RULES FOR CLASSIFICATION(STEEL SHIPS)

(Ministry of Oceans and Fisheries)

Part 14 Structural Rules for Container Ships

2022. 1. 26

Hull Rule Development Team

- Main Amendments -

(1) Enter into force on 1 July 2022 (the contract date for ship construction)

◉ To reflect Request for Establishment/Revision of Classification Technical Rules

◉ The regulations for liquefied natural gas fuel tank is newly added

◉ Coefficients and factors are improved for local scantling based on numerical assessment

◉ To clarify the requirements for the Cargo Hold Analysis

◉ To improve the fraction of time for the Fatigue Strength Assessment

⚓

Present

Chapter 1 General Principles

Section 1 〈omitted〉

Section 2 Rule Principles

1. ~ 3. 〈omitted〉

4. Rule design method

4.1 ~ 4.2 〈omitted〉

4.3 Load-capacity based requirements

4.3.1 〈omitted〉

4.3.2 Design loads for SLS, ULS and ALS

〈omitted〉

Table 1 : Load scenarios and corresponding rule requirements

Operation	Load type	Design load scenario	Acceptance criteria
Seagoing operations			
〈omitted〉			
Harbour and sheltered operations			
〈omitted〉			
Accidental condition			
〈newly added〉			
Flooded conditions	Typically maximum loads on internal watertight subdivision structure in accidental flooded conditions	A	AC-A
Testing condition			
Tank testing	Typical maximum loads during tank testing operations	T	AC-T

Amendment

Chapter 1 General Principles

Section 1 〈same as the present〉

Section 2 Rule Principles

1. ~ 3. 〈same as the present〉

4. Rule design method

4.1 ~ 4.2 〈same as the present〉

4.3 Load-capacity based requirements

4.3.1 〈same as the present〉

4.3.2 Design loads for SLS, ULS and ALS

〈same as the present〉

Table 1 : Load scenarios and corresponding rule requirements

Operation	Load type	Design load scenario	Acceptance criteria
Seagoing operations			
〈same as the present〉			
Harbour and sheltered operations			
〈same as the present〉			
Accidental condition			
Collision conditions	Maximum loads on internal watertight subdivision structure including cofferdam bulkheads in collision	A	AC-A
Flooded conditions	Typically maximum loads on internal watertight subdivision structure in accidental flooded conditions	A	AC-A
Testing condition			
Tank testing	Typical maximum loads during tank testing operations	T	AC-T

Note

- the accidental condition for container ship with liquefied natural gas fuel tank is newly added.

Present

4.4 Acceptance criteria

4.4.1 General

〈omitted〉

d) The acceptance criteria set AC-A is applied for the static design loads in accidental ~~flooded~~ condition

e) The acceptance criteria set AC-T is applied for the design loads in tank testing condition.

Table 2 : Acceptance criteria – prescriptive requirements

Acceptance criteria	Plate panels and local support members(1)		Primary supporting members(1)		Hull girder members	
	Yield	Buckling	Yield	Buckling	Yield	Buckling
AC-S AC-SD AC-A AC-T	〈omitted〉					
AC-I	〈omitted〉					

(1) Refer to **Ch 10** for Other structures and to **Ch 11** for Superstructure, deckhouses and hull outfitting

〈newly added〉

Table 3 : Acceptance criteria – FE analysis

Acceptance criteria	Cargo hold analysis		Fine mesh analysis
	Yield	Buckling	Yield
AC-S, AC-SD, AC-A, AC-T	Permissible stress: **Ch 7, Sec 2, [5]**	Allowable buckling utilisation factor: **Ch 8, Sec 1, [3]**	Permissible Von Mises stress: **Ch 7, Sec 3, [6]** ~~Screening criteria: **Ch 7, Sec 3, [3.3]**~~

Amendment

4.4 Acceptance criteria

4.4.1 General

〈same as the present〉

d) The acceptance criteria set AC-A is applied for the static design loads in accidental condition

e) The acceptance criteria set AC-T is applied for the design loads in tank testing condition.

Table 2 : Acceptance criteria – prescriptive requirements

Acceptance criteria	Plate panels and local support members(1)		Primary supporting members(1)		Hull girder members	
	Yield	Buckling	Yield	Buckling	Yield	Buckling
AC-S AC-SD AC-A AC-T	〈same as the present〉					
AC-I(2)	〈same as the present〉					

(1) Refer to **Ch 10** for Other structures and to **Ch 11** for Superstructure, deckhouses and hull outfitting

(2) If necessary, direct analysis guidance specified Classification Society can be applied.

Table 3 : Acceptance criteria – FE analysis

Acceptance criteria	Cargo hold analysis		Fine mesh analysis
	Yield	Buckling	Yield
AC-S, AC-SD, AC-A AC-T	Permissible stress: **Ch 7, Sec 2, [5]**	Allowable buckling utilisation factor: **Ch 8, Sec 1, [3]**	Permissible Von Mises stress: **Ch 7, Sec 3, [6]**

Note

- not only flooded condition but also collision condition is included in accidental condition, AC-A for container ships with liquefied natural gas fuel tank
- adopted the direct analysis for evaluation of structural members subjected impact loads.
- the screening criteria in acceptance criteria for FE analysis is removed

Present	Amendment	Note
Section 3 Verification of Compliance **1. ⟨omitted⟩** **2. Document to be submitted** **2.1 ⟨omitted⟩** **2.2 Submission of plans and supporting calculations** **2.2.1 ~ 2.2.2 ⟨omitted⟩** **2.2.3 Plans and instruments to be supplied onboard the ship** As a minimum, the following plans and instrument are to be supplied onboard: a) One copy of the following plans indicating the newbuilding thickness for each structural item is to be supplied onboard the ship: plans of midship sections, construction profiles, shell expansion, transverse bulkheads, aft and fore part structures, machinery space structures, superstructures, deckhouses and casing. b) One copy of the final approved loading manual, see **[2.1.1]**. c) One copy of the final approved loading instrument, see **[2.1.1]**. d) Welding. e) Details of the extent and location of higher tensile steel together with details of the specification and mechanical properties, and any recommendations for welding, working and treatment of these steels. f) Details and information on use of special materials, such as an aluminium alloy, used in the hull construction. g) Towing and mooring arrangements plan, ~~see **Ch 11, Sec 3**.~~ ⟨omitted⟩	**Section 3 Verification of Compliance** **1. ⟨same as the present⟩** **2. Document to be submitted** **2.1 ⟨same as the present⟩** **2.2 Submission of plans and supporting calculations** **2.2.1 ~ 2.2.2 ⟨same as the present⟩** **2.2.3 Plans and instruments to be supplied onboard the ship** As a minimum, the following plans and instrument are to be supplied onboard: a) One copy of the following plans indicating the newbuilding thickness for each structural item is to be supplied onboard the ship: plans of midship sections, construction profiles, shell expansion, transverse bulkheads, aft and fore part structures, machinery space structures, superstructures, deckhouses and casing. b) One copy of the final approved loading manual, see **[2.1.1]**. c) One copy of the final approved loading instrument, see **[2.1.1]**. d) Welding. e) Details of the extent and location of higher tensile steel together with details of the specification and mechanical properties, and any recommendations for welding, working and treatment of these steels. f) Details and information on use of special materials, such as an aluminium alloy, used in the hull construction. g) Towing and mooring arrangements plan. ⟨same as the present⟩	- Ch 11, Sec 3 is amended or deleted

Present	Amendment	Note
Chapter 3 Structural Design Principles	**Chapter 3 Structural Design Principles**	
Section 1 ~ 2 〈omitted〉 **Section 3 Corrosion Additions**	**Section 1 ~ 2 〈same as the present〉** **Section 3 Corrosion Additions**	
1. General	**1. General**	
1.1 〈omitted〉	**1.1 〈same as the present〉**	
1.2 Corrosion addition determination	**1.2 Corrosion addition determination**	
1.2.1 〈omitted〉 In case of stainless clad steel, the corrosion additions, t_{c1}, for the carbon steel side and t_{c2}, for the stainless steel side are respectively to be taken as: a) t_{c1} as specified for the corresponding compartment in **Table 1** b) t_{c2} = 0.0	**1.2.1** 〈same as the present〉 In case of stainless clad steel, the corrosion additions, t_{c1}, for the carbon steel side and t_{c2}, for the stainless steel side are respectively to be taken as: a) t_{c1} as specified for the corresponding compartment in **Table 1** b) t_{c2} = 0.0	
The total corrosion addition, t_c in mm, need not to be taken more than 20 % of gross offered thickness, t_{gr_off} in mm.		- move to 1.2.4
1.2.3 〈omitted〉	**1.2.3 〈same as the present〉**	
1.2.4 Maximum of corrosion addition	**1.2.4 Corrosion addition limit**	- revised the subtitle
Considering the renewal criteria specified in Ch 13, Sec 2, the corrosion addition satisfy the following condition:	Considering the renewal criteria specified in **Ch 13**, **Sec 2**, the total corrosion addition, t_c in mm, need not to be taken more than 20 % of gross offered thickness, t_{gr_off} in mm. The corrosion addition satisfy the following condition:	
$t_c \le 0.2\, t_{gr\_off}$ with nearest half millimetre	$t_c \le 0.2\, t_{gr\_off}$ with nearest half millimetre	
For examples;	For examples;	
0.75 ≤ t 〈 1.25mm, the corrosion addition, t_c, is 1.0mm.	0.75 ≤ t_c 〈 1.25mm, the corrosion addition, t_c, is 1.0mm.	- typo
1.25 ≤ t 〈 1.75mm, the corrosion addition, t_c, is 1.5mm.	1.25 ≤ t_c 〈 1.75mm, the corrosion addition, t_c, is 1.5mm.	

Present	Amendment	Note
Section 5 Limit States **1. General** **1.1 Limit states** **1.1.1 ~ 1.1.4 〈omitted〉** **1.1.5 Accidental limit state** Accidental limit states are concerned with the ability of the structure to resist accident situations or abnormal events. 〈newly added〉 Flooded conditions of any compartment without progression of the flooding to another compartment are considered. The limit states are concerned with the following in intact (undamaged) conditions with accidental or abnormal loads, or in damaged conditions with environmental loads the ship meets during a limited time frame: • The safety of life. • Environment. Property (ship and cargo). Accidental limit state includes: • Loss of structural strength without loss of containment. • Loss of structural strength and loss of containment. 〈omitted〉	**Section 5 Limit States** **1. General** **1.1 Limit states** **1.1.1 ~ 1.1.4 〈same as the present〉** **1.1.5 Accidental limit state** Accidental limit states are concerned with the ability of the structure to resist accident situations or abnormal events. As described in **Pt 7, Ch 5**, this limit states are concerned with the collision loads imposed on a liquefied natural gas fuel containment system and its supporting structure in intact (undamaged) conditions as follows: • 0.5g in the forward direction in full condition. • 0.25g in the aft direction in full condition. where, “g” is gravitational acceleration. Flooded conditions of any compartment without progression of the flooding to another compartment are considered. The limit states are concerned with the following in intact (undamaged) conditions with accidental or abnormal loads, or in damaged conditions with environmental loads the ship meets during a limited time frame: • The safety of life. • Environment. Property (ship and cargo). Accidental limit state includes: • Loss of structural strength without loss of containment. • Loss of structural strength and loss of containment. 〈same as the present〉	– Collision load is included in accidental limit states for liquefied natural gas fuel containment system and its supporting structures.

Present

1.2 Failure modes

1.2.1

A number of possible failure modes may be relevant for the various parts of the ship structure. For each failure mode, one or more limit states may be relevant. The failure modes to be considered for the assessment of ship structural safety with relation to the limit states are shown in **Table 1**.

Table 13 : Failure modes in relation to the limit states to be considered

Possible failure modes to be considered	Limit states[1]			
	SLS	ULS	FLS	ALS
Yielding	Y	Y	–	Y
Plastic collapse	–	Y	–	Y
Buckling	Y	Y	–	Y
Rupture	–	Y	–	Y
Fatigue cracking	–	–	Y	–
Brittle fracture[2]	–	–	–	–

[1] "Y" indicates that the structural assessment is to be carried out.
[2] Controlled by the material rule requirement of steel grade

1.2.2 ~ 1.2.3 ⟨omitted⟩

Amendment

1.2 Failure modes

1.2.1

A number of possible failure modes may be relevant for the various parts of the ship structure. For each failure mode, one or more limit states may be relevant. The failure modes to be considered for the assessment of ship structural safety with relation to the limit states are shown in **Table 1**.

Table 14 : Failure modes in relation to the limit states to be considered

Possible failure modes to be considered	Limit states[1]			
	SLS	ULS	FLS	ALS
Yielding	Y	Y	–	Y
Plastic collapse	–	Y	–	Y
Buckling	Y	Y	–	–
Rupture	–	Y	–	Y
Fatigue cracking	–	–	Y	–
Brittle fracture[2]	–	–	–	–

[1] "Y" indicates that the structural assessment is to be carried out.
[2] Controlled by the material rule requirement of steel grade

1.2.2 ~ 1.2.3 ⟨same as the present⟩

Note

- Possible failure mode due to buckling is removed in ALS.

Present	Amendment	Note
1.2.4 Buckling The buckling failure mode is the instability phenomena of structural members under compressive loads. When the stress in structural members just attains the elastic buckling stress, elastic (reversible) buckling occurs during the compressive load. This buckling failure mode is controlled in SLS. By further increasing the compressive load, stress redistribution occurs due to buckling of the weakest structural member and the stress in some structural members reaches the yield stress. This buckling failure mode with large elastic deflection is controlled in ULS ~~or ALS~~. When compression is unloaded, no consequence of failure due to buckling is seen. On the other hand, plastic (irreversible) buckling occurs when the stress in structural members exceeds the yield stress. As a result, the substantial permanent deflections due to plastic buckling appear. This irreversible buckling failure mode is controlled only in ULS ~~or ALS~~ for global hull girder strength. 〈omitted〉	**1.2.4 Buckling** The buckling failure mode is the instability phenomena of structural members under compressive loads. When the stress in structural members just attains the elastic buckling stress, elastic (reversible) buckling occurs during the compressive load. This buckling failure mode is controlled in SLS. By further increasing the compressive load, stress redistribution occurs due to buckling of the weakest structural member and the stress in some structural members reaches the yield stress. This buckling failure mode with large elastic deflection is controlled in ULS. When compression is unloaded, no consequence of failure due to buckling is seen. On the other hand, plastic (irreversible) buckling occurs when the stress in structural members exceeds the yield stress. As a result, the substantial permanent deflections due to plastic buckling appear. This irreversible buckling failure mode is controlled only in ULS for global hull girder strength. 〈same as the present〉	- need not to be considering the buckling failure mode in ALS
2. Criteria **2.1 ~ 2.4 〈omitted〉** **2.5 Accidental limit state** **2.5.1 〈newly added〉**	**2. Criteria** **2.1 ~ 2.4 〈same as the present〉** **2.5 Accidental limit state** **2.5.1 Bulkhead structure** The fore and aft cofferdam transverse bulkheads in liquefied natural gas fuel tank boundary, are to be assessed for regarding bow/stern collision loads in accordance with **Ch 6** and **Ch 7** for yielding criteria.	- collision load is considering in accidental limit states for bulkhead structure of liquefied natural gas fuel tank
2.5.1 Plating, stiffeners and PSM The plating, stiffeners and PSM are to be assessed in flooded conditions in accordance with **Ch 6** and **Ch 7** for yielding criteria. 〈omitted〉	**2.5.2 Plating, stiffeners and PSM** The plating, stiffeners and PSM are to be assessed in flooded conditions in accordance with **Ch 6** and **Ch 7** for yielding criteria. 〈same as the present〉	

Present	Amendment	Note
Section 6 Structural Detail Principles **1. ~ 2. 〈omitted〉** **3. Stiffeners** **3.1 ~ 3.3 〈omitted〉** **3.4 Sniped ends** **3.4.1** Sniped ends may be used where dynamic loads are small, provided the net thickness of plating supported by the stiffener, t_p in mm, is not less than: $t_p = c_1 \sqrt{(1000\,\ell - \frac{s}{2})\frac{s\,P\,k}{10^6}}$ t. where: P : Design pressure for the stiffener for the design load set being considered, in $\mathrm{kN/m^2}$. c_1 : Coefficient for the design load set being considered, to be taken as: c_1 = 1.2 for acceptance criteria set AC-S. c_1 = 1.1 for acceptance criteria set AC-SD and AC-T. Sniped stiffeners are not to be used on structures in the vicinity of engines or generators in the machinery space, propeller impulse zone in the stern area nor on the shell envelope. 〈omitted〉	**Section 6 Structural Detail Principles** **1. ~ 2. 〈same as the present〉** **3. Stiffeners** **3.1 ~ 3.3 〈same as the present〉** **3.4 Sniped ends** **3.4.1** Sniped ends may be used where dynamic loads are small, provided the net thickness of plating supported by the stiffener, t_p in mm, is not less than: $t_p = c_1 \sqrt{(1000\,\ell - \frac{s}{2})\frac{s\,P\,k}{10^6}}$ t. where: P : Design pressure for the stiffener for the design load set being considered, in $\mathrm{kN/m^2}$. c_1 : Coefficient for the design load set being considered, to be taken as: c_1 = 1.2 for acceptance criteria set AC-S. c_1 = 1.0 for acceptance criteria set AC-SD, AC-A and AC-T. In general, sniped stiffeners are not to be used on structures in the vicinity of engines or generators in the machinery space, propeller impulse zone in the stern area nor on the shell envelope. 〈same as the present〉	- improving the coefficient for the design load set and newly adding the missing AC-A for sniped ends

Present	Amendment	Note
5. Intersection of stiffeners and primary supporting members	**5. Intersection of stiffeners and primary supporting members**	
5.1 ⟨omitted⟩	**5.1 ⟨same as the present⟩**	
5.2 Connection of stiffeners to PSM	**5.2 Connection of stiffeners to PSM**	
5.2.1 ~ 5.2.2 ⟨omitted⟩	**5.2.1 ~ 5.2.2 ⟨same as the present⟩**	
5.2.3	**5.2.3**	
The load, W_2, in kN, transmitted through the PSM web stiffener is to be taken as: • If the web stiffener is connected to the intersecting stiffener: $W_2 = W\left(1-\alpha_a-\frac{A_1}{4\,f_c\,A_W+A_1}\right)$ • If the web stiffener is not connected to the intersecting stiffener: W_2 = 0.0	The load, W_2, in kN, transmitted through the PSM web stiffener is to be taken as: • If the web stiffener is connected to the intersecting stiffener: $W_2 = W\left(1-\alpha_a-\frac{A_1}{4\,f_c\,A_W+A_1}\right)$ • If the web stiffener is not connected to the intersecting stiffener: W_2 = 0.0	
⟨omitted⟩ where: ⟨omitted⟩	⟨same as the present⟩ where: ⟨same as the present⟩	
A_{wc} : Effective net area, in cm^2, of the PSM web stiffener in way of the weld as shown in **Figure 8**.	A_{wc} : Effective net area, in cm^2, of the PSM web stiffener in way of the weld as shown in **Figure 8**.	
σ_{perm} : Permissible direct stress given in **Table 1** for AC-S, AC-SD, AC-I and AC-T, in $\mathrm{N/mm}^2$.	σ_{perm} : Permissible direct stress given in **Table 1** for AC-S, AC-SD, AC-I, AC-A and AC-T, in $\mathrm{N/mm}^2$.	- to represent the missing AC-A
τ_{perm} : Permissible shear stress given in **Table 1** for AC-S, AC-SD, AC-I and AC-T, in $\mathrm{N/mm}^2$.	τ_{perm} : Permissible shear stress given in **Table 1** for AC-S, AC-SD, AC-I, AC-A and AC-T, in $\mathrm{N/mm}^2$.	

Present	Amendment	Note

Table 1 : Permissible stresses for connection between stiffeners and PSMs

Item	Direct stress, σ_{perm}, in $\mathrm{N/mm^2}$			shear stress, τ_{perm}, in $\mathrm{N/mm^2}$		
	Acceptance criteria set			Acceptance criteria set		
	AC-S	AC-SD and AC-T	AC-I	AC-S	AC-SD and AC-T	AC-I
PSM web stiffener	$0.83R_{eH}$ (2)	R_{eH}	R_{eH}	-	-	-
PSM web stiffener to intersecting stiffener in way of weld connection: • Double continuous fillet • Partial penetration weld	 $0.58R_{eH}$ (2) $0.83R_{eH}$ (1)(2)	 $0.70R_{eH}$ (2) R_{eH} (1)	 R_{eH} R_{eH}	 - -	 - -	 - -
PSM stiffener to intersecting stiffener in way of lapped welding	$0.50R_{eH}$	$0.60R_{eH}$	R_{eH}	-	-	-
Shear connection including lugs or collar plates: • Single sided connection • Double sided connection	 - -	 - -	 - -	 $0.71\tau_{eH}$ $0.83\tau_{eH}$	 $0.85\tau_{eH}$ τ_{eH}	 τ_{eH} τ_{eH}

(1) The root face is not to be greater than one third of the gross thickness of the PSM stiffener.

(2) Permissible stresses may be increased by 5 % where a soft heel is provided in way of the heel of the PSM web stiffener.

<table>
<tr><th>Present</th><th>Amendment</th><th>Note</th></tr>
<tr><td></td><td>
Table 1 : Permissible stresses for connection between stiffeners and PSMs
<table>
<tr><td rowspan="3">Item</td><td colspan="3">Direct stress, σ_{perm}, in $\mathrm{N/mm^2}$</td><td colspan="3">shear stress, τ_{perm}, in $\mathrm{N/mm^2}$</td></tr>
<tr><td colspan="3">Acceptance criteria set</td><td colspan="3">Acceptance criteria set</td></tr>
<tr><td>AC-S</td><td>AC-SD
AC-A
AC-T</td><td>AC-I</td><td>AC-S</td><td>AC-SD
AC-A
AC-T</td><td>AC-I</td></tr>
<tr><td>PSM web stiffener</td><td>$0.83R_{eH}$(2)</td><td>R_{eH}</td><td>R_{eH}</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>PSM web stiffener to intersecting stiffener in way of weld connection:
• Double continuous fillet
• Partial penetration weld</td><td>$0.58R_{eH}$(2)
$0.83R_{eH}$(1)(2)</td><td>$0.70R_{eH}$(2)
R_{eH}(1)</td><td>R_{eH}
R_{eH}</td><td>–
–</td><td>–
–</td><td>–
–</td></tr>
<tr><td>PSM stiffener to intersecting stiffener in way of lapped welding</td><td>$0.50R_{eH}$</td><td>$0.60R_{eH}$</td><td>R_{eH}</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>Shear connection including lugs or collar plates:
• Single sided connection
• Double sided connection</td><td>–
–</td><td>–
–</td><td>–
–</td><td>$0.71\tau_{eH}$
$0.83\tau_{eH}$</td><td>$0.85\tau_{eH}$
τ_{eH}</td><td>τ_{eH}
τ_{eH}</td></tr>
<tr><td colspan="7">(1) The root face is not to be greater than one third of the gross thickness of the PSM stiffener.
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</table>
</td><td>- to represent the missing AC-A</td></tr>
</table>

Present

5.2.4 ~ 5.2.7 〈omitted〉

5.2.8

The size of the fillet welds is to be calculated according to **Ch 12, Sec 3, [2.5]** based on the weld factors given in **Table 2.** For the welding in way of the shear connection the size is not to be less than that required for the PSM web plate for the location under consideration.

Table 2 : Weld factors for connection between stiffeners and PSMs

Item	Acceptance criteria	Weld factor
PSM stiffener to intersecting stiffener	AC-S, AC-SD, AC-I and AC-T	$0.6\,\sigma_{wc}\,/\,\sigma_{perm}$ not to be less than 0.38
Shear connection inclusive of lug or collar plate	AC-S, AC-SD, AC-I and AC-T	0.38
Shear connection inclusive of lug or collar plate, where the web stiffener of the PSM is not connected to the intersection stiffener	AC-S, AC-SD, AC-I and AC-T	$0.6\,\tau_w\,/\,\tau_{perm}$ not to be less than 0.44

τ_w : Shear stress, in $\mathrm{N/mm^2}$, as defined in **[5.2.3]**.
σ_{wc} : Stress, in $\mathrm{N/mm^2}$, as defined in **[5.2.3].**
τ_{perm} : Permissible shear stress, in $\mathrm{N/mm^2}$, see **Table 1.**
σ_{perm} : Permissible direct stress, in $\mathrm{N/mm^2}$, see **Table 1.**
W : Load, in kN, as defined in **[5.2.2].**
A_1 : Effective net shear area, in $\mathrm{cm^2}$, as defined in **[5.2.2].**
A_w : Effective net cross sectional area, in $\mathrm{cm^2}$, as defined in **[5.2.2].**

Amendment

5.2.4 ~ 5.2.7 〈same as the present〉

5.2.8

The size of the fillet welds is to be calculated according to **Ch 12, Sec 3, [2.5]** based on the weld factors given in **Table 2.** For the welding in way of the shear connection the size is not to be less than that required for the PSM web plate for the location under consideration.

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Item	Acceptance criteria	Weld factor
PSM stiffener to intersecting stiffener	AC-S, AC-SD, AC-I, AC-A and AC-T	$0.6\,\sigma_{wc}\,/\,\sigma_{perm}$ not to be less than 0.38
Shear connection inclusive of lug or collar plate	AC-S, AC-SD, AC-I, AC-A and AC-T	0.38
Shear connection inclusive of lug or collar plate, where the web stiffener of the PSM is not connected to the intersection stiffener	AC-S, AC-SD, AC-I, AC-A and AC-T	$0.6\,\tau_w\,/\,\tau_{perm}$ not to be less than 0.44

τ_w : Shear stress, in $\mathrm{N/mm^2}$, as defined in **[5.2.3]**.
σ_{wc} : Stress, in $\mathrm{N/mm^2}$, as defined in **[5.2.3].**
τ_{perm} : Permissible shear stress, in $\mathrm{N/mm^2}$, see **Table 1.**
σ_{perm} : Permissible direct stress, in $\mathrm{N/mm^2}$, see **Table 1.**
W : Load, in kN, as defined in **[5.2.2].**
A_1 : Effective net shear area, in $\mathrm{cm^2}$, as defined in **[5.2.2].**
A_w : Effective net cross sectional area, in $\mathrm{cm^2}$, as defined in **[5.2.2].**

Note

- to represent the missing AC-A

Present	Amendment	Note
Chapter 4 Loads	**Chapter 4 Loads**	
Section 1 ~ 3 ⟨omitted⟩ **Section 4 Hull girder loads**	**Section 1 ~ 3 ⟨same as the present⟩** **Section 4 Hull girder loads**	
Symbols	Symbols	
For symbols not defined in this section, refer to **Ch 1, Sec 4.**	For symbols not defined in this section, refer to **Ch 1, Sec 4.**	
x : X coordinate, in m, of the calculation point with respect to the reference coordinate system defined in **Ch 4, Sec 1, [1.2.1].**	x : X coordinate, in m, of the calculation point with respect to the reference coordinate system defined in **Ch 4, Sec 1, [1.2.1].**	
f_β : Heading correction factor, to be taken as:	f_β : Heading correction factor, to be taken as:	
a) For strength assessment:	a) For strength assessment:	
⟨newly added⟩	f_β = 1.0 in general	- to simplify the application of factor
f_β = 0.8 for BSR and BSP load cases for the extreme sea loads design load scenario.	f_β = 0.8 for BSR and BSP load cases for the extreme sea loads design load scenario.	
~~f_β = 1.0, for HSM, HSA, FSM, OST and OSA load cases for the extreme sea loads design load scenario.~~	⟨deleted⟩	
~~f_β = 1.0, for ballast water exchange at sea, harbour / sheltered water and accidental flooded design load scenarios.~~	⟨deleted⟩	
b) For fatigue assessment:	b) For fatigue assessment:	
f_β = 1.0	f_β = 1.0	
⟨omitted⟩	⟨same as the present⟩	

Present	Amendment	Note
1. 〈omitted〉	**1. 〈same as the present〉**	
2. Vertical still water hull girder loads	**2. Vertical still water hull girder loads**	
2.1 ~ 2.2 〈omitted〉	**2.1 ~ 2.2 〈same as the present〉**	
2.3 Vertical still water shear force	**2.3 Vertical still water shear force**	
2.3.1 〈omitted〉	**2.3.1 〈same as the present〉**	
2.3.2 Permissible still water shear force in harbour / sheltered water ~~and tank testing~~ condition The permissible vertical still water shear forces, Q_{sw-p}, in the harbour / sheltered water ~~and tank testing~~ condition at any longitudinal position are to envelop: a) The most severe still water shear forces, positive or negative, for the harbour / sheltered water loading conditions defined in **Ch 4, Sec 8**. b) The most severe still water shear forces for the harbour / sheltered water loading conditions defined in the loading manual.	**2.3.2 Permissible still water shear force in harbour / sheltered water condition** The permissible vertical still water shear forces, Q_{sw-p}, in the harbour / sheltered water at any longitudinal position are to envelop: a) The most severe still water shear forces, positive or negative, for the harbour / sheltered water loading conditions defined in **Ch 4, Sec 8**. b) The most severe still water shear forces for the harbour / sheltered water loading conditions defined in the loading manual.	- tank testing condition in 2.3.2 is moved to 2.3.4.
2.3.3 〈omitted〉	**2.3.3 〈same as the present〉**	
2.3.4 〈newly added〉	**2.3.4 Permissible still water shear force in tank testing condition** The permissible vertical still water shear forces, Q_{sw-t}, in tank testing condition at any longitudinal position are to envelop: a) The most severe still water shear forces for the tank testing conditions defined in the tank testing procedure. b) When the still water shear forces are not defined in the tank testing procedure, the permissible still water shear force may be taken the values as defined in **[2.3.1]**.	- the Q_{sw-t} for the tank testing condition is newly added

Present	Amendment	Note
2.4 Torsional still water moment **2.4.1** The value and distribution of still water moment torsional, M_{st}, are to be specified by designer and are not to be less than minimum design value to still water torsional moment. The minimum design value of still water torsional moment, M_{st}, in kNm, at any position along the ship is defined as: $M_{st} = 0.11\, f_{st}\, B\, W_{total-cont}(1 - L/500)$ where: f_{st} : Distribution factor along the ship length. To be taken as: f_{st} = 0.0, for $x \le 0$ f_{st} = 1.0, for $0.2L \le x \le 0.8L$ f_{st} = 0.0, for $x \ge L$ Intermediate values of f_{sw-t} are to be obtained by linear interpolation. W_{cont} : maximum total container weight of vessel, in ton	**2.4 Torsional still water moment** **2.4.1** The value and distribution of still water moment torsional, M_{st}, are to be specified by designer and are not to be less than minimum design value to still water torsional moment. The minimum design value of still water torsional moment, M_{st}, in kNm, at any position along the ship is defined as: $M_{st} = 0.11\, f_{st}\, B\, W_{total-cont}(1 - L/500)$ where: f_{st} : Distribution factor along the ship length. To be taken as: f_{st} = 0.0, for $x \le 0$ f_{st} = 1.0, for $0.2L \le x \le 0.8L$ f_{st} = 0.0, for $x \ge L$ Intermediate values of f_{st} are to be obtained by linear interpolation. $W_{total-cont}$: maximum total container weight of vessel, in ton $W_{total-cont} = n \cdot W_{cont}$ where: n : Maximum number of containers W_{cont} : Maximum weight of 20 ft container, in ton	- typo (f_{sw-t}→f_{st}) - for clarification of definition for the maximum total container weight

Present	Amendment	Note
3. Dynamic hull girder loads	**3. Dynamic hull girder loads**	
3.1 ~ 3.3 ⟨omitted⟩	**3.1 ~ 3.3 ⟨same as the present⟩**	
3.4 Horizontal wave bending moment	**3.4 Horizontal wave bending moment**	
3.4.1	**3.4.1**	
The horizontal wave bending moment at any longitudinal position, in kNm, is to be taken as:	The horizontal wave bending moment at any longitudinal position, in kNm, is to be taken as:	
$M_{wh} = 0.25 f_{nlh} f_R f_p L^2 T_{LC} C_w \left(\frac{1.2L}{1000}+1\right) f_{m-H}$	$M_{wh} = 0.25\ f_R f_p L^2 T_{LC} C_w \left(\frac{1.2L}{1000}+1\right) f_{m-H}$	
where:	where:	
~~f_{nlh} : Coefficient considering nonlinear effect to be taken as:~~ ~~$f_{nlh} = 1.0$~~	⟨deleted⟩	- the coefficient f_{nlh} is removed for simplification.
⟨omitted⟩	⟨same as the present⟩	
3.5 Horizontal wave shear force	**3.5 Horizontal wave shear force**	
3.5.1	**3.5.1**	
The horizontal wave shear force at any longitudinal position with respect to the ship baseline, in kNm, is to be taken as:	The horizontal wave shear force at any longitudinal position with respect to the ship baseline, in kNm, is to be taken as:	
$Q_{wh} = f_{nlh}\ f_R f_p L\ T_{LC} C_B C_w \left(\frac{17L}{10000}+1.27\right) f_{q-H}$	$Q_{wh} = f_R f_p L\ T_{LC} C_B C_w \left(\frac{17L}{10000}+1.27\right) f_{q-H}$	
where:	where:	
~~f_{nlh} : Coefficient considering nonlinear effect to be taken as:~~ ~~$f_{nlh} = 1.0$~~	⟨deleted⟩	- the coefficient f_{nlh} is removed for simplification.
⟨omitted⟩	⟨same as the present⟩	

Present	Amendment	Note
3.6 Wave torsional moment **3.6.1** The wave torsional moment at any longitudinal position with respect to the ship baseline, in kNm, is to be taken as: $M_{wt}=f_{nlh}\,f_R\,f_p\,L\,B\,C_w\,T_{LC}\left(\frac{5B}{1000}+0.44\right)f_{m-T}f_{sc}$ where: f_p : Coefficient to be taken as: $f_p=f_{ps}$ for strength assessment. $f_p=0.9[0.2+(5f_T-4.25)B\times10^{-4}]$ for fatigue assessment. ⟨omitted⟩	**3.6 Wave torsional moment** **3.6.1** The wave torsional moment at any longitudinal position with respect to the ship baseline, in kNm, is to be taken as: $M_{wt}=f_R\,f_p\,L\,B\,C_w\,T_{LC}\left(\frac{5B}{1000}+0.44\right)f_{m-T}f_{sc}$ where: f_p : Coefficient to be taken as: $f_p=f_{ps}$ for strength assessment. $f_p=0.9[0.2+(5f_T-4.25)B\times10^{-4}]$ for fatigue assessment. ⟨same as the present⟩	- the coefficient f_{nlh} is removed for simplification.

Present	Amendment	Note
Section 5 ⟨omitted⟩ **Section 6 Internal loads**	**Section 5 ⟨same as the present⟩** **Section 6 Internal loads**	
Symbols	**Symbols**	
For symbols not defined in this section, refer to **Ch 1, Sec 4.**	For symbols not defined in this section, refer to **Ch 1, Sec 4.**	
⟨omitted⟩	⟨same as the present⟩	
z_{top} : Z coordinate of the highest point of tank, excluding small hatchways, in m.	z_{top} : Z coordinate of the highest point of tank, excluding small hatchways, in m.	
ρ_L : Density of liquid in the tank, in $\mathrm{t/m^3}$, but not less than: $\rho_L = 1.025$	ρ_L : Density of liquid in the tank, in $\mathrm{t/m^3}$, but not less than: • For liquefied natural gas fuel tank $\rho_L = 0.5$ for strength assessment $\rho_L = 0.46$ or higher value for fatigue assessment • For other cases $\rho_L = 1.025$	- the density of liquefied natural gas fuel for strength assessment and for fatigue assessment is newly added
ρ_{slh} : Liquid density, in $\mathrm{t/m^3}$, to be used for sloshing assessment, taken as: $\rho_{slh} = \rho_L$	ρ_{slh} : Liquid density, in $\mathrm{t/m^3}$, to be used for sloshing assessment, taken as: $\rho_{slh} = \rho_L$	
⟨omitted⟩	⟨same as the present⟩	

Present	Amendment	Note
1. Pressure due to liquids	**1. Pressure due to liquids**	
1.1 〈omitted〉	**1.1 〈same as the present〉**	
1.2 Static liquid pressure	**1.2 Static liquid pressure**	
1.2.1 Normal operations at sea The static pressure due to liquid in tanks, P_{ls} during normal operations at sea, in $\mathrm{kN/m^2}$, is to be taken as: 〈newly added〉 $P_{ls}=\rho_L g(z_{top}-z)$ for other cases	**1.2.1 Normal operations at sea** The static pressure due to liquid in tanks, P_{ls} during normal operations at sea, in $\mathrm{kN/m^2}$, is to be taken as: $P_{ls}=\rho_L g(z_{top}-z)+P_{PV}$ for liquefied natural gas fuel tank $P_{ls}=\rho_L g(z_{top}-z)$ for other cases	- newly adding the static pressure at sea, harbour and sheltered water for liquefied natural gas fuel tank
1.2.2 Harbour / sheltered water operations The static pressure, P_{ls} due to liquid in tanks for harbour / sheltered water operations, in $\mathrm{kN/m^2}$, is to be taken as: 〈newly added〉 $P_{ls}=\rho_L g(z_{top}-z)$ for other cases 〈omitted〉	**1.2.2 Harbour / sheltered water operations** The static pressure, P_{ls} due to liquid in tanks for harbour / sheltered water operations, in $\mathrm{kN/m^2}$, is to be taken as: $P_{ls}=\rho_L g(z_{top}-z)+P_{PV}$ for liquefied natural gas fuel tank $P_{ls}=\rho_L g(z_{top}-z)$ for other cases 〈same as the present〉	
1.3 Dynamic liquid pressure	**1.3 Dynamic liquid pressure**	
1.3.1 The dynamic pressure, P_{ld} due to liquid in tanks, in $\mathrm{kN/m^2}$, is to be taken as: $P_{ld}=f_\beta\,\rho_L[a_Z(z_0-z)+f_{ull-l}\,a_X(x_0-x)+f_{ull-t}\,a_Y(y_0-y)]$ where: f_{ull-l} : Longitudinal acceleration correction factor to account for the ullage space above the liquid in tanks, taken as $f_{ull-l}=1.0$	**1.3.1** The dynamic pressure, P_{ld} due to liquid in tanks, in $\mathrm{kN/m^2}$, is to be taken as: $P_{ld}=f_\beta\,\rho_L[a_Z(z_0-z)+f_{ull-l}\,a_X(x_0-x)+f_{ull-t}\,a_Y(y_0-y)]$ where: f_{ull-l} : Longitudinal acceleration correction factor to account for the ullage space above the liquid in tanks, taken as • For strength assessment: $f_{ull-l}=0.62$ for liquefied natural gas fuel tank and fuel oil tank. $f_{ull-l}=1.0$ for other cases.	- newly adding the factors for dynamic liquid pressure for liquefied natural gas fuel tank

Present	Amendment	Note
	• For fatigue assessment: $f_{ull-l} = 0.5 + \frac{\lvert z_o - z \rvert}{\ell_{fs}} \frac{180}{\phi \, \pi}$ for liquefied natural gas fuel tank and fuel oil tank. $f_{ull-l} = 1.0$ for other cases. f_{ull-l} is not to be less than 0.0 nor greater than 1.0	- the factors for dynamic liquid pressure for liquefied natural gas fuel tank is newly added
⟨newly added⟩	ℓ_{fs} : Fuel tank length at the top of the tank, in m	
f_{ull-t} : Transverse acceleration correction factor to account for the ullage space above the liquid in tanks, taken as $f_{ull-l} = 1.0$	f_{ull-t} : Transverse acceleration correction factor to account for the ullage space above the liquid in tanks, taken as • For strength assessment: $f_{ull-l} = 0.67$ for liquefied natural gas fuel tank and fuel oil tank. $f_{ull-l} = 1.0$ for other cases. • For fatigue assessment: $f_{ull-t} = 0.5 + \frac{\lvert z_o - z \rvert}{b_{top}} \frac{180}{\theta \, \pi}$ for liquefied natural gas fuel tankand fuel oil tank. $f_{ull-t} = 1.0$ for other cases. f_{ull-t} is not to be less than 0.0 nor greater than 1.0	
⟨newly added⟩	b_{top} : Fuel tank breadth at the top of the tank, in m, determined at mid length of the tank.	
x_0 : X coordinate, in m, of the reference point.	x_0 : X coordinate, in m, of the reference point.	
y_0 : Y coordinate, in m, of the reference point.	y_0 : Y coordinate, in m, of the reference point.	
z_0 : Z coordinate, in m, of the reference point.	z_0 : Z coordinate, in m, of the reference point.	
⟨omitted⟩	⟨same as the present⟩	

Present	Amendment	Note
2. ⟨omitted⟩	**2. ⟨same as the present⟩**	
⟨newly added⟩	**3. Pressure by IGF** **3.1 General** **3.1 Application** For the liquefied natural gas fuel tank, the internal pressure acting on a tank boundary, which is symbolized as in **Ch 6**, is given in "**Rules/Guidance for the Classification of Ships Using Low-flashpoint Fuels", Ch 6, Sec 4, 409.** in $\mathrm{kN/m^2}$. This pressure is calculated with dimensionless acceleration, which is combined with 3 components(a_x, a_y, a_z) in an arbitrary direction according to an ellipsoid surface. For the corner points of the liquefied natural gas fuel tank, pressure may be calculated with different acceleration direction so as to have a maximum. The pressure between corner points is decided by linear interpolation.	- the IGF pressure for container ships with liquefied natural gas fuel tank is newly added
3. Sloshing pressure in tanks **3.1.1 ~ 3.1.2 ⟨omitted⟩** **3.1.3 Sloshing pressure on tank boundaries and internal divisions** The sloshing pressure due to liquid motions in a tank P_{slh} acting on any load point of a tank boundary or internal divisions, in $\mathrm{kN/m^2}$, for the sloshing design load scenario, given in **Ch 4, Sec 7,** is to be taken as follows, without being less than $P_{slh-\min}$, as given in **[3.2]:**	**4. Sloshing pressure in tanks** **4.1.1 ~ 4.1.2 ⟨same as the present⟩** **4.1.3 Sloshing pressure on tank boundaries and internal divisions** The sloshing pressure due to liquid motions in a tank P_{slh} acting on any load point of a tank boundary or internal divisions, in $\mathrm{kN/m^2}$, for the sloshing design load scenario, given in **Ch 4, Sec 7,** is to be taken as follows, without being less than $P_{slh-\min}$, as given in **[4.2]:**	- renumbering
a) $P_{slh}=P_{slh-lng}$ for transverse bulkheads, as defined in **[3.3.2]**.	a) $P_{slh}=P_{slh-lng}$ for transverse bulkheads, as defined in **[4.3.2]**.	
	b) $P_{slh}=P_{slh-wf}$ for web frames and transverse stringers, as defined in **[4.3.3].**	- the definition of pressure for web frames and transverse stringers is newly added
b) $P_{slh}=P_{slh-t}$ for longitudinal bulkheads, as defined in **[3.4.2]**.	c) $P_{slh}=P_{slh-t}$ for longitudinal bulkheads, as defined in **[4.4.2]**.	
c) $P_{slh}=P_{slh-grd}$ for longitudinal girders and stringers, see **[3.4.3]**.	d) $P_{slh}=P_{slh-grd}$ for longitudinal girders and stringers, see **[4.4.3]**.	

<table>
<tr><th>Present</th><th>Amendment</th><th>Note</th></tr>
<tr><td>3.2 〈omitted〉</td><td>4.2 〈same as the present〉</td><td></td></tr>
<tr><td>3.3 Sloshing pressure due to longitudinal liquid motion</td><td>4.3 Sloshing pressure due to longitudinal liquid motion</td><td></td></tr>
<tr><td>3.3.1
〈omitted〉</td><td>4.3.1
〈same as the present〉</td><td></td></tr>
<tr><td>3.3.2 Sloshing pressure in way of transverse bulkheads</td><td>4.3.2 Sloshing pressure in way of transverse bulkheads</td><td></td></tr>
<tr><td>The sloshing pressure in way of transverse bulkheads due to longitudinal liquid motion, $P_{slh-lng}$, in $\mathrm{kN/m^2}$, for a particular filling level, is to be taken as:
$$P_{slh-lng} = \rho_{slh} g \ell_{tk-h} f_{slh}\left[0.4-\left(0.39-\frac{1.7\ell_{tk-h}}{L}\right)\frac{L}{350}\right]$$
where:
ℓ_{tk-h} : Length of cargo tank, in m, at considered filling height.
f_{slh} : Coefficient taken as:
$$f_{slh} = 1-2\left(0.7-\frac{h_{fill}}{h_{\max}}\right)^2$$
h_{fill} : Filling height, measured from tank bottom, in m.</td><td>The sloshing pressure in way of transverse bulkheads due to longitudinal liquid motion, $P_{slh-lng}$, in $\mathrm{kN/m^2}$, for a particular filling level, is to be taken as:
$$P_{slh-lng} = \rho_{slh} g \ell_{tk-h} f_{slh}\left[0.4-\left(0.39-\frac{1.7\ell_{tk-h}}{L}\right)\frac{L}{350}\right]$$
where:
ℓ_{tk-h} : Length of cargo tank, in m, at considered filling height.
f_{slh} : Coefficient as defined in Table 1.
h_{fill} : Filling height, measured from tank bottom, in m.</td><td>- the coefficient, f_{slh} is replaced with the table 1 instead of formula.</td></tr>
<tr><td>〈newly added〉</td><td>Table 1 : Coefficient f_{slh}
<table>
<tr><th>h_{fill}</th><th>f_{slh}</th></tr>
<tr><td>0.0h_{Tank}</td><td>0.0</td></tr>
<tr><td>0.1h_{Tank}</td><td>$f_{slh} = 1.5\left[1-2\left(0.3-\frac{h_{fill}}{h_{Tank}^2}\right)^2\right]$</td></tr>
<tr><td>0.3h_{Tank}</td><td>$f_{slh} = 2.0\left[1-2\left(0.3-\frac{h_{fill}}{h_{Tank}^2}\right)^2\right]$</td></tr>
<tr><td>1.0h_{Tank}</td><td>$f_{slh} = 1.5\left[1-2\left(0.3-\frac{h_{fill}}{h_{Tank}^2}\right)^2\right]$</td></tr>
<tr><td colspan="2">For intermediate values of h_{fill}, f_{slh} are to be obtained by linear interpolation.</td></tr>
</table></td><td></td></tr>
</table>

Present	Amendment	Note
3.4 Sloshing pressure due to transverse liquid motion	**4.4 Sloshing pressure due to transverse liquid motion**	
3.4.1 ⟨omitted⟩	**4.4.1 ⟨same as the present⟩**	
3.4.2 Sloshing pressure in way of longitudinal bulkheads	**4.4.2 Sloshing pressure in way of longitudinal bulkheads**	
The sloshing pressure in way of longitudinal bulkheads including wash bulkheads due to transverse liquid motion, P_{slh-t}, in $\mathrm{kN/m^2}$, for a particular filling level, is to be taken as:	The sloshing pressure in way of longitudinal bulkheads including wash bulkheads due to transverse liquid motion, P_{slh-t}, in $\mathrm{kN/m^2}$, for a particular filling level, is to be taken as:	
$P_{slh-t} = 7\rho_{slh}\, g\, f_{slh}\left(\frac{b_{tk-h}}{B} - 0.3\right) GM^{0.75}$	$P_{slh-t} = 7\rho_{slh}\, g\, f_{slh}\left(\frac{b_{tk-h}}{B} - 0.3\right) GM^{0.75}$	
where:	where:	
b_{tk-h} : Breadth of cargo tank, in m, at considered filling height.	b_{tk-h} : Breadth of cargo tank, in m, at considered filling height.	
⟨newly added⟩	f_{slh} : Coefficient to be taken as defined in **[4.3.2] Table 1**.	- reflecting the coefficient, f_{slh}
GM : Metacentric height, given in **Ch 4, Sec 3, [2.1.1]**.	GM : Metacentric height, given in **Ch 4, Sec 3, [2.1.1]**.	
⟨omitted⟩	⟨same as the present⟩	

<table>
<tr><th>Present</th><th>Amendment</th><th>Note</th></tr>
<tr>
<td>
4. Design pressure for tank testing
4.1 Definition
4.1.1
In order to assess the structure, static design pressures are to be applied. The design pressure for tank testing, P_{ST}, in $\mathrm{kN/m^2}$, is to be taken as:
$P_{ST} = 10(z_{ST} - z)$
where:
z_{ST} : Design testing load height, in m, as defined in Table 1.
Table 1 : Design testing load height z_{ST}
<table>
<tr><th>Compartment</th><th>z_{ST}</th></tr>
<tr><td>Double bottom tanks</td><td>The greater of the following:
$z_{ST} = z_{top} + h_{air}$
$z_{ST} = z_{bd}$</td></tr>
<tr><td colspan="2">〈newly added〉</td></tr>
<tr><td>Tank bulkheads, deep tanks, fuel oil bunkers</td><td>The greater of the following:
$z_{ST} = z_{top} + h_{air}$
$z_{ST} = z_{top} + 2.4$
$z_{ST} = z_{top} + 0.1P_{PV}$</td></tr>
<tr><td>Chain locker (if aft of collision bulkhead)</td><td>$z_{ST} = z_c$</td></tr>
<tr><td>Independent tanks</td><td>The greater of the following:
$z_{ST} = z_{top} + h_{air}$
$z_{ST} = z_{top} + 0.9$</td></tr>
<tr><td>Ballast ducts</td><td>Testing load height corresponding to ballast pump maximum pressure</td></tr>
<tr><td colspan="2">z_{bd} : z coordinate, in m, of the bulkhead deck.
~~z_h : z coordinate, in m, of the top of hatch coaming.~~
z_c : z coordinate, in m, of the top of the chain pipe.</td></tr>
</table>
</td>
<td>
5. Design pressure for tank testing
5.1 Definition
5.1.1
In order to assess the structure, static design pressures are to be applied. The design pressure for tank testing, P_{ST}, in $\mathrm{kN/m^2}$, is to be taken as:
$P_{ST} = 10(z_{ST} - z)$
where:
z_{ST} : Design testing load height, in m, as defined in Table 1.
Table 1 : Design testing load height z_{ST}
<table>
<tr><th>Compartment</th><th>z_{ST}</th></tr>
<tr><td>Double bottom tanks (1)</td><td>The greater of the following:
$z_{ST} = z_{top} + h_{air}$
$z_{ST} = z_{bd}$</td></tr>
<tr><td>Double side tanks,
fore and aft peaks used as tank</td><td>The greater of the following:
$z_{ST} = z_{top} + h_{air}$
$z_{ST} = z_{top} + 2.4$</td></tr>
<tr><td>Tank bulkheads, deep tanks, fuel oil bunkers</td><td>The greater of the following:
$z_{ST} = z_{top} + h_{air}$
$z_{ST} = z_{top} + 2.4$
$z_{ST} = z_{top} + 0.1P_{PV}$</td></tr>
<tr><td>Chain locker (if aft of collision bulkhead)</td><td>$z_{ST} = z_c$</td></tr>
<tr><td>Independent tanks</td><td>The greater of the following:
$z_{ST} = z_{top} + h_{air}$
$z_{ST} = z_{top} + 0.9$</td></tr>
<tr><td>Ballast ducts</td><td>Testing load height corresponding to ballast pump maximum pressure</td></tr>
<tr><td colspan="2">z_{bd} : z coordinate, in m, of the bulkhead deck.

z_c : z coordinate, in m, of the top of the chain pipe.
(1) For double bottom tanks connected with double side tanks, corresponding to "Double side tanks, fore and aft peaks used as tank" is applicable.</td></tr>
</table>
</td>
<td>- the design testing load height for double side tanks, fore and aft peaks used as tank is newly added</td>
</tr>
</table>

Present	Amendment	Note
Section 7 Design load scenarios **1. 〈omitted〉** **2. Design load scenarios for strength assessment** **2.1 Principal design load scenarios** **2.1.1** The principal design load scenarios are given in **Table 1.**	**Section 7 Design load scenarios** **1. 〈same as the present〉** **2. Design load scenarios for strength assessment** **2.1 Principal design load scenarios** **2.1.1** The principal design load scenarios are given in **Table 1.**	

Present	Amendment	Note

Table 1 : Principal design load scenarios for strength assessment

Design load scenario			Harbour and sheltered water	Seagoing conditions with extreme sea loads	Ballast water exchange	Accidental flooded conditions	Tank testing
Load components			Static (S)	Static + Dynamic (S+D)	Static + Dynamic (S+D)	Accidental (A)	Test (T)
Hull Girder	VBM		M_{sw-p}	$M_{sw}+M_{wv-LC}$	$M_{sw}+M_{wv-LC}$	M_{sw-f}	M_{sw-t}
	HBM		–	M_{wh-LC}	M_{wh-LC}	–	–
	VSF		Q_{sw-p}	$Q_{sw}+Q_{wv-LC}$	$Q_{sw}+Q_{wv-LC}$	–	Q_{sw-t}
	TM		–	$M_{st}+M_{wt-LC}$	$M_{st}+M_{wt-LC}$	–	–
Local Loads	P_{ex}	External deck for green sea	–	P_D	–	–	–
		Hull envelope	P_s	P_s+P_w	P_s+P_w	–	P_s
	P_{in}	Ballast tanks	$P_{\ell s}$	$P_{\ell s}+P_{\ell d}$	$P_{\ell s}+P_{\ell d}$	–	P_{ST}
		〈newly added〉					
		Other tanks			–	–	
		Watertight boundaries	–	–	–	P_{fs}	–
	F_{con}	Container	F_{con-s}	$F_{con-s}+F_{con-d}$	–	–	–
	P_{dk}	Internal decks for dry spaces	P_{dl-s}	$P_{dl-s}+P_{dl-d}$	–	–	–
		External deck for distributed loads	P_{dl-s}	$P_{dl-s}+P_{dl-d}$	–	–	–
		External deck for heavy units	F_{U-s}	$F_{U-s}+F_{U-d}$	–	–	–

Present	Amendment	Note

Table 1 : Principal design load scenarios for strength assessment

Design load scenario			Harbour and sheltered water	Seagoing conditions with extreme sea loads	Ballast water exchange(1)	Flooded conditions	Collision conditions
Load components			Static (S)	Static + Dynamic (S+D)	Static + Dynamic (S+D)	Accidental (A)	Accidental (A)
Hull Girder	VBM		M_{sw-p}	$M_{sw}+M_{wv-LC}$	$M_{sw}+M_{wv-LC}$	M_{sw-f}	M_{sw}
	HBM		–	M_{wh-LC}	M_{wh-LC}	–	–
	VSF		Q_{sw-p}	$Q_{sw}+Q_{wv-LC}$	$Q_{sw}+Q_{wv-LC}$	–	–
	TM		–	$M_{st}+M_{wt-LC}$	$M_{st}+M_{wt-LC}$	–	–
Local Loads	P_{ex}	External deck for green sea	–	P_D	–	–	–
		Hull envelope	P_s	P_s+P_w	P_s+P_w	–	–
	P_{in}	Ballast tanks	P_{ls}	$P_{ls}+P_{ld}$	$P_{ls}+P_{ld}$	–	–
		Liquefied natural gas fuel tanks			–	–	$0.5g,\ -0.25g$
		Other tanks			–	–	–
		Watertight boundaries	–	–	–	P_{fs}	–
	F_{con}	Container	F_{con-s}	$F_{con-s}+F_{con-d}$	–	–	–
	P_{dk}	Internal decks for dry spaces	P_{dl-s}	$P_{dl-s}+P_{dl-d}$	–	–	–
		External deck for distributed loads	P_{dl-s}	$P_{dl-s}+P_{dl-d}$	–	–	–
		External deck for heavy units	F_{U-s}	$F_{U-s}+F_{U-d}$	–	–	–

(1) Applicable to prescriptive assessment only

- the local loads at design load scenario, collision condition for container ships with liquefied natural gas fuel tank is newly added

Present	Amendment	Note

Table 2 : Design load scenarios for impact and sloshing conditions

Design load scenario			Bow impact	Bottom slamming	Stern slamming	Sloshing
Load components			Impact (I)	Impact (I)	Impact (I)	Sloshing (SL)
Hull Girder	VBM		–	–	–	M_{sw}
	HBM		–	–	–	–
	VSF		–	–	–	–
	TM		–	–	–	–
Local Loads	P_{ex}	External deck for green sea	–	–	–	–
		Hull envelope	P_{FB}	P_{SL}	P_{SS}	–
	P_{in}	Ballast tanks	–	–	–	$P_{s\ell h}$
		〈newly added〉				
		Other tanks				
		Watertight boundaries		–	–	–
	F_{con}	Container	–	–	–	–
	P_{dk}	Internal decks for dry spaces	–	–	–	–
		External deck for distributed loads	–	–	–	–
		External deck for heavy units	–	–	–	–

<table>
<tr><th>Present</th><th>Amendment</th><th>Note</th></tr>
<tr><td></td><td>

Table 2 : Design load scenarios for impact, sloshing and tank test conditions

<table>
<tr><td colspan="3">Design load scenario</td><td>Bow impact</td><td>Bottom slamming</td><td>Stern slamming</td><td>Sloshing</td><td>Tank testing(1)</td></tr>
<tr><td colspan="3">Load components</td><td>Impact (I)</td><td>Impact (I)</td><td>Impact (I)</td><td>Sloshing (SL)</td><td>Test (T)</td></tr>
<tr><td rowspan="4">Hull Girder</td><td colspan="2">VBM</td><td>–</td><td>–</td><td>–</td><td>M_{sw}</td><td>M_{sw-t}</td></tr>
<tr><td colspan="2">HBM</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td colspan="2">VSF</td><td>–</td><td>–</td><td>–</td><td>–</td><td>Q_{sw-t}</td></tr>
<tr><td colspan="2">TM</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td rowspan="11">Local Loads</td><td rowspan="2">P_{ex}</td><td>External deck for green sea</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>Hull envelope</td><td>P_{FB}</td><td>P_{SL}</td><td>P_{SS}</td><td>–</td><td>P_s</td></tr>
<tr><td rowspan="4">P_{in}</td><td>Ballast tanks</td><td rowspan="3">–</td><td rowspan="3">–</td><td rowspan="3">–</td><td rowspan="3">P_{slh}</td><td>P_{ST}</td></tr>
<tr><td>Liquefied natural gas fuel tanks</td><td>–</td></tr>
<tr><td>Other tanks</td><td>P_{ST}</td></tr>
<tr><td>Watertight boundaries</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>F_{con}</td><td>Container</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td rowspan="3">P_{dk}</td><td>Internal decks for dry spaces</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>External deck for distributed loads</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>External deck for heavy units</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td colspan="8">(1) Applicable to prescriptive assessment only</td></tr>
</table>

</td><td>- the local loads at design load scenario for container ships with liquefied natural gas fuel tank is newly added and tank testing condition is moved from table 1 to table 2.</td></tr>
</table>

Present	Amendment	Note

Table 3 : Design load scenarios for fatigue assessment

Design load scenario			Fatigue: Static + Dynamic (F: S+D)
Load components			
Hull Girder	VBM		$M_{sw}+M_{wv-LC}$
	HBM		M_{wh-LC}
	VSF		$Q_{sw}+Q_{wv-LC}$
	TM		$M_{st}+M_{wt-LC}$
Local Loads	P_{ex}	External deck for green sea	-
		Hull envelope	P_s+P_w
	P_{in}	Ballast tanks	$P_{ls}+P_{ld}$
		⟨newly added⟩	
		Other tanks	
		Watertight boundaries	-
	F_{con}	Container	$F_{con-s}+F_{con-d}$
	P_{dk}	Internal decks for dry spaces	-
		External deck for distributed loads	-
		External deck for heavy units	-

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<tr><th>Present</th><th>Amendment</th><th>Note</th></tr>
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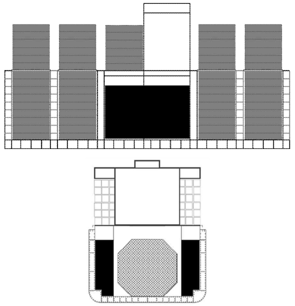
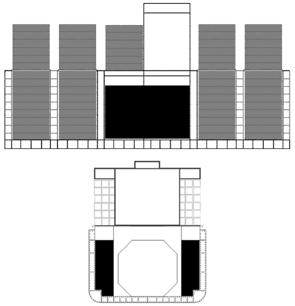
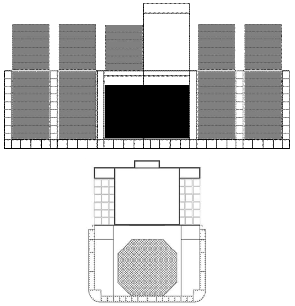
Table 3 : Design load scenarios for fatigue assessment

<table>
<tr><td colspan="3">Design load scenario</td><td rowspan="2">Fatigue: Static + Dynamic
(F: S + D)</td></tr>
<tr><td colspan="3">Load components</td></tr>
<tr><td rowspan="4">Hull Girder</td><td colspan="2">VBM</td><td>$M_{sw}+M_{wv-LC}$</td></tr>
<tr><td colspan="2">HBM</td><td>M_{wh-LC}</td></tr>
<tr><td colspan="2">VSF</td><td>$Q_{sw}+Q_{wv-LC}$</td></tr>
<tr><td colspan="2">TM</td><td>$M_{st}+M_{wt-LC}$</td></tr>
<tr><td rowspan="10">Local Loads</td><td rowspan="2">P_{ex}</td><td>External deck for green sea</td><td>-</td></tr>
<tr><td>Hull envelope</td><td>P_s+P_w</td></tr>
<tr><td rowspan="4">P_{in}</td><td>Ballast tanks</td><td rowspan="3">$P_{ls}+P_{ld}$</td></tr>
<tr><td>Liquefied natural gas fuel tanks</td></tr>
<tr><td>Other tanks</td></tr>
<tr><td>Watertight boundaries</td><td>-</td></tr>
<tr><td>F_{con}</td><td>Container</td><td>$F_{con-s}+F_{con-d}$</td></tr>
<tr><td rowspan="3">P_{dk}</td><td>Internal decks for dry spaces</td><td>-</td></tr>
<tr><td>External deck for distributed loads</td><td>-</td></tr>
<tr><td>External deck for heavy units</td><td>-</td></tr>
</table>

</td>
<td>- the local loads at design load scenario for fatigue assessment is newly added for container ships with liquefied natural gas fuel tank</td>
</tr>
</table>

Present	Amendment	Note
Section 8 Loading Conditions	**Section 8 Loading Conditions**	
1. 〈omitted〉	**1. 〈same as the present〉**	
2. Design loading conditions	**2. Design loading conditions**	
2.1 ~ 2.3 〈omitted〉	**2.1 ~ 2.3 〈same as the present〉**	
2.4 Loading conditions	**2.4 Loading conditions**	
2.4.1 ~ 2.4.3 〈omitted〉	**2.4.1 ~ 2.4.3 〈same as the present〉**	
2.4.4 〈newly added〉	**2.4.4 Standard loading conditions for liquefied natural gas fuel tank strength check** The loading conditions to be considered for liquefied natural gas fuel tank strength check are given in **Table 3.**	- the standard loading conditions for container ships with liquefied natural gas fuel tank is newly added
2.4.4 Standard loading conditions for cargo holds fatigue check The loading conditions to be considered for cargo hold fatigue check are given in **Table 3.**	**2.4.5 Standard loading conditions for cargo holds fatigue check** The loading conditions to be considered for cargo hold fatigue check are given in **Table 4.**	

Present	Amendment	Note
〈newly added〉	**Table 3 : Standard loading conditions for liquefied natural gas fuel tanks strength check in cargo hold region**	- the standard loading conditions for container ships with liquefied natural gas fuel tank is newly added in table 3

No.	Loading Pattern	Still Water Loads					Dynamic Load Cases
		Draught	Container Load		% of perm. SWBM	% of perm. SWSF	Midship cargo region
			In hold	On deck			
Seagoing conditions							
GF1		T_{SC}	Max. 40 ft stack weight All ballast tanks empty All fuel tanks full	Max. 40 ft stack weight	100% (Sag. or Min. Hog.)	≤100%	HSM-1 HSA-1 FSM-1 BSR-1P BSR-2P BSP-1P BSP-2P
GF2		T_{SC}	Max. 40 ft stack weight All ballast tanks empty Fuel oil tanks full LNG fuel tank empty	Max. 40 ft stack weight	100% (Sag. or Min. Hog.)	≤100%	HSM-1 HSA-1 FSM-1 BSR-1P BSR-2P BSP-1P BSP-2P
GF3		T_{SC}	Max. 40 ft stack weight All ballast tanks empty Fuel oil tanks empty LNG fuel tank full	Max. 40 ft stack weight	100% (Sag. or Min. Hog.)	≤100%	HSM-1 HSA-1 FSM-1 BSR-1P BSR-2P BSP-1P BSP-2P

<table>
<tr><th>Present</th><th>Amendment</th><th>Note</th></tr>
<tr>
<td>⟨newly added⟩</td>
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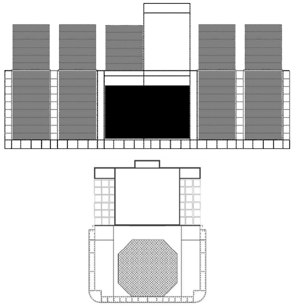
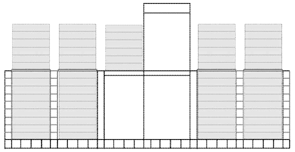
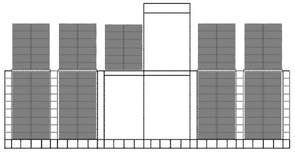
<table>
<tr><th rowspan="3">No.</th><th rowspan="3">Loading Pattern</th><th colspan="5">Still Water Loads</th><th>Dynamic Load Cases</th></tr>
<tr><th rowspan="2">Draught</th><th colspan="2">Container Load</th><th rowspan="2">% of perm. SWBM</th><th rowspan="2">% of perm. SWSF</th><th rowspan="2">Midship cargo region</th></tr>
<tr><th>In hold</th><th>On deck</th></tr>
<tr><td>GF3 -IGF</td><td></td><td>T_{SC}</td><td>Max. 40 ft stack weight
All ballast tanks empty
Fuel oil tanks empty
LNG fuel tank full</td><td>Max. 40 ft stack weight</td><td>≤100%</td><td>≤100%</td><td>Static
Pressure by IGF with heel angle, $\theta_{\beta} \leq 30^{\circ}$</td></tr>
<tr><td>GF4</td><td></td><td>T_{SC}</td><td>55% of Max. 40 ft stack weight not exceeding 16.5 t/FEU
All ballast tanks empty
All fuel tanks empty</td><td>90% of Max. 40 ft stack weight not exceeding 17 t/FEU</td><td>100% (Hog.)</td><td>≤100%</td><td>HSM-2
HSA-2
FSM-2</td></tr>
<tr><td>GF5</td><td></td><td>$0.9T_{SC}$</td><td>Max 20 ft stack weight,
All ballast tanks empty
All fuel tanks empty</td><td>Max. 20 ft stack weight, if mixed stowage is applicable, Max. 20 ft + 40 ft stack weight</td><td>100% (Sag. or Min.Hog.)</td><td>≤100%</td><td>HSM-1
HSA-1
FSM-1</td></tr>
</table>
</td>
<td>- the standard loading conditions for container ships with liquefied natural gas fuel tank is newly added in table 3</td>
</tr>
</table>

<table>
<tr><th>Present</th><th>Amendment</th><th>Note</th></tr>
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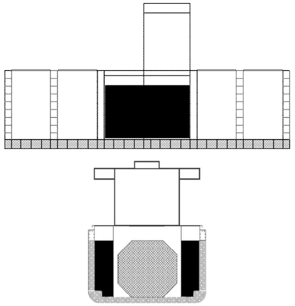
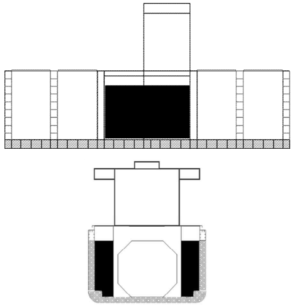
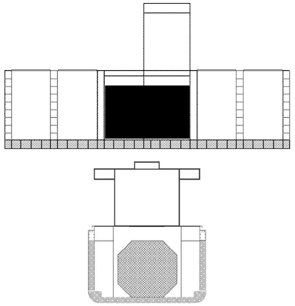
<table>
<tr><th rowspan="3">No.</th><th rowspan="3">Loading Pattern</th><th colspan="5">Still Water Loads</th><th>Dynamic Load Cases</th></tr>
<tr><th rowspan="2">Draught</th><th colspan="2">Container Load</th><th rowspan="2">% of perm. SWBM</th><th rowspan="2">% of perm. SWSF</th><th rowspan="2">Midship cargo region</th></tr>
<tr><th>In hold</th><th>On deck</th></tr>
<tr><td colspan="8">Ballast conditions</td></tr>
<tr><td>GB1</td><td></td><td>T_{BAL}[1)]</td><td>All container bays empty
All ballast tanks full
All fuel tanks full</td><td>All container bays are empty</td><td>SWBM in ballast condition[2)]</td><td>≤100%</td><td>HSM-1
HSA-1
FSM-1</td></tr>
<tr><td>GB2</td><td></td><td>T_{BAL}[1)]</td><td>All container bays empty
All ballast tanks full
Fuel oil tanks full
LNG fuel tank empty</td><td>All container bays are empty</td><td>SWBM in ballast condition[2)]</td><td>≤100%</td><td>HSM-1
HSA-1
FSM-1</td></tr>
<tr><td>GB3</td><td></td><td>T_{BAL}[1)]</td><td>All container bays empty
All ballast tanks full
Fuel oil tanks empty
LNG fuel tank full</td><td>All container bays are empty</td><td>SWBM in ballast condition[2)]</td><td>≤100%</td><td>HSM-1
HSA-1
FSM-1</td></tr>
</table>
</td>
<td>- the standard loading conditions for container ships with liquefied natural gas fuel tank is newly added in table 3</td>
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<tr><th>Present</th><th>Amendment</th><th>Note</th></tr>
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<td>〈newly added〉</td>
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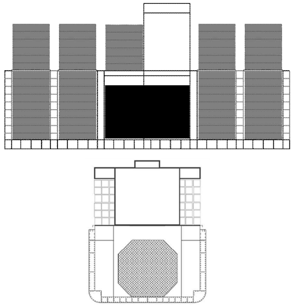
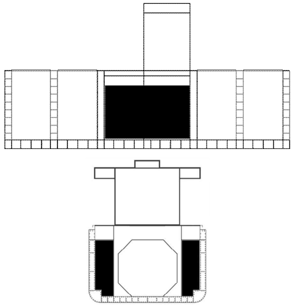
<table>
<tr><td rowspan="3">No.</td><td rowspan="3">Loading Pattern</td><td colspan="5">Still Water Loads</td><td>Dynamic Load Cases</td></tr>
<tr><td rowspan="2">Draught</td><td colspan="2">Container Load</td><td rowspan="2">% of perm. SWBM</td><td rowspan="2">% of perm. SWSF</td><td rowspan="2">Midship cargo region</td></tr>
<tr><td>In hold</td><td>On deck</td></tr>
<tr><td colspan="8">Accidental condition</td></tr>
<tr><td>A1</td><td></td><td>T_{SC}</td><td>Max. 40 ft stack weight
All ballast tanks empty
Fuel oil tanks empty
LNG fuel tank full</td><td>Max. 40 ft stack weight</td><td>≤100%</td><td>≤100%</td><td>Static
Forward a_x=0.5g
Afward a_x=0.25g</td></tr>
<tr><td colspan="8">Testing condition</td></tr>
<tr><td>GT1</td><td></td><td>T_{BAL}1)</td><td>All container bays empty
All ballast tanks empty
Fuel oil tanks full
LNG fuel tank empty</td><td>All container bays are empty</td><td>SWBM in ballast condition2)</td><td>≤100%</td><td>Static</td></tr>
<tr><td colspan="8">▆ heavy cargo ░ light cargo ▒ ballast tank ■ fuel oil tank ▩ LNG fuel tank</td></tr>
<tr><td colspan="8">1) Minimum ballast draught corresponding to the ballast departure loading condition from loading manual.
2) Still water bending moment corresponding to the ballast departure loading condition from loading manual.</td></tr>
</table>
</td>
<td>- the standard loading conditions for container ships with liquefied natural gas fuel tank is newly added in table 3</td>
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<tr><th>Present</th><th>Amendment</th><th>Note</th></tr>
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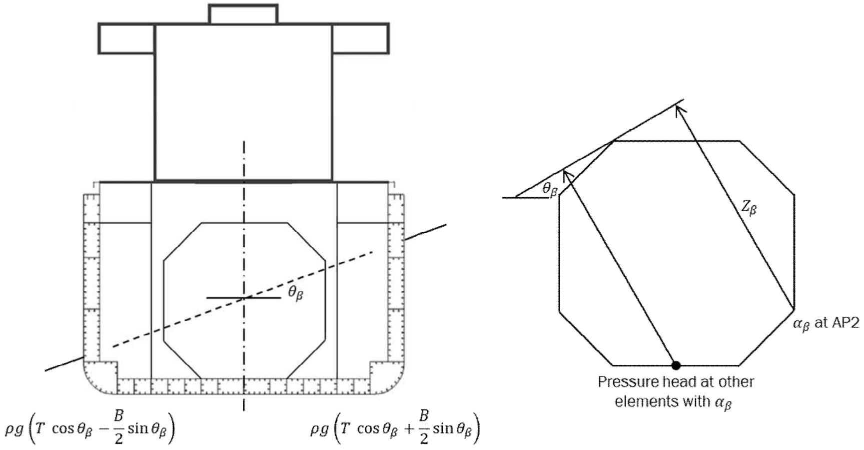
<tr><th rowspan="2">Draught</th><th colspan="2">Container Load</th><th rowspan="2">% of perm. SWBM</th><th rowspan="2">% of perm. SWSF</th><th rowspan="2">Midship cargo region</th></tr>
<tr><th>In hold</th><th>On deck</th></tr>
<tr><td colspan="8">


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</td>
<td>- the standard loading conditions for container ships with liquefied natural gas fuel tank is newly added in table 3</td>
</tr>
</table>

Present	Amendment	Note
Chapter 5 Hull Girder Strength	**Chapter 5 Hull Girder Strength**	
Section 1 Hull Girder Yield Strength	**Section 1 Hull Girder Yield Strength**	
1. ~ 2. 〈omitted〉	**1. ~ 2. 〈same as the present〉**	
3. Hull girder strength assessment	**3. Hull girder strength assessment**	
3.1 ~ 3.3 〈omitted〉	**3.1 ~ 3.3 〈same as the present〉**	
3.4 Hull girder bending strength assessment	**3.4 Hull girder bending strength assessment**	
3.4.1 General acceptance criteria	**3.4.1 General acceptance criteria**	
The normal stress, σ_{hg} is to be assessed for all conditions, along the full length of the hull girder, from AE to FE. The normal stress at any point of the hull transverse section is to comply with the following formula: $\sigma_L \leq \sigma_{perm}$ $\sigma_L = \sigma_{sw} + C_{wv}\sigma_{wv} + C_{wh}\sigma_{wh} + C_{st}\sigma_{sw} + C_{tor}\sigma_{wt}$ 〈omitted〉	The normal stress, σ_L is to be assessed for all conditions, along the full length of the hull girder, from AE to FE. The normal stress at any point of the hull transverse section is to comply with the following formula: $\sigma_L \leq \sigma_{perm}$ $\sigma_L = \sigma_{sw} + C_{WV}\sigma_{wv} + C_{WH}\sigma_{wh} + C_{st}\sigma_{st} + C_{tor}\sigma_{wt}$ 〈same as the present〉	- typo $\sigma_{hg} \rightarrow \sigma_L$ $C_{wv} \rightarrow C_{WV}$ $C_{wh} \rightarrow C_{WH}$ $C_{st}\sigma_{sw} \rightarrow C_{st}\sigma_{st}$
4. 〈newly added〉	**4. Stress control of inner hull forming liquefied natural gas fuel tank** **4.1 General** **4.1.1** Liquefied natural gas fuel tanks with a membrane containment system may have some limitation such as elongation or stress level of adjacent installed hull structure. Any required criteria for inner hull is to be confirmed by the designer of the fuel containment system.	- the limitation for liquefied natural gas fuel tank with membrane containment system is newly added

Present	Amendment	Note
Chapter 6 Hull Local Scantling	**Chapter 6 Hull Local Scantling**	
Section 1 〈omitted〉 **Section 2 Load Application**	**Section 1 〈same as the present〉** **Section 2 Load Application**	
1. Load combination	**1. Load combination**	
1.1 Hull girder bending **1.1.1 Normal stresses**	**1.1 Hull girder bending** **1.1.1 Normal stresses**	
The normal stress σ_{hg}, in $\mathrm{N/mm^2}$, induced by acting vertical and horizontal bending moments at the position being considered is given as follow. This stress is to be calculated for each design load set, as defined in **[2]** covering all dynamic load cases defined in **Ch 4** in combination with M_{sw} both in hogging and in sagging. 〈omitted〉	The normal stress σ_{hg}, in $\mathrm{N/mm^2}$, induced by acting vertical and horizontal bending moments at the position being considered is given as follow. This stress is to be calculated for each design load set, as defined in **[2]** covering all dynamic load cases defined in **Ch 4** in combination with M_{sw} both in hogging and in sagging. 〈same as the present〉	
C_{tor} : Warping stress coefficient, as defined in **Ch 5, Sec 1, [3.4.1]**.	C_{tor} : Warping stress coefficient, as defined in **Ch 5, Sec 1, [3.4.1]**.	
σ_{WT} : Warping stress, in $\mathrm{N/mm^2}$, as defined in **Ch 5, Sec 1, [2.1.5]** to **[2.1.7]**.	σ_{WT} : Warping stress, in $\mathrm{N/mm^2}$, as defined in **Ch 5, Sec 1, [2.1.4]** to **[2.1.6]**.	- typo
1.2 Lateral pressures **1.2.1 〈omitted〉**	**1.2 Lateral pressures** **1.2.1 〈same as the present〉**	
1.2.2 〈newly added〉	**1.2.2 Pressure in collision condition** The internal liquefied natural gas fuel pressure due to collision is to be considered with colliding acceleration a_x, whose direction is decided depending on the position of transverse bulkhead of the liquefied natural gas fuel tank considered, combined with static liquefied natural gas fuel pressure.	- defined the pressure in collision condition
1.2.2 Lateral pressure in flooded conditions 〈omitted〉	**1.2.3 Lateral pressure in flooded conditions** 〈same as the present〉	- renumbering

Present

2. Design load sets

2.1 Application of load components

2.1.1 〈omitted〉

2.1.2 Load components

〈omitted〉

Table 1 : Design load sets

Structural member	Design load set	Load component	Draught	Design load	Loading condition
External shell and Exposed deck	〈omitted〉				
Water ballast tank	〈omitted〉				
Tanks other than water ballast tank	〈omitted〉				
〈newly added〉	〈newly added〉				
	〈newly added〉				
Watertight boundaries	FD-1(2)	P_{in}	-	A	Flooded condition
Dry space and hatch coaming	〈omitted〉				

(1) P_{ex} is to be considered for external shell only.
〈newly added〉

(2) FD-1 is not applicable to external shell.

〈omitted〉

Amendment

2. Design load sets

2.1 Application of load components

2.1.1 〈same as the present〉

2.1.2 Load components

〈same as the present〉

Table 1 : Design load sets

Structural member	Design load set	Load component	Draught	Design load	Loading condition
External shell and Exposed deck	〈same as the present〉				
Water ballast tank	〈same as the present〉				
Tanks other than water ballast tank	〈same as the present〉				
Liquefied natural gas fuel tank	FTK-1	P_{in}	T_{SC}	S + D	Full load condition
	COL(2)	P_{in}	-	A	Collision condition
Watertight boundaries	FD-1(3)	P_{in}	-	A	Flooded condition
Dry space and hatch coaming	〈same as the present〉				

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

(2) COL set means collision conditions that 0.5g and -0.25g of colliding accelerations in way of longitudinal direction are to be applied for liquefied natural gas fuel tank full condition under Accidental design load (A) in order to verify structural integrity of liquefied natural gas fuel tank boundary and support structures, refer to "Rules/Guidance for the Classification of Ships Using Low-flashpoint Fuels", Ch 6, Sec 4, 409.5.

(3) FD-1 is not applicable to external shell.

〈same as the present〉

Note

- FTK-1 and COL are newly added for liquefied natural gas fuel tank in design load sets
- the meaning of COL set for liquefied natural gas fuel tank is described

Present	Amendment	Note
Section 3 〈omitted〉 **Section 4 Plating**	**Section 3 〈same as the present〉** **Section 4 Plating**	
1. 〈omitted〉	**1. 〈same as the present〉**	
2. Special requirements	**2. Special requirements**	
2.1 Minimum thickness of keel plating	**2.1 Minimum thickness of keel plating**	
2.1.1 The net thickness of the keel plating is not to be taken less than the offered net thickness of the adjacent 2.0 m width bottom plating, measured from the edge of the keel strake. The width of the keel is defined in **Ch 3, Sec 6, [7.2.1].**	**2.1.1** The net thickness of the keel plating is not to be taken less than the required net thickness of the adjacent 2.0 m width bottom plating, measured from the edge of the keel strake. The width of the keel is defined in **Ch 3, Sec 6, [7.2.1].**	- min. thickness of keel plate is based on required net thickness of adjacent bottom plate instead of offered one.
2.2 ~ 2.6 〈omitted〉	**2.2 ~ 2.6 〈same as the present〉**	- the requirement for liquefied natural gas fuel tank boundary based on IGF code is newly added
2.7 〈newly added〉	**2.7 Plating in liquefied natural gas fuel tank boundary**	
2.7.1 〈newly added〉	**2.7.1 By IGF pressure** The net thickness of inner hull plating protected by fuel containment system, t in mm, is not to be taken less than: $t = 0.0158\alpha_p b\sqrt{\frac{\lvert P_{IGF}\rvert}{\chi C_{a-IGF}R_{eH}}}$ where: P_{IGF} : Pressure given in **“Rules/Guidance for the Classification of Ships Using Low-flashpoint Fuels”, Ch 6, Sec 4, 409.**, in $\mathrm{kN/m^2}$ C_{a-IGF} : Permissible bending stress coefficient for plate taken equal to: $C_{a-IGF} = \beta_{IGF} - \alpha_{IGF}\frac{\lvert\sigma_{hg-IGF}\rvert}{R_{eH}}$, not to be taken greater than $C_{a-IGF-\max}$	

<table>
<tr><th>Present</th><th>Amendment</th><th>Note</th></tr>
<tr><td></td><td>

$$\sigma_{hg-IGF}=\max\left[\left|\left(\frac{M_{sw}+M_{wv-LC}}{I_{y-n50}}(z-z_n)\right)10^{-3}\right|,\left|\left\{\left(\frac{M_{sw}+0.5M_{wv-LC}}{I_{y-n50}}(z-z_n)\right)+\left(\frac{M_{wh-LC}}{I_{z-n50}}(y-y_n)\right)\right\}10^{-3}\right|\right]$$

β_{IGF} : Coefficient as defined in **Table 2.**
α_{IGF} : Coefficient as defined in **Table 2.**
$C_{a-IGF-\max}$: Maximum permissible bending stress coefficient as defined in **Table 2.**

Table 2 : Definition β_{IGF}, α_{IGF} and $C_{a-IGF-max}$

<table>
<tr><th>Acceptance criteria set</th><th colspan="2">Structural member</th><th>β_{IGF}</th><th>α_{IGF}</th><th>C_{a-IGF}</th></tr>
<tr><td rowspan="3">IGF condition</td><td rowspan="2">Longitudinal strength members</td><td>Longitudinally stiffened plating</td><td>1.05</td><td>0.5</td><td>0.95</td></tr>
<tr><td>Transversely stiffened plating</td><td>1.05</td><td>1.0</td><td>0.95</td></tr>
<tr><td colspan="2">Other members</td><td>1.0</td><td>0.0</td><td>1.0</td></tr>
</table>

</td><td></td></tr>
<tr><td>

2.7.2 〈newly added〉

</td><td>

2.7.2 By sloshing pressure

The net thickness of plating, t in mm, subjected to sloshing pressures is not to be less than:

$$t=0.0158\,\alpha_p b\sqrt{\frac{P_{slh}}{\chi\,C_{a-slh}R_{eH}}}$$

where:

P_{slh} : Pressure given in **Ch 4, Sec 6, [3.2.3]**, in $\mathrm{kN/m^2}$.
C_{a-slh} : Permissible bending stress coefficient for plate taken equal to:

$$C_{a-slh}=\beta-\alpha\frac{|\sigma_{hg-slh}|}{R_{eH}}$$, not to be taken greater than $C_{a-\max}$

$$\sigma_{hg-slh}=\left(\frac{M_{sw}}{I_{y-n50}}(z-z_n)\right)10^{-3}\ \text{in}\ \mathrm{N/mm^2}$$

β : Coefficient of AC-S as defined in **Table 1.**
α : Coefficient of AC-S as defined in **Table 1.**
$C_{a-\max}$: Maximum permissible bending stress coefficient of AC-S as defined in **Table 1.**

</td><td>

- the requirement for liquefied natural gas fuel tank boundary subjected to sloshing pressure is newly added

</td></tr>
</table>

Present

Section 5 Stiffeners

1. Stiffeners subject to lateral pressure

1.1 Yielding check

1.1.1 ⟨omitted⟩

1.1.2 Section modulus

The minimum net section modulus, Z in cm^3, is not to be taken less than the greatest value calculated for all applicable design load sets as defined in **Ch 6, Sec 2, [2.1.3],** given by:
⟨omitted⟩

Table 2 : Definition of β_s, α_s and $C_{s-\max}$

Acceptance criteria set	Structural member	β_s	α_s	$C_{s-\max}$
AC-S	Longitudinal strength member	0.85	1.0	0.75
	Transverse or vertical member	0.75	0.0	0.75
AC-SD	Longitudinal strength member	1.00	1.0	0.90
	Transverse or vertical member	0.90	0.0	0.90
AC-A	Longitudinal strength member	1.10	1.0	1.00
	Transverse or vertical member	1.00	0.0	1.00
AC-T	Longitudinal strength member	1.20	1.0	1.00
	Transverse or vertical member	1.00	0.0	1.00

⟨omitted⟩

Amendment

Section 5 Stiffeners

1. Stiffeners subject to lateral pressure

1.1 Yielding check

1.1.1 ⟨same as the present⟩

1.1.2 Section modulus

The minimum net section modulus, Z in cm^3, is not to be taken less than the greatest value calculated for all applicable design load sets as defined in **Ch 6, Sec 2, [2.1.3],** given by:
⟨same as the present⟩

Table 2 : Definition of β_s, α_s and $C_{s-\max}$

Acceptance criteria set	Structural member	β_s	α_s	$C_{s-\max}$
AC-S	Longitudinal strength member	0.95	1.0	0.85
	Transverse or vertical member	0.85	0.0	0.85
AC-SD	Longitudinal strength member	1.10	1.0	0.95
	Transverse or vertical member	0.95	0.0	0.95
AC-A	Longitudinal strength member	1.10	1.0	1.00
	Transverse or vertical member	1.00	0.0	1.00
AC-T	Longitudinal strength member	1.25	1.0	1.15
	Transverse or vertical member	1.15	0.0	1.15

⟨same as the present⟩

Note

- the permissible bending stress coefficient for AC-S, AC-SD and AC-T is improved based on simulation

Present	Amendment	Note
2. Special requirements	**2. Special requirements**	
2.1 ⟨omitted⟩	**2.1 ⟨same as the present⟩**	
2.2 ⟨newly added⟩	**2.2 Section modulus of stiffener attached on liquefied natural gas fuel tank boundary**	
2.2.1 ⟨newly added⟩	**2.2.1 By IGF pressure** The minimum net section modulus of stiffeners connected to inner hull protected by fuel containment system, Z_{IGF} in cm^3, is not to be taken less than: $Z_{IGF} = \frac{\lvert P_{IGF} \rvert \, s \, \ell_{bdg}^2}{f_{bdg} \, \chi \, C_{s-IGF} R_{eH}}$ with $\chi \, C_{s-IGF}$ not to be taken greater than 1.0 where: P_{IGF} : Dynamic pressure defined in **Ch 6, Sec 4, [2.7.1].** f_{bdg} : Bending moment factor taken as: a) For continuous stiffeners with fixed ends, f_{bdg} is not to be taken higher than: • $f_{bdg} = 12$ for horizontal stiffeners and upper end of vertical stiffeners. • $f_{bdg} = 10$ for lower end of vertical stiffeners. b) For stiffeners with reduced end fixity, variable load or being part of grillage, the requirement in **[1.2]** applies. C_{s-IGF} : Permissible bending stress coefficient as defined in **Table 3** for the design load set being considered. σ_{hg-IGF} : Hull girder bending stress as defined in **Ch 6, Sec 4, [2.7.1].** β_{s-IGF} : Coefficient as defined in **Table 4.**	- the requirement of stiffeners for liquefied natural gas fuel tank boundary based on IGF code is newly added

Present	Amendment	Note

2.2.2 〈newly added〉

α_{s-IGF} : Coefficient as defined in **Table 4.**

$C_{s-IGF-\max}$: Coefficient as defined in **Table 4.**

Table 3 : Definition of C_{s-IGF}

Sign of hull girder bending stress, σ_{hg-IGF}	Lateral pressure acting on	Coefficient C_{s-IGF}
Compression (negative)	Plate side	$C_{s-IGF} = \beta_{s-IGF} - \alpha_{s-IGF} \frac{\lvert\sigma_{hg-IGF}\rvert}{R_{eH}}$ but not to be taken greater than $C_{s-IGF-\max}$
Tension (positive)	Plate side	$C_{s-IGF} = C_{s-IGF-\max}$

Table 4 : Definition of β_{s-IGF}, α_{s-IGF} and $C_{s-IGF-\max}$

Acceptance criteria set	Structural member	β_{s-IGF}	α_{s-IGF}	$C_{s-IGF-\max}$
IGF condition	Longitudinal strength member	1.0	1.0	0.9
	Transverse or vertical member	0.9	0.0	0.9

2.2.2 By sloshing pressure

The net section modulus Z in cm^3, of stiffeners subject to sloshing pressure is not to be taken less than:

$$Z = \frac{P_{slh}\, s\, \ell_{bdg}^2}{f_{bdg}\, \chi\, C_{s-slh}\, R_{eH}}$$

where:

P_{slh} : Pressure given in **Ch 4, Sec 6, [3.2.3]**, in $\mathrm{kN/m^2}$.

f_{bdg} : Bending moment factor taken as:

a) For continuous stiffeners generally, $f_{bdg} = 12$

b) For discontinuous stiffeners, $f_{bdg} = 8$

- the requirement for liquefied natural gas fuel tank boundary subjected to sloshing pressure is newly added

Present	Amendment	Note
〈newly added〉	C_{s-slh} : Permissible bending stress coefficient taken equal to: $C_{s-slh} = \beta_s - \alpha_s \frac{\lvert\sigma_{hg-slh}\rvert}{R_{eH}}$, not to be taken greater than $C_{s-\max}$ $\sigma_{hg-slh} = \left(\frac{M_{sw}}{I_{y-n50}}(z-z_n)\right)10^{-3}$ in $\mathrm{N/mm^2}$ β_s : Coefficient of AC-S as defined in **Table 2.** α_s : Coefficient of AC-S as defined in **Table 2.** $C_{s-\max}$: Maximum permissible bending stress coefficient of AC-S as defined in **Table 2.**	

Present

Section 6 Primary Support members and Pillars

1. ~ 2. 〈omitted〉

3. Primary supporting members outside cargo hold region

3.1 〈omitted〉

3.2 Scantling requirements

3.2.1 〈omitted〉

3.2.2 Net shear area

The net shear area, $A_{shr-n50}$ in cm^2, of primary supporting members subjected to lateral pressure is not to be taken less than the greatest value for all applicable design load sets defined in **Ch 6, Sec 2, [2],** given by:

$$A_{shr-n50} = 10\,\frac{f_{shr}\,|P|\,S\,\ell_{shr}}{C_t\,\tau_{eH}}$$

where:

f_{shr} : Shear force distribution factor, as given in **Table 14.**

C_t : Permissible shear stress coefficient for the acceptance criteria set being considered, as given in **Table 13.**

Table 13 : Permissible bending and shear stress coefficients for primary supporting members

Acceptance criteria set	Structure attached to primary supporting member	C_s and C_t
AC-S	All boundaries, including decks and flats	0.70
AC-SD	All boundaries, including decks and flats	0.85
〈newly added〉		

Amendment

Section 6 Primary Support members and Pillars

1. ~ 2. 〈same as the present〉

3. Primary supporting members outside cargo hold region

3.1 〈same as the present〉

3.2 Scantling requirements

3.2.1 〈same as the present〉

3.2.2 Net shear area

The net shear area, $A_{shr-n50}$ in cm^2, of primary supporting members subjected to lateral pressure is not to be taken less than the greatest value for all applicable design load sets defined in **Ch 6, Sec 2, [2],** given by:

$$A_{shr-n50} = 10\,\frac{f_{shr}\,|P|\,S\,\ell_{shr}}{C_t\,\tau_{eH}}$$

where:

f_{shr} : Shear force distribution factor, as given in **Table 14.**

C_t : Permissible shear stress coefficient for the acceptance criteria set being considered, as given in **Table 13.**

Table 13 : Permissible bending and shear stress coefficients for primary supporting members

Acceptance criteria set	Structure attached to primary supporting member	C_s and C_t
AC-S	All boundaries, including decks and flats	0.70
AC-SD	All boundaries, including decks and flats	0.85
AC-A AC-T	All boundaries, including decks and flats	0.95

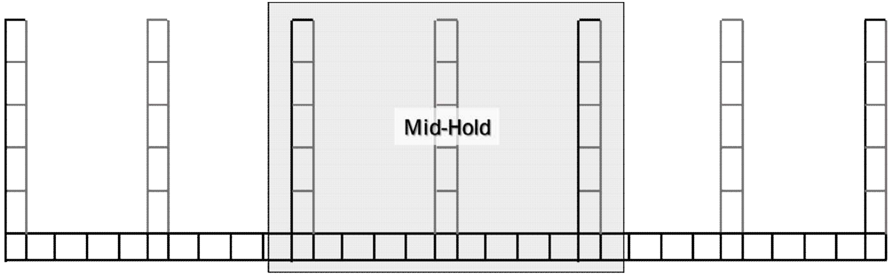
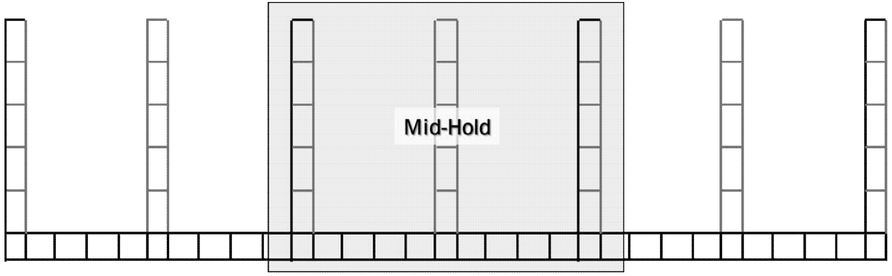
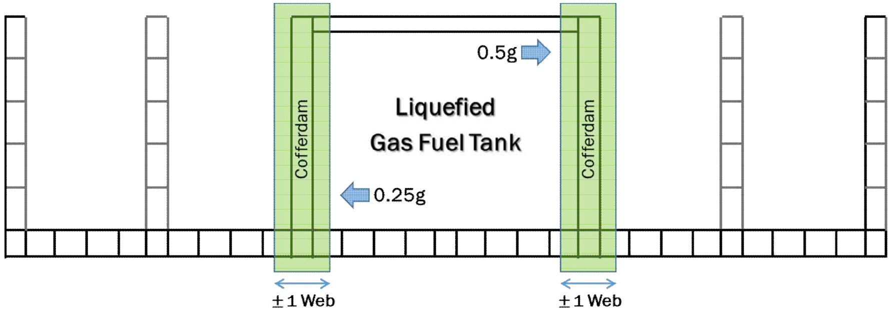
Note

- the missing AC-A and AC-T is reflected

Present	Amendment	Note
Chapter 7 Direct Strength Analysis **Section 1 Strength Assessment** **1. General** **1.1 Application** **1.1.1 ~ 1.1.4 〈omitted〉** **1.1.5 Class notation** Global Analysis is to be carried out for ships of length 290 m or above in accordance with the requirements in **Pt 3, Annex 3-2**. Cargo Hold Analysis is to be carried out for ships of length 150 m or above in accordance with the requirements in this chapter. 〈newly added〉 A flow diagram showing the minimum requirement of finite element analysis is shown in **Figure 1.** 〈omitted〉	**Chapter 7 Direct Strength Analysis** **Section 1 Strength Assessment** **1. General** **1.1 Application** **1.1.1 ~ 1.1.4 〈same as the present〉** **1.1.5 Class notation** Global Analysis is to be carried out for ships of length 290 m or above in accordance with the requirements in **Pt 3, Annex 3-2**. Cargo Hold Analysis is to be carried out for ships of length 150 m or above in accordance with the requirements in this chapter. In case of ships of lengths less than 150 m, where it is deemed to be necessary by the Society, the Cargo Hold Analysis should be performed additionally. A flow diagram showing the minimum requirement of finite element analysis is shown in **Figure 1.** 〈same as the present〉	- to clarify the application of rule for ships of lengths less than 150 m.

Present	Amendment	Note
Section 2 Cargo Hold Structural Strength Analysis	**Section 2 Cargo Hold Structural Strength Analysis**	
1. ~ 3. 〈omitted〉	**1. ~ 3. 〈same as the present〉**	
4. Load application	**4. Load application**	
4.1 〈omitted〉	**4.1 〈same as the present〉**	
4.2 External and internal loads	**4.2 External and internal loads**	
4.2.1 External loads	**4.2.1 External loads**	
External pressure is to be calculated for each load case in accordance with **Ch 4, Sec 5.** External pressures include static sea pressure, wave pressure and green sea pressure. ~~The effect of the hatch cover self weight is to be ignored in the loads applied to the ship structure.~~	External pressure is to be calculated for each load case in accordance with **Ch 4, Sec 5.** External pressures include static sea pressure, wave pressure and green sea pressure.	- the unclear statement is removed (typo)
4.2.2 〈omitted〉	**4.2.2 〈same as the present〉**	
4.2.3 〈Newly added〉	**4.2.3 Liquefied natural gas fuel density** Maximum liquefied natural gas fuel density is generally taken as not less than 0.5 t/m^3. To take into account of the volume difference between 1st barrier and inner hull, the liquefied natural gas fuel density may be used as adjusted below, $\rho_{c_{adjusted}} = \rho_c \frac{V_C}{V_{Hull}} + \rho_{CCS} \frac{V_{Hull} - V_C}{V_{Hull}}$ where: V_C : Volume of liquefied natural gas fuel tank enclosed by primary barrier of fuel containment system in m^3. V_{Hull} : Volume of liquefied natural gas fuel tank enclosed by inner hull structure in m^3. ρ_{CCS} : Density of fuel containment system in t/m^3, generally 0.12 can be used.	- definition of liquefied natural gas fuel density is newly added for container ship with liquefied natural gas fuel tank

Present	Amendment	Note
〈newly added〉	And, effective liquefied natural gas fuel density may be adjusted to consider the maximum filling height as below, $\rho_{c_{eff}} = \rho_{c_{adjusted}} \frac{M_{Max\,filling\%\,by\,\rho_{Max-LM}}}{M_{100\%\,by\,\rho_c}}$ where: $M_{Max\,filling\%\,by\,\rho_{Max-LM}}$: Mass of liquefied natural gas fuel when filled to maximum level(%) with design fuel density $M_{100\%\,by\,\rho_c}$: Mass of liquefied natural gas fuel when filled to 100% with ρ_c= $0.5\ \mathrm{t/m^3}$ $\rho_{c_{eff}}$: Effective liquefied natural gas fuel density for internal loads in FE analysis $(\mathrm{t/m^3})$	
4.2.3 Pressure application on FE element Constant pressure, calculated at the element's centroid, is applied to the shell element of the loaded surfaces, e.g. outer shell and deck for external pressure and tank / hold boundaries for internal pressure. Alternately, pressure can be calculated at element nodes applying linear pressure distribution within elements. 〈omitted〉	**4.2.4 Pressure application on FE element** Constant pressure, calculated at the element's centroid, is applied to the shell element of the loaded surfaces, e.g. outer shell and deck for external pressure and tank / hold boundaries for internal pressure. Alternately, pressure can be calculated at element nodes applying linear pressure distribution within elements. 〈same as the present〉	- renumbering
5. Analysis criteria **5.1 General** **5.1.1 Evaluation areas** Verification of results against the acceptance criteria is to be carried out within the longitudinal extent of the mid-hold, as shown in **Figure 13.** 〈newly added〉	**5. Analysis criteria** **5.1 General** **5.1.1 Evaluation areas** Verification of results against the acceptance criteria is to be carried out within the longitudinal extent of the mid-hold, as shown in **Figure 13.** For accidental condition, the evaluation is carried out for the members within one web frame forward and one frame aftward in way of cofferdam structure, where the collision load direction is coincided. Refer to **Figure 14**.	- evaluation area for accidental condition is newly added for liquefied natural gas fuel tank

Present	Amendment	Note
 Figure 13 : Longitudinal extent of evaluation area	 Figure 13 : Longitudinal extent of evaluation area	
⟨newly added⟩	 Figure 14 : Longitudinal extent of evaluation area for accidental condition	- figure of evaluation area for accidental condition is newly added for liquefied natural gas fuel tank
⟨omitted⟩	⟨same as the present⟩	

Present

Chapter 8 Buckling

Section 1 General

1. ~ 2. ⟨omitted⟩

3. Definitions

3.1 ~ 3.2 ⟨omitted⟩

3.3 Allowable buckling utilisation factor

3.3.1 General structural elements

The allowable buckling utilisation factor is defined in **Table 1.**

Table 1 : Allowable buckling utilisation factor

Structural component	η_{all}, Allowable buckling utilisation factor
Plates and stiffeners Stiffened and unstiffened panels Web plate in ways of openings	1.00 for load combination: S+D 0.80 for load combination: S 1.00 for load combination: A
Pillars	0.75 for load combination: S+D 0.65 for load combination: S 0.75 for load combination: A

⟨omitted⟩

Amendment

Chapter 8 Buckling

Section 1 General

1. ~ 2. ⟨same as the present⟩

3. Definitions

3.1 ~ 3.2 ⟨same as the present⟩

3.3 Allowable buckling utilisation factor

3.3.1 General structural elements

The allowable buckling utilisation factor is defined in **Table 1.**

Table 1 : Allowable buckling utilisation factor

Structural component	η_{all}, Allowable buckling utilisation factor
Plates and stiffeners Stiffened and unstiffened panels Web plate in ways of openings	1.00 for load combination: S+D 0.80 for load combination: S 1.00 for load combination: A, T
Pillars	0.75 for load combination: S+D 0.65 for load combination: S 0.75 for load combination: A, T

⟨same as the present⟩

Note

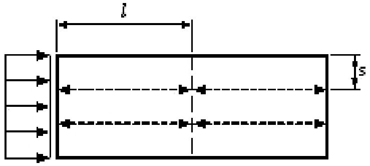
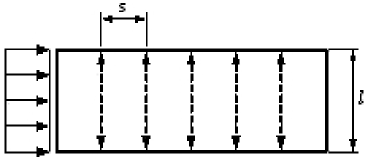
- the missing AC-T is reflected

Present	Amendment	Note
Section 2 Slenderness requirements	**Section 2 Slenderness requirements**	
1. ~ 2. 〈omitted〉	**1. ~ 2. 〈same as the present〉**	
3. Stiffeners	**3. Stiffeners**	
3.1 Proportions of stiffeners	**3.1 Proportions of stiffeners**	
3.1.1 ~ 3.1.2 〈omitted〉	**3.1.1 ~ 3.1.2 〈same as the present〉**	
3.1.3 Bending stiffness of stiffeners	**3.1.3 Bending stiffness of stiffeners**	
The net moment of inertia, in cm^4, of the stiffener with the effective width of attached plate, about the neutral axis parallel to the attached plating, is not to be less than the minimum value given by:	The net moment of inertia, in cm^4, of the stiffener with the effective width of attached plate, about the neutral axis parallel to the attached plating, is not to be less than the minimum value given by:	
$I_{st} \geq C\ell^2 A_{eff}\dfrac{R_{eH}}{235}$ where:	$I_{st} \geq C\ell^2 A_{eff}\dfrac{R_{eH}}{235}$ where:	
A_{eff} : Net sectional area of stiffener including effective attached plate, s_{eff}, in cm^2.	A_{eff} : Net sectional area of stiffener including effective attached plate, s_{eff}, in cm^2.	
R_{eH} : Specified minimum yield stress of the material of the attached plate, in $\mathrm{N/mm}^2$.	R_{eH} : Specified minimum yield stress of the material of the attached plate, in $\mathrm{N/mm}^2$.	
C : Slenderness coefficient taken as:	C : Slenderness coefficient taken as:	
C = 0.93 for longitudinal stiffeners including sniped stiffeners. C = 0.72 for other stiffeners.	C = 0.81 for longitudinal stiffeners including sniped stiffeners. C = 0.72 for other stiffeners.	- the slenderness coefficient is improved from C=0.93 to 0.81

Present	Amendment	Note
4. PRIMARY SUPPORTING MEMBERS **4.1 ⟨omitted⟩** **4.2 Web stiffeners of primary supporting members** **4.2.1 ⟨omitted⟩** **4.2.2 Bending stiffness of web stiffeners** The net moment of inertia, in cm^4, of web stiffener, I_{st}, fitted on primary supporting members, with effective attached plate, s_{eff}, is not to be less than the minimum moment of inertia defined in Table 2.	**4. PRIMARY SUPPORTING MEMBERS** **4.1 ⟨same as the present⟩** **4.2 Web stiffeners of primary supporting members** **4.2.1 ⟨same as the present⟩** **4.2.2 Bending stiffness of web stiffeners** The net moment of inertia, in cm^4, of web stiffener, I_{st}, fitted on primary supporting members, with effective attached plate, s_{eff}, is not to be less than the minimum moment of inertia defined in Table 2.	

Present	Amendment	Note

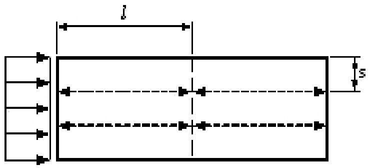
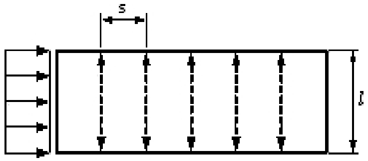
Table 2 : Stiffness criteria for web stiffeners

Stiffener arrangement		Minimum moment of inertia of web stiffeners, in cm^4
A	Web stiffeners fitted along the PSM span  	$I_{st} \geq C\,\ell^2 A_{eff}\frac{R_{eH}}{235}$
B	Web stiffeners fitted normal to the PSM span  	$I_{st} \geq 1.14\,\ell s^2 t_w\left(2.5\frac{1000\,\ell}{s} - 2\frac{s}{1000\,\ell}\right)\frac{R_{eH}}{235}10^{-5}$

C : Slenderness coefficient to be taken as:
C = 0.93 for longitudinal stiffeners including sniped stiffeners.
C = 0.72 for other stiffeners.
ℓ : Length of web stiffener, in m.
For web stiffeners welded to local supporting members, 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 supporting member as shown for stiffener arrangement B.
A_{eff} : Net section area of web stiffener including effective attached plate, s_{eff}, in cm^2.
t_w : Net web thickness of the primary supporting member, in mm.
R_{eH} : Specified minimum yield stress of the material of the web plate of the primary supporting member, in $\mathrm{N/mm}^2$.

<table>
<tr><th>Present</th><th>Amendment</th><th>Note</th></tr>
<tr><td></td><td>

Table 2 : Stiffness criteria for web stiffeners

<table>
<tr><th colspan="2">Stiffener arrangement</th><th>Minimum moment of inertia of web stiffeners, in cm^4</th></tr>
<tr><td>A</td><td>Web stiffeners fitted along the PSM span
 </td><td>$I_{st} \geq C\ell^2 A_{eff}\frac{R_{eH}}{235}$</td></tr>
<tr><td>B</td><td>Web stiffeners fitted normal to the PSM span
 </td><td>$I_{st} \geq 1.14\,\ell s^2 t_w\left(2.5\frac{1000\,\ell}{s} - 2\frac{s}{1000\,\ell}\right)\frac{R_{eH}}{235}10^{-5}$</td></tr>
<tr><td colspan="3">

C : Slenderness coefficient to be taken as:
C = 0.81 for longitudinal stiffeners including sniped stiffeners.
C = 0.72 for other stiffeners.
ℓ : Length of web stiffener, in m.
For web stiffeners welded to local supporting members, 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 supporting member as shown for stiffener arrangement B.
A_{eff} : Net section area of web stiffener including effective attached plate, s_{eff}, in cm^2.
t_w : Net web thickness of the primary supporting member, in mm.
R_{eH} : Specified minimum yield stress of the material of the web plate of the primary supporting member, in $\mathrm{N/mm}^2$.

</td></tr>
</table>

</td><td>

- the slenderness coefficient is improved from C=0.93 to 0.81

</td></tr>
</table>

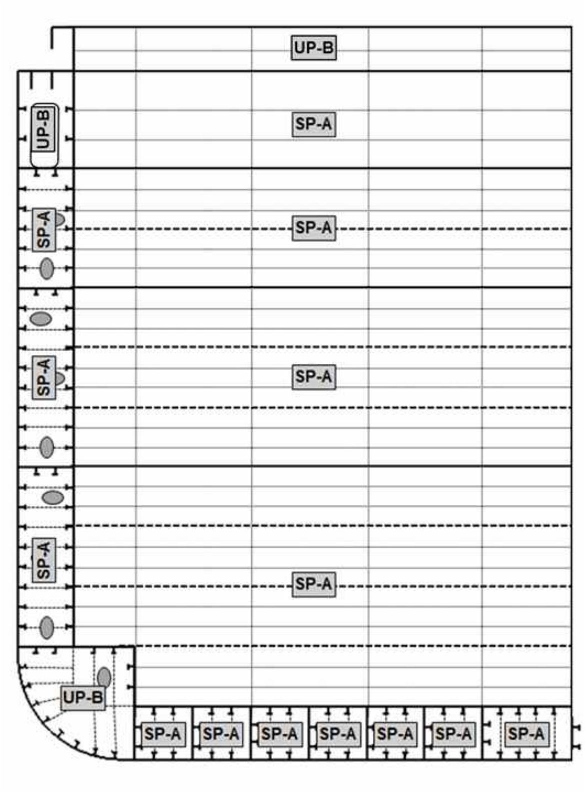
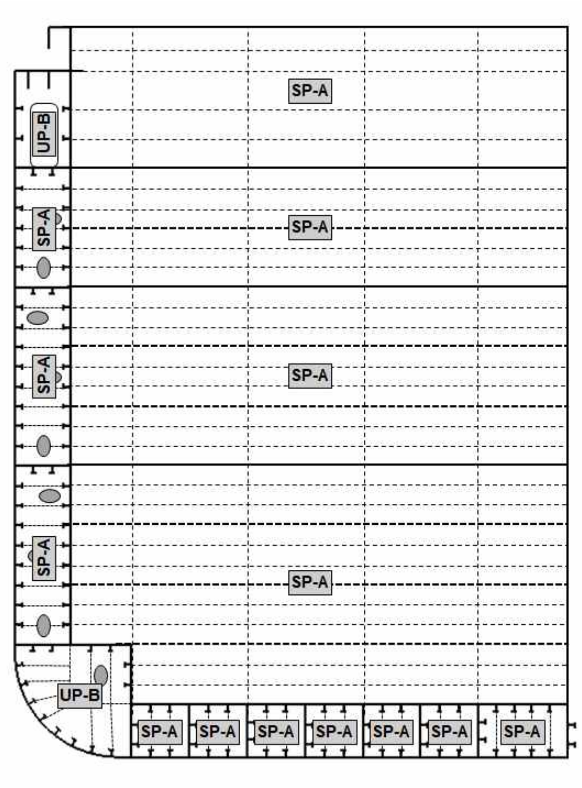
Present	Amendment	Note
Section 4 Buckling requirements for DSA	**Section 4 Buckling requirements for DSA**	
1. ⟨omitted⟩	**1. ⟨same as the present⟩**	
2. Stiffened and unstiffened panels	**2. Stiffened and unstiffened panels**	
2.1 General	**2.1 General**	
2.1.1	**2.1.1**	
The plate panel of hull structure is to be modelled as stiffened or unstiffened panel. Method A and Method B as defined in **Ch 8, Sec 1, [3]** are to be used according to **Figure 1** to **Figure 4.**	The plate panel of hull structure is to be modelled as stiffened or unstiffened panel. Method A and Method B as defined in **Ch 8, Sec 1, [3]** are to be used according to **Table 1.**	
⟨newly added⟩	• For PSM web panels with one of the long edges along the face plate or along the attached plating without "in-line support", i.e. the edge is free to pull in, Method B (SP-B or UP-B) shall be applied. In other cases Method A (SP-A or UP-A) is applicable. • Typically the short plate edge is attached to the plate flanges and Method A (SP-A or UP-A) is applicable. However, in case of one of the long edges is without "in-line support" and is free to pull in, Method B (SP-B or UP-B) shall be applied.	- the description for method A and method B is newly added

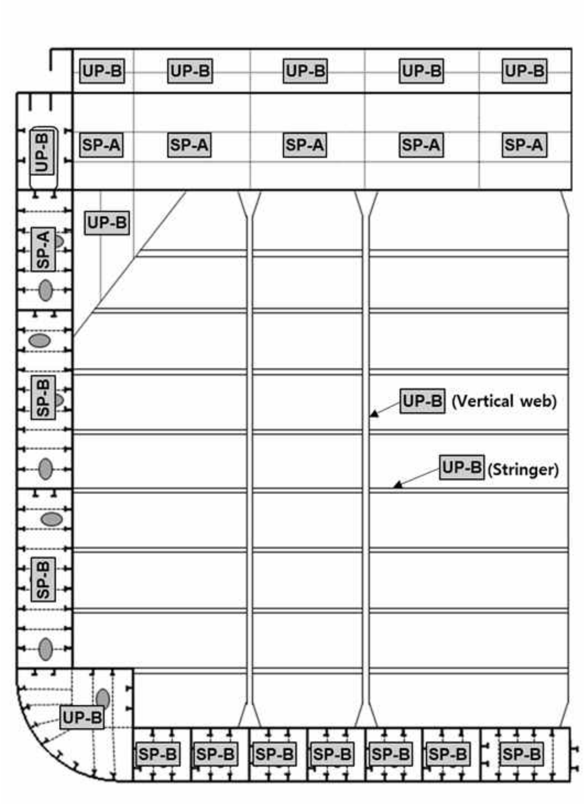
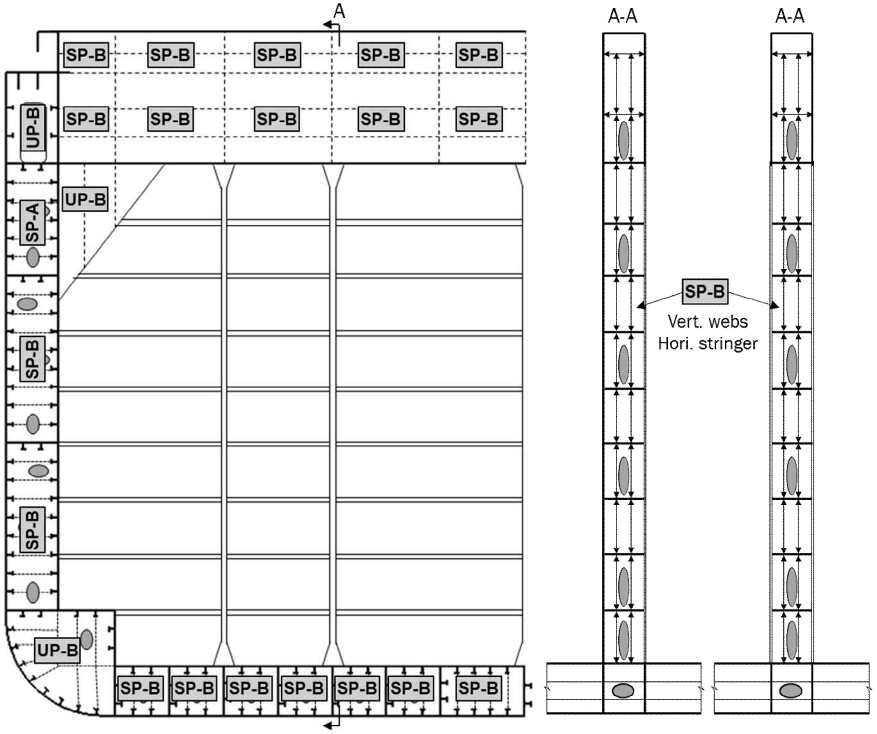
<table>
<tr><th>Present</th><th>Amendment</th><th>Note</th></tr>
<tr>
<td>〈newly added〉</td>
<td>

Table 1 : Structual members

<table>
<tr><th colspan="2">Structural elements</th><th>Assessment method</th><th>Normal panel definition</th></tr>
<tr><td colspan="4">Ordinary section, see Figure 1</td></tr>
<tr><td colspan="2">Longitudinally stiffened panels
Shell envelope
Longitudinal bulkhead
Stringer deck(bench strucutre)
Longitudinal bulkhead(bench strucutre)</td><td>SP-A</td><td>Length: between web frames
Width: between PSM</td></tr>
<tr><td colspan="2">Stringer in line with stringer deck(bench strucutre)
Double bottom girder in line with longitudinal bulkhead(bench strucutre)</td><td>SP-A</td><td>Length: between web frames
Width: full web depth</td></tr>
<tr><td colspan="2">Upper deck</td><td>SP-B</td><td>Length: between web frames
Width: between PSM</td></tr>
<tr><td colspan="2">Stringers in double side
Double bottom girders</td><td>SP-B</td><td>Length: between web frames
Width: full web depth</td></tr>
<tr><td colspan="2">Hatch coaming top
Hatch side coaming</td><td>UP-B</td><td>Length: between web frames
Width: between PSM</td></tr>
<tr><td colspan="4">Typical web section, see Figure 2</td></tr>
<tr><td rowspan="2">Vertical web in double side</td><td>Regularly stiffened web between PSM</td><td>SP-B</td><td>Length: full web depth
Width: between PSM</td></tr>
<tr><td>Irregularly stiffened web between PSM</td><td>UP-B</td><td>Plate between local stiffeners/face plate/PSM</td></tr>
<tr><td colspan="2">Double bottom floor</td><td>SP-B</td><td>Length: full web depth
Width: between PSM</td></tr>
<tr><td colspan="2">Webs in passage way and duct keel
Irregularly stiffened web panels in way of bilge</td><td>UP-B</td><td>Plate between local stiffeners/face plate/PSM</td></tr>
<tr><td colspan="4">Watertight bulkhead, see Figure 3</td></tr>
<tr><td rowspan="2">Bulkhead plating</td><td>Regularly stiffened panels</td><td>SP-A</td><td>Length: between PSM
Width: between PSM</td></tr>
<tr><td>Irregularly stiffened panels</td><td>UP-A</td><td>Plate between local stiffeners/face plate/PSM</td></tr>
<tr><td rowspan="2">Vertical web in double side</td><td>Regularly stiffened web between PSM</td><td>SP-A</td><td>Length: between PSM
Width: between PSM</td></tr>
<tr><td>Irregularly stiffened web between PSM</td><td>UP-A</td><td>Plate between local stiffeners/face plate/PSM</td></tr>
<tr><td colspan="2">Double bottom floor</td><td>SP-A</td><td>Length: between PSM
Width: between PSM</td></tr>
<tr><td colspan="2">Irregularly stiffened web panels in way of bilge</td><td>UP-B</td><td>Plate between local stiffeners/face plate/PSM</td></tr>
<tr><td colspan="4">Support bulkhead, see Figure 4</td></tr>
<tr><td colspan="2">Vertical web in double side in way of large end bracket of box girder</td><td>SP-A</td><td>Length: full web depth
Width: between PSM</td></tr>
<tr><td colspan="2">Box girder</td><td>SP-B</td><td>Length: between PSM
Width: between PSM</td></tr>
<tr><td colspan="2">Vertical webs
Horizontal stringers</td><td>SP-B</td><td>Length: between PSM
Width: full web depth</td></tr>
<tr><td colspan="2">Large end bracket of box girder</td><td>UP-B</td><td>Plate between local stiffeners/face plate/PSM</td></tr>
<tr><td colspan="4">Note
1. SP and UP stand for stiffened and unstiffened panel respectively.
2. A and B stand for Method A and Method B respectively.</td></tr>
</table>

</td>
<td>- the table for application of assessment method is newly added</td>
</tr>
</table>

Present	Amendment	Note
 Figure 3 : Transverse bulkhead for container ship	 Figure 3 : Transverse bulkhead for container ship	– the figures is modified for improving the application of assessment method

Present	Amendment	Note
 Figure 4 : Support bulkhead for container ship	 Figure 4 : Support bulkhead for container ship	- the figures is modified for improving the application of assessment method

Present	Amendment	Note
Chapter 9 Fatigue	**Chapter 9 Fatigue**	
Section 1 General Considerations	**Section 1 General Considerations**	
1. Rule Application for Fatigue Requirements	**1. Rule Application for Fatigue Requirements**	
1.1 Scope	**1.1 Scope**	
1.1.1 ~ 1.1.7 〈omitted〉	**1.1.1 ~ 1.1.7 〈same as the present〉**	
1.1.8 Class notation	**1.1.8 Class notation**	
For ships which were checked based on this chapter, following class notation are assigned. a) The method of simplified fatigue analysis : **SeaTrust(FSA1)** b) The method of fatigue analysis by hold analysis : **SeaTrust(FSA2)** c) The method of fatigue analysis by global analysis : **SeaTrust(FSA3)**	For ships which were checked based on this chapter, following class notation are assigned. a) The method of simplified fatigue analysis : **SeaTrust(FSA1)** b) The method of fatigue analysis by hold analysis : **SeaTrust(FSA2)** c) The method of fatigue analysis by global analysis : **SeaTrust(FSA3)**	
However, in case that **SeaTrust(FSA2)** or **SeaTrust(FSA3)** is assigned to ships, **SeaTrust(FSA1)** is to be performed.	However, in case that **SeaTrust(FSA2)** or **SeaTrust(FSA3)** requested by the applicant(i.e., the owner or the builder) is assigned to ships, **SeaTrust(FSA1)** is to be performed.	- to clarify the application of rule for FSA2 and FSA3
The container ships fully complying with **Pt 3, Annex 3-3** is assigned the notation **SeaTrust(FSA3)**.	The container ships fully complying with **Pt 3, Annex 3-3** is assigned the notation **SeaTrust(FSA3)**.	

Present	Amendment	Note
1. ~ 2. 〈omitted〉	**1. ~ 2. 〈same as the present〉**	
3. Assumptions	**3. Assumptions**	
3.1 General	**3.1 General**	
3.1.1	**3.1.1**	
The following assumptions are made in the fatigue assessment:	The following assumptions are made in the fatigue assessment:	
a) A linear cumulative damage model, i.e. Palmgren-Miner's Rule, given in **Ch 9, Sec 3, [5],** has been used in connection with the design S-N curves, given in **Ch 9, Sec 3, [4].**	a) A linear cumulative damage model, i.e. Palmgren-Miner's Rule, given in **Ch 9, Sec 3, [5],** has been used in connection with the design S-N curves, given in **Ch 9, Sec 3, [4].**	
b) Design fatigue life, T_{DF}, is taken not less than 25 years.	b) Design fatigue life, T_{DF}, is taken not less than 25 years.	
c) Rule quasi-static wave induced loads are based on North Atlantic wave environment. They are determined at 10^{-2} probability level of exceedance by the Equivalent Design Wave (EDW) concept.	c) Rule quasi-static wave induced loads are based on North Atlantic wave environment. They are determined at 10^{-2} probability level of exceedance by the Equivalent Design Wave (EDW) concept.	
d) Net thickness t_{n50} approach is used, according to **[5].**	d) Net thickness, t_{n50}, is used for simplified stress analysis and gross thickness, t_{gr}, is used for finite element stress analysis respectively.	- the FEM for fatigue assessment is to be made using gross thick instead of net thickness in accordance with Ch 3, Sec 2, Table 1.
e) Type of stress used for crack initiating at the weld toe is the hot spot stress. Type of stress used for crack initiating at free edge of non-welded details is local stress at free edge.	e) Type of stress used for crack initiating at the weld toe is the hot spot stress. Type of stress used for crack initiating at free edge of non-welded details is local stress at free edge.	
f) Fatigue stress range $\triangle\sigma_{FS}$ may be calculated by simplified stress analysis or by finite element stress analysis for details with more complex geometry.	f) Fatigue stress range $\triangle\sigma_{FS}$ may be calculated by simplified stress analysis or by finite element stress analysis for details with more complex geometry.	
〈omitted〉	〈same as the present〉	

Present	Amendment	Note
4. ⟨omitted⟩	**4. ⟨same as the present⟩**	
5. Corrosion Model	**5. Corrosion Model**	- the FEM for fatigue assessment is to be made using gross thick instead of net thickness in accordance with Ch 3, Sec 2, Table 1. - stress correction factor is applied only for simplified stress analysis due to application of gross thickness for FSA
5.1 Net thickness	**5.1 Net or Gross thickness**	
5.1.1 General The fatigue assessment should be performed based on net thicknesses according to **Ch 3, Sec 2.**	**5.1.1 General** The fatigue assessment by simplified method should be performed based on net thicknesses according to **Ch 3, Sec 2.** When accessing the fatigue strength by finite element stress analysis, it shall be performed based on gross thicknesses.	
5.1.2 Stress correction The hull girder stresses for simplified stress analysis ~~and stresses calculated by FE analysis are~~ to be corrected by multiplying the calculated stress by f_c, correction factor taken as: f_c = 0.95 ⟨omitted⟩	**5.1.2 Stress correction** The hull girder stresses for simplified stress analysis is to be corrected by multiplying the calculated stress by f_c, correction factor taken as: f_c = 0.95 ⟨same as the present⟩	
6. Loading Conditions	**6. Loading Conditions**	
6.1 ⟨same as the present⟩	**6.1 ⟨same as the present⟩**	
6.2 Loading conditions	**6.2 Loading conditions**	
6.2.1 The loading conditions to be considered and corresponding fraction of time for each loading condition, $\alpha_{(j)}$, are defined in **Table 1.** The standard loading conditions for fatigue assessment are provided in **Ch 4, Sec 8, [3].**	**6.2.1** The loading conditions to be considered and corresponding fraction of time for each loading condition, $\alpha_{(j)}$, are defined in **Table 1.** The standard loading conditions for fatigue assessment are provided in **Ch 4, Sec 8, [3].**	

Present

Table 1 : Fraction of time in each loading condition

Loading conditions		$\alpha_{(j)}$
Full Load	Ballast Tank – Full	0.7 1)
	Ballast Tank – Empty	0.3 1)

1) Two loading conditions, a minimum and maximum hogging condition, shall be checked ~~separately. The lowest fatigue life from the two loading conditions is representative of the calculated fatigue life, T_F.~~ For each loading condition, the ballast tank shall be considered as full (to the tank top) 70% and empty 30% of the time, and the fatigue damage shall be calculated as the sum of these two contributions.

〈omitted〉

Section 2 Structural Details to be Assessed

1. 〈omitted〉

2. Finite Element Analysis

2.1 General

2.1.1 General

Critical structural details to be checked for fatigue by finite element analysis according to **Ch 9, Sec 5** are given in [2.1.2].

Table 2 give the list of hot spots for structural details.
〈omitted〉

Amendment

Table 1 : Fraction of time in each loading condition

Loading conditions		$\alpha_{(j)}$
Full Load	Ballast Tank – Full	0.7 1)
	Ballast Tank – Empty	0.3 1)

1) Two loading conditions, a minimum and maximum hogging condition, shall be checked. For each loading condition, the ballast tank shall be considered as full (to the tank top) 70% and empty 30% of the time, and the fatigue damage shall be calculated as the sum of these two contributions.

〈same as the present〉

Section 2 Structural Details to be Assessed

1. 〈same as the present〉

2. Finite Element Analysis

2.1 General

2.1.1 General

Critical structural details to be checked for fatigue by finite element analysis according to **Ch 9, Sec 5** are given in [2.1.2]. Additional fatigue assessment may be required for other locations where deemed necessary by Society.
Table 2 give the list of hot spots for structural details.
〈same as the present〉

Note

- the fraction of time is revised for the reasonable concept to improve the fatigue strength assessment

- if necessary, additional fatigue assessment is required by Society

Present	Amendment	Note
Section 3 Fatigue Evaluation	**Section 3 Fatigue Evaluation**	
1. ~ 2. 〈omitted〉	**1. ~ 2. 〈same as the present〉**	
3. Reference Stresses for Fatigue Assessment	**3. Reference Stresses for Fatigue Assessment**	
3.1 ~ 3.2 〈omitted〉	**3.1 ~ 3.2 〈same as the present〉**	
3.3 Thickness effect	**3.3 Thickness effect**	
3.3.1	**3.3.1**	
Plate thickness primarily influences the fatigue strength of welded joints through the effect of geometry, and through-thickness stress distribution. The correction factor, f_{thick}, for plate thickness effect is taken as:	Plate thickness primarily influences the fatigue strength of welded joints through the effect of geometry, and through-thickness stress distribution. The correction factor, f_{thick}, for plate thickness effect is taken as:	
• f_{thick} = 1.0 for $t_{n50} \leq 22.0$ mm • f_{thick} = $(t_{n50}/22.0)^n$ for $t_{n50} > 22.0$ mm	• For simplified stress analysis f_{thick} = 1.0 for $t_{n50} \leq 22.0$ mm f_{thick} = $(t_{n50}/22.0)^n$ for $t_{n50} > 22.0$ mm • For finite element stress analysis f_{thick} = 1.0 for $t_{gr} \leq 22.0$ mm f_{thick} = $(t_{gr}/22.0)^n$ for $t_{gr} > 22.0$ mm	- the FEM for fatigue assessment is to be made using gross thick instead of net thickness in accordance with Ch 3, Sec 2, Table 1.
where: t_{n50} : Net thickness of the considered member in way of the hot spot for welded joints or base material free edge, in mm. • For simplified stress analysis, the net thickness to be considered for stiffeners is as follows: • Flat bar and Bulb profile: no correction, • Angle bar and T-bar: flange net thickness.	where: t_{n50} : Net thickness of the considered member in way of the hot spot for welded joints or base material free edge, in mm, for simplified stress analysis. • The net thickness to be considered for stiffeners is as follows: • Flat bar and Bulb profile: no correction, • Angle bar and T-bar: flange net thickness.	

Present	Amendment	Note
- For FE analysis, the net thickness to be considered is the net thickness of the member where the crack is likely to initiate and propagate. For 90° attachments, i.e. cruciform welded joints, transverse T-joints and plates with transverse attachment, the net thickness to be considered is to be taken as: $t_{n50} = \min\left(\frac{d}{2}, t_{1n50}\right)$	t_{gr} : Gross thickness of the considered member in way of the hot spot for welded joints or base material free edge where the crack is likely to initiate and propagate, in mm, for FE analysis. - For 90° attachments, i.e. cruciform welded joints, transverse T-joints and plates with transverse attachment, the gross thickness to be considered is to be taken as: $t_{gr} = \min\left(\frac{d}{2}, t_{1-gr}\right)$	
n : Thickness exponent provided in **Table 1** and **Table 4** respectively for welded and non-welded joints. n is to be selected according to the considered stress direction. For this selection, $\triangle\sigma_{HS1}$ and $\triangle\sigma_{HS2}$ are considered perpendicular and parallel to the weld respectively.	n : Thickness exponent provided in **Table 1** and **Table 4** respectively for welded and non-welded joints. n is to be selected according to the considered stress direction. For this selection, $\triangle\sigma_{HS1}$ and $\triangle\sigma_{HS2}$ are considered perpendicular and parallel to the weld respectively.	- the FEM for fatigue assessment is to be made using gross thick instead of net thickness in accordance with Ch 3, Sec 2, Table 1.
d : Toe distance, in mm, as shown in **Figure 2**, taken as: $d = t_{2n50} + 2\ell_{leg}$	d : Toe distance, in mm, as shown in **Figure 2**, taken as: $d = t_{2-gr} + 2\ell_{leg}$	
t_{1n50} : Net thickness, in mm, of the continuous plate as shown in **Figure 2.**	t_{1-gr} : Gross thickness, in mm, of the continuous plate as shown in **Figure 2.**	
t_{2n50} : Net thickness, in mm, of the transverse attach plate where the hot spot is assessed, as shown in **Figure 2.**	t_{2-gr} : Gross thickness, in mm, of the transverse attach plate where the hot spot is assessed, as shown in **Figure 2.**	
ℓ_{leg} : Fillet weld leg length, in mm.	ℓ_{leg} : Fillet weld leg length, in mm.	
When post-weld treatment methods are applied to improve the fatigue life of considered welded joint, the thickness exponent is provided in **[6].**	When post-weld treatment methods are applied to improve the fatigue life of considered welded joint, the thickness exponent is provided in **[6].**	
〈omitted〉	〈same as the present〉	

Present	Amendment	Note
Section 4 〈omitted〉 **Section 5 Finite Element Stress Analysis** **1. 〈omitted〉** **2. FE Modelling** **2.1 General** **2.1.1 〈omitted〉** **2.1.2 Corrosion model** The very fine mesh finite element models used for fatigue assessment are to be made using net thickness, t_{n50}, in accordance with **Ch 9, Sec 1, [5.1].** **2.1.3 〈omitted〉** **2.1.4** The evaluation of hot spot stress for ‘a’ type hot spot is to be based on shell element of mesh size $t_{n50} \times t_{n50}$, where t_{n50} is the net thickness of the plate in way of the considered hot spot. The evaluation of hot spot stress for a ‘b’ type hot spot is to be based on shell element of mesh size 10 × 10 mm. The aforementioned mesh size is to be maintained within the very fine mesh zone, extending over at least 10 elements in all directions from the fatigue hot spot position. The transition of element size between the coarser mesh and the very fine mesh zone is to be done gradually and an acceptable mesh quality is to be maintained. This transition mesh is to be such that a uniform mesh with regular shape gradually transitions from smaller elements to larger ones. An example of the mesh transition in way of hatch coaming top and deck plating is shown in **Figure 3.** 〈omitted〉	**Section 4 〈same as the present〉** **Section 5 Finite Element Stress Analysis** **1. 〈same as the present〉** **2. FE Modelling** **2.1 General** **2.1.1 〈same as the present〉** **2.1.2 Corrosion model** The very fine mesh finite element models used for fatigue assessment are to be made using gross thickness, t_{gr}, in accordance with **Ch 9, Sec 1, [5.1].** **2.1.3 〈same as the present〉** **2.1.4** The evaluation of hot spot stress for ‘a’ type hot spot is to be based on shell element of mesh size $t_{gr} \times t_{gr}$, where t_{gr} is the gross thickness of the plate in way of the considered hot spot. The evaluation of hot spot stress for a ‘b’ type hot spot is to be based on shell element of mesh size 10 × 10 mm. The aforementioned mesh size is to be maintained within the very fine mesh zone, extending over at least 10 elements in all directions from the fatigue hot spot position. The transition of element size between the coarser mesh and the very fine mesh zone is to be done gradually and an acceptable mesh quality is to be maintained. This transition mesh is to be such that a uniform mesh with regular shape gradually transitions from smaller elements to larger ones. An example of the mesh transition in way of hatch coaming top and deck plating is shown in **Figure 3.** 〈same as the present〉	– the FEM for fatigue assessment is to be made using gross thick instead of net thickness in accordance with Ch 3, Sec 2, Table 1.

Present	Amendment	Note
2.2 Hatch coaming top and deck plating **2.2.1 ~ 2.2.2 〈omitted〉** **2.2.3** The hatch coaming top and deck plating are to be represented by shell finite elements having both membrane and bending properties. **Figure 4** shows a typical FE model of hatch coaming and the deck plating with the very fine mesh zone having $\underline{t_{n50} \times t_{n50}}$ mesh size. 〈omitted〉 **3. Hot Spot Stress for Details Different from Web-Stiffened Cruciform Joints** **3.1 Welded details** **3.1.1** For hot spot type 'a', the structural hot spot stress, σ_{HS}, is calculated from a finite element analysis with $\underline{t_{n50} \times t_{n50}}$ mesh density and is obtained by the following formula: $\sigma_{HS} = 1.12 \cdot \sigma$ where: σ : Surface principal stress, in N/mm^2, read out at a distance $\underline{t_{n50}/2}$ away from the intersection line. $\underline{t_{n50}}$: Plate net thickness, in mm, in way of the weld toe. 〈omitted〉	**2.2 Hatch coaming top and deck plating** **2.2.1 ~ 2.2.2 〈same as the present〉** **2.2.3** The hatch coaming top and deck plating are to be represented by shell finite elements having both membrane and bending properties. **Figure 4** shows a typical FE model of hatch coaming and the deck plating with the very fine mesh zone having $\underline{t_{gr} \times t_{gr}}$ mesh size. 〈same as the present〉 **3. Hot Spot Stress for Details Different from Web-Stiffened Cruciform Joints** **3.1 Welded details** **3.1.1** For hot spot type 'a', the structural hot spot stress, σ_{HS}, is calculated from a finite element analysis with $\underline{t_{gr} \times t_{gr}}$ mesh density and is obtained by the following formula: $\sigma_{HS} = 1.12 \cdot \sigma$ where: σ : Surface principal stress, in N/mm^2, read out at a distance $\underline{t_{gr}/2}$ away from the intersection line. $\underline{t_{gr}}$: Plate gross thickness, in mm, in way of the weld toe. 〈same as the present〉	- the FEM for fatigue assessment is to be made using gross thick instead of net thickness in accordance with Ch 3, Sec 2, Table 1.

Present	Amendment	Note
3.1.2 Stress read out methods Depending on the element type, one of the following stress read out method is to be used: • With 4-node shell element: Element surface stress components at the centre points are linearly extrapolated to the line A-A as shown in **Figure 7** to determine the stress components for load case ‘$i1$’ and ‘$i2$’ at the stress read out point located at a distance $\underline{t_{n50}/2}$ from the intersection line for type 'a' hot spot. Two principal hot spot stress ranges are determined at the stress read out point from the stress components tensor differences (between load case ‘$i1$’ and ‘$i2$’) calculated from each side (side L, side R) of line A-A. The angle θ between the direction x of the element co-ordinate system and the principal direction pX of the principal hot spot stress range co-ordinate system has to be determined. • With 8-node shell element: With a $\underline{t_{n50}\times t_{n50}}$ element mesh using 8-node element type, the element mid-side node is located on the line A-A at a distance $\underline{t_{n50}/2}$ for type 'a' hot spots. This node coincides with the stress read out point. The element surface stress components for load case ‘$i1$’ and ‘$i2$’ can be used directly without extrapolation within each adjacent element located on each side (side L, side R) of the line A-A as illustrated in **Figure 8.** Two principal hot spot stress ranges are determined at the stress read out point from the stress components tensor difference (between load case ‘$i1$’ and ‘$i2$’) calculated from each side of line A-A. The angle θ between the direction x of the element coordinate system and the principal direction pX of the principal hot spot stress range coordinate system has to be determined. ⟨omitted⟩	**3.1.2 Stress read out methods** Depending on the element type, one of the following stress read out method is to be used: • With 4-node shell element: Element surface stress components at the centre points are linearly extrapolated to the line A-A as shown in **Figure 7** to determine the stress components for load case ‘$i1$’ and ‘$i2$’ at the stress read out point located at a distance $\underline{t_{gr}/2}$ from the intersection line for type 'a' hot spot. Two principal hot spot stress ranges are determined at the stress read out point from the stress components tensor differences (between load case ‘$i1$’ and ‘$i2$’) calculated from each side (side L, side R) of line A-A. The angle θ between the direction x of the element co-ordinate system and the principal direction pX of the principal hot spot stress range co-ordinate system has to be determined. • With 8-node shell element: With a $\underline{t_{gr}\times t_{gr}}$ element mesh using 8-node element type, the element mid-side node is located on the line A-A at a distance $\underline{t_{gr}/2}$ for type 'a' hot spots. This node coincides with the stress read out point. The element surface stress components for load case ‘$i1$’ and ‘$i2$’ can be used directly without extrapolation within each adjacent element located on each side (side L, side R) of the line A-A as illustrated in **Figure 8.** Two principal hot spot stress ranges are determined at the stress read out point from the stress components tensor difference (between load case ‘$i1$’ and ‘$i2$’) calculated from each side of line A-A. The angle θ between the direction x of the element coordinate system and the principal direction pX of the principal hot spot stress range coordinate system has to be determined. ⟨same as the present⟩	- the FEM for fatigue assessment is to be made using gross thick instead of net thickness in accordance with Ch 3, Sec 2, Table 1.

Present	Amendment	Note
4.2 Calculation of hot spot stress at the flange **4.2.1** 〈omitted〉 The hot spot stress, in N/mm^2, is to be obtained as: $\sigma_{HS} = 1.12\,\sigma_{shift}$ where: σ_{shift} : Surface principal stress, in N/mm^2, at shifted stress read out position. The stress read out point shifted away from the intersection line is obtained as: $x_{shift} = \frac{t_{1-n50}}{2} + x_{wt}$ where: t_{1-n50} : Net plate thickness of the plate number 1, in mm, as shown in **Figure 10.** x_{wt} : Extended fillet weld leg length, in mm, as defined in **Figure 10,** not taken larger than t_{1-n50}.	**4.2 Calculation of hot spot stress at the flange** **4.2.1** 〈same as the present〉 The hot spot stress, in N/mm^2, is to be obtained as: $\sigma_{HS} = 1.12\,\sigma_{shift}$ where: σ_{shift} : Surface principal stress, in N/mm^2, at shifted stress read out position. The stress read out point shifted away from the intersection line is obtained as: $x_{shift} = \frac{t_{1-gr}}{2} + x_{wt}$ where: t_{1-gr} : Gross plate thickness of the plate number 1, in mm, as shown in **Figure 10.** x_{wt} : Extended fillet weld leg length, in mm, as defined in **Figure 10,** not taken larger than t_{1-gr}.	– the FEM for fatigue assessment is to be made using gross thick instead of net thickness in accordance with Ch 3, Sec 2, Table 1.

Present	Amendment	Note
4.2.2 The stress at the shifted position is derived according to the following formula and illustrated in **Figure 11**: $\sigma_{shift} = [\sigma_{membrane}(x_{shift}) + 0.60 \bullet \sigma_{bending}(x_{shift})] \bullet \beta$ where: $\sigma_{bending}(x_{shift})$: Bending stress, in N/mm^2, at the shifted position taken as: $\sigma_{bending}(x_{shift}) = \sigma_{surface}(x_{shift}) - \sigma_{membrane}(x_{shift})$ $\sigma_{surface}(x_{shift})$: Total surface stress at x_{shift} position (including membrane stress and bending stress), in N/mm^2. $\sigma_{membrane}(x_{shift})$: Membrane stress at x_{shift} position, in N/mm^2. β : Plate angle hot spot stress correction factor, taken as: • For $\alpha = 135^{\circ}$: $\underline{\beta = 0.96 - 0.13\frac{x_{wt}}{t_{1-n50}} + 0.20\left(\frac{x_{wt}}{t_{1-n50}}\right)^2}$ • For $\alpha = 120^{\circ}$: $\underline{\beta = 0.97 - 0.14\frac{x_{wt}}{t_{1-n50}} + 0.32\left(\frac{x_{wt}}{t_{1-n50}}\right)^2}$ • For $\alpha = 90^{\circ}$: $\underline{\beta = 0.96 + 0.031\frac{x_{wt}}{t_{1-n50}} + 0.24\left(\frac{x_{wt}}{t_{1-n50}}\right)^2}$ α : Angle, in deg, between the plates forming a web-stiffened cruciform joint as shown in **Figure 11.** 〈omitted〉	**4.2.2** The stress at the shifted position is derived according to the following formula and illustrated in **Figure 11**: $\sigma_{shift} = [\sigma_{membrane}(x_{shift}) + 0.60 \bullet \sigma_{bending}(x_{shift})] \bullet \beta$ where: $\sigma_{bending}(x_{shift})$: Bending stress, in N/mm^2, at the shifted position taken as: $\sigma_{bending}(x_{shift}) = \sigma_{surface}(x_{shift}) - \sigma_{membrane}(x_{shift})$ $\sigma_{surface}(x_{shift})$: Total surface stress at x_{shift} position (including membrane stress and bending stress), in N/mm^2. $\sigma_{membrane}(x_{shift})$: Membrane stress at x_{shift} position, in N/mm^2. β : Plate angle hot spot stress correction factor, taken as: • For $\alpha = 135^{\circ}$: $\underline{\beta = 0.96 - 0.13\frac{x_{wt}}{t_{1-gr}} + 0.20\left(\frac{x_{wt}}{t_{1-gr}}\right)^2}$ • For $\alpha = 120^{\circ}$: $\underline{\beta = 0.97 - 0.14\frac{x_{wt}}{t_{1-gr}} + 0.32\left(\frac{x_{wt}}{t_{1-gr}}\right)^2}$ • For $\alpha = 90^{\circ}$: $\underline{\beta = 0.96 + 0.031\frac{x_{wt}}{t_{1-gr}} + 0.24\left(\frac{x_{wt}}{t_{1-gr}}\right)^2}$ α : Angle, in deg, between the plates forming a web-stiffened cruciform joint as shown in **Figure 11.** 〈same as the present〉	- the FEM for fatigue assessment is to be made using gross thick instead of net thickness in accordance with Ch 3, Sec 2, Table 1.

Present	Amendment	Note
4.3 Calculation of hot spot stress in the web **4.3.1** Hot spots located in way of the web as indicated in **Figure 13** are to be checked with the hot spot stress defined from the maximum principal surface stress at the intersection offset by the distance x_{shift} from the vertical and horizontal element intersection lines as illustrated in **Figure 13**. The intersection line is taken at the mid thickness of the cruciform joint assuming a median alignment. The hot spot stress, in N/mm^2, is to be obtained as: $\sigma_{HS} = \sigma_{shift}$ where: σ_{shift} : Maximum principal surface stress, in N/mm^2, at the intersection offset by the distance x_{shift}. The stress read out point at the intersection offset is obtained as: $x_{shift} = \frac{t_{3-n50}}{2} + x_{wt}$ where: t_{3-n50} : Net plate thickness of the web, in mm, as shown in **Figure 13.** x_{wt} : Extended fillet weld leg length, in mm, taken as: $x_{wt} = \min(\ell_{leg1}, \ell_{leg2})$ ℓ_{leg1}, ℓ_{leg2} : Leg length, in mm, of the vertical and horizontal weld lines as shown in **Figure 13.** 〈omitted〉	**4.3 Calculation of hot spot stress in the web** **4.3.1** Hot spots located in way of the web as indicated in **Figure 13** are to be checked with the hot spot stress defined from the maximum principal surface stress at the intersection offset by the distance x_{shift} from the vertical and horizontal element intersection lines as illustrated in **Figure 13**. The intersection line is taken at the mid thickness of the cruciform joint assuming a median alignment. The hot spot stress, in N/mm^2, is to be obtained as: $\sigma_{HS} = \sigma_{shift}$ where: σ_{shift} : Maximum principal surface stress, in N/mm^2, at the intersection offset by the distance x_{shift}. The stress read out point at the intersection offset is obtained as: $x_{shift} = \frac{t_{3-gr}}{2} + x_{wt}$ where: t_{3-gr} : Gross plate thickness of the web, in mm, as shown in **Figure 13.** x_{wt} : Extended fillet weld leg length, in mm, taken as: $x_{wt} = \min(\ell_{leg1}, \ell_{leg2})$ ℓ_{leg1}, ℓ_{leg2} : Leg length, in mm, of the vertical and horizontal weld lines as shown in **Figure 13.** 〈same as the present〉	- the FEM for fatigue assessment is to be made using gross thick instead of net thickness in accordance with Ch 3, Sec 2, Table 1.

Present	Amendment	Note
Section 6 Detail Design Standard **1. 〈omitted〉** **2. Stiffener-Frame Connections** **2.1 〈omitted〉** **2.2 Equivalent design of stiffener-frame connections** **2.2.1 ~ 2.2.2 〈omitted〉** **2.2.3** The very fine mesh finite element models are made to analyse the behaviour in way of double side or double bottom. The models should have an extent of 3 stiffeners in cross section, i.e. 4 stiffener spacings, and the longitudinal extent is to be one half frame spacing in both forward and aft direction. A typical model is shown in **Figure 1.** No cut-outs for access openings are to be included in the models. Connection between the lug or the web-frame to the longitudinal stiffener web, connections of the lug to the web-frame and free edges on lugs and cut-outs in web-frame are to be modelled with elements of net plate thickness size ($t_{n50} \times t_{n50}$). The mesh with net plate thickness size should extend at least five elements in all directions. Outside this area, the mesh size may gradually be increased in accordance with the requirements in **Ch 9, Sec 5, [2]**. The eccentricity of the lapped lug plates is to be included in the model. Transverse web and lug plates are to be connected by eccentricity elements (transverse plate elements). The height of eccentricity element is to be the distance between mid-layers of transverse web and lug plates having a thickness equal to 2 times the net thickness of web-frame plate t_{w-n50}. Eccentricity elements representing fillet welds are shown in **Figure 2**. 〈omitted〉	**Section 6 Detail Design Standard** **1. 〈same as the present〉** **2. Stiffener-Frame Connections** **2.1 〈same as the present〉** **2.2 Equivalent design of stiffener-frame connections** **2.2.1 ~ 2.2.2 〈same as the present〉** **2.2.3** The very fine mesh finite element models are made to analyse the behaviour in way of double side or double bottom. The models should have an extent of 3 stiffeners in cross section, i.e. 4 stiffener spacing, and the longitudinal extent is to be one half frame spacing in both forward and aft direction. A typical model is shown in **Figure 1.** No cut-outs for access openings are to be included in the models. Connection between the lug or the web-frame to the longitudinal stiffener web, connections of the lug to the web-frame and free edges on lugs and cut-outs in web-frame are to be modelled with elements of gross plate thickness size ($t_{gr} \times t_{gr}$). The mesh with gross plate thickness size should extend at least five elements in all directions. Outside this area, the mesh size may gradually be increased in accordance with the requirements in **Ch 9, Sec 5, [2]**. The eccentricity of the lapped lug plates is to be included in the model. Transverse web and lug plates are to be connected by eccentricity elements (transverse plate elements). The height of eccentricity element is to be the distance between mid-layers of transverse web and lug plates having a thickness equal to 2 times the gross thickness of web-frame plate t_{w-gr}. Eccentricity elements representing fillet welds are shown in **Figure 2**. 〈same as the present〉	- the FEM for fatigue assessment is to be made using gross thick instead of net thickness in accordance with Ch 3, Sec 2, Table 1.

Present	Amendment	Note
Chapter 11 Superstructure, Deckhouses and Hull Outfitting **Section 1 ~ 2 〈omitted〉** **Section 3 Equipment**	**Chapter 11 Superstructure, Deckhouses and Hull Outfitting** **Section 1 ~ 2 〈same as the present〉** **Section 3 Equipment**	
~~Symbols~~	〈deleted〉	- to avoid any possible discrepancy between this rule and UR A1, A2 and Rec.10.
~~For symbols not defined in this section, refer to **Ch 1, Sec 4**.~~		
1. General	**1. General**	
1.1 Application	**1.1 Application**	
1.1.1	1.1.1	
~~The anchoring equipment specified in this section is intended for temporary mooring of a ship within a harbour or sheltered area when the ship is awaiting berth, tide, etc.~~	The anchoring equipment are to be in accordance with relevant chapters of **Pt 4** of the **Rules and Guidance for the Classification of Steel Rules**.	
~~1.1.2~~	~~1.1.2~~ **〈deleted〉**	
〈omitted〉	〈deleted〉	
~~1.1.3~~	~~1.1.3~~ **〈deleted〉**	
〈omitted〉	〈deleted〉	
~~2. Equipment number calculation~~	**~~2.~~ 〈deleted〉**	
〈omitted〉	〈deleted〉	
~~3. Anchoring equipment~~	**~~3.~~ 〈deleted〉**	
〈omitted〉	〈deleted〉	

Present	Amendment	Note
Section 4 Supporting Structure for Deck Equipment and Fittings	**Section 4 Supporting Structure for Deck Equipment and Fittings**	
~~Symbols~~ ~~For symbols not defined in this section, refer to **Ch 1, Sec 4**.~~ ~~SWL : Safe working load as defined in **[4.1.4]**.~~ ~~Normal stress : The sum of bending stress and axial stress with the corresponding shearing stress acting perpendicular to the normal stress.~~	⟨deleted⟩	- to avoid any possible discrepancy between this rule and UR A1, A2 and Rec.10.
1. General **1.1 Application** **1.1.1** ~~Information pertaining to the supporting structure for deck equipment and fittings, as listed in this section, is to be submitted for approval.~~ ~~This section includes scantling requirements to the supporting structure and foundations of the following pieces of equipment and fittings:~~ ~~a) Anchor windlasses.~~ ~~b) Anchoring chain stoppers.~~ ~~c) Mooring winches.~~ ~~d) Deck cranes, derricks and lifting masts.~~ ~~e) Bollards and bitts, fairleads, stand rollers, chocks and capstans.~~	**1. General** **1.1 Application** **1.1.1** The supporting structure and foundations for deck equipment and fittings are to be in accordance with relevant chapters of **Pt 4** of the **Rules and Guidance for the Classification of Steel Rules**.	
⟨omitted⟩	⟨same as the present⟩	

Present	Amendment	Note
2. 〈omitted〉	**2. 〈same as the present〉**	
~~3. Mooring winches~~ 〈omitted〉	**~~3.~~ 〈deleted〉** 〈deleted〉	- to avoid any possible discrepancy between this rule and UR A1, A2 and Rec.10.
4. 〈omitted〉	**4. 〈same as the present〉**	
~~5. Bollards and bitts, fairleads, stand rollers, chocks and capstans~~ 〈omitted〉	**~~5.~~ 〈deleted〉** 〈deleted〉	
6. 〈omitted〉	**6. 〈same as the present〉**	

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<tr><th>Present</th><th>Amendment</th><th>Note</th></tr>
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Chapter 12 Construction

Section 1 ~ 3 〈omitted〉

Section 4 Use of Extremely Thick Steel

1. ~ 5. 〈omitted〉

6. Application of YP47 Steel Plates

These requirements apply to YP47 steel plates specified in **Pt 2, Ch 1,Sec 3, 311**.

6.1 Hull structure(design)

6.1.1 ~ 6.1.2 〈omitted〉

6.1.3

The free edge including hatch corner of the hatch side coaming should not have any defects such as notch that could be harmful against fatigue strength. Appropriate edge treatment including treatment of corner edge (as an example, see **Figure 7**) is to be performed so that the edges should have adequate fatigue strength.

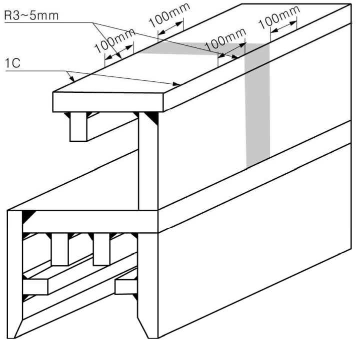

Figure 7 : An example of appropriate edge treatment including corner edge

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Chapter 12 Construction

Section 1 ~ 3 〈same as the present〉

Section 4 Use of Extremely Thick Steel

1. ~ 5. 〈same as the present〉

6. Application of YP47 Steel Plates

These requirements apply to YP47 steel plates specified in **Pt 2, Ch 1,Sec 3, 311**.

6.1 Hull structure(design)

6.1.1 ~ 6.1.2 〈same as the present〉

6.1.3

The free edge including hatch corner of the hatch side coaming should not have any defects such as notch that could be harmful against fatigue strength. Appropriate edge treatment including treatment of corner edge (as an example, see **Figure 7**) is to be performed so that the edges should have adequate fatigue strength.

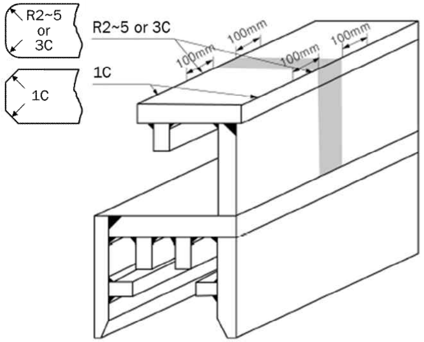

Figure 7 : An example of appropriate edge treatment including corner edge

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- the Figure 7 is modified to clarify the application of treatment method for fatigue strength

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