3}
g	acceleration due to gravity, 9.81*m/s*^{2}

Section 8 SCANTLING REQUIREMENTS

1. Longitudinal Strength

1.1 Loading Guidance

1.1.2 Loading Manual

In paragraph 1.1.2.9(a), the wording" loading pattern of A7" has been amended to "loading pattern of A7".

In paragraph 1.1.2.9(c), the wording" seagoing loading conditions with wing cargo tanks" has been amended to "seagoing loading conditions with cargo tanks".

In paragraph 1.1.2.9(e), the wording" the difference in filling level between wing and adjacent centre cargo tanks" has been amended to "the difference in filling level between corresponding port and starboard wing cargo tanks" .

1.3 Hull Girder Shear Strength

In paragraph 1.3.3.1, the wording" the effective net plating thickness" has been amended to "the effective net plating thickness of the plating above the inner bottom".

In paragraph 1.3.3.2, the definition of "z_p" has been amended as follows:

z_p the vertical distance from the lower edge of plate *ij* to the base line, in *m*. Not to be taken as less than h_{db}

In paragraph 1.3.3.6, the formula" $r = \frac{1}{\left[\frac{A_{3-net50}}{A_{1-net50} + A_{2-net50}} + \frac{b_{80}(n_s + 1)}{l_{tk}(n_s A_{T-net50} + R)}\right]}$ " has been amended to

"$r = \frac{1}{\left[\frac{A_{3-net50}}{A_{1-net50} + A_{2-net50}} + \frac{2\times10^4 b_{80}(n_s + 1)A_{3-net50}}{l_{tk}(n_s A_{T-net50} + R)}\right]}$".

In paragraph 1.3.3.6, the wording"F_3" has been amended to"f_3".

1.4 Hull Girder Buckling Strength

1.4.2 Buckling assessment

Sub-paragraph 1.4.2.7 has been amended as follows:

1.4.2.7 The shear buckling strength, of plate panels, is to satisfy the following criteria:

$\eta \leq \eta_{allow}$

Where:

η buckling utilisation factor

$= \dfrac{\tau_{hg-net50}}{\tau_{cr}}$

$\tau_{hg\text{-}net50}$ design hull girder shear stress, in N/mm^2, as defined in **1.4.2.5**

τ_{cr} critical shear buckling stress, in N/mm^2, as specified in **Section 10/3.2.1.3**. The critical shear buckling stress is to be calculated for the effects of hull girder shear stress only. The effects of other membrane stresses and lateral pressure are to be ignored. The net thickness given as $t_{grs} - t_{corr}$ as described in **Section 6/3.3.2.2** is to be used for the calculation of τ_{cr}

η_{allow} allowable buckling utilisation factor

= 0.95

t_{grs} gross plate thickness, in *mm*

t_{corr} corrosion addition, in *mm*, as defined in **Section 6/3.2**

2. Cargo Tank Region

2.1 General

2.1.4 General scantling requirements

In sub-paragraph 2.1.4.7, the wording" See also Section 4/3.2" has been deleted.

2.2 Hull Envelope Plating

2.2.4 Side shell plating

Sub-paragraph 2.2.4.3(b) has been amended as follows:

(b) vertical extent:
between 300*mm* below the minimum design ballast waterline, T_{bal}, amidships to $0.25T_{sc}$ or 2.2*m*, whichever is greater, above the draught T_{sc}.

2.5 Bulkheads

Sub-paragraph 2.5.6 has been amended as follows:

2.5.6 Corrugated bulkheads

Sub-paragraph 2.5.6.1 has been amended as follows:

2.5.6.1 The scantling requirements relating to corrugated bulkheads defined in **2.5.6** and **2.5.7** are net requirements. The gross scantling requirements are obtained from the applicable requirements by adding the full corrosion additions specified in **Section 6/3**.

In sub-paragraph 2.5.6.3, the wording" FEM model" has been amended to "FEM model in the midship".

2.5.7 Vertically corrugated bulkheads

In sub-paragraph 4.2.2.2, the wording" the thickness of plating" has been amended to "the net plate thickness".

Sub-paragraph 2.5.7.5 has been amended as follows:

2.5.7.5 The net thicknesses of the flanges of corrugated bulkheads, $t_{f\text{-}net}$, for two thirds of the corrugation length from the lower end are to be taken as the greatest value calculated for all applicable design load sets, as given in **Table 8.2.7**, and given by the following. This requirement is not applicable to corrugated bulkheads without a lower stool, see **2.5.7.9**.

In sub-paragraph 2.5.7.5, the wording" the net section modulus at the lower and upper ends of the corrugation" has been amended to "the net section modulus at the lower and upper ends".

In sub-paragraph 2.5.7.8(c), the wording" the same material strength" has been amended to "the same material yield strength".

In sub-paragraph 2.5.7.9(c), the wording" the same material strength" has been amended to "the same material yield strength".

In table 8.2.5, the definition of "C_s" has been amended as follows:

C_s permissible bending stress coefficient for the design load set being considered, to be taken as:

Sign of Hull Girder Bending Stress, σ_{hg}	Side Pressure Acting On	Acceptance Criteria
Tension (+ve)	Stiffener side	$C_s = \beta_s - \alpha_s \frac{\lvert\sigma_{hg}\rvert}{\sigma_{yd}}$ but not to be taken greater than $C_{s\text{-max}}$
Compression (-ve)	Plate side	
Tension (+ve)	Plate side	$C_s = C_{s\text{-max}}$
Compression (-ve)	Stiffener side	

Acceptance Criteria Set	Structural Member	β_s	α_s	$C_{s\text{-max}}$
AC1	Longitudinal strength member	0.85	1.0	0.75
	Transverse or vertical member	0.75	0	0.75
AC2	Longitudinal strength member	1.0	1.0	0.9
	Transverse or vertical member	0.9	0	0.9
	Watertight boundary Stiffeners	0.9	0	0.9

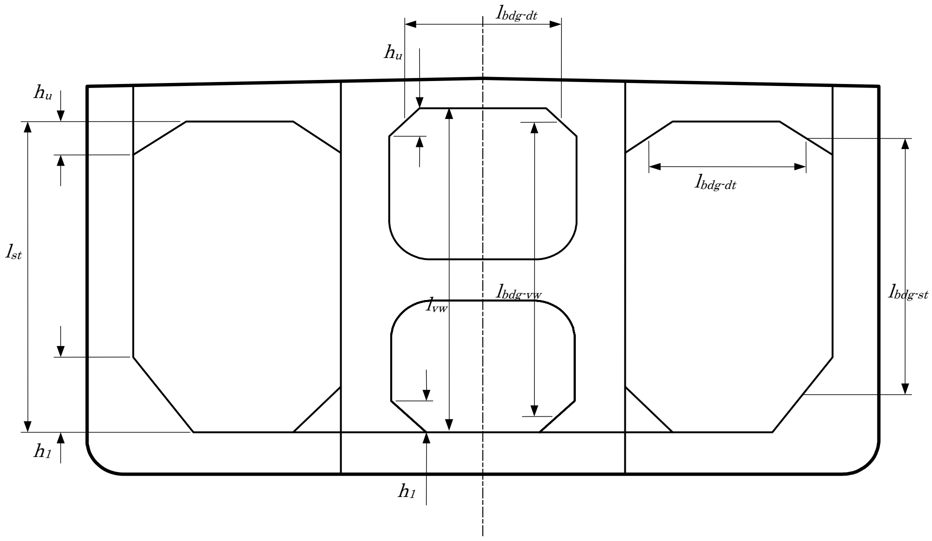
In table 8.2.6, the definition of "C_t" has been amended as follows:

C_t permissible shear stress coefficient for the design load set being considered, to be taken as:
= 0.75 for acceptance criteria set AC1
= 0.90 for acceptance criteria set AC2

2.6 Primary Support Members

2.6.4 Deck transverse

In Figure 8.2.7, the third Figure has been amended as follows:



In sub-paragraph 2.6.4.4, the definition of "ρ" has been amended as follows:

ρ density of liquid in the tank, in *tonnes/m*^{3}, not to be taken less than 1.025, see **Section 3.1.8**

2.6.5 Side transverse

In sub-paragraph 2.6.5.1, the definition of "Q_u" has been amended as follows:

Q_u $= S[c_u l_{st} (P_u + P_l) - h_u P_u]$

where a cross tie is fitted in a wing cargo tank and $l_{st\text{-}ct}$ is greater than $0.7l_{st}$, then l_{st} in the above formula is to be taken as $l_{st\text{-}ct}$.

In sub-paragraph 2.6.5.1, the definition of "Q_l" has been amended as follows:

Q_l to be taken as the greater of the following:

$S[c_l l_{st} (P_u + P_l) - h_l P_l]$

$0.35 c_l S l_{st} (P_u + P_l)$

$1.2 Q_u$

where a cross tie is fitted in a wing cargo tank and $l_{st\text{-}ct}$ is greater than $0.7l_{st}$, then l_{st} in the above formula is to be taken as $l_{st\text{-}ct}$.

2.6.6 Vertical web frames on longitudinal bulkhead

In sub-paragraph 2.6.6.2, the definition of "M" has been amended as follows:

M design bending moment, in kNm, as follows:

$= c_u P S l_{bdg-vw}^2$ for upper part of the web frame

$= c_l P S l_{bdg-vw}^2$ for lower part of the web frame

where a cross tie is fitted and $l_{bdg-vw-ct}$ is greater than $0.7 l_{bdg-vw}$, then l_{bdg-vw} in the above formula is to be taken as $l_{bdg-vw-ct}$.

Table 8.2.14 has been amended as follows:

Table 8.2.14
Values of c_u and c_l for Vertical Web Frame on Longitudinal Bulkheads

Structural Configuration			c_u	c_l
Ships with a centreline longitudinal bulkhead			0.057	0.071
Ships with two longitudinal bulkheads	Cross tie in centre cargo tank	M based on $l_{bdg-vw-ct}$	0.057	0.071
		M based on l_{bdg-vw}	0.012	0.028
	Cross ties in wing cargo tanks	M based on $l_{bdg-vw-ct}$	0.057	0.071
		M based on l_{bdg-vw}	0.016	0.032

In sub-paragraph 2.6.6.4, the definition of "Q_u" has been amended as follows:

$Q_u = S\ [c_u l_{vw} (P_u + P_l) - h_u P_u]$

where a cross tie is fitted in a centre or wing cargo tank and l_{vw-ct} is greater than $0.7 l_{vw}$, then l_{vw} in the above formula is to be taken as l_{vw-ct}.

In sub-paragraph 2.6.6.4, the definition of "Q_l" has been amended as follows:

Q_l to be taken as the greater of the following:

$S[c_l l_{vw} (P_u + P_l) - h_l P_l]$

$c_w S c_l l_{vw} (P_u + P_l)$

$1.2 Q_u$

where a cross tie is fitted in a centre or wing cargo tank and l_{vw-ct} is greater than $0.7 l_{vw}$, then l_{vw} in the above formula is to be taken as l_{vw-ct}.

3. Forward of the Forward Cargo Tank

3.9 Scantling Requirements

3.9.2 Plating and local support members

In sub-paragraph 3.9.2.1, the definition of "α_p" has been amended as follows:

α_p correction factor for the panel aspect ratio

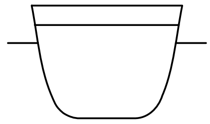
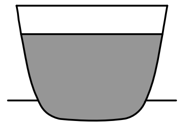
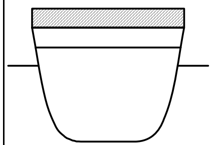
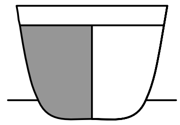
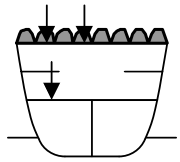
$$= 1.2 - \frac{s}{2100 l_p}\text{, but not to be greater than 1.0}$$

3.9.3 Primary support members

In sub-paragraph 3.9.3.3, the wording" the effective net web area" has been amended to "the effective net shear area".

Table 8.3.8 has been amended as follows:

Table 8.3.8
Design Load Sets for Plating, Local Support Members and Primary Support Members

Type of Local Support and Primary Support Member	Design Load Set [(1)]	Load Component	External Draught	Comment	Diagrammatic Representation
Shell Envelope	1	P_{ex}	T_{sc}	Sea pressure only	
	2	P_{ex}	T_{sc}		
	5	P_{in}	T_{bal}	Tank pressure only. Sea pressure to be ignored	
	6	P_{in}	$0.25T_{sc}$		
External Decks	1	P_{ex}	T_{sc}	Green sea pressure only	
Tank Boundaries and/or Watertight Boundaries	5	P_{in}	T_{bal}	Pressure from one side only Full tank with adjacent tank empty	
	6	P_{in}	$0.25T_{sc}$		
	11	$P_{in\text{-}flood}$	-		
Internal and External Decks or Flats	9	P_{dk}	T_{bal}	Distributed or concentrated loads only. Adjacent tanks empty. Green sea pressure may be ignored	
	10	P_{dk}	T_{bal}		

Where:

T_{sc} scantling draught, in *m*, as defined in Section **4/1.1.5.5**

T_{bal} minimum design ballast draught, in *m*, as defined in Section **4/1.1.5.2**

Notes

1. The specification of design load combinations and other load parameters for the design load sets are given in **Table 8.2.8**
2. When the ship's configuration cannot be described by the above, then the applicable Design Load Sets to determine the scantling requirements of structural boundaries are to be selected so as to specify a full tank on one side with the adjacent tank or space empty. The boundary is to be evaluated for loading from both sides. Design Load Sets are to be selected based on the tank or space contents and are to maximise the pressure on the structural boundary, the draught to use is to be taken in accordance with the Design Load Set and this table. Design Load Sets covering the S and S+D design load combinations are to be selected. See **Note 4** on **Table 8.2.7** and **Table 8.2.8**.
3. The boundaries of void and dry space not forming part of the hull envelope are to be evaluated using Design Load Set 11. See **Note 2.**

4. Machinery Space

4.1 General

4.1.3 Structural continuity

In sub-paragraph 4.1.3.4, the wording" See also Section 4/3.2" has been deleted.

4.2.2 Bottom shell plating

Sub-paragraph 4.2.2.1 has been amended as follows:

4.2.2.1 The keel plate breadth is to comply with the requirements in **Section 8/2.2.1.1**.

Sub-paragraph 4.2.2.2 has been amended as follows:

4.2.2.2 The thickness of the bottom shell plating (including keel plating) is to comply with the requirements in **4.8.1.1**.

5. Aft End

5.1 General

5.1.3 Structural continuity

In sub-paragraph 5.1.3.4, the wording" See also Section 4/3.2" has been deleted.

6. Evaluation of Structure for Sloshing and Impact Loads

6.2 Sloshing in Tanks

6.2.2 Application of sloshing pressure

Sub-paragraph 6.2.2.5(d) has been amended as follows:

(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.

6.3 Bottom Slamming

6.3.7 Primary support members

In sub-paragraph 6.3.7.3, the definition" f_{slm} " has been amended as follows:

f_{slm} patch load modification factor

$$= 0.5\frac{b_{slm}}{S}, \text{ but not to be greater than } 1.0$$

6.4 Bow Impact

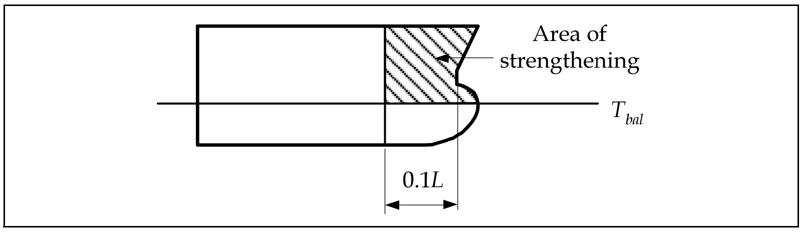
6.4.2 Extent of strengthening

Sub-paragraph 6.4.2.1 has been amended as follows:

6.4.2.1 The strengthening is to extend forward of $0.1L$ from the F.P. and vertically above the minimum design ballast draught, T_{bal}, defined in **Section 4/1.1.5.2**. See **Figure 8.6.6**.

Figure 8.6.6 has been amended as follows:

Figure 8.6.6
Extent of Strengthening Against Bow Impact



6.4.7 Primary support members

In sub-paragraph 6.4.7.5, the formula" $Z_{net50} = 10 \dfrac{f_{bdg-pt} P_{im} \, b_{slm} f_{slm} \, l_{bdg}^{\,2}}{f_{bdg} C_s \sigma_{yd}}$ " has been amended to " $Z_{net50} = 1000 \dfrac{f_{bdg-pt} P_{im} \, b_{slm} f_{slm} \, l_{bdg}^{\,2}}{f_{bdg} C_s \sigma_{yd}}$ ".

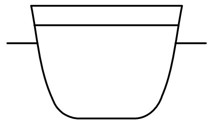
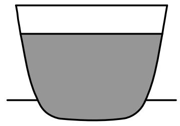
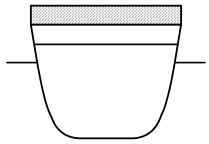
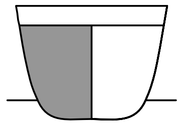
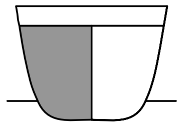
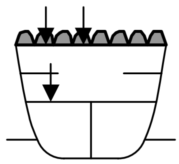
7. Application of Scantling Requirements to Other Structure

7.2 Scantling Requirements

7.2.1 General

Table 8.7.2 has been amended as follows:

Table 8.7.2
Design Load Sets for Plating, Local Support Members and Primary Support Members

Type of Local Support and Primary Support Member	Design Load Set [1]	Load Component	External Draught	Comment	Diagrammatic Representation
Shell Envelope	1	P_{ex}	T_{sc}	Sea pressure only	
	2	P_{ex}	T_{sc}		
	5	P_{in}	T_{bal}	Tank pressure only. Sea pressure to be ignored	
	6	P_{in}	$0.25T_{sc}$		
External Decks	1	P_{ex}	T_{sc}	Green sea pressure only	
Cargo Tank Boundaries	3	P_{in}	$0.6T_{sc}$	Pressure from one side only Full tank with adjacent tank empty	
	4	P_{in}	-		
	11	$P_{in\text{-}flood}$	-		
Other Tank Boundaries or Watertight Boundaries	5	P_{in}	T_{bal}	Pressure from one side only Full tank with adjacent tank empty	
	6	P_{in}	$0.25T_{sc}$		
	11	$P_{in\text{-}flood}$	-		
Internal and External Decks or Flats	9	P_{dk}	T_{bal}	Distributed or concentrated loads only. Adjacent tanks empty. Green sea pressure may be ignored	
	10	P_{dk}	T_{bal}		

Where:

T_{sc} scantling draught, in m, as defined in **Section 4/1.1.5.5**

T_{bal} minimum design ballast draught, in *m*, as defined in Section **4/1.1.5.2**

Notes

1. The specification of design load combinations, and other load parameters for the design load sets are given in **Table 8.2.8**
2. When the ship's configuration cannot be described by the above, then the applicable Design Load Sets to determine the scantling requirements of structural boundaries are to be selected so as to specify a full tank on one side with the adjacent tank or space empty. The boundary is to be evaluated for loading from both sides. Design Load Sets are to be selected based on the tank or space contents and are to maximise the pressure on the structural boundary, the draught to use is to be taken in accordance with the Design Load Set and this table. Design Load Sets covering the S and S+D design load combinations are to be selected. See Note 4 on **Table 8.2.7** and **Table 8.2.8**.
3. The boundaries of void and dry space not forming part of the hull envelope are to be evaluated using Design Load Set 11. See Note 2.

Section 9 DESIGN VERIFICATION

1. Hull Girder Ultimate Strength

1.4 Partial Safety Factors

Table 9.1.1 has been amended as follows:

Table 9.1.1 Partial Safety Factors

Design load combination	Definition of Still Water Bending Moment, M_{sw}	γ_S	γ_W	γ_R
a)	Permissible sagging still water bending moment, $M_{sw\text{-}perm\text{-}sea}$, in *kNm*, see **Section 7/2.1.1**	1.0	1.2	1.1
b)	Maximum sagging still water bending moment for operational seagoing homogeneous full load condition, $M_{sw\text{-}full}$, in *kNm*, see note 1	1.0	1.3	1.1
Where: γ_S partial safety factor for the sagging still water bending moment γ_W partial safety factor for the sagging vertical wave bending moment covering environmental and wave load prediction uncertainties γ_R partial safety factor for the sagging vertical hull girder bending capacity covering material, geometric and strength prediction uncertainties				
Notes 1 The maximum sagging still water bending moment is to be taken from the departure condition with the ship homogeneously loaded at maximum draught and corresponding arrival and any mid-voyage conditions.				

2. Strength Assessment (FEM)

2.2 Local Fine Mesh Structural Strength Analysis

2.3.1 Objective and scope

Sub-paragraph 2.3.1.4 has been amended as follows:

2.3.1.4 Where the geometry can not be adequately represented in the cargo tank finite element model, a fine mesh analysis may be used to demonstrate satisfactory scantlings. In such cases the average stress within an area equivalent to that specified in the cargo tank analysis (typically s by s) is to comply with the requirement given in **Table 9.2.1**. See also Note 1 of **Table 9.2.3**.

2.4 Application of Scantlings in Cargo Tank Region

2.4.5 Application of scantlings to side shell, longitudinal bulkheads and inner hull longitudinal bulkheads

In sub-paragraph 2.4.5.2, the formula" $t_{net} = t_{net-mid} \frac{s_{ib}}{s_{ib-mid}}$ " has been amended to "$t_{net} = t_{net-mid} \frac{s}{s_{mid}}$".

In sub-paragraph 2.4.5.2, the wording" s_{ib} " has been amended to " s ".

In sub-paragraph 2.4.5.2, the wording" s_{ib-mid} " has been amended to " s_{mid} ".

Section 10 BUCKLING AND ULTIMATE STRENGTH

2. Stiffness and Proportions

2.2 Plates and Local Support Members

2.2.2 Stiffness of stiffeners

In sub-paragraph 2.2.2.1, the definition of" σ_{yd} " has been amended as follows.

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

2.3 Primary Support Members

2.3.1 Proportions of web plate and flange/face plate

Sub-paragraph 2.3.1.1 has been amended as follows:

2.3.1.1 The net thicknesses of the web plates and face plates of primary support members are to satisfy the following criteria:

(a) web plate

$$t_{w-net} \geq \frac{s_w}{C_w}\sqrt{\frac{\sigma_{yd}}{235}}$$

(b) flange/face plate

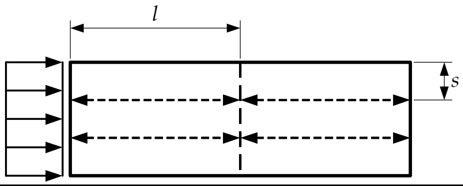
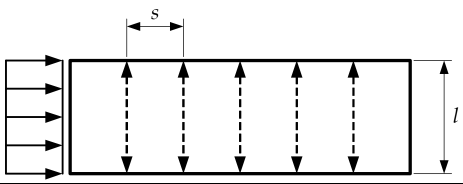
$$t_{f-net} \geq \frac{b_{f-out}}{C_f}\sqrt{\frac{\sigma_{yd}}{235}}$$

Where:

s_w	plate breadth, in *mm*, taken as the spacing between the web stiffeners. For web plates with stiffening parallel to the attached plate the spacing may be corrected in accordance with **Appendix D/Fig. 5.6**.
t_{w-net}	net web thickness, in *mm*
b_{f-out}	breadth of flange outstand, in *mm*
t_{f-net}	net flange thickness, in *mm*
C_w	slenderness coefficient for the web plate = 100
C_f	slenderness coefficient for the flange/face plate = 12
σ_{yd}	specified minimum yield stress of the material, in N/mm^2

Table 10.2.2 has been amended as follows:

Table 10.2.2 Stiffness Criteria for Web Stiffening

Mode	Inertia requirements, cm^4
(a) web stiffeners parallel to compression stresses 	$I_{net} = Cl^2 A_{net} \frac{\sigma_{yd}}{235}$
(b) web stiffeners normal to compression stresses 	$I_{net} = 1.14\text{x}10^{-5} l \ s^2 t_{w-net} \left(2.5 \frac{1000l}{s} - 2 \frac{s}{1000l} \right) \frac{\sigma_{yd}}{235}$
Where:	
C	= 1.43 for longitudinal stiffeners subject to hull girder stresses = 0.72 for other stiffeners
l	length of web stiffener, in *m*. For web stiffeners welded to local support members (LSM), the length is to be measured between the flanges of the local support members. For sniped web stiffeners the length is to be measured between the lateral supports e.g. the total distance between the flanges of the primary support member as shown for Mode (b).
A_{net}	net section area of web stiffener including attached plate assuming effective breadth of 80% of stiffener spacing *s*, in cm^2
s	spacing of stiffeners, in mm, as defined in **Section 4/2.2.1**
t_{w-net}	net web thickness of the primary support member, in *mm*
σ_{yd}	specified minimum yield stress of the material of the web plate of the primary support member, in N/mm^2

2.4 Other Structure

2.4.2 Proportions of brackets

In sub-paragraph 2.4.2.1, the formula" $t_{bkt} = \frac{d_{bkt}}{C} \sqrt{\frac{\sigma_{yd}}{235}}$ " has been amended as "$t_{bkt-net} = \frac{d_{bkt}}{C} \sqrt{\frac{\sigma_{yd}}{235}}$ ".

In sub-paragraph 2.4.2.3, the formula" $l_{bkt} = 75 t_{bkt}$ " has been amended as "$l_{bkt} = 75 t_{bkt-net}$ ".

3. Prescriptive Buckling Requirements

3.3 Buckling of Stiffeners

3.3.2 Column buckling mode

In sub-paragraph 3.3.2.3, the definition of" σ_x " has been amended as follows:

σ_x compressive axial stress in the stiffener, in *N/mm*^{2}, in way of the midspan of the stiffener. See **Section 3/5.2.3.1**

3.3.3 Torsional buckling mode

In sub-paragraph 3.3.3.1, the definition of" σ_x " has been amended as follows:

σ_x compressive axial stress in the stiffener, in *N/mm*^{2}, in way of the midspan of the stiffener. See **Section 3/5.2.3.1**

In figure 10.3.1, note 2 has been amended as follows:

2. Characteristic flange data for bulb profiles are given in **Appendix C/Table C.1.2**

Section 11 GENERAL REQUIREMETNTS

3. Support Structure and Structural Appendages

3.1 Support Structure for Deck Equipment

3.1.2 Supporting structures for anchoring windlass and chain stopper

Sub-paragraph 3.1.2.9 has been amended as follows:

3.1.2.9 The following forces are to be applied separately in the load cases that are to be examined for the design loads due to green seas in the forward 0.25*L*, see **Figure 11.3.1**:

$P_x = 200A_x$ *kN*, acting normal to the shaft axis

$P_y = 150A_y f$ *kN*, acting parallel to the shaft axis (inboard and outboard directions to be examined separately)

Where:

A_x projected frontal area, in m^2

A_y projected side area, in m^2

f = $1+B_W/H$, but not to be taken greater than 2.5

B_W breadth of windlass measured parallel to the shaft axis, in *m*. See **Figure 11.3.1**

H overall height of windlass, in *m*, see **Figure 11.3.1**

3.1.3 Supporting structure for mooring winches

Sub-paragraph 3.1.3.3 has been amended as follows:

3.1.3.3 The Rated Pull is defined as the maximum load which the mooring winch is designed to exert during operation and is to be stated on the mooring winch foundation/support plan.

Sub-paragraph 3.1.3.4 has been amended as follows:

3.1.3.4 The Holding Load is defined as the maximum load which the mooring winch is designed to resist during operation and is to be taken as the design brake holding load or equivalent and is to be stated on the mooring winch foundation/support plan.

The following sentence has been added after the end of sub-paragraph 3.1.3.8.

The design load is to be applied through the mooring line according to the arrangement shown on the mooring arrangement plan.

4. Equipment

4.2 Anchors and Mooring Equipment

4.2.4 Documentation

Sub-paragraph 4.2.4.1(f) has been amended as follows:

(f) emergency towing, towing and mooring arrangement plans and applicable Safe Working Load data, and other information related to emergency towing and mooring arrangements that will be available onboard the ship for the guidance of the Master.

4.2.18 Mooring winches

In sub-paragraph 4.2.18.1, Guidance Note has been amended as follows:

Guidance Note:
Mooring winches should be fitted with drum brakes, the strength of which is to be sufficient to prevent unreeling of the mooring line when the rope tension is equal to 80 percent of that for a rope with breaking strength equal to the greater of the maximum breaking strength of the rope specified on the mooring arrangement plan or that according to Table 11.4.2 for the ship’s corresponding equipment number, as fitted on the first layer on the winch drum.

Appendix A HULL GIRDER ULTIMATE STRENGTH

2. Calculation of Hull Girder Ultimate Capacity

2.2 Simplified Method Based on an Incremental-iterative Approach

2.2.1 Procedure

In sub-paragraph 2.2.1.7, Step 6 has been amended as follows:

Step 6 Calculate the corresponding moment by summating the force contributions of all elements as follows:

$M_i = 0.1\sum \left|\sigma_j A_j \left(z_j - z_{NA-i}\right)\right|$ *kNm*

2.3 Stress-strain Curves *σ-ε* (or Load-end Shortening Curves)

2.3.6 Web local buckling of stiffeners with flanged profiles

In sub-paragraph 2.3.6.1, the formula" $\sigma_{CR3} = \Phi\sigma_{yd}\left(\frac{b_{eff-s}t_{net50} + d_{w-eff}t_{w-net50} + b_f t_{f-net50}}{st_{net50} + d_w t_{w-net50} + b_f t_{f-net50}}\right)$"

has been amended to "$\sigma_{CR3} = \Phi\sigma_{yd}\left(\frac{b_{eff-p}t_{net50} + d_{w-eff}t_{w-net50} + b_f t_{f-net50}}{st_{net50} + d_w t_{w-net50} + b_f t_{f-net50}}\right)$".

In sub-paragraph 2.3.6.1, the wording" b_{eff-s} " has been amended to "b_{eff-p}".

In sub-paragraph 2.3.6.1, the definition of "b_{eff-p}" has been amended as follows:

b_{eff-p} effective width, in *mm*, of the plating, defined in **2.3.4**

Appendix B STRUCTURAL STRENGTH ASSESSMENT

2. Cargo Tank Structural Strength Analysis

2.2 Structural Modelling

2.2.1 General

Sub-paragraph 2.2.1.11(a) has been amended as follows:

(a) for beam elements, out of plane bending properties are to represent the inertia of the combined plating and stiffener. The width of the attached plate is to be taken as ½ + ½ stiffener spacing on each side of the stiffener. The eccentricity of the neutral axis is not required to be modelled.

In table B.2.2, the formula” $t_{2\text{-}net50}$” has been amended as follows.

$$t_{2-net50} = \frac{h - h_o}{h g_o} t_{w-net50}$$

2.3 Loading Conditions

2.3.1 Finite element load cases

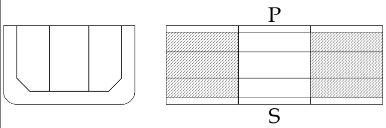
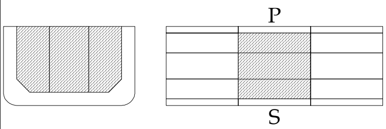
In sub-paragraph 2.3.1.3, the wording” non-symmetric loading conditions” has been amended to “non-symmetric seagoing loading conditions”.

Sub-paragraph 2.3.1.6 has been amended as follows:

2.3.1.6 For loading patterns A1, A2, B1, B2 and B3, with cargo tank(s) empty, a minimum ship draught of $0.9T_{sc}$ is to be used in the analysis. If conditions in the ship loading manual specify greater draughts for loading patterns with empty cargo tank(s), then the maximum specified draught for the actual condition is to be used.

In table B.2.3, the rows of A3 and A5 have been amended as follows respectively:

Table B.2.3 FE Load Cases for Tankers with Two Oil-tight Longitudinal Bulkheads

Loading Pattern	Figure	Still Water Loads			Dynamic load cases		
		Draught	% of Perm. SWBM[2]	% of Perm. SWSF[2]	Strength assessment [1a]	Strength assessment against hull girder shear loads [1b]	
					Midship region	Forward region	Midship and aft regions
Design load combination S + D (Sea-going load cases)							
A3		0.55 T_{sc} see note 6	100% (hog)	100% (-ve fwd) See note 5	2	4	2
				100% (-ve fwd) See note 4	5a	¥	¥
A5		0.8 T_{sc} See note 7	100% (sag)	100% (+ve fwd) See note 5	1	3	1
				100% (+ve fwd) See note 4	5a	¥	¥

3. Local Fine Mesh Structural Strength Analysis

3.1 General

3.1.6 Screening criteria for Fine Mesh Analysis

In sub-paragraph B.3.1, the formula" λ_y " has been amended as follows:

$$\lambda_y = 0.85 C_h \left(\left| \sigma_x + \sigma_y \right| + \left(2 + \left(\frac{l_0}{2r} \right)^{0.74} + \left(\frac{h_0}{2r} \right)^{0.74} \right) \left| \tau_{xy} \right| \right) \frac{k}{235}$$

4. Evaluation of Hot Spot Stress for Fatigue Analysis

4.3 Loading Conditions

4.3.2 Finite element load cases for hopper knuckle connection

Table B.4.3.2 has been amended as follows:

Table B.4.1 Load Cases for the Evaluation of Component Stress Range for Hopper Knuckle Joint

<table>
<tr><th>Load case</th><th>Component Stress</th><th>Applied Load</th><th>Parameters for calculation of loads</th></tr>
<tr><td colspan="4">Full load condition</td></tr>
<tr><td>L1</td><td>s_{e1}</td><td>Dynamic wave pressure (full range) applies only to the side of the hull where the hopper knuckle is analysed.</td><td rowspan="5">Ship draught = midship draught from departure homogeneous full load condition in the ship loading manual, see Appendix C/1.3.2.
GM: see Section 7/3.1.3.4
$r_{roll-gyr}$: see Section 7/3.1.3.4
Cargo density = $0.9 t/m^3$ (minimum, see 4.3.1.2)</td></tr>
<tr><td>L2</td><td>s_{e2}</td><td>Dynamic wave pressure (full range) applies only to the side of the hull where the hopper knuckle is not analysed.</td></tr>
<tr><td>L3</td><td>s_{ix}</td><td>Dynamic tank pressure (full range) due to longitudinal acceleration.</td></tr>
<tr><td>L4</td><td>s_{iy}</td><td>Dynamic tank pressure (full range) due to transverse accelerations.</td></tr>
<tr><td>L5</td><td>s_{iz}</td><td>Dynamic tank pressure (full range) due to vertical acceleration.</td></tr>
<tr><td colspan="4">Ballast condition</td></tr>
<tr><td>L6</td><td>s_{e1}</td><td>Dynamic wave pressure (full range) applies only to the side of the hull where the hopper knuckle is analysed.</td><td rowspan="2">Ship draught = midship draught from departure normal ballast condition in the ship loading manual. If normal ballast condition is not defined, then the midship draught from light ballast condition is to be used, see Appendix C/1.3.2</td></tr>
<tr><td>L7</td><td>s_{e2}</td><td>Dynamic wave pressure (full range) applies only to the side of the hull where the hopper knuckle is not analysed.</td></tr>
<tr><td colspan="4">Load cases for bending moment correction</td></tr>
<tr><td>C1</td><td>s_{VBM}</td><td>Unit vertical bending moment applies to ends of cargo tank model</td><td rowspan="2">No other loads are to be applied</td></tr>
<tr><td>C2</td><td>s_{HBM}</td><td>Unit horizontal bending moment applies to ends of cargo tank model</td></tr>
</table>

4.5 Result Evaluation

4.5.2 Hopper knuckle connection

In sub-paragraph 4.5.2.2 has been amended as follows:

4.5.2.2 The component stress ranges are to be obtained by eliminating the stress induced by hull girder vertical and horizontal bending moments from the component stress determined from load cases L1 to L7 in **Table B.4.1** as follows:

$$S_{c\_i} = \left| s_{c\_i} - M_{V\_i}\, s_{VBM} - M_{H\_i}\, s_{HBM} \right|$$

Where:

S_{c_i}	S_{e1}, S_{e2}, S_{ix}, S_{iy} or S_{iz}, component stress range after correction for bending moment effects
s_{c_i}	s_{e1}, s_{e2}, s_{ix}, s_{iy} or s_{iz}, component stress (with proper sign convention used) including vertical and horizontal bending moment effects obtained from load cases L1 to L7, see **Table B.4.1**
M_{Vi}	is the vertical hull girder bending moment due to loads applied to the cargo tank FE model obtained from load case L1, L2, L3, L4, L5, L6 or L7. The bending moment is to be calculated at the longitudinal position where the centroid of shell element under evaluation is located
M_{Hi}	is the horizontal hull girder bending moment due to loads applied to the cargo tank FE model obtained from load case L1, L2, L3, L4, L5, L6 or L7. The bending moment is to be calculated at the longitudinal position where the centroid of shell element under evaluation is located
s_{VM}	stress due to unit vertical bending moment obtained from load case C1, see **Table B.4.1**
s_{HBM}	stress due to unit horizontal bending moment obtained from load case C2, see **Table B.4.1**

Appendix C FATIGUE STRENGTH ASSESSMENT

1. Nominal Stress Approach

1.4 Fatigue Damage Calculaton

1.4.4 Definition of stress components

In sub-graph 1.4.4.11, the formula" s_{2A} " has been amended as follows:

$$\sigma_{2A} = K_n K_d \frac{M}{Z_{net50}} 10^3$$

In sub-graph 1.4.4.11, the definition of " M " has been amended as follows:

M moment at stiffener support adjusted to weld toe location at the stiffener (e.g. at bracket toe), in kNm:

$$= \frac{Ps\, l_{bdg}^2 10^{-3}}{12} r_p$$

1.5 Classification of Structural Details

1.5.1 General

Sub-paragraph 1.5.1.2 has been amended as follows:

1.5.1.2 In case where pillar-less connections are adopted in way of bottom, side and inner hull, see **note 6 of Table C.1.7**.

In Table C.1.7, Notes has been amended as follows:

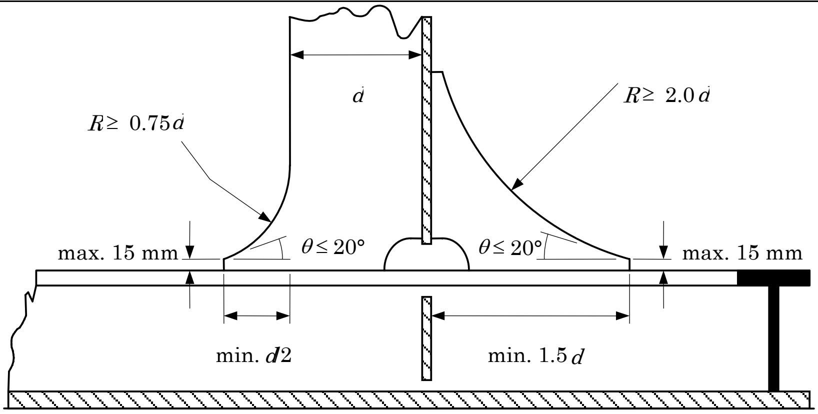
Table C.1.7 Classification of Structural Details

Notes

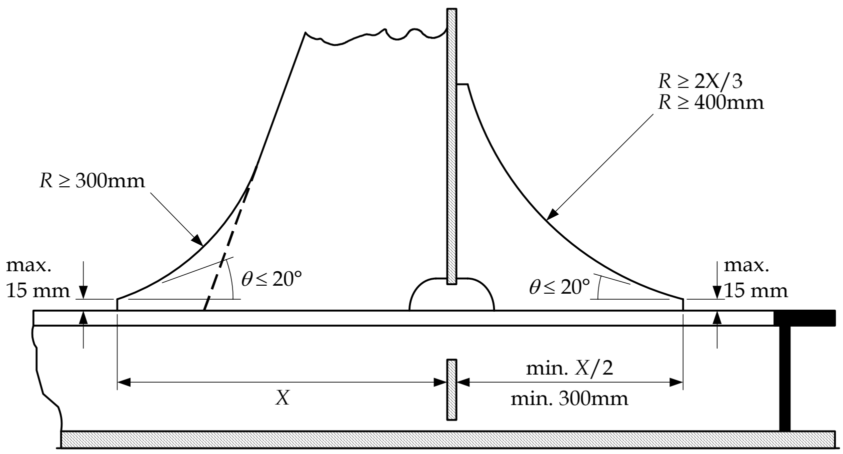
1. Where the attachment length is less than or equal to 150*mm*, the S-N curve is to be upgraded one class from those specified in the table. For example, if the class shown in the table is *F2*, upgrade to *F*. Attachment length is defined as the length of the weld attachment on the longitudinal stiffener face plate without deduction of scallop.
2. Where the longitudinal stiffener is a flat bar and there is a stiffener/bracket welded to the face, the S-N curve is to be downgraded by one class from those specified in the table. For example, if the class shown in the table is *F*, downgrade to *F2*; if the class shown in the table is *F2*, downgrade to *G*. This also applies to unsymmetrical profiles where there is less than 8*mm* clearance between the edge of the stiffener flange and the face of the attachment, e.g. bulb or angle profiles where the stated clearance cannot be achieved.
3. Lapped connections (attachments welded to the web of the longitudinals) should not be adopted and therefore these are not covered by the table.
4. For connections fitted with a soft heel, class *F* may be used if it is predominantly subjected to axial loading. Stiffeners fitted on deck and within 0.1*D* below deck at side are considered to satisfy this condition.
5. For connections fitted with a tight collar around the face plate, class *F* may be used if subjected to axial loading. Stiffeners fitted on deck and within 0.1*D* below deck at side are considered to satisfy this condition
6. ID32 is applicable in cases where web stiffeners are omitted or are not connected to the longitudinal stiffener face plate. In the dynamic wave wetted zone at side and below, in way of bottom and in way of inner hull below 0.1*D* from the deck at side, a water-tight collar or alternatively a detail design for cut-outs as shown in **Figure C.1.11** or equivalent is to be adopted. Other designs are subject to a satisfactory fatigue assessment by using comparative FEM based hot spot stress. For detail design of cut-outs as shown in **Figure C.1.11** or equivalent, the S-N curve may be upgraded to *E* for the dynamic wave wetted zone at side and below, in way of bottom and in way of inner hull below 0.1*D* from the deck at side.
7. In way of other areas besides what is mentioned in **Note 6**, i.e. side above wave wetted zone, deck, inner hull areas within 0.1*D* from the deck at side, in cases where web stiffeners are omitted or not connected to the longitudinal stiffener face plate, conventional slot configurations are permitted and an *F* class is in general to be applied, as described in ID 32. *E* class may however be applied with combined global and local stress ranges provided 25 years is achieved applying *F* class considering global stress range only. Stress range combination factors for deck may be used to obtain the global stress range in this instance.

Figure C.1.10 has been amended as follows:

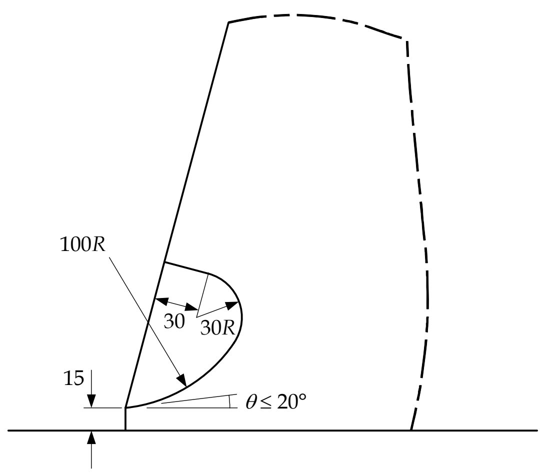
Figure C.1.10 Detail Design for Soft Toes and Backing Brackets



Recommended Design of Soft Toes and Backing Bracket of Pillar Stiffeners



Recommended Design of Soft Toes and Backing Bracket of Tripping Brackets



Recommended Alternative Design of Soft Toes of Tripping Brackets

In figure C.1.11, Notes has been amended as follows:

Notes

1. Soft toes marked "*" are to be dimensioned to suit the weld leg length such that smooth transition from the weld to the radiused part can be achieved. Max. 15 *mm.*

2. Configurations 1 and 4 indicate acceptable lapped lug plate connections, alternatively, butted lug plates with similar shape may be adopted.

3. Designs that are different than shown in the above sketches are acceptable subject to a satisfactory fatigue assessment by using comparative FEM based hot spot stress.

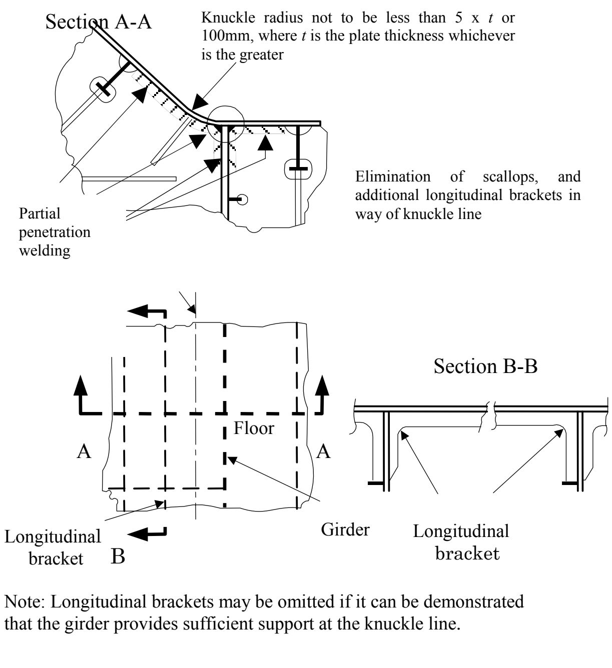
2. Hot spot Stress (FE Based) Approach

2.5 Detail Design Standard

2.5.1 Hopper knuckles

In Figure C.2.4, the column of "DETAIL DESIGN STANDARD" has been amended as follows:

DETAIL DESIGN STANDARD C



Note: Longitudinal brackets may be omitted if it can be demonstrated that the girder provides sufficient support at the knuckle line.

Appendix D BUCKLING STRENGTH ASSESSMENT

1. Advanced Buckling Analysis

1.1 General

1.1.3 Definitions

Sub-paragraph 1.1.3.2 and 1.1.3.3 have been amended as follows respectively:

1.1.3.2 Buckling capacity accepting local elastic plate buckling with load redistribution is referred to as Method 1. The buckling capacity is the load that results in the first occurrence of membrane yield stress anywhere in the stiffened panel. Buckling capacity based on this principle gives a lower bound estimate of ultimate capacity, or the maximum load the panel can carry without suffering major permanent set. Method 1 buckling capacity assessment utilizes the positive elastic post-buckling effect for plates and accounts for load redistribution between the structural components, such as between plating and stiffeners. For slender structures the capacity calculated using this method is typically higher than the ideal elastic buckling stress (minimum Eigen-value). Accepting elastic buckling of structural components in slender stiffened panels implies that large elastic deflections and reduced in-plane stiffness will occur at higher buckling utilization levels.

1.1.3.3 Method 2 buckling capacity does not accept load redistribution between structural components and refers to the minimum of value of the ideal elastic buckling stress and the Method 1 buckling capacity. Method 2 buckling capacity normally equals the same strength as Method 1 for stocky panels, while it is the ideal elastic buckling stress (minimum Eigen-value cut-off) for slender panels. By applying the ideal elastic buckling stress limitation, large elastic deflections and reduced in-plane stiffness will be avoided at higher buckling utilization levels.

5. Strength Assessment (FEM) – Buckling Procedure

5.2 Structural Modelling and Capacity Assessment Method

5.2.2 Stiffened panels

The following sentence has been added after the end of sub-paragraph 5.2.2.2.

Where the panel between stiffeners consists of several plate thickness the weighted average thickness may by used for the thickness of the plating for assessment of the corresponding stiffener/plating combination. Calculation of weighted average is to be in accordance with **5.2.3.3**.

5.2.3 Un-stiffened panels

In figure D.5.6, Note has been added as follows:

Note
The correction of panel breadth is applicable also for other slot configurations with or without collar plates provided the web/collar plate is attached to the passing stiffener.

EFFECTIVE DATE AND APPLICATION(Amendment 1-1)

1. The effective date of the amendments is 1st April 2006.
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 IACS Procedural Requirement(PR) No.29 (Rev.3).

IACS PR No.29 (Rev.3)

Unless specified otherwise:

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 sister 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, a "series of sister vessels" is a series of vessels built to the same approved plans for classification purposes, under a single contract for construction. The optional vessels will be considered part of the same series of sister 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:
1. This Procedural Requirement applies to all IACS Members and Associates.
2. This Procedural Requirement is effective for ships "contracted for construction" on or after 1 January 2005.
3. Sister vessels may have minor design alterations provided such alterations do not affect matters related to classification.
4. Revision 2 of this Procedural Requirement is effective for ships "contracted for construction" on or after 1 April 2006.
5. Revision 3 of this Procedural Requirement was approved on 5 January 2007 with immediate effect.

Amendment 1-2

Section 6 Material and Welding

3. Corrosion Additions

3.2 Local Corrosion Additions

3.2.1 General

Table 6.3.1 has been amended as follows:

Table 6.3.1 Corrosion Addition, t_{corr}, for Typical Structural Elements Within the Cargo Tank Region

Category of contents			Corrosion Addition t_{corr}, in *mm*
Internal members and plate boundary between spaces with the same category of contents			
In and between ballast water tanks	Face plate of PSM	Within 3*m* below top of tank (1)	4.5
		Elsewhere	3.5
	Other members	Within 3*m* below top of tank (1)	4.0
		Elsewhere	3.0
	Stiffeners on boundaries to heated cargo tanks	Within 3*m* below top of tank (1)	4.5
		Elsewhere	3.5
In and between cargo oil tanks	Face plate of PSM	Within 3*m* below top of tank (1)	4.0
		Elsewhere	3.5
	Other members	Within 3*m* below top of tank (1)	4.0
		Elsewhere	2.5
Exposed to atmosphere on both sides	Support members on deck		2.5
In and between void spaces	Spaces not normally accessed, e.g. access only via bolted manhole openings, pipe tunnels, etc.		2.0
In and between dry spaces	Internals of deckhouses, machinery spaces, pump room, store rooms, steering gear space, etc.		1.5
Plate boundary between spaces having a different category			
Boundary between ballast tank and cargo oil tank	Unheated cargo tank	Within 3*m* below top of tank (1)	4.0
		Inner bottom plating	4.0
		Elsewhere	3.0
	Heated cargo tank	Within 3*m* below top of tank (1)	4.5
		Inner bottom plating	4.5
		Elsewhere	3.5
Boundary between ballast tank and atmosphere or sea	Weather deck plating		4.0
	Other members(2)	Within 3*m* below top of tank (1)	3.5
		Elsewhere	3.0
Boundary between ballast tank and void or dry space	Within 3*m* below top of tank(1)		3.0
	Elsewhere		2.5
Boundary between cargo tank and atmosphere	Weather deck plating		4.0
Boundary between cargo tank and void spaces	Within 3*m* below top of tank (1)		3.0
	Elsewhere		2.5
Boundary between cargo tank and dry spaces	Within 3*m* below top of tank (1)		3.0
	Elsewhere		2.0

<u>Note</u>
Only applicable to cargo and ballast tanks with weather deck as the tank top
0.5*mm* to be added for side plating in the quay contact region defined in **Section 8/Figure 8.2.2**
Heated cargo oil tanks are defined as cargo tanks arranged with any form of heating capability

Section 8 Scantling Requirements

1. Longitudinal Strength

1.1 Loading Guidance

Sub-paragraph 1.1.2.1 has been amended as follows.

1.1.2.1 The Loading Manual is a document that:

(a) describes the loading conditions on which the design and approval of the ship has been based for seagoing- and harbour/sheltered water operation

(b) describes the results of the calculations of still water bending moments, shear forces and where applicable, limitations due to torsional and lateral loads

(c) describes relevant operational limitations as given in **1.1.2.7**.

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 0.015*L*, where *L* 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 tanks are fitted, the lower is required to be full. The upper fore peak tank may be full, partially full or empty.
  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 0.015*L*, where *L* 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

(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.

1.4 Hull Girder Buckling Strength

1.4.2 Buckling assessment

Sub-paragraph 1.1.2.1 has been amended as follows.

1.4.2.6 The compressive buckling strength, of plate panels, is to satisfy the following criteria:

$$\eta \le \eta_{allow}$$

Where:

η	buckling utilisation factor $\dfrac{\sigma_{hg-net50}}{\sigma_{cr}}$
$\sigma_{hg-net50}$	hull girder compressive stress based on net hull girder sectional properties, in N/mm^2 as defined in **1.4.2.3**
σ_{cr}	critical compressive buckling stress, σ_{xcr} or σ_{ycr} as appropriate, in N/mm^2, as specified in **Section 10/3.2.1.3**. The critical compressive buckling stress is to be calculated for the effects of hull girder compressive stress only. The effects of other membrane stresses and lateral pressure are to be ignored. The net thickness given as $t_{grs} - t_{corr}$ as described in **Section 6/3.3.2.2** is to be used for calculation of σ_{cr}
η_{allow}	allowable buckling utilisation factor: = 1.0 for plate panels above 0.5*D* = 0.90 for plate panels below 0.5*D*
t_{grs}	gross plate thickness, in *mm*
t_{corr}	corrosion addition, in *mm*, as defined in **Section 6/3.2**

Sub-paragraph 1.4.2.8 has been amended as follows.

1.4.2.8 The compressive buckling strength of longitudinal stiffeners is to satisfy the following criteria:

$\eta \le \eta_{allow}$

Where:

η greater of the buckling utilisation factors given in **Section 10/3.3.2.1** and **Section 10/3.3.3.1**. The buckling utilisation factor is to be calculated for the effects of hull girder compressive stress only. The effects of other membrane stresses and lateral pressure are to be ignored.

η_{allow} allowable buckling utilisation factor:
= 1.0 for stiffeners above 0.5*D*
= 0.90 for stiffeners below 0.5*D*

Section 9 Design Verification

2. Strength Assessment (FEM)

2.2 Cargo Tank Structural Strength Analysis

2.2.5 Acceptance criteria

Table 9.2.1 has been amended as follows:

Table 9.2.1 Maximum Permissible Stresses

Structural component	Yield utilisation factor
Internal structure in tanks	
Plating of all non-tight structural members including transverse web frame structure, wash bulkheads, internal web, horizontal stringers, floors and girders. Face plate of primary support members modelled using plate or rod elements	$\lambda_y \le 1.0$ (load combination $S + D$) $\lambda_y \le 0.8$ (load combination S)
Structure on tank boundaries	
Plating of deck, sides, inner sides, hopper plate, bilge plate, plane and corrugated cargo tank longitudinal bulkheads. Tight floors, girders and webs	$\lambda_y \le 0.9$ (load combination $S + D$) $\lambda_y \le 0.72$ (load combination S)
Plating of inner bottom, bottom, plane transverse bulkheads and corrugated bulkheads.	$\lambda_y \le 0.8$ (load combination $S + D$) $\lambda_y \le 0.64$ (load combination S)

Where:

λ_y yield utilisation factor

$= \frac{\sigma_{vm}}{\sigma_{yd}}$ for plate elements in general

$= \frac{\sigma_{rod}}{\sigma_{yd}}$ for rod elements in general

σ_{vm} von Mises stress calculated based on membrane stresses at element's centroid, in N/mm^2

σ_{rod} axial stress in rod element, in N/mm^2

σ_{yd} specified minimum yield stress of the material, in N/mm^2, but not to be taken as greater than 315 N/mm^2 for load combination $S + D$ in areas of stress concentration (2)

Note

Structural items given in the table are for guidance only. Stresses for all parts of the FE model specified in **2.2.5.2** are to be verified against the permissible stress criteria. See also **Appendix B/2.7.1**

Areas of stress concentration are corners of openings, knuckle joints, toes and heels of primary supporting structural members and stiffeners

Where a lower stool is not fitted to a transverse or longitudinal corrugated bulkhead, the maximum permissible stresses are to be reduced by 10% in accordance with **2.2.5.5**.

Section 10 Bucking and Ultimate Strength

2. Stiffness and Proportions

2.2 Plates and Local Support Members

2.2.1 Proportions of plate panels and local support members

Table 10.2.1 has been amended as follows:

Table 10.2.1 Slenderness Coefficients

Item		Coefficient
plate panel, C	hull envelope and tank boundaries	100
	other structure	125
stiffener web plate, C_w	angle and T profiles	75
	bulb profiles	41
	flat bars	22
flange/face plate(1), C_f	angle and T profiles	12

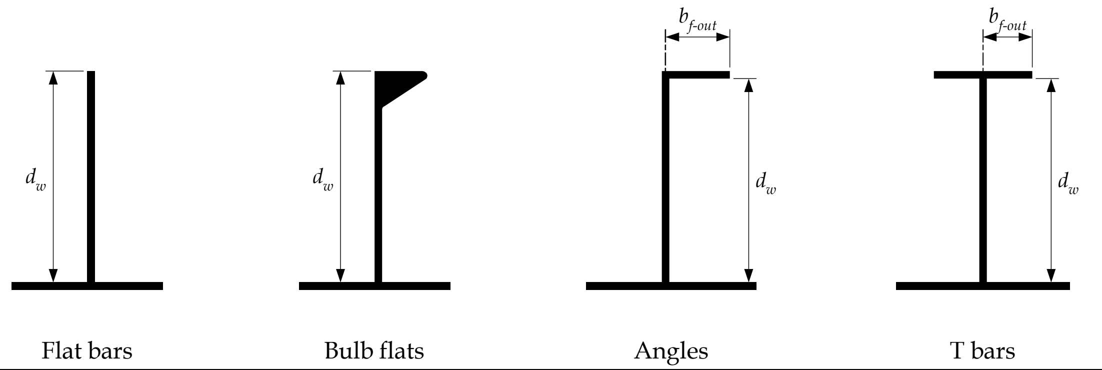
Note

The total flange breadth, b_f, for angle and T profiles is not to be less than: $b_f = 0.25 d_w$

Measurements of breadth and depth are based on gross scantlings as described in **Section 4/2.4.1.2**.

Where:

t_{net}	net thickness of plate, in *mm*
d_w	depth of web plate, in *mm*
$t_{w\text{-}net}$	net web thickness, in *mm*
$b_{f\text{-}out}$	breadth of flange outstands, in *mm*
$t_{f\text{-}net}$	net flange thickness, in *mm*



Section 11 General Requirements

3. Support Structure and Structural Appendages

3.1 Support Structure for Deck Equipment

3.1.4 Supporting structure for cranes, derricks and lifting masts

Sub-paragraph 3.1.4.14 has been amended as follows.

3.1.4.14 Depending on the arrangement of the deck connection in way of crane pedestals, the following additional requirements are to be complied with:

(a) where the pedestal is directly connected to the deck, without above deck brackets, adequate under deck structure directly in line with the crane pedestal is to be provided. Where the crane pedestal is attached to the deck without bracketing or where the crane pedestal is not continuous through the deck, welding to the deck of the crane pedestal and its under deck support structure is to be made by suitable full penetration welding. This could include a deep penetration welding procedure with a maximum root face of 3*mm* provided this results in full penetration and consequently enables ultrasonic lamination testing after welding has been completed. The design of the weld connection is to be adequate for the calculated stress in the welded connection, in accordance with **3.1.4.21**.

(b) where the pedestal is directly connected to the deck with brackets, under deck support structure is to be fitted to ensure a satisfactory transmission of the load, and to avoid structural hard spots. Above deck brackets may be fitted inside or outside of the pedestal and are to be aligned with deck girders and webs. The design is to avoid stress concentrations caused by an abrupt change of section. Brackets and other direct load carrying structure and under deck support structure are to be welded to the deck by suitable full penetration welding. This could include a deep penetration welding procedure with a maximum root face of 3*mm* provided this results in full penetration and consequently enables ultrasonic lamination testing after welding has been completed. The design of the connection is to be adequate for the calculated stress, in accordance with **3.1.4.21**.

Section 12 Ship in Operation Renewal Criteria

1. Allowable Thickness Diminution for Hull Structure

1.4 Renewal Criteria of Local Structure for General Corrosion

Table 10.2.1 has been amended as follows:

Table 12.1.2
Local Wastage Allowance for One Side of Structural Elements

Compartment Type	Structural Member		Ship in Operation Component Wastage Allowance, t_{was-1} or t_{was-2} (*mm*)
Ballast water tank and chain locker	Face plate of PSM	Within 3*m* below top of tank [1]	2.0
		Elsewhere	1.5
	Other members[3]	Within 3*m* below top of tank [1]	1.7
		Elsewhere	1.2
Cargo oil tank	Face plate of PSM	Within 3*m* below top of tank [1]	1.7
		Elsewhere	1.4
	Inner-bottom plating/bottom of tank		2.1
	Other members	Within 3*m* below top of tank [1]	1.7
		Elsewhere	1.0
Exposed to atmosphere	Weather deck plating		1.7
	Other members		1.0
Exposed to sea water	Shell plating[2]		1.0
Fuel and lube oil tank [4]	Top of tank and attached internal stiffeners		1.0
	Elsewhere		0.7
Fresh water tank	Top of tank and attached internal stiffeners		1.0
	Elsewhere		0.7
Void spaces	Spaces not normally accessed, e.g. access only via bolted manhole openings, pipe tunnels, etc.		0.7
Dry spaces	Internals of deckhouses, machinery spaces, pump room, store rooms, steering gear space, etc.		0.5

Notes

Only applicable to cargo and ballast tanks with weather deck as the tank top.

0.5*mm* to be added for side plating in the quay contact region as defined in **Section 8/Figure 8.2.2**.

0.5*mm* to be added to the plate surface exposed to ballast for plate boundary between water ballast and heated cargo oil tanks. 0.3*mm* 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. Heated cargo oil tanks are defined as tank arranged with any form of heating capability (most common type is heating coils).

0.7*mm* to be added for plate boundary between water ballast and heated fuel oil tanks.

Appendix C Fatigue Strength Assessment

2. Hot Spot Stress (FE Based) Approach

2.5 Detail Design Standard

2.5.1 Hopper knuckles

In Figure C.2.2, the item ”Building Tolerances” has been amended as follows:

Building Tolerances	Median line of hopper sloping plate is to be in line with the median line of the girder with an allowable tolerance of *t*/3 or 5*mm*, whichever is less, towards centreline in way of the floor, where *t* is the inner bottom thickness.

In Figure C.2.2, the item ”Building Tolerances” has been amended as follows:

Building Tolerances	Median line of hopper sloping plate is to be in line with the median line of the girder with an allowable tolerance of *t*/3 or 5*mm*, whichever is less, towards centreline in way of the floor, where *t* is the inner bottom thickness.

EFFECTIVE DATE AND APPLICATION(Amendment 1-2)

1. The effective date of the amendments is 1st April 2007.

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 IACS Procedural Requirement(PR) No.29 (Rev.3).

3. Notwithstanding the provision of preceding **2.**, application to ship contracted for construction prior to 1st April 2007 is acceptable where agreed by builder and prospective owner.

IACS PR No.29 (Rev.3)

Unless specified otherwise:

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 sister 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, a "series of sister vessels" is a series of vessels built to the same approved plans for classification purposes, under a single contract for construction. The optional vessels will be considered part of the same series of sister 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:

1. This Procedural Requirement applies to all IACS Members and Associates.
2. This Procedural Requirement is effective for ships "contracted for construction" on or after 1 January 2005.
3. Sister vessels may have minor design alterations provided such alterations do not affect matters related to classification.
4. Revision 2 of this Procedural Requirement is effective for ships "contracted for construction" on or after 1 April 2006.
5. Revision 3 of this Procedural Requirement was approved on 5 January 2007 with immediate effect.