Rules for the Classification of Steel Ships Revision

(External Inquiry)

Part 15 Structural Rules for Membrane Type Liquefied Natural Gas Carriers

2023. 9.

Hull Rule Development Team

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- Main Amendments -

(1) Enter into force on 1 July 2024 (the contract date for ship construction)

◉ Add a term definition for stern slamming content (T_{AE}).

◉ Revision and addition of application formula according to the development of slamming load.

- Revision for the bottom slamming and bow impact.
- Add the stern slamming formula.

◉ Revision of standard loading conditions for Direct Strength Analysis.

Present	Amendment	Note

Present

Chapter 1 General Principles

Section 4 Symbols and Definitions

Table 2 : Ship's main data

Symbols	Meaning	Units
L	Rule length	m
L_{LL}	Freeboard length	m
L_{PP}	Length between perpendiculars	m
B	Moulded breadth of ship	m
D	Moulded depth of ship	m
T	Moulded draught	m
T_{SC}	Scantling draught	m
T_{BAL}	Ballast draught (minimum midship)	m
T_{LC}	Midship draught at considered loading condition	m
T_{F-f}, T_{F-e}	Minimum draught at forward perpendicular for bottom slamming, with respectively all ballast tanks full or with any tank empty in bottom slamming area	m
Δ	Moulded displacement at draught T_{SC}	t
C_B	Block coefficient at draught T_{SC}	-
V	Maximum service speed	knot
x, y, z	X, Y, Z coordinates of the calculation point with respect to the reference coordinate system	m

Amendment

Chapter 1 General Principles

Section 4 Symbols and Definitions

Table 3 : Ship's main data

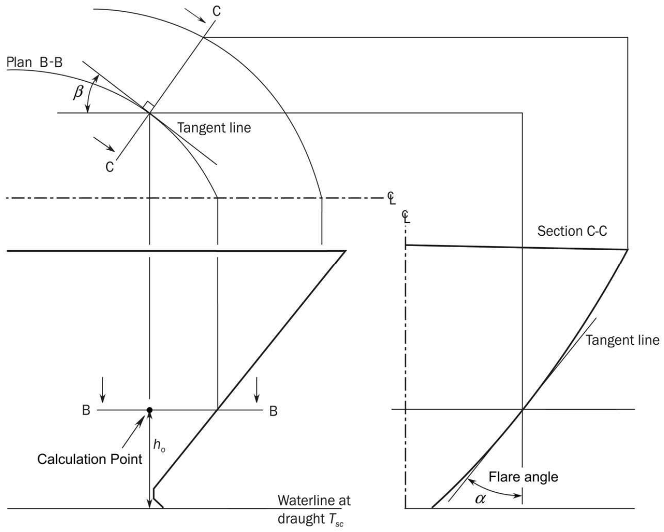
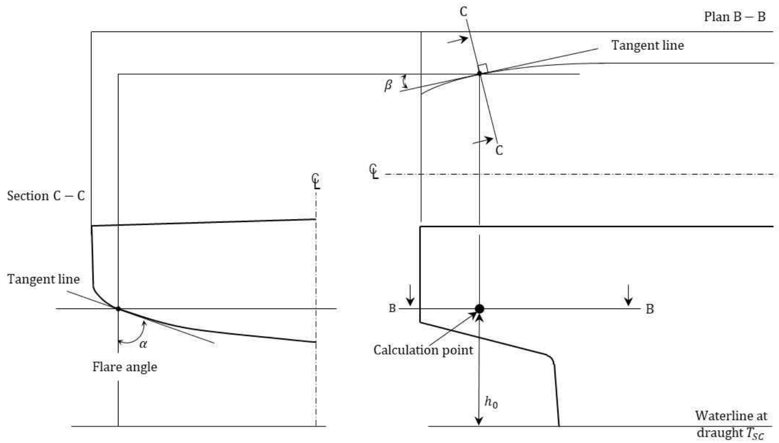
Symbols	Meaning	Units
L	Rule length	m
L_{LL}	Freeboard length	m
L_{PP}	Length between perpendiculars	m
B	Moulded breadth of ship	m
D	Moulded depth of ship	m
T	Moulded draught	m
T_{SC}	Scantling draught	m
T_{BAL}	Ballast draught (minimum midship)	m
T_{LC}	Midship draught at considered loading condition	m
T_{AE}	Minimum draught at aft end for stern slamming	m
T_{F-f}, T_{F-e}	Minimum draught at forward perpendicular for bottom slamming, with respectively all ballast tanks full or with any tank empty in bottom slamming area	m
Δ	Moulded displacement at draught T_{SC}	t
C_B	Block coefficient at draught T_{SC}	-
V	Maximum service speed	knot
x, y, z	X, Y, Z coordinates of the calculation point with respect to the reference coordinate system	m

Note

- added a definition (T_{AE})

Present	Amendment	Note
Chapter 4 Loads **Section 1 ~ 4 ⟨omitted⟩** **Section 5 External Loads** **1. ~ 2. ⟨omitted⟩** **3. External impact pressures for the bow area** **3.1 Application** **3.1.1** The impact pressures for the bow area are only to be applied for strength assessment. **3.2 Bottom slamming pressure** **3.2.1** The bottom slamming pressure P_{SL}, in kN/m^2, for the bottom slamming design load scenario is to be evaluated for the following two cases: Case 1 : An empty ballast tank or a void space in way of the bottom shell. $P_{SL} = 10\,g\sqrt{L}\,f_{SL}c_{SL-et}$ for L < 170 m $P_{SL} = 130\,g\,f_{SL}c_{SL-et}e^{c_1}$ for L ≥ 170 m Case 2 : A full ballast tank in way of the bottom shell. $P_{SL} = 10\,g\sqrt{L}\,f_{SL}c_{SL-ft} - 1.25\,\rho g\,(z_{top} - z)$ for L < 170 m $P_{SL} = 130\,g\,f_{SL}c_{SL-ft}e^{c_1} - 1.25\,\rho g\,(z_{top} - z)$ for L ≥ 170 m where: c_1 : Coefficient to be taken as: $c_1 = 0$ for L ≤ 180 m $c_1 = -0.0125(L-180)^{0.705}$ for L > 180 m c_{SL-et} : Slamming coefficient for case with an empty ballast tank or void	**Chapter 4 Loads** **Section 1 ~ 4 ⟨omitted⟩** **Section 5 External Loads** **1. ~ 2. ⟨omitted⟩** **3. External impact pressures for the bow area** **3.1 Application** **3.1.1** The impact pressures for the bow area are only to be applied for strength assessment. **3.2 Equivalent design pressure** **3.2.1 Entry impact pressure** The entry impact pressure, P_{EI} in kN/m2, as equivalent static pressure is to be taken as: $P_{EI} = CP_EC_E$ where: C : Vertical distribution coefficient, to be taken as: $C = 1.0$ for bottom slamming $C = 0.18(C_W - 0.5h_0)$ for bow impact $C = 0.18(C_W - 2.0h_0)$ for stern slamming C is not to be less than 0.0 nor greater than 1.0. C_W : Wave coefficient as defined in **Ch 4, Sec 4.** h_0 : Vertical distance, in m, from the waterline at the draught T_{SC} to the calculation point, see **Figure 2** and **Figure 3**, to be taken as: • For bow impact $h_0 = 0$ for calculation point between T_{BAL} and T_{SC} $h_0 = z - T_{SC}$ for calculation point above the draught T_{SC}	- developed the impact pressure

Present	Amendment	Note
space: $c_{SL-et} = 5.95 - 10.5\left(\frac{T_{F-e}}{L}\right)^{0.2}$ c_{SL-ft}: Slamming coefficient for case with a full ballast tank: $c_{SL-ft} = 5.95 - 10.5\left(\frac{T_{F-f}}{L}\right)^{0.2}$ f_{SL} : Longitudinal slamming distribution factor, to be taken as: $f_{SL} = 0$ for x/L ≤ 0.5 $f_{SL} = 1.0$ for x/L = 0.5 + c_2 $f_{SL} = 1.0$ for x/L = 0.65 + c_2 $f_{SL} = 0.5$ for x/L ≥ 1.0 Intermediate values of f_{SL} are to be obtained by linear interpolation. c_2 : Coefficient to be taken as: $c_2 = 0.33\,C_B + \frac{L}{2500}$ but not to be taken greater than 0.35. T_{F-e} : Design slamming draught at the FP to be provided by the Designer. T_{F-e} is not to be greater than the minimum draught at the FP indicated in the loading manual for all seagoing conditions where any of the ballast tanks within the bottom slamming region are empty. (2023) T_{F-f} : Design slamming draught at the FP to be provided by the Designer. T_{F-f} is not to be greater than the minimum draught at the FP indicated in the loading manual for all seagoing conditions where all ballast tanks within the bottom slamming region are full. (2023) z_{top} : Z-coordinate of the highest point of the tank, excluding small hatchways, in m. For strength assessment of double bottom floors and girders, z_{top} is not to be taken greater than the double bottom height.	• For stern slamming $h_0 = 0$ for calculation point between T_{AE} and T_{SC} $h_0 = z - T_{SC}$ for calculation point above the draught T_{SC} C_E : Equivalent coefficient, to be taken as: • For $\xi \le 30°$ $C_E = 0.03\xi + 0.1$ for bottom slamming $C_E = 0.03\xi + 0.1$ for bow impact $C_E = 0.032\xi + 0.04$ for stern slamming • For $\xi > 30°$ $C_E = 1.0$ ξ : Angle, in deg, to be taken as: $\xi = 90 - \alpha > 3.85$ for bottom slamming $\xi = 64 - \alpha > 3.85$ for bow impact $\xi = 90 - \alpha > 0$ for stern slamming α : Flare angle, in deg, at the calculation point defined as the angle between a vertical line and the tangent to the side plating, measured in a vertical plane normal to the horizontal tangent to the shell plating, see **Figure 2** and **Figure 3**. P_E : Impact pressure, in kN m. $P_E = \frac{1}{2}\rho K_E V_E^2$ K_E : Pressure factor, to be taken as: $K_E = 745\xi^{-1.22}$ V_E : Entrance speed, in m/s $V_E = 0.38(22.8 - 0.014L)$ for bottom slamming and bow impact $V_E = 0.6(6.8 + 0.01L)$ for stern slamming	- developed the impact pressure

Present	Amendment	Note
	 **Figure 2 : Definition of bow geometry**  **Figure 3 : Definition of stern geometry**	– developed the impact pressure

Present	Amendment	Note
3.2.2 Loading manual information The loading guidance information is to clearly state the design slamming draughts and the ballast water exchange method used for each ballast tank, if any. **3.3 Bow impact pressure** **3.3.1 Design pressures** The bow impact pressure P_{FB}, in kN/m^2, to be considered for the bow impact design load scenario is to be taken as: $P_{FB} = 1.025 f_{FB} c_{FB} V_{im}^2 \sin\gamma_{wl}$ where: f_{FB} : Longitudinal bow flare impact pressure distribution factor. To be taken as: $f_{FB} =$ 0.55 for $x/L \le 0.9$ $f_{FB} =$ 4 $(x/L - 0.9) + 0.55$ for $0.9 < x/L \le 0.9875$ $f_{FB} =$ 8 $(x/L - 0.9875) + 0.9$ for $0.9875 < x/L \le 1$ $f_{FB} =$ 1.0 for $x/L > 1.0$ V_{im} : Impact speed, in knots, to be taken as: $V_{im} = 0.514\, V_{ref} \sin\alpha_{wl} + \sqrt{L}$ V_{ref} : Forward speed, in knots, to be taken as: $V_{ref} = 0.75\,V$ but not less than 10. α_{wl} : Local waterline angle, in deg, at the considered position, but not less than 35 deg. See **Figure 12**. γ_{wl} : Local bow impact angle, in deg, measured in a vertical plane containing the normal to the shell, from the horizontal to the tangent line at the considered position but not less than 50 deg, as shown in **Figure 12**. Where this value is not available, it may be taken as: $\gamma_{wl} = \tan^{-1}\left(\frac{\tan\beta_{pl}}{\cos\alpha_{wl}}\right)$	**3.2.1 Breaking wave impact pressure** The breaking wave impact pressure, P_{BI} in kN/m2, is to be taken as: $P_{BI} = CP_B$ where: C : Vertical distribution coefficient, as given in **[3.2.1]**. C_W : Wave coefficient, as defined in **Ch 4, Sec 4**. h_0 : Vertical distance, in m, as given in **[3.2.1]**. P_B : Impact pressure, in kN m. $P_B = \frac{1}{2}\rho K_E V_B^2 C_\varnothing$ K_B : Coefficient, to be taken as: K_B = 4 V_B : Relative velocity, in m/, to be taken as: $V_B = 0.514\,V \bullet \sin(\beta + 30) + V_{BW}$ V_{BW} : Breaking wave velocity, in m/s, to be taken as: $V_{BW} = 12 C_\beta$ C_β : Coefficient, to be taken as: $C_\beta = 0.25 + \frac{\beta}{60}$ for $0^\circ < \beta < 45^\circ$ $C_\beta = 1$ for $45^\circ \le \beta \le 90^\circ$ $C_\varnothing$: Hull inclination angle influence coefficient, in deg, to be taken as: $C_\varnothing = 1 - \frac{\alpha}{60}$ for $\beta < 15^\circ$ $C_\varnothing = 1$ for $\beta \ge 15^\circ$ α : Flare angle, in deg, as given in **[3.2.1]**. β : Angle, in deg, at the calculation point defined as the angle between a longitudinal line and a tangent to the side plating in a horizontal plan, see **Figure 2** and **Figure 3**.	– developed the impact pressure

Present	Amendment	Note

Present

β_{pl} : Local body plan angle, in deg, at the considered position from the horizontal to the tangent line, but not less than 35 deg.

c_{FB} : Coefficient to be taken as:

$c_{FB} = 1.0$ for positions between draughts T_{BAL} and T_{SC}.

$T_{SC}.c_{FB} = \sqrt{1.0 + \cos^2[90\frac{(h_{fb} - 2h_0)}{h_{fb}}]}$ for positions above draughts

h_{fb} : Vertical distance, in m, from the waterline at the draught T_{SC} to the highest deck at side. See Figure 12.

h_0 : Vertical distance, in m, from the waterline at the draught T_{SC} to the considered position. See Figure 12.

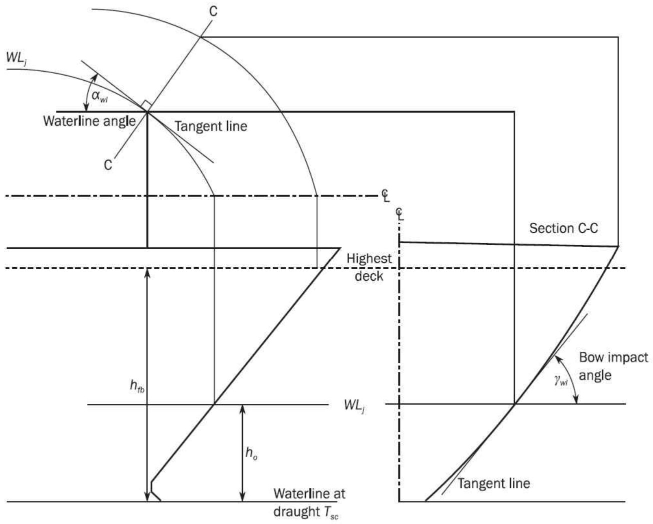


Figure 4 : Definition of bow geometry

Amendment

3.3 Bottom slamming

3.3.1 Design pressures

The bottom slamming pressure, P_{SL} in kN/m^2, at the centre line for the bottom slamming design load scenario is to be taken as:

$$P_{SL} = C_x P_{EI}$$

where:

C_x : Longitudinal distribution factor along the ship length, to be taken as:

$C_x = 0.0$ for $f_{xL} \leq 0.5$

$C_x = 1.0$ for $f_{xL} = 0.5 + c_2$

$C_x = 1.0$ for $f_{xL} = 0.6 + c_2$

$C_x = 0.5$ for $f_{xL} = 1.0$

Intermediate values of C_x are obtained by linear interpolation.

c_2 : Coefficient to be taken as:

$c_2 = 0.33\,C_B + \frac{L}{2500}$ but not to be taken greater than 0.35.

P_{EI} : Entry impact pressure, in kN/m^2, as defined in **[3.2.1]**.

α : Flare angle, in deg, at the bottom centerline in the longi tudinal direction of the ship, see **Figure 2.**

Note

- developed the impact pressure

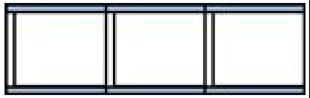
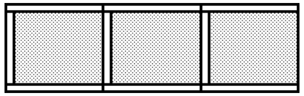
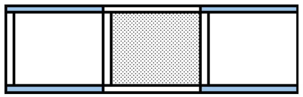
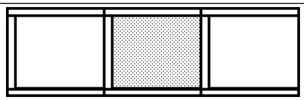
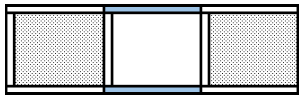
Present	Amendment	Note
	3.4 Bow impact **3.4.1 Design pressures** The bow impact pressure, P_{FB} in kN/m2, to be considered for the bow impact design load scenario is to be taken as: $P_{FB} = \max(P_{EI}, P_{BI}) \cdot f_{FB}$ where: P_{EI} : Entry impact pressure, in kN m^2, as defined in **[3.2.1]**. P_{BI} : Breaking wave impact pressure, in kN m^2, as defined in **[3.2.2]**. f_{FB} : Longitudinal distribution factor along the ship length, to be taken as follow but not to be taken greater than 1.0: $f_{FB} = 0.0$ for $f_{xL} < 0.5$ $f_{FB} = 2.5 f_{xL} - 1.25$ for $f_{xL} \geq 0.5$ **3.5 Stern slamming** **3.5.1 Design pressures** The stern slamming pressure, P_{SS} in kN/m^2,, to be considered for the stern slamming design load scenario is to be taken as: $P_{SS} = P_{EI}$ where: P_{EI} : Entry impact pressure, in kN/m^2, as defined in **[3.2.1]**.	- developed the impact pressure

Present	Amendment	Note
(see below)		- changed the heel condition.

Chapter 7 Direct Strength Analysis

Section 2 Cargo Hold Structural Strength Analysis

Table 5 : Standard loading conditions applicable to midship cargo hold region

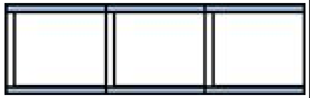
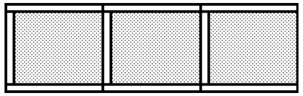
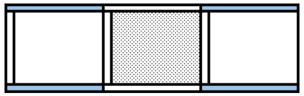
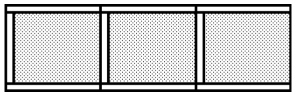
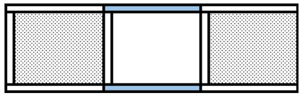
No	Loading Pattern	Draught	% of perm. SWBM	% of perm. SWSF	Dynamic load cases	Pressure by IGC (Pt 7, Ch 5, 428)
Seagoing conditions						
LM1[2)]		$0.7T_{SC}$[1)]	0% Sagging	≤100%	HSM1	N/A
			100% Hogging	≤100%	HSM2, FSM2, BSR-2P, OST-1P, OST-2P	N/A
LM2[2)]		T_{SC}	100% Sagging	≤100%	HSM1, BSP-2P, BSR-1P, OST-1P	N/A
			30% Hogging	≤100%	HSM2, BSP-1P, BSR-2P, OST-2P	N/A
LM3[2)]		$0.8T_{SC}$	100% Sagging	100% Max SFLC (aft-, fwd+)	HSM1	N/A
				≤100%	BSP-1P, BSP-2P	N/A
			75% Hogging	≤100%	HSM2	N/A
LM3 -IGC		$0.8T_{SC}$[3)]	≤100%	≤100%	N/A	α_{β} associated with Max P_{gd} at AP2[4)]
LM4[2)]		$0.9\,T_{SC}$	70% Sagging	≤100%	HSM1	N/A
			60% Hogging	100% Max SFLC (aft+, fwd-)	HSM2, FSM2	N/A
				≤100%	BSR-1P, BSR-2P	N/A
〈omitted〉						

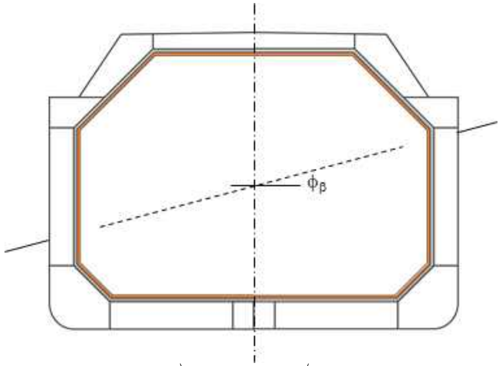
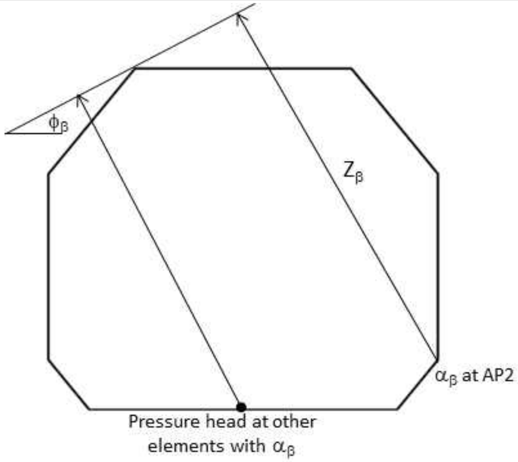
Present	Amendment	Note
	Chapter 7 Direct Strength Analysis; Section 2 Cargo Hold Structural Strength Analysis; Table 5	- changed the heel condition.

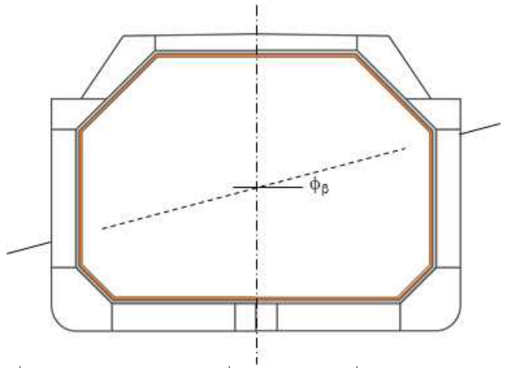
Chapter 7 Direct Strength Analysis

Section 2 Cargo Hold Structural Strength Analysis

Table 5 : Standard loading conditions applicable to midship cargo hold region

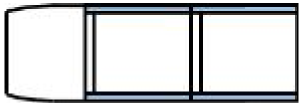
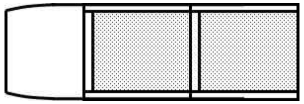
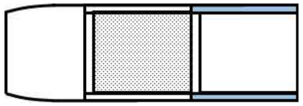
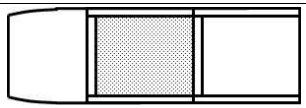
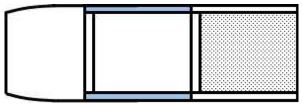
No	Loading Pattern	Draught	% of perm. SWBM	% of perm. SWSF	Dynamic load cases	Pressure by IGC (Pt 7, Ch ~~5, 428~~)
Seagoing conditions						
LM1[2)]		$0.7T_{SC}$[1)]	0% Sagging	≤100%	HSM1	N/A
			100% Hogging	≤100%	HSM2, FSM2, BSR-2P, OST-1P, OST-2P	N/A
LM2[2)]		T_{SC}	100% Sagging	≤100%	HSM1, BSP-2P, BSR-1P, OST-1P	N/A
			30% Hogging	≤100%	HSM2, BSP-1P, BSR-2P, OST-2P	N/A
LM3[2)]		$0.8T_{SC}$	100% Sagging	100% Max SFLC (aft-, fwd+)	HSM1	N/A
				≤100%	BSP-1P, BSP-2P	N/A
			75% Hogging	≤100%	HSM2	N/A
LM3 ~~-IGC~~ I		~~$0.8T_{SC}$[3)]~~	≤100%	≤100%	N/A	~~α_β associated with Max P_{gd} at AP2[4)]~~ Static 30° Heel angle[3)]
LM4[2)]		$0.9\,T_{SC}$	70% Sagging	≤100%	HSM1	N/A
			60% Hogging	100% Max SFLC (aft+, fwd-)	HSM2, FSM2	N/A
				≤100%	BSR-1P, BSR-2P	N/A
〈omitted〉						

Present	Amendment	Note
〈omitted〉 Note : 1) Draught needs not greater than the minimum ballast draught in the loading manual. 2) For the ship with an asymmetrical structures, BSR-1S, BSR-2S, BSP-1S, BSP-2S, OST-1S and OST-2S shall be investigated additionally. For ships with symmetrical about the centerline, results of one side should be considered as same as the other side 3) Hydrostatic external sea pressure with heel angle ϕ_β corresponding roll angle of α_β is applicable, but heel angle need not greater than 30°. Additional boundary condition is to be applied as shown **Figure 9**. 4) When the internal pressure calculated according to **Pt7, Ch 5, Sec 4 428** is used, P_{IGC} is calculated with $f_{IGC}=0.8$ considering operational profile. In that case, acceptance criteria is AC-A. If other alternative pressure is used, f_{IGC} is not applicable and acceptance criteria is AC-SD.  $\rho g\left(T\cos\phi_\beta-\frac{B}{2}\sin\phi_\beta\right)$ $\rho g\left(T\cos\phi_\beta+\frac{B}{2}\sin\phi_\beta\right)$  		- changed the heel condition.

Present	Amendment	Note
	〈omitted〉 Note : 1) Draught needs not greater than the minimum ballast draught in the loading manual. 2) For the ship with an asymmetrical structures, BSR-1S, BSR-2S, BSP-1S, BSP-2S, OST-1S and OST-2S shall be investigated additionally. For ships with symmetrical about the centerline, results of one side should be considered as same as the other side 3) Hydrostatic external sea pressure with 30° heel angle ϕ_β (ϕ_β = 30°). ~~corresponding roll angle of α_β is applicable, but heel angle need not greater than 30°. Additional boundary condition is to be applied as shown **Figure 9**.~~ ~~4) When the internal pressure calculated according to **Pt7, Ch 5, Sec 4 428** is used, P_{IGC} is calculated with $f_{IGC}=0.8$ considering operational profile. In that case, acceptance criteria is AC-A.~~ ~~If other alternative pressure is used, f_{IGC} is not applicable and acceptance criteria is AC-SD.~~  $\rho g\left(T\cos\phi_\beta-\frac{B}{2}\sin\phi_\beta\right)$ $\rho g\left(T\cos\phi_\beta+\frac{B}{2}\sin\phi_\beta\right)$	- changed the heel condition.

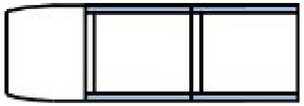
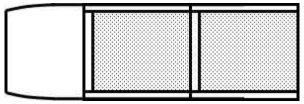
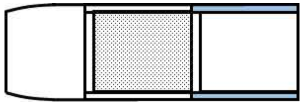
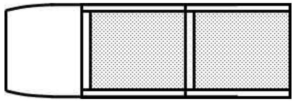
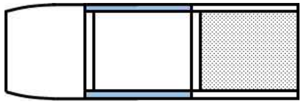
Present	Amendment	Note
Table 6 : Standard loading conditions applicable to aftmost cargo hold region		- changed the heel condition.

Table 6 : Standard loading conditions applicable to aftmost cargo hold region

No	Loading Pattern	Draught	% of perm. SWBM	% of perm. SWSF	Dynamic load cases	Acceleration by IGC(Pt 7, Ch 5, 428)
Seagoing conditions						
LA1[2)]		$0.7T_{SC}$[1)]	0% Sagging	≤100%	HSM1	N/A
			100% Hogging	≤100%	HSM2, FSM2, OST-1P, OST-2P	N/A
LA2[2)]		T_{SC}	100% Sagging	≤100%	HSM1, FSM1 BSP-1P, BSP-2P BSR-1P, BSR-2P OST-1P, OST-2P	N/A
			40% Hogging	≤100%	HSM2	N/A
LA3		$0.85T_{SC}$	0% Sagging	100% Max SFLC(Aft-)	HSM1	N/A
			60% Hogging	100% Max SFLC(fwd+)	HSM2	N/A
LA3 -IGC		$0.85T_{SC}$[3)]	≤100%	≤100%	N/A	α_β associated with Max P_{gd} at AP2[4)]
LA4[5)]		$0.85T_{SC}$	30% Sagging	100% Max SFLC(Fwd-)	HSM1	N/A
			70% Hogging	100% Max SFLC(Aft+)	HSM2	N/A
〈omitted〉						

Present	Amendment	Note
	Table 6 : Standard loading conditions applicable to aftmost cargo hold region	- changed the heel condition.

Table 6 : Standard loading conditions applicable to aftmost cargo hold region

No	Loading Pattern	Draught	% of perm. SWBM	% of perm. SWSF	Dynamic load cases	Acceleration by IGC(Pt 7, Ch 5, ~~428~~)
Seagoing conditions						
LA1[2)]		$0.7T_{SC}$[1)]	0% Sagging	≤100%	HSM1	N/A
			100% Hogging	≤100%	HSM2, FSM2, OST-1P, OST-2P	N/A
LA2[2)]		T_{SC}	100% Sagging	≤100%	HSM1, FSM1 BSP-1P, BSP-2P BSR-1P, BSR-2P OST-1P, OST-2P	N/A
			40% Hogging	≤100%	HSM2	N/A
LA3		$0.85T_{SC}$	0% Sagging	100% Max SFLC(Aft-)	HSM1	N/A
			60% Hogging	100% Max SFLC(fwd+)	HSM2	N/A
LA3 ~~-IGC~~ I		~~$0.85T_{SC}$ 3)~~	≤100%	≤100%	N/A	~~α_β associated with Max P_{gd} at AP2 4)~~ Static 30° Heel angle[3)]
LA4[5)]		$0.85T_{SC}$	30% Sagging	100% Max SFLC(Fwd-)	HSM1	N/A
			70% Hogging	100% Max SFLC(Aft+)	HSM2	N/A
〈omitted〉						

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

〈omitted〉

Note : 1) Draught needs not greater than the minimum ballast draught in the loading manual.

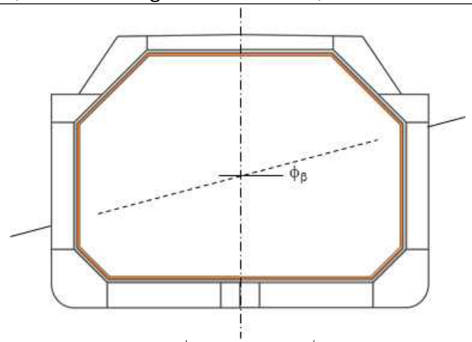
2) For the ship with an asymmetrical structures, BSR-1S, BSR-2S, BSP-1S, BSP-2S, OST-1S and OST-2S shall be investigated additionally. For ships with symmetrical about the centerline, results of one side should be considered as same as the other side

3) Hydrostatic external sea pressure with heel angle ϕ_β corresponding roll angle of α_β is applicable, but heel angle need not greater than 30°. Additional boundary condition is to be applied as shown **Figure 9**.

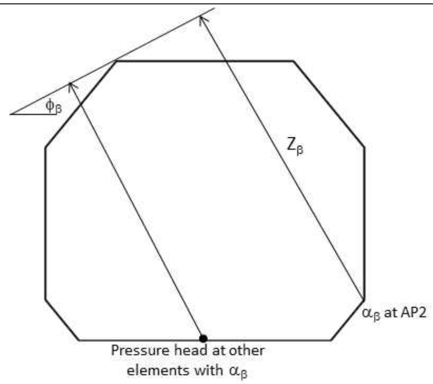
4) When the internal pressure calculated according to **Pt7, Ch 5, Sec 4 428** is used, P_{IGC} is calculated with $f_{IGC} = 0.8$ considering operational profile. In that case, acceptance criteria is AC-A.

If other alternative pressure is used, f_{IGC} is not applicable and acceptance criteria is AC-SD.

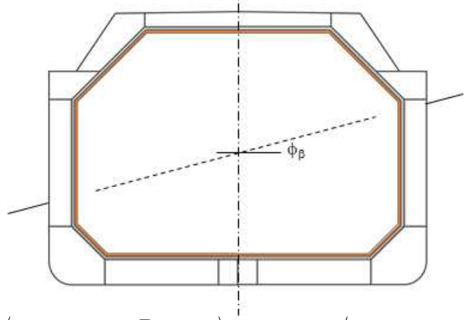
5) 100% filling of tanks in E/R



$\rho g\left(T\cos\phi_\beta - \frac{B}{2}\sin\phi_\beta\right)$ $\rho g\left(T\cos\phi_\beta + \frac{B}{2}\sin\phi_\beta\right)$

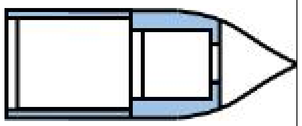
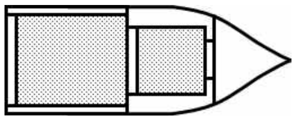
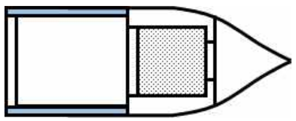
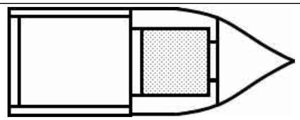
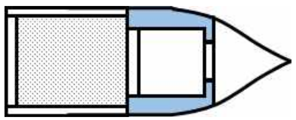


</td><td></td><td>- changed the heel condition.</td></tr>
</table>

Present	Amendment	Note
	⟨omitted⟩ Note : 1) Draught needs not greater than the minimum ballast draught in the loading manual. 2) For the ship with an asymmetrical structures, BSR-1S, BSR-2S, BSP-1S, BSP-2S, OST-1S and OST-2S shall be investigated additionally. For ships with symmetrical about the centerline, results of one side should be considered as same as the other side 3) Hydrostatic external sea pressure with 30° heel angle ϕ_β(ϕ_β = 30°). ~~corresponding roll angle of α_β is applicable, but heel angle need not greater than 30°. Additional boundary condition is to be applied as shown **Figure 9**.~~ ~~4) When the internal pressure calculated according to **Pt7, Ch 5, Sec 4 428** is used, P_{IGC} is calculated with $f_{IGC} = 0.8$ considering operational profile. In that case, acceptance criteria is AC-A.~~ ~~If other alternative pressure is used, f_{IGC} is not applicable and acceptance criteria is AC-SD.~~ ~~5)~~4) 100% filling of tanks in E/R  $\rho g\left(T\cos\phi_\beta - \frac{B}{2}\sin\phi_\beta\right)$ $\rho g\left(T\cos\phi_\beta + \frac{B}{2}\sin\phi_\beta\right)$	- changed the heel condition.

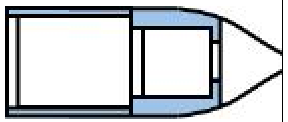
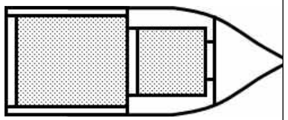
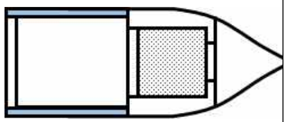
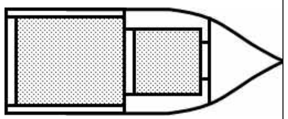
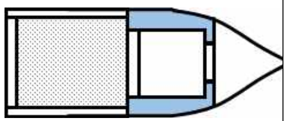
Present	Amendment	Note
Table 7 (below)		- changed the heel condition.

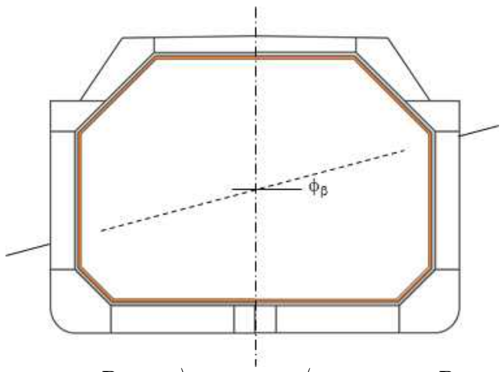
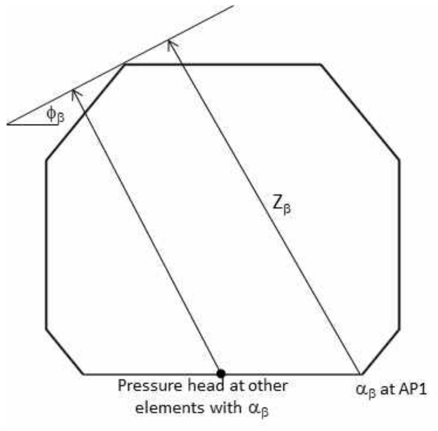
Table 7 : Standard loading conditions applicable to foremost cargo hold region

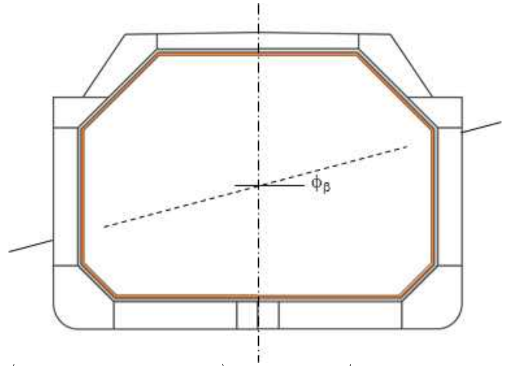
No	Loading Pattern	Draught	% of perm. SWBM	% of perm. SWSF	Dynamic load cases	Acceleration by IGC(Pt 7, Ch 5, 428)
Seagoing conditions						
LF1[2]		$0.7T_{SC}$[1]	0% Sagging	≤100%	HSM1, BSR-2P, OSA-2P	N/A
			100% Hogging	≤100%	HSM2, FSM2, BSR-1P, OST-1P, OST-2P, OSA-1P	N/A
LF2[2]		T_{SC}	100% Sagging	≤100%	HSM1, FSM1 BSP-1P, BSP-2P, BSR-1P, BSR-2P OST-1P, OST-2P	N/A
			30% Hogging	≤100%	HSM2	N/A
LF3		$0.85T_{SC}$	60% Sagging	≤100%	HSM1	N/A
			100% Hogging	100% Max SFLC(Aft-)	HSM2	N/A
LF3 -IGC		$0.85T_{SC}$[3]	≤100%	≤100%	N/A	a_β associated with Max P_{gd} at AP1[4]
LF4[5]		0.9 T_{SC}	100% Sagging	100% Max SFLC(Aft+)	HSM1	N/A
			50% Hogging	100% Max SFLC(Aft-)	HSM2	N/A
〈omitted〉						

Present	Amendment	Note
	Table 7 : Standard loading conditions applicable to foremost cargo hold region (below)	- changed the heel condition.

Table 7 : Standard loading conditions applicable to foremost cargo hold region

No	Loading Pattern	Draught	% of perm. SWBM	% of perm. SWSF	Dynamic load cases	Acceleration by IGC(Pt 7, Ch 5, ~~428~~)
Seagoing conditions						
LF1[2)]		$0.7T_{SC}$[1)]	0% Sagging	≤100%	HSM1, BSR-2P, OSA-2P	N/A
			100% Hogging	≤100%	HSM2, FSM2, BSR-1P, OST-1P, OST-2P, OSA-1P	N/A
LF2[2)]		T_{SC}	100% Sagging	≤100%	HSM1, FSM1 BSP-1P, BSP-2P, BSR-1P, BSR-2P OST-1P, OST-2P	N/A
			30% Hogging	≤100%	HSM2	N/A
LF3		$0.85T_{SC}$	60% Sagging	≤100%	HSM1	N/A
			100% Hogging	100% Max SFLC(Aft-)	HSM2	N/A
LF3 ~~IGC~~ I		~~$0.85T_{SC}$[3)]~~	≤100%	≤100%	N/A	~~α_β associated with Max P_{gd} at AP1[4)]~~ Static 30° Heel angle[3)]
LF4~~[5)]~~[4)]		$0.9T_{SC}$	100% Sagging	100% Max SFLC(Aft+)	HSM1	N/A
			50% Hogging	100% Max SFLC(Aft-)	HSM2	N/A
〈omitted〉						

Present	Amendment	Note
〈omitted〉 Note : 1) Draught needs not greater than the minimum ballast draught in the loading manual. 2) For the ship with an asymmetrical structures, BSR-1S, BSR-2S, BSP-1S, BSP-2S, OST-1S and OST-2S shall be investigated additionally. For ships with symmetrical about the centerline, results of one side should be considered as same as the other side 3) Hydrostatic external sea pressure with heel angle ϕ_β corresponding roll angle of α_β is applicable, but heel angle need not greater than 30°. Additional boundary condition is to be applied as shown **Figure 9**. 4) When the internal pressure calculated according to **Pt7, Ch 5, Sec 4 428** is used, P_{IGC} is calculated with $f_{IGC}=0.8$ considering operational profile. In that case, acceptance criteria is AC-A. If other alternative pressure is used, f_{IGC} is not applicable and acceptance criteria is AC-SD. 5) 100% filling of tanks in fore end structure outside of cargo hold region  $\rho g\left(T\cos\phi_\beta-\frac{B}{2}\sin\phi_\beta\right)$ $\rho g\left(T\cos\phi_\beta+\frac{B}{2}\sin\phi_\beta\right)$  		- changed the heel condition.

Present	Amendment	Note
	〈omitted〉 Note : 1) Draught needs not greater than the minimum ballast draught in the loading manual. 2) For the ship with an asymmetrical structures, BSR-1S, BSR-2S, BSP-1S, BSP-2S, OST-1S and OST-2S shall be investigated additionally. For ships with symmetrical about the centerline, results of one side should be considered as same as the other side 3) Hydrostatic external sea pressure with 30° heel angle ϕ_β(ϕ_β = 30°). ~~corresponding roll angle of α_β is applicable, but heel angle need not greater than 30°. Additional boundary condition is to be applied as shown **Figure 9**.~~ ~~4) When the internal pressure calculated according to **Pt7, Ch 5, Sec 4 428** is used, P_{IGC} is calculated with $f_{IGC}=0.8$ considering operational profile. In that case, acceptance criteria is AC-A.~~ ~~If other alternative pressure is used, f_{IGC} is not applicable and acceptance criteria is AC-SD.~~ ~~5)~~4) 100% filling of tanks in fore end structure outside of cargo hold region  $\rho g\left(T\cos\phi_\beta - \frac{B}{2}\sin\phi_\beta\right)$ $\rho g\left(T\cos\phi_\beta + \frac{B}{2}\sin\phi_\beta\right)$	- changed the heel condition.

Present	Amendment	Note
Chapter 10 Other Structures **Section 3 Aft Part** **1. ~ 4. 〈same as the present〉** **5. Structure subjected to impact loads (Newly added)**	**Chapter 10 Other Structures** **Section 3 Aft Part** **1. ~ 4. 〈same as the present〉** **5. Structure subjected to impact loads** **5.1 General** **5.2.1 Application** The requirements of this sub-section cover the strengthening requirements for local impact loads that may occur in the stern bottom structure of the ships with length $L \geq 150$m. The stern slamming loads, P_{SS}, to be applied in **[5.2]** are described in **Ch 4, Sec 5, [3]**. The requirements of **[5.2]** are to be applied in addition to applicable scantling requirements in **Ch 6**. **5.2 Stern slamming** **5.2.1 Application** The stern bottom structure is to be strengthened against stern slamming pressures. **5.2.2 Extent of strengthening** In general the strengthening is to extend aft of 0.1L forward of AE and vertically above the minimum design ballast draught, T_{AE}, defined in **Ch 1, Sec 4, Table 2**. Outside the strengthening area the scantlings are to be tapered to maintain continuity of longitudinal and / or transverse strength.	- newly added

Present	Amendment	Note
	5.2.3 Side shell plating The net thickness of the side shell plating, t in mm, is not to be less than: $t = 0.0158\alpha_p b\sqrt{\frac{P_{SS}}{R_{eH}}}$ where: P_{SS} : Stern slamming pressure defined in **Ch 4, Sec 5, [3.5.1]**, in $\mathrm{kN/m^2}$. **5.2.4 Side shell stiffeners** The side shell stiffeners within the strengthening area defined in **[5.2.2]** are to comply with the following criteria: a) The net web thickness, t_w in mm, is not to be less than: $t_w = \frac{f_{shr} P_{SS} s \ell_{shr}}{d_{shr} \tau_{eH}}$ where: f_{shr} : Shear force distribution factor: $f_{shr} = 0.7$ b) The net plastic section modulus, Z_{pl} in $\mathrm{cm^3}$, is not to be less than: $Z_{pl} = \frac{1.2 P_{SS} s \ell_{bdg}^2}{f_{bdg} R_{eH}}$	

Present	Amendment	Note
	5.2.5 Primary supporting members The size and number of openings in web plating of the floors and girders is to be minimised considering the required shear area as given: a) Section modulus The section modulus of each primary supporting member, Z in cm^3, is not to be less than: $Z = 1000 \dfrac{P_{SS} S \ell_{bdg}^2}{f_{bdg} R_{eH}}$ with f_{bdg} is not to be taken less than 10 b) Shear area The shear area, A_{shr} in cm^2, of each primary supporting member web at any position along its span is not to be less than: $A_{shr} = 10 \dfrac{f_{shr} P_{SS} S \ell_{shr}}{\tau_{eH}}$ where: f_{shr} : Shear force distribution factor, as defined in **Ch 6, Sec 6, Table 2.** c) Web thickness of primary supporting member The net thickness of primary supporting members in way of stern impact strengthening area defined in **[5.2.2]**, t_w in mm, is not to be less than: $t_w = \dfrac{s_W}{75} \sqrt{\dfrac{R_{eH}}{235}}$ where: s_W : Plate breadth, in mm, taken as the spacing between the web stiffening.	