Amendments of Rules / Guidance

(External Review)

Pt. 7 Ships of Special service

2019. 8.

Hull Rule Development Team

Present	Amendment	Note

Part 7 <Rules>

CHAPTER 2 ORE CARRIERS

Section 3 Wing Tanks or Void Spaces

301. <omit>

302. Bulkhead plating

1. The ~ <omit> :

S = spacing of stiffeners (m).

h = water head of h_1, h_2 or h_3 is obtained from **Table 7.2.2**, whichever is the greater.

C_1 = <omit>

C_2 = <omit>

Table 7.2.2 Water head h_1, h_2, and h_3

h_1	Vertical distance from the lower edge of the bulkhead plating under consideration to the mid-point between the point on tank top and the upper end of the overflow pipe. ~ <omit>
h_2	As obtained from the following formula $h_2 = 0.85(h_1 + \Delta h)$ ~ <omit>
h_3	Value (m) obtained by multiplying 0.7 by vertical distance from the lower edge of the bulkhead plating under consideration to the point 2.0 m above the top of overflow pipe.

Present	Amendment	Note

Part 7 <Rules>

CHAPTER 2 ORE CARRIERS

Section 3 Wing Tanks or Void Spaces

301. <same as current>

302. Bulkhead plating (2020)

1. The ~ <same as current> :

S = spacing of stiffeners (m).

h = water head of h_1, h_2 or h_3 is obtained from **Table 7.2.2**, whichever is the greater. When the ship use the flow-through ballast water exchange operations method, h_4 and h_5 are to be additionally considered.

C_1 = <same as current>

C_2 = <same as current>

Table 7.2.2 Water head h_1, h_2, and h_3

h_1	<same as current>
h_2	<same as current>
h_3	<same as current>
h_4	Vertical distance from the lower edge of the bulkhead plating under consideration to the top of the overflow pipe (or air pipe) to the point where the overpressure is added (m). (Overpressure : due to sustained liquid flow through overflow pipe in case of over-filling or filling during flow through ballast water exchange. It is to be defined by the designer, but not to be less than 2.5.)
h_5	$0.85(h_4 + \Delta h)$ Δh : as specified in h_2

Present	Amendment	Note
2. ~ 6. <omit> **303. Longitudinals and Stiffeners** **1. ~ 5. <omit>** **6.** The section modulus of stiffeners attached to bulkhead plating in deep tanks is not to be less than the value obtained from the following formula: $Z = 125 C_1 C_2 C_3 S h l^2$ (cm^3) Where: S = spacing of stiffeners (m). h = water head h_1, h_2 or h_3 as specified in **Table 7.2.2.** Where, however, "from the lower edge of the bulkhead plating under consideration" is to be construed as "from the stiffener under consideration" for horizontal stiffeners, and as "from the mid-point of l" for vertical stiffeners l = distance between the supports of stiffeners (m). C_1 = <omit> C_2 = <omit> C_3 = <omit> <omit> **7. ~ 9. <omit>** **304. <omit>** **Section 4 ~ Section 7 <omit>** ⚓	**2. ~ 6. <same as current>** **303. Longitudinals and Stiffeners** **1. ~ 5. <same as current>** **6.** The section modulus of stiffeners attached to bulkhead plating in deep tanks is not to be less than the value obtained from the following formula: **(2020)** $Z = 125 C_1 C_2 C_3 S h l^2$ (cm^3) Where: S = spacing of stiffeners (m). h = water head h_1, h_2 or h_3 as specified in **Table 7.2.2.** Where, however, "from the lower edge of the bulkhead plating under consideration" is to be construed as "from the stiffener under consideration" for horizontal stiffeners, and as "from the mid-point of l" for vertical stiffeners. When the ship use the flow-through ballast water exchange operations method, h_4 and h_5 as specified in **302.** are to be additionally considered. l = distance between the supports of stiffeners (m). C_1 = <same as current> C_2 = <same as current> C_3 = <same as current> <same as current> **7. ~ 9.** <same a current> **304. <same as current>** **Section 4 ~ Section 7 <same as current>** ⚓	

Present	Amendment	Note

CHAPTER 10 DOUBLE HULL TANKER

Section 1 <omit>

Section 2 Bulkhead Plating

201. Bulkhead plating in cargo oil tanks and deep tanks **[See Guidance]**

1. The thickness of bulkhead plating is not to be less than the greatest of the values obtained from the following formula when h is substituted with h_1, h_2 and h_3.

$$t_1 = C_1 C_2 S \sqrt{h} + 2.5 \quad (\mathrm{mm})$$

where:

h = water head of h_1, h_2 or h_3 is obtained from **Table 7.10.2.**

Table 7.10.2 Water head h_1, h_2, and h_3

	Cargo oil tanks	Deep tanks
h_1	<omit>	Vertical distance ~ <omit>
h_2	As obtained from the following formula $h_2 = 0.85(h_1 + \Delta h)$ <omit>	
h_3	<omit>	Value (m) obtained by multiplying 0.7 by vertical distance from the lower edge of the bulkhead plating under consideration to the point 2.0 m above the top of overflow pipe..

202., 203. **<omit>**

Present	Amendment	Note

CHAPTER 10 DOUBLE HULL TANKER

Section 1 <same as current>

Section 2 Bulkhead Plating

201. Bulkhead plating in cargo oil tanks and deep tanks (2020) 【See Guidance】

1. The thickness of bulkhead plating is not to be less than the greatest of the values obtained from the following formula.

<same as current>

where:

h = water head of h_1, h_2 or h_3 is obtained from **Table 7.10.2.** When the tank use the flow-through ballast water exchange operations method, h_4 and h_5 are to be additionally considered.

Table 7.10.2 Water head h_1, h_2, and h_3

	Cargo oil tanks	Deep tanks
h_1	<same as current>	<same as current>
h_2	<same as current>	
h_3	<same as current>	<same as current>
h_4	-	Vertical distance from the lower edge of the bulkhead plating under consideration to the top of the overflow pipe (or air pipe) to the point where the overpressure is added (m). (Overpressure : due to sustained liquid flow through overflow pipe in case of overfilling or filling during flow through ballast water exchange. It is to be defined by the designer, but not to be less than 2.5.)
h_5	-	$0.85(h_4 + \Delta h)$ Δh : as specified in h_2

202., 203. <same as current>

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

Section 3 Longitudinals and Stiffeners

301. <omit>

302. Bulkhead stiffeners in cargo oil tanks and deep tanks

1. Section modulus of stiffeners is not to be less than that obtained from the following formula :

$Z = 125 C_1 C_2 C_3 S h l^2 \quad (\mathrm{cm}^3)$

Where:

h = water head h_1, h_2 or h_3 as specified in **Table 7.10.2.** Where, however, "the lower edge of the bulkhead plating under consideration" is to be construed as "the mid-point of the stiffener under consideration" for vertical stiffeners and as "the stiffener under consideration" for horizontal stiffeners. And "side shell plating" is to be construed as "stiffener attached to side shell plating".

C_2 = <omit>

C_3 = <omit>

C_1, S and l = <omit>

2. <omit>

301. <omit>

⚓

</td><td>

Section 3 Longitudinals and Stiffeners

301. <same as current>

302. Bulkhead stiffeners in cargo oil tanks and deep tanks (2020)

1. Section modulus of stiffeners is not to be less than that obtained from the following formula :

$Z = 125 C_1 C_2 C_3 S h l^2 \quad (\mathrm{cm}^3)$

Where:

h = water head h_1, h_2 or h_3 as specified in **Table 7.10.2.** Where, however, "the lower edge of the bulkhead plating under consideration" is to be construed as "the mid-point of the stiffener under consideration" for vertical stiffeners and as "the stiffener under consideration" for horizontal stiffeners. And "side shell plating" is to be construed as "stiffener attached to side shell plating". When the tank use the flow-through ballast water exchange operations method, h_4 and h_5 as specified in **201.** are to be additionally considered.

C_2 = <omit>

C_3 = <omit>

C_1, S and l = <omit>

2. <same as current>

301. <same as current>

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

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

Section 4 Girders

401.~ 404. <omit>

405. Girders and transverse in cargo oil tanks and deep tanks 【See Guidance】

1. The section modulus of girders is not to be less than that obtained from the following formula :

$Z = 7.13\, C_1' k^2 K S h l^2 \quad (\mathrm{cm}^3)$

Where:

h = waterhead h_1, h_2 or h_3 as specified in **Table 7.10.2.** whichever is the greatest. Where, however, "from the lower edge of the bulkhead plating under consideration" is to be construed as "from the mid-point of S" for horizontal girders, and as "from the mid-point of l" for vertical girders in applying the value of h.

k = <omit>

C_1', S and l = <omit>

2. ~ 6. <omit>

406. ~ 408. <omit>

Section 5 ~ Section 10 <omit>

⚓

</td><td>

Section 4 Girders

401.~ 404. <same as current>

405. Girders and transverse in cargo oil tanks and deep tanks (2020)【See Guidance】

1. The section modulus of girders is not to be less than that obtained from the following formula :

$Z = 7.13\, C_1' k^2 K S h l^2 \quad (\mathrm{cm}^3)$

Where:

h = waterhead h_1, h_2 or h_3 as specified in **Table 7.10.2.** whichever is the greatest. Where, however, "from the lower edge of the bulkhead plating under consideration" is to be construed as "from the mid-point of S" for horizontal girders, and as "from the mid-point of l" for vertical girders in applying the value of h. <u>When the ship use the flow-through ballast water exchange operations method, h_4 and h_5 as specified in **201.** are to be additionally considered.</u>

k = <same as current>

C_1', S and l = <same as current>

2. ~ 6. <same as current>

406. ~ 408. <same as current>

Section 5 ~ Section 10 <same as current>

⚓

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

Present	Amendment	Note
Part 7 <Guidances>	**Part 7 <Guidances>**	
CHAPTER 2 ORE CARRIERS	**CHAPTER 2 ORE CARRIERS**	
Section 1, 2 <omit>	**Section 1, 2 <same as current>**	
Section 3 Wing Tanks or Void Spaces	**Section 3 Wing Tanks or Void Spaces**	
302. Bulkhead plating **1.** When the flow-through ballast water exchange operations is used in applying the requirements in **302. 1** of the Rules, the following water heads are to be additionally considered. $h_4 = z_T + h_{air} + h_{drop} - z$ z_{top} : height of highest point of tank (m) h_{air} : height of air or overflow pipe above tank top (m) h_{drop} : Overpressure due to sustained liquid flow through air pipe or overflow pipe in case of overfilling or filling during flow through ballast water exchange. It is to be defined by the designer, but not to be less than 25. z : height to the considered location (m) $h_5 = 0.85(h_4 + \Delta h)$ Δh : as specified in **Pt 3 Ch.15 105.** of the Rules	302. <delete>	
303. Longitudinals and Stiffeners **1.** When the flow-through ballast water exchange operations is used in applying the requirements in **303. 6** of the Rules, the following water heads are to be additionally considered. h_4 and h_5 = as specified in **302.1**	303. <delete>	
304. ~ <omit>	304. ~ <same as current>	
Section 5, Section 7 <same as current>	**Section 5, Section 7 <same as current>**	

<table>
<tr><th>Present</th><th>Amendment</th><th>Note</th></tr>
<tr>
<td>
CHAPTER 10 DOUBLE HULL TANKER
Section 1 <same as current>
Section 2 Bulkhead Plating
201. Bulkhead plating in cargo oil tanks and deep tanks [
1. ~ 3. <omit>
4. When the flow-through ballast water exchange operations is used in applying the requirements in 201. 1 of the Rules, the following water heads are to be additionally considered.
$h_4 = z_{T} + h_{air} + h_{drop} - z$
z_{top} : height of highest point of tank (m)
h_{air} : height of air or overflow pipe above tank top (m)
h_{drop} : Overpressure due to sustained liquid flow through air pipe or overflow pipe in case of overfilling or filling during flow through ballast water exchange. It is to be defined by the designer, but not to be less than 25.
z : height to the considered location (m)
$h_5 = 0.85\,(h_4 + \Delta h)$
Δh : as specified in Pt 3 Ch.15 105. of the Rules
202. <omit>
</td>
<td>
CHAPTER 10 DOUBLE HULL TANKER
Section 1 <same as current>
Section 2 Bulkhead Plating
201. Bulkhead plating in cargo oil tanks and deep tanks
1. ~ 3. <same as current>
4.<delete>
202. <same as current>
</td>
<td></td>
</tr>
</table>

Present	Amendment	Note
Section 3 Longitudinals and Stiffeners **301. <omit>** **302. Bulkhead stiffeners in cargo oil tanks and deep tanks** **1.** When the flow-through ballast water exchange operations is used in applying the requirements in **302. 1** of the Rules, the following water heads are to be additionally considered. h_4 and h_5 = as specified in **201. 4** **Section 4 Girders** **401. ~ 404. <omit>** **405. Girders and transverse in cargo oil tanks and deep tanks** **1.~2. <omit>** **3.** When the flow-through ballast water exchange operations is used in applying the requirements in **405. 1.** of the Rules, the following water heads are to be additionally considered. h_4 and h_5 = as specified in **201. 4** **Section 5 ~ Section 10 <omit>**	**Section 3 Longitudinals and Stiffeners** **301. <same as current>** **302. <delete>** **Section 4 Girders** **401. ~ 404. <same as current>** **405. Girders and transverse in cargo oil tanks and deep tanks** **1.~2. <same as currentt>** **3. <delete>** **Section 5 ~ Section 10 <same as current>**	

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

Part 7 <Rules>

CHAPTER 4 CONTAINER SHIPS

Section 8 Tug Pushing Area

801. Strengthenings for harbour and tug manoeuvres

1. In those zones of the side shell which may be exposed to concentrated loads due to harbour manoeuvres the plate thickness is not to be less than required by **Par 2.** These zones are mainly the plates in way of the ship's fore and aft shoulder and in addition amidships. The exact locations where the tugs shall push are to be defined in the building specification. They are to be identified in the shell expansion plan. The length of the strengthened areas shall not be less than approximately 5 m. The height of the strengthened areas shall extend from about 0,5 m above ballast draught to about 4,0 m above scantling draught. (Where the side shell thickness so determined exceeds the thickness required by this section, it is recommended to specially mark these areas.)

2. The plate thickness in the strengthened areas is to be determined by the following formula:

$t = 0.65\sqrt{P_{fl}K} + 1.5$ (mm)

P_{fl}: local design impact force (kN)

$= D/100$ (200 kN $\le P_{fl} \leqq$ 1,000 kN)

D : displacement of the ship (t)

3. In the strengthened areas the section modulus of side longitudinals is not to be less than: 3

$Z = 0.35\, P_{fl}\, l\, K$ (cm^3)

l : unsupported span (m) of longitudinal

4. Tween decks, transverse bulkheads, stringer and transverse walls are to be investigated for sufficient buckling strength against loads acting in the ship's transverse direction.

Section 9 ~ Section 11 <omit> ⚓

</td><td>

Part 7 <Rules>

CHAPTER 4 CONTAINER SHIPS

Section 8 Tug Pushing Area

801. Strengthenings for harbour and tug manoeuvres

1. In those zones of the side shell which may be exposed to concentrated loads due to harbour manoeuvres the plate thickness is not to be less than required by **Par 2.** These zones are mainly the plates in way of the ship's fore and aft shoulder and in addition amidships. The exact locations where the tugs shall push are to be defined in the building specification. They are to be identified in the shell expansion plan. The length of the strengthened areas shall not be less than approximately 5 m. The height of the strengthened areas shall extend from about 0,5 m above ballast draught to about 4,0 m above scantling draught. (Where the side shell thickness so determined exceeds the thickness required by this section, it is recommended to specially mark these areas.)

2. The plate thickness in the strengthened areas is to be determined by the following formula:

$t = 0.65\sqrt{P_{fl}K} + 1.5$ (mm)

P_{fl}: local design impact force (kN)

$= D/100$ (200 kN $\le P_{fl} \leqq$ 700 kN)

D : displacement of the ship (t)

3. In the strengthened areas the section modulus of side longitudinals is not to be less than: 3

$Z = 0.35\, P_{fl}\, l\, K$ (cm^3)

l : unsupported span (m) of longitudinal

4. Tween decks, transverse bulkheads, stringer and transverse walls are to be investigated for sufficient buckling strength against loads acting in the ship's transverse direction.

Section 9 ~ Section 11 <omit> ⚓

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

Present	Amendment	Note
Part 7 <Rules> **CHAPTER 4 CONTAINER SHIPS** **Section 1 ~ Section 9 <omit>** **Section 10 Freight Container Securing Arrangements** **1001. Cell guide <omit>** **1002. Freight container securing systems [See Guidance]** **1.** For freight container securing systems plans showing materials, arrangement and scantling, etc. may be submitted for approval of the Society. Where container securing fittings are applied for part container only, this requirements may be suitably applied. **2.** Securing devices specified in **Par 1** are to be approved in accordance with the special requirements given by the Society prior to installation on board the ship. <newly added> **Section 11 <omit>** ⚓	**Part 7 <Rules>** **CHAPTER 4 CONTAINER SHIPS** **Section 1 ~ Section 9 <same as current>** **Section 10 Freight Container Securing Arrangements** **1001. Cell guide <same as current>** **1002. Freight container securing systems [See Guidance]** **1.** For freight container securing systems plans showing materials, arrangement and scantling, etc. may be submitted for approval of the Society. Where container securing fittings are applied for part container only, this requirements may be suitably applied. **2.** Securing devices specified in **Par 1** are to be approved in accordance with the special requirements given by the Society prior to installation on board the ship. **3.** Container supporting structures are to be of rolled steel for hull structural specified in **Pt 2, Ch 1, 301.** However, other materials may be used if approved by the Society. **Section 11 <same as current>** ⚓	

Present	Amendment	Note
Part 7 <Rule> **CHAPTER 5 SHIPS CARRYING LIQUEFIED GASES IN BULK** **Section 1 ~ Section 3 <omit>** **Section 4 Cargo Containment** **403. ~ 405. <omit>** **406. Design of secondary barriers** **[See Rules]** **1. Standards of secondary barrier <omit>** **2. Periodical Inspection of Secondary Barrier** (1) With respect to the requirement of **406. 2** (4), it is to be verified that secondary barriers keep a specific level of tightness required in the system design in accordance with an appropriated procedures. (2) For cargo containment system with glued secondary barriers, at the time of construction, tightness test are to be carried out in accordance with approved system designers' procedure and acceptance criteria before and after initial cool down and related values obtained in the test are to be recorded for the use as reference for periodical surveys. (A) Low differential pressures tests are not considered an acceptable test. (B) If the designer's threshold values are exceeded, an investigation is to be carried out and additional testing such as differential pressure, thermographic or acoustic emissions testing is to be carried out as necessary. (3), (4) <omit> **3. Thermal stress analysis for hull structure <omit>** **407. ~ 428. <omit>** **Section 5 ~ Section 19 <omit>**	**Part 7 <Rule>** **CHAPTER 5 SHIPS CARRYING LIQUEFIED GASES IN BULK** **Section 1 ~ Section 3 <same as current>** **Section 4 Cargo Containment** **403. ~ 405. <same as current>** **406. Design of secondary barriers** **[See Rules]** **1. Standards of secondary barrier <same as current>** **2. Periodical Inspection of Secondary Barrier** (1) With respect to the requirement of **406. 2** (4), it is to be verified that secondary barriers keep a specific level of tightness required in the system design in accordance with an appropriated procedures. (2) For cargo containment system with glued secondary barriers, at the time of construction, tightness test are to be carried out in accordance with approved system designers' procedure and acceptance criteria before and after initial cool down. The values recorded are to be used as reference for future assessment of secondary barrier tightness. (A) Low differential pressures tests are not considered an acceptable test. (B) If the designer's threshold values are exceeded, an investigation is to be carried out and additional testing such as differential pressure, thermographic or acoustic emissions testing is to be carried out as necessary. (3), (4) <same as current> **3. Thermal stress analysis for hull structure <same as current>** **407. ~ 428. <same as current>** **Section 5 ~ Section 19 <same as current>**	- UI GC 12 Interpretation

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

Part 7 <Guidance>

Annex 7-3 Guidance for Car Ferries

1. ~ 7. <omit>

8. Bow door, etc

(1) General <omit>
(2) Strength of lamp *(2018)*
The strength of ramp is to be complied with the followings. When the stern and inner door are used for ramp, the followings are to be satisfied.
(A) The thickness of deck to ramp t is to be in accordance with the requirements in **Ch 7, 301. 1.**
(B) The section modulus Z of tripping brackets is to be in accordance with the requirements in **Ch 7, 301. 2.**
(C) The dimensions of longitudinal and transverse girders of the lamp deck can be calculated by assuming that the girder is a simple support beam or continuous beam <u>or</u> by direct strength calculation method. In this case, the load is not less than the value calculated by using 1.3 times of designed maximum vehicle load(ton) and permissible stress 177/K N/mm^2. <u>Deflection is not more than 1/800 of span.</u>
(D) The strength of ramp which is considered as one of shell for navigating is not less than that of side shell or upper structure.
(3) ~ (5) <omit>

9. ~ 13. <omit>

</td><td>

Part 7 <Guidance>

Annex 7-3 Guidance for Car Ferries

1. ~ 7. <omit>

8. Bow door, etc

(1) General <omit>
(2) Strength of lamp *(2018)*
The strength of ramp is to be complied with the followings. When the stern and inner door are used for ramp, the followings are to be satisfied.
(A) The thickness of deck to ramp t is to be in accordance with the requirements in **Ch 7, 301. 1.**
(B) The section modulus Z of tripping brackets is to be in accordance with the requirements in **Ch 7, 301. 2.**
(C) The dimensions of longitudinal and transverse girders of the lamp deck can be calculated by assuming that the girder is a simple support beam or continuous beam<u>. In this case, the load should be the designed maximum vehicle load and the allowable deflection should be less than 1/800 of the span. Alternatively the dimensions may be determined by </u>direct strength calculation method. In this case, the load is not less than the value calculated by using 1.3 times of designed maximum vehicle load(ton) and permissible stress 177/K N/mm^2.
(D) The strength of ramp which is considered as one of shell for navigating is not less than that of side shell or upper structure.
(3) ~ (5) <omit>

9. ~ 13. <omit>

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

Present	Amendment	Note
Annex 7-11 Guidelines on Providing Safe Working Conditions for Securing of Containers on Deck *(2019)* 3. Design requirements (4) Fencing design (A) Lashing bridges, platforms and other working area from which persons may fall 2.0 m or more should be provided with fencing satisfying the requirements given in (D). (5) Access openings (A) Access openings in working area with a potential fall of 2.0 m or more should be either protected by fencing in accordance with (4)(D) or possible to be closed by access covers. (7) Container securing equipment arrangement (B) During tightening or loosening motions on turnbuckles, the risk for hand injury should be minimised, e.g., by keeping sufficient distance between turnbuckles. During tightening or loosening motions, the distance between turnbuckles is typically not less than 45mm.	**Annex 7-11 Guidelines on Providing Safe Working Conditions for Securing of Containers on Deck *(2019)*** 3. Design requirements (4) Fencing design (A) Lashing bridges, platforms and other working area from which persons may fall should be provided with fencing satisfying the requirements given in (D). (5) Access openings (A) Access openings in working area with a potential fall should be either protected by fencing in accordance with (4)(D) or possible to be closed by access covers. (7) Container securing equipment arrangement (B) During tightening or loosening motions on turnbuckles, the risk for hand injury should be minimised, e.g., by keeping sufficient distance between turnbuckles. During tightening or loosening motions, the distance between turnbuckles is typically not less than 70mm.	

Present	Amendment	Note
Part 7 <Guidance> **CHAPTER 7 CAR FERRIES AND ROLL-ON/ROLL-OFF SHIPS** **Section 1 <omit>** **Section 3 Deck Load** **301. <omit>**	**Part 7 <Guidance>** **CHAPTER 7 CAR FERRIES AND ROLL-ON/ROLL-OFF SHIPS** **Section 1 <same as current>** **Section 3 Deck Load** **301. <same as current>** **303. Deck loads** **【See Guidance】** **1.** Deck load h (kN/m^2) for the weather deck is not to be less than that obtained from the following formula. $h = a(bf - y)$ (kN/m2) where: a, b = as given by **Table 7.7.7** according to the position of decks. C_{b1}= block coefficient, however, where C_b is less than 0.6, C_{b1} is to be taken as 0.6, and where C_b is 0.8 and over, C_{b1} is to be taken as 0.8. f = as given in **Table 7.7.8.** (see **Fig 7.7.4**): y = vertical distance from the load line to weather deck at side (m), and y is to be measured at fore end for deck forward of 0.15L abaft the fore end; at 0.15L abaft the fore end for deck between 0.3L and 0.15L abaft the fore end; at midship for deck between 0.3L abaft the fore end and 0.2L afore the aft end; and at aft end for deck afterward of 0.2L afore the aft end (see **Fig 7.7.4**)	

Present	Amendment	Note

Table 7.7.7 Values of a and b

Line	Position of deck	a			
		Beams(1), Deck plating	Pillars	Deck girders	b
I	Forward of $0.15L$ abaft the fore end	14.7	4.90	7.35	$1+\frac{0.338}{(C_{b1}+0.2)^2}$
II	Forward of $0.15L$ and $0.3L$ abaft the fore end	11.8	3.90	5.90	$1+\frac{0.158}{(C_{b1}+0.2)^2}$
III	Between $0.3L$ abaft the fore end and $0.2L$ afore the aft end	6.90	2.25	2.25(2) 3.45(3)	1.0
IV	Afterward of $0.2L$ afore the aft end	9.80	3.25	4.90	$1+\frac{0.123}{(C_{b1}+0.2)^2}$

NOTE:
(1) Where L is 150 m or less, value a may be multiplied by the value of following formula:
$$C=0.0055L+0.175$$
(2) In case of longitudinal deck girders outside the line of hatchway opening of the strength deck for midship part.
(3) In case of deck girders other than (2).

2. h for deck in Line II in **Table 7.7.7,** need not exceed that in Line I.

3. h is not to be less than that obtained from the formulae in **Table 7.7.3,** irrespective of the provisions in **1.** and **2.**

4. Where multi-tier decks of more than 3 are fitted, however, the load applied to the weather deck is to be greater than the value obtained by multiplying the load obtained in **1., 2.** and **3.** by the values in **Table 7.7.4**.

Present	Amendment	Note

5. In the provision of "h" specified in **303.**, a weather deck may be regarded as follows in accordance with the vertical distance, H_D from an imaginary freeboard deck to the weatherdeck at side.

$h_s \leq H_D < 2h_s$: Superstructure deck of first tier above an imaginary freeboard deck

$2h_s \leq H_D < 3h_s$: Superstructure deck of second tier above an imaginary freeboard deck

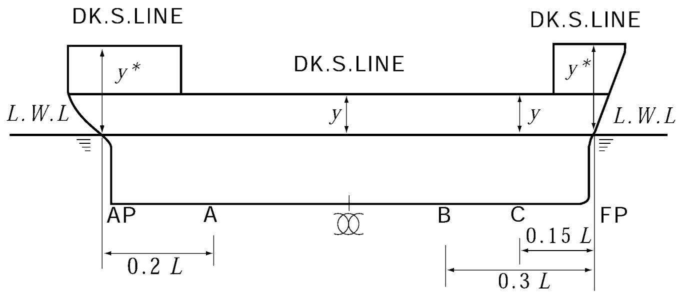
-

-

$nh_s \leq H_D < (n+1)h_s$: Superstructure deck of nth tier above an imaginary freeboard deck

Table 7.7.8 Coefficient f

Length of ship	f
$L < 150$ m	$\frac{L}{10} e^{-\frac{L}{300}} + \left(\frac{L}{150}\right)^2 - 1.0$
150 m $\leq L < 300$ m	$\frac{L}{10} e^{-\frac{L}{300}}$
300 m $\leq L$	11.03



Abaft A y is to be measured at AP.
Between A and B y is to be measured at ⊗.
Between B and C y is to be measured at C.
Afore C y is to be measured at FP.
y^* : In case of no superstructure, y is the distance to the upper deck.

Fig. 7.7.4 Position of measuring y

Present	Amendment	Note
	(see tables below)	

Table 7.7.9 Minimum Values of h

Line	Position of deck	$h^{(1)}$	C	
			Beams(2), Deck plating	Pillars, Deck girders
I and II	Forward of $0.3L$ abaft the fore end	$C\sqrt{L'+50}$	4.20	1.37
III	Between $0.3L$ abaft the fore end and $0.2L$ afore the aft end		2.05	1.18
IV	Afterward of $0.2L$ afore the aft end	$C\sqrt{L'}$	2.95	1.47
Second tier superstructure deck above the freeboard deck 1.95 0.69			1.95	0.69

NOTES:

(1) L' = length of ship (m). Where, however, L exceeds 230 m, L' is to be taken as 230 m.

(2) Where L is 150 m or less, value C may be multiplied by the value of following formula:.

$$0.0055L+0.175$$

Table 7.7.10 Coefficient for pressure on exposed decks

Position of exposed deck	
Freeboard deck	1.0
3rd tier deck	0.32
4th tier deck	0.25
5th tier deck	0.20
6th tier deck	0.15
7th tier deck and above	0.10

Present	Amendment	Note
Part 7 <Rule> **CHAPTER 3 BULK CARRIERS** **Section 1 General**	**Part 7 <Rule>** **CHAPTER 3 BULK CARRIERS** **Section 1 General**	
101. Application [See Guidance]	**101. Application [See Guidance]**	
1. The construction and equipment of ships intended to be registered as "Bulk Carriers" are to be in accordance with the requirements in this Chapter or equivalent thereto. **2.** The requirements in this Chapter are not applied to bulk carriers which were contracted for construction after 1 April 2006 according to **Pt.11** (IACS Common Structural Rules for Bulk Carriers). However, the requirements in **Sec 14** and **Sec 16** apply to bulk carriers including the vessels which should be applied **Pt 11**. **3.** Except where specially required in this Chapter, the general requirements for the construction and equipment of steel ships are to be applied.	**1. ~ 3.** <same as current>	
4. The requirements in this Chapter are framed for ships not less than 100 m and up to 250 m in length and of usual form, having single deck, machinery aft, bilge hopper tanks and topside tanks, and also double bottoms under cargo holds, and decks and bottoms with longitudinal framing.	**4.** The requirements in this Chapter are framed for ships not less than 100 m and up to 250 m in length and of usual form, having single deck, machinery aft, bilge hopper tanks and topside tanks, and also double bottoms under cargo holds, and decks and bottoms with longitudinal framing. <u>In addition, SUBC(Self-Unloading Bulk Carrier), which has a hopper type cargo hold and a conveyor systemfor unloading cargo, is also subject to the requirements of this Chapter.</u>	
5. Ships with different construction from the scope of application given above or larger ships to which the requirements in this Chapter are not applicable, are to be at the discretion of the Society. **6.** Bulk carriers, which were contracted for construction before 1 July 1998, and the keels of which were laid or which were at a similar stage of construction before 1 July 1999, are to be determined at the discretion of the Society.	**5.** ~ **6.** <same as current>	
102. ~ 108. <omit>	**102. ~ 108. <same as current>**	

Present	Amendment	Note
Section 2 ~ Section 8 <omit> **Section 9 Hatch Covers and Hatch Coamings of Cargo Holds** **901. Application and definitions** **1.** These requirements apply to all bulk carriers, ore carriers and combination carriers, and are for all cargo hatch covers and hatch forward and side coamings on exposed decks in position Ⅰ, as defined in **Pt 4, Ch 2, Sec. 1 102.** These requirements applies to ships contracted for construction on or after 1 January 2004. **2.** The strength requirements are applicable to hatch covers and hatch coamings of stiffened plate construction. **3. ~ 10. <omit>** **902. ~ 906. <omit>**	**Section 2 ~ Section 8 <same as current>** **Section 9 Hatch Covers and Hatch Coamings of Cargo Holds** **901. Application and definitions** **1.** These requirements apply to all bulk carriers, SUBC(Self-Unloading Bulk Carrier), ore carriers and combination carriers, and are for all cargo hatch covers and hatch forward and side coamings on exposed decks in position Ⅰ, as defined in **Pt 4, Ch 2, Sec. 1 102.** These requirements applies to ships contracted for construction on or after 1 January 2004. **2.** The strength requirements are applicable to hatch covers and hatch coamings of stiffened plate construction. **3. ~ 10. <same as current>** **902. ~ 906. <same as currnt>**	- IACS UR S21

<table>
<tr><th>Present</th><th>Amendment</th><th>Note</th></tr>
<tr><td>
Section 10 Longitudinal Strength of Hull Girder in Flooded Condition for Bulk Carriers

1001., 1002. <omit>

1003. Flooding conditions
1. Floodable holds
Each cargo hold is to be considered individually flooded up to the equilibrium waterline.
<newly added>
2. Loads
The still water loads in flooded conditions are to be calculated for the above cargo and ballast loading conditions.
The wave loads in the flooded conditions are assumed to be equal to 80% of those given in Pt 3, Ch 3, Sec. 2 Table 3.3.1 and Sec. 3 301. 1.

1004., 1005. <omit>

Section 11 <omit>
</td><td>
Section 10 Longitudinal Strength of Hull Girder in Flooded Condition for Bulk Carriers

1001., 1002. <same as current>

1003. Flooding conditions
1. Floodable holds
Each cargo hold is to be considered individually flooded up to the equilibrium waterline. <u>This application is to be applied to SUBC(Self-Unloading Bulk Carrier) where the unloading system maintains the watertightness during seagoing operations. In SUBCs with unloading systems that do not maintain watertightness, the longitudinal strength in the flooded conditions are to be considered using the extent to which the flooding may occur.</u>
2. Loads
The still water loads in flooded conditions are to be calculated for the above cargo and ballast loading conditions.
The wave loads in the flooded conditions are assumed to be equal to 80% of those given in Pt 3, Ch 3, Sec. 2 Table 3.3.1 and Sec. 3 301. 1.

1004., 1005. <same as current>

Section 11 <same as current>
</td><td>
- IACS UR S17(R.10 2020.7.1.))
</td></tr>
</table>

Present	Amendment	Note
Section 12 Evaluation of Scantlings of Corrugated Transverse Watertight Bulkheads in Bulk Carriers Considering Hold Flooding **1201. Application and definitions <omit>** **1202. Load model** **1. General** (1) The loads to be considered as acting on the bulkheads are those given by the combination of the cargo loads with those induced by the flooding of one hold adjacent to the bulkhead under examination. In any case, the pressure due to the flooding water alone is to be considered. <newly added> (2) The most severe combinations of cargo induced loads and flooding loads are to be used for the check of the scantlings of each bulkhead, depending on the loading conditions included in the loading manual : (a) homogeneous loading conditions; (b) non-homogeneous loading conditions(considering the individual flooding of both loaded and empty holds); (3) ~ (6) <omit> **2. ~ 5. <omit>** **1203. ~ 1206. <omit>** **Section 13 ~ Section 17 <omit>**	**Section 12 Evaluation of Scantlings of Corrugated Transverse Watertight Bulkheads in Bulk Carriers Considering Hold Flooding** **1201. Application and definitions <same as current>** **1202. Load model** **1. General** (1) The loads to be considered as acting on the bulkheads are those given by the combination of the cargo loads with those induced by the flooding of one hold adjacent to the bulkhead under examination. In any case, the pressure due to the flooding water alone is to be considered. <u>This application is to be applied to SUBC(Self-Unloading Bulk Carrier) where the unloading system maintains the watertightness during seagoing operations. In SUBCs with unloading systems that do not maintain watertightness, the combination loads acting on the bulkheads in the flooded conditions are to be considered using the extent to which the flooding may occur.</u> (2) The most severe combinations of cargo induced loads and flooding loads are to be used for the check of the scantlings of each bulkhead, depending on the loading conditions included in the loading manual : (a) homogeneous loading conditions; (b) non-homogeneous loading conditions(considering the individual flooding of both loaded and empty holds); (3) ~ (6) <osame as current> **2. ~ 5. <same as current>** **1203. ~ 1206. <same as current>** **Section 13 ~ Section 17 <same as current>**	- IACS UR S17(R.10 2020.7.1.))

Present	Amendment	Note
Section 18 Cargo Hatch Cover Securing Arrangements **1801. Application and implementation** **1.** These requirements apply to all bulk carriers which were not built in accordance with **Pt 7, Ch 3, Sec 9** and are for steel hatch cover securing devices and stoppers for cargo hold hatchways No.1 and No.2 which are wholly or partially within 0.25*L* of the fore perpendicular, except pontoon type hatch cover. **2.** All bulk carriers not built in accordance with **Pt 7, Ch 3, Sec 9** are to comply with the requirements in accordance with **Pt 1, Ch 3, 201.** (6) **3.** All bulk carriers not built in accordance with **Pt 7, Ch 3, Sec 9** and in order to postpone these requirements are to be followed **Pt 1, Ch 3, 201.** (6). <newly added> **1802. ~ 1804. <omit>** ⚓	**Section 18 Cargo Hatch Cover Securing Arrangements** **1801. Application and implementation** **1.** These requirements apply to all bulk carriers which were not built in accordance with **Pt 7, Ch 3, Sec 9** and are for steel hatch cover securing devices and stoppers for cargo hold hatchways No.1 and No.2 which are wholly or partially within 0.25*L* of the fore perpendicular, except pontoon type hatch cover. **2.** All bulk carriers not built in accordance with **Pt 7, Ch 3, Sec 9** are to comply with the requirements in accordance with **Pt 1, Ch 3, 201.** (6) **3.** All bulk carriers not built in accordance with **Pt 7, Ch 3, Sec 9** and in order to postpone these requirements are to be followed **Pt 1, Ch 3, 201.** (6). **4.** These requirements are not applicable to SUBC(Self-Unloading Bulk Carrier). **1802. ~ 1804. <same as current>** ⚓	- IACS UR S30(Corr.1)

Errata

(External Review)

Hull – Pt.3, Pt.7, Pt.10

2019. 8.

Hull Rule Development Team

Present	Amendment	Note
Pt. 7 <Rule> **CHAPTER 1 OIL TANKERS** **101. Application [See Guidance]** **1.** The requirements in this Chapter apply to oil tankers which were contracted for construction after 1 April 2006, excluding the vessels which should be applied **Pt 12** (Common Structural Rules for Double Hull Oil Tankers) and **Ch 10** (Double Hull Tanker). However, **Sec 10** (Piping Systems and Venting Systems for Oil Tankers) and **Sec 11** (Electrical Equipment) apply to oil tankers including the vessels which should be applied **Pt 12** (Common Structural Rules for Double Hull Oil Tankers) and **Ch 10** (Double Hull Tanker).	**Pt. 7 <Rule>** **CHAPTER 1 OIL TANKERS** **101. Application [See Guidance]** **1.** The requirements in this Chapter apply to oil tankers which were contracted for construction after 1 April 2006, excluding the vessels which should be applied **Pt 13** (Common Structural Rules for Bulk Carriers and Oil Tankers) and **Ch 10** (Double Hull Tanker). However, **Sec 10** (Piping Systems and Venting Systems for Oil Tankers) and **Sec 11** (Electrical Equipment) apply to oil tankers including the vessels which should be applied **Pt 13** (Common Structural Rules for Bulk Carriers and Oil Tankers) and **Ch 10** (Double Hull Tanker).	- modifying ref. no.
CHAPTER 3 BULK CARRIERS **101. Application [See Guidance]** **2.** The requirements in this Chapter are not applied to bulk carriers which were contracted for construction after 1 April 2006 according to **Pt.11** (IACS Common Structural Rules for Bulk Carriers). However, the requirements in **Sec 14** and **Sec 16** apply to bulk carriers including the vessels which should be applied **Pt 11**.	**CHAPTER 3 BULK CARRIERS** **101. Application [See Guidance]** **2.** The requirements in this Chapter are not applied to bulk carriers which were contracted for construction after 1 April 2006 according to **Pt 13** (Common Structural Rules for Bulk Carriers and Oil Tankers). However, the requirements in **Sec 14** and **Sec 16** apply to bulk carriers including the vessels which should be applied **Pt 13**.	
CHAPTER 10 DOUBLE HULL TANKER **101. Application [See Guidance]** **1.** The requirements in this Chapter apply to double hull oil tankers which were contracted for construction after 1 April 2006, excluding the vessels which should be applied **Pt.12** (IACS Common Structural Rules for Oil Tankers).	**CHAPTER 10 DOUBLE HULL TANKER** **101. Application [See Guidance]** **1.** The requirements in this Chapter apply to double hull oil tankers which were contracted for construction after 1 April 2006, excluding the vessels which should be applied **Pt 13** (Common Structural Rules for Bulk Carriers and Oil Tankers).	

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

CHAPTER 2 ORE CARRIERS

Section 3 Wing Tanks or Void Spaces

Table 7.2.3 Coefficient C_2

<table>
<tr><td rowspan="3">For h_1</td><td></td><td></td></tr>
<tr><td><omit></td><td></td></tr>
<tr><td colspan="2"></td></tr>
<tr><td>For h_2 or h_3 and for transverse bulkhead</td><td colspan="2"></td></tr>
<tr><td colspan="3">

α = either α_1 or α_2 according to value of y. However, value of α is not to be less than α_3.

$\alpha_1 = 15.5\, f_D \left(\frac{y - y_B}{Y'} \right)$ for $y > y_B$

$\alpha_2 = 15.5\, f_B \left(\frac{y_B - y}{y_B} \right)$ for $y \le y_B$

$\alpha_3 = \beta \left(\frac{B - 2b}{B} \right)$

<omit>

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

</td>
<td>

CHAPTER 2 ORE CARRIERS

Section 3 Wing Tanks or Void Spaces

Table 7.2.3 Coefficient C_2

<table>
<tr><td rowspan="3">For h_1</td><td></td><td></td></tr>
<tr><td><same as current></td><td></td></tr>
<tr><td colspan="2"></td></tr>
<tr><td>For h_2 or h_3 and for transverse bulkhead</td><td colspan="2"></td></tr>
<tr><td colspan="3">

α = either α_1 or α_2 according to value of y. However, value of α is not to be less than α_3.

$\alpha_1 = 15.0\, f_D \left(\frac{y - y_B}{Y'} \right)$ for $y > y_B$

$\alpha_2 = 15.0\, f_B \left(\frac{y_B - y}{y_B} \right)$ for $y \le y_B$

$\alpha_3 = \beta \left(\frac{B - 2b}{B} \right)$

<same as current>

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

</td>
<td>- errata 15.5→ 15.0</td>
</tr>
</table>

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

CHAPTER 3 BULK CARRIERS

Section 1 General

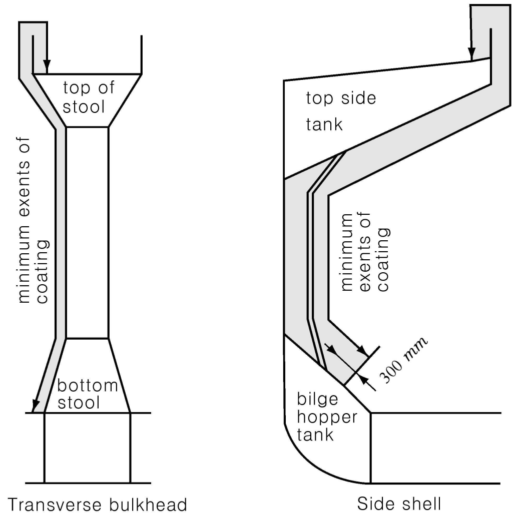


Fig 7.3.1 Minimum extent of corrosion protection coating for cargo hold

</td><td>

CHAPTER 3 BULK CARRIERS

Section 1 General

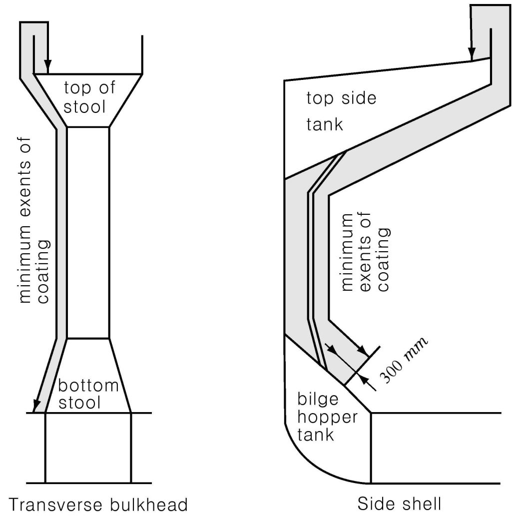


Fig 7.3.1 Minimum extent of corrosion protection coating for cargo hold

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

Present	Amendment	Note

Present

Pt. 7 <Guidance>

CHAPTER 7 CAR FERRIES AND ROLL-ON/ROLL-OFF SHIPS

Section 3 Deck Structure

4. Movable vehicle deck girder

(2) Strength requirement

(B)

(b) Allowable stresses (N/mm^2)

As specified in **Table 3.11.1**. Where, σ_F(N/mm^2) is minimum upper yield stress or proof stress of the material.

Table 3.11.1 Allowable stress

Normal stress	$0.8\sigma_F$
Shear stress	$0.46\sigma_F$

(3) Structural details

(A) Fillet weld of the connection of girder webs to the vehicle deck is to be in accordance with **Table 3.11.2.**

Table 3.11.2 Fillet weld of girder to movable vehicle deck

1) Girders on the deck panel periphery	<omit>	
2) Within $0.3l$ midspan of girders other than mentioned in (2)		
<omit>		

Amendment

Pt. 7 <Guidance>

CHAPTER 7 CAR FERRIES AND ROLL-ON/ROLL-OFF SHIPS

Section 3 Deck Structure

4. Movable vehicle deck girder

(2) Strength requirement

(B)

(b) Allowable stresses (N/mm^2)

As specified in **Table 7.7.5**. Where, σ_F(N/mm^2) is minimum upper yield stress or proof stress of the material.

Table 7.7.5 Allowable stress

Normal stress	$0.8\sigma_F$
Shear stress	$0.46\sigma_F$

(3) Structural details

(A) Fillet weld of the connection of girder webs to the vehicle deck is to be in accordance with **Table 7.7.6.**

Table 7.7.6 Fillet weld of girder to movable vehicle deck

1) Girders on the deck panel periphery	<same as current>	
2) Within $0.3l$ midspan of girders other than mentioned in (2)		
<same as current>		

Note

- modifying ref. no.

Present	Amendment	Note
Annex 7-2 Guidance for the Container Securing Arrangements **8. Determination and application of forces** C_c : height ratio of container weight, generally, <u>0.33</u>	**Annex 7-2 Guidance for the Container Securing Arrangements** **8. Determination and application of forces** C_c : height ratio of container weight, generally, <u>0.45</u>	- errata

Amendments of Guidance

(External review)

Pt. 7 Ships of Special Services

2019. 11.

Hull Rule Development Team

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

Annex 7-2 Guidance for the Container Securing Arrangements

1. ~ 6. <omit>

7. Container support structure (2019)

(1) <omit>

(2) Structural strength evaluation
(A) Structure modelling
(a) Model extent <omit>

(b) FE model
(i) <omit>
(ii) In general, plate elements should be used and mesh size of the lashing bridge should be approximately $20t \times 20t$ or 150mm×150mm which is smaller(t is the thinnest plate thickness in mm).
(iii) The element size of fine mesh area should not be greater than 50×50mm and should be sufficiently small to be able to represent the shape of the structure and to limit stress concentration. In general, the members which have a stress variation in the depth direction should be meshed into 3 sub depths. The minimum required element size of fine mesh area need not be less than the thickness of the plate.

(B) ~ (F) <omit>

(3) <omit>
8.~ 6. <omit>

Appendix 1 ~ 3 <omit>

</td><td>

Annex 7-2 Guidance for the Container Securing Arrangements

1. ~ 6. <same as current>

7. Container support structure (2019)

(1) <same as current>

(2) Structural strength evaluation
(A) Structure modelling
(a) Model extent <same as current>

(b) FE model
(i) <same as current>
(ii) In general, plate elements should be used.
(iii) The element size should be sufficiently small to be able to represent the shape of the structure and to limit stress concentration. In general, the members which have a stress variation in the depth direction should be meshed into 3 sub depths. The minimum required element size of fine mesh area need not be less than the thickness of the plate.

(B) ~ (F) <same as current>

(3) <same as current>
8.~ 6. <same as current**>**

Appendix 1 ~ 3 <same as current>

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

Amendments of the Rules

(External review)

Pt. 7 Ships of Special Service

2019. 11.

Hull Rule Development Team

Present	Amendment	Note

Present

Pt. 7 Ships of Special Service

CHAPTER 1 OIL TANKERS

Section 1 ~ Section 3 <omit>

Section 4 Girders, Transverses and Cross Ties in Cargo Oil Spaces

401. <omit>

402. Transverses and girders provided in centre or side tanks in ships having two or more longitudinal bulkheads 【See Guidance】

1. Bottom transverses and bottom girders:

(1) The depth, web thickness and section modulus of bottom transverses and the web thickness and section modulus of bottom girders provided in the middle between longitudinal bulkheads are not to be less than those obtained from the given in **Table 7.1.3** respectively.

Table 7.1.3 Scantlings of bottom transverses and bottom girders

	Depth (mm)	Web thickness (mm)	Section modulus (cm^3)
Bottom transverses	<omit>	<omit>	<omit>
Bottom girders	<omit>	<omit>	<omit>
<omit>			

<omit>

Section 5 ~ Section 11 <omit>

Amendment

Pt. 7 Ships of Special Service

CHAPTER 1 OIL TANKERS

Section 1 ~ Section 3 <same as current>

Section 4 Girders, Transverses and Cross Ties in Cargo Oil Spaces

401. <same acurrent>

402. Transverses and girders provided in centre or side tanks in ships having two or more longitudinal bulkheads 【See Guidance】

1. Bottom transverses and bottom girders:

(1) The depth, web thickness and section modulus of bottom transverses and the web thickness and section modulus of bottom girders provided in the middle between longitudinal bulkheads are not to be less than those obtained from the given in **Table 7.1.3** respectively.

Table 7.1.3 Scantlings of bottom transverses and bottom girders

	Depth (m)	Web thickness (mm)	Section modulus (cm^3)
Bottom transverses	<same as current>	<same as current>	<same as current>
Bottom girders	<same as current>	<same as current>	<same as current>
<same as current>			

<omit>

Section 5 ~ Section 11 <omit>

Amendments of the Rule Guidance

(Internal review)

Pt. 7 Ships for Special Service

Annex 7-7 Unified Interpretation of Convention

2020. 02.

Hull Rule Development Team

Present	Amendment	Note
Pt. 7 Ships of Special Service <Guidance> **Annex 7-7 Unified Interpretation of Convention** (Unless expressly specified otherwise, the requirements in these Annex apply in accordance with keeling date based on SOLAS Convention) **1. UI SC 207 (Structural Strength of Bulk Carriers in case of Accidental Hold Flooding)** (1) This is to clarify the implementation date between SOLAS XII/5.2 and IACS UR S17, S18 and S20, these structural requirements are to be complied with in respect of the flooding of any cargo hold of bulk carriers of 150 m in length and above, intending to carry solid bulk cargoes 1.0 t/m^3 density or above. (2) Unified Interpretation Regardless of the date of contract for construction, or the cargo hold cross section configuration, of ships which shall comply with SOLAS XII/5.2, such ships are to comply with IACS Unified Requirements(UR) S17(rev.7), S18(rev.7) for corrugated transverse bulkheads, where fitted, and S20(rev.4), if they do not comply with the IACS CSR for bulk carriers. 3) This is uniformly implemented from 1 July 2006.	**Pt. 7 Ships of Special Service <Guidance>** **Annex 7-7 Unified Interpretation of Convention** (Unless expressly specified otherwise, the requirements in these Annex apply in accordance with keeling date based on SOLAS Convention) **1. UI SC 207 (Structural Strength of Bulk Carriers in case of Accidental Hold Flooding)** (1) This is to clarify the implementation between SOLAS XII/5.2 and IACS UR S17, S18 and S20, these structural requirements are to be complied with in respect of the flooding of any cargo hold of bulk carriers of 150 m in length and above, intending to carry solid bulk cargoes 1.0 t/m^3 density or above. (2) Unified Interpretation Regardless of the date of contract for construction, or the cargo hold cross section configuration, of ships which shall comply with SOLAS XII/5.2, such ships are to comply with IACS Unified Requirements(UR) S17, S18 for corrugated transverse bulkheads, where fitted, and S20, if they do not comply with the IACS CSR for Bulk Carriers and Oil Tankers. (3) This UI is to be applied to ships contracted for construction on or after 1 July 2015.	

Present	Amendment	Note
2. UI SC 208 (Protection of Cargo Holds Loading/Unloading Equipment) (1) This is to clarify the implementation date between SOLAS XII/6.4.1 (SLS. 14 / Circ. 250) and IACS CSR, in terms of protection of cargo holds from loading/discharge equipment of bulk carriers of 150 m in length and above, intending to carry solid bulk cargoes 1.0 t/m^3 density or above. (2) Unified Interpretation Bulk carriers which shall comply with SOLAS regulation XII/6.4.1 and which do not comply with the IACS CSR for Bulk Carriers, are to comply with the following: (A) The grab requirements of **Pt 3,** of the Rules. (B) Wire rope grooving in way of cargo holds openings is to be prevented by fitting suitable protection such as half-round bar on the hatch side girders(i.e. upper portion of top side tank plates)/hatch end beams in cargo hold and upper portion of hatch coamings. (3) The requirements of (A) and (B) are satisfied, "Grab" notation of our Society is to be imposed. (4) This is uniformly implemented from 1 July 2006.	**2. UI SC 208 (Protection of Cargo Holds Loading/Unloading Equipment)** (1) This is to clarify the implementation between SOLAS XII/6.4.1 (SLS. 14 / Circ. 250) and IACS CSR for Bulk Carriers and Oil Tankers, in terms of protection of cargo holds from loading/discharge equipment of bulk carriers of 150 m in length and above, intending to carry solid bulk cargoes 1.0 t/m^3 density or above. (2) Unified Interpretation Bulk carriers which shall comply with SOLAS regulation XII/6.4.1 and which do not comply with the IACS CSR for Bulk Carriers and Oil Tankers, are to comply with the following: (A) The grab requirements of **Pt 3,** of the Rules. (B) Wire rope grooving in way of cargo holds openings is to be prevented by fitting suitable protection such as half-round bar on the hatch side girders(i.e. upper portion of top side tank plates)/hatch end beams in cargo hold and upper portion of hatch coamings. (3) The requirements of (A) and (B) are satisfied, "Grab" notation of our Society is to be imposed. (4) This UI is to be applied to ships contracted for construction on or after 1 July 2015.	

Present	Amendment	Note
3. UI SC 209 (Failure of Cargo Hold Structural Members and Panels) (1) This is to bridge the gap - The 1 April 2006 contract for construction date associated with CSR for bulk carriers and the 1 July 2006 keel laying date associated with the entry into force of the amended SOLAS XII/6.5.3. - The definition of bulk carriers according to UR and the new definition of the amended SOLAS XII/6.5.3. and to give an equivalent criteria regarding lateral buckling of ordinary stiffeners for ships which shall comply with SOLAS XII/6.5.3, but are not designed according to CSR for bulk carriers. (2) Unified Interpretation Ships which shall comply with SOLAS XII/6.5.3 are to satisfy either (A) or (B) as given below. (A) CSR for bulk carriers, **Ch 3, Sec 1** "Material" and **Ch 6, Sec 3** "Buckling & ultimate strength of ordinary stiffeners and stiffened panels. (B) For ships not designed according to CSR for Bulk Carriers (**Ch 3, Sec 1** and **Ch 6, Sec 3**): (a) <omit> (b) <omit> (3) This is uniformly implemented from 1 July 2006 at the time of the assessment of concerned parts. ⚓ ⚓	**3. UI SC 209 (Failure of Cargo Hold Structural Members and Panels)** (1) This is to provide a standard for the transverse buckling of ordinary stiffeners for ships which shall comply with SOLAS XII/6.4.3, but are not designed according to CSR for Bulk Carriers and Oil Tankers. (2) Unified Interpretation Ships which shall comply with SOLAS XII/6.4.3 are to satisfy either (A) or (B) as given below. (A) For ships subjected to CSR : **Pt 13 Sub-part 1 Ch 3, Sec 1** "Material" and **Pt 13 Sub-part 1 Ch 8, Sec 5 Ch 6, Sec 3** "Buckling Capacity". (B) For ships not designed according to CSR (**Pt 13 Sub-part 1 Ch 3, Sec 1** and **Ch 8, Sec 5**): (a) <same as current> (b) <same as current> (3) This UI is to be applied to ships contracted for construction on or after 1 July 2020. ⚓ ⚓	

Amendments of the Rules

(External review)

Pt. 7 Ships of Special Service

2019. 11.

Hull Rule Development Team

Present	Amendment	Note

Present

Pt. 7 Ships of Special Service

CHAPTER 1 OIL TANKERS

Section 1 ~ Section 3 <omit>

Section 4 Girders, Transverses and Cross Ties in Cargo Oil Spaces

401. <omit>

402. Transverses and girders provided in centre or side tanks in ships having two or more longitudinal bulkheads 【See Guidance】

1. Bottom transverses and bottom girders:

(1) The depth, web thickness and section modulus of bottom transverses and the web thickness and section modulus of bottom girders provided in the middle between longitudinal bulkheads are not to be less than those obtained from the given in **Table 7.1.3** respectively.

Table 7.1.3 Scantlings of bottom transverses and bottom girders

	Depth (mm)	Web thickness (mm)	Section modulus (cm^3)
Bottom transverses	<omit>	<omit>	<omit>
Bottom girders	<omit>	<omit>	<omit>
<omit>			

<omit>

Section 5 ~ Section 11 <omit>

Amendment

Pt. 7 Ships of Special Service

CHAPTER 1 OIL TANKERS

Section 1 ~ Section 3 <same as current>

Section 4 Girders, Transverses and Cross Ties in Cargo Oil Spaces

401. <same acurrent>

402. Transverses and girders provided in centre or side tanks in ships having two or more longitudinal bulkheads 【See Guidance】

1. Bottom transverses and bottom girders:

(1) The depth, web thickness and section modulus of bottom transverses and the web thickness and section modulus of bottom girders provided in the middle between longitudinal bulkheads are not to be less than those obtained from the given in **Table 7.1.3** respectively.

Table 7.1.3 Scantlings of bottom transverses and bottom girders

	Depth (m)	Web thickness (mm)	Section modulus (cm^3)
Bottom transverses	<same as current>	<same as current>	<same as current>
Bottom girders	<same as current>	<same as current>	<same as current>
<same as current>			

<omit>

Section 5 ~ Section 11 <omit>

Note

Annex 7-10 Guidelines for Direct Strength Assessment for Ore Carriers

(1) General

The direct strength calculation of the ore carrier is in accordance with following (1) to (9) and proceeds according to the structural analysis flow chart in Fig 1. The members that can determine the scantling by direct strength calculation are as follows. Bottom transverse, deck transverse, side transverse, longitudinal bulkhead transverse, cross-tie, floor, inner bottom, bottom shell, side shell, cross deck and girder. Gross thickness is applied for the direct strength calculation. The buckling strength is evaluated for net thickness considering the corrosion margin defined in following (7).

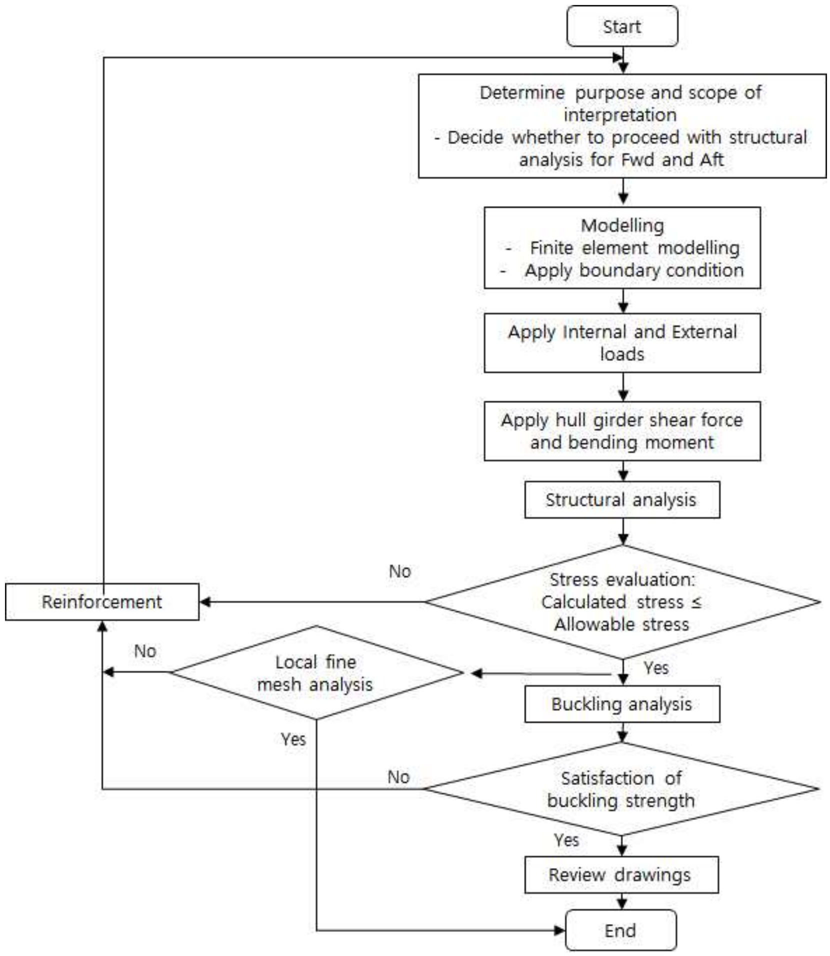


Fig 1 Structural analysis flow of cargo hold and froe/aft structure

(2) Modelling

The procedure of structural modelling for mid cargo hold(or tank)is to be as follows:

(A) Range of analysis

(a) The analysis of the mid-cargo hold structure should be carried out to reflect the structural strength assessment from the No. 2 cargo hold to the No. n-1 cargo hold. In addition, the bow structure analysis should be carried out to re-flect the structural strength evaluation of No.1 cargo hold, and the stern structure analysis should be carried out to reflect the structural strength evaluation of the No. n cargo hold.

(b) The longitudinal extent of the finite element model of the mid-hold is to include three cargo holds and four transverse bulkheads as shown in Fig 2. The transverse bulkheads at both ends of the model range should be included with the connected stool. Both ends of the model shall form a vertical plane and, if applicable, shall include all transverse web frames on the plane. The model should be made in both port and starboard.

(c) The Fwd and Aft models should be extend to the fore peak for the Fwd part and after end transverse bulkhead for Aft part including the full length of the cargo hold, as shown in Fig 3 to Fig 5. The range of analysis should be determined taking into consideration the cargo/ the ballast conditions and the longitudinal/lateral symmetry of the bulkhead/the girders attached to the bulkheads. In the Fwd model, from the center of the collision bulkhead and fore peak to the fore peak, the forward hull form and cross section can be modeled with a simplified geometry. In the Aft model, from middle of machinery space to the after end transverse bulkhead can be modelled with a simplified geometry.

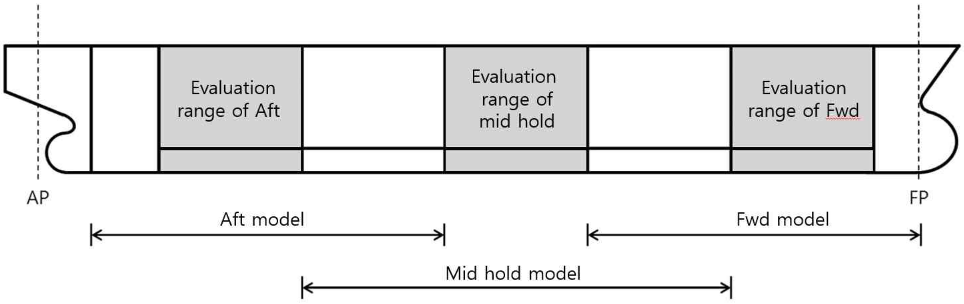


Fig 2 Model and evaluation range

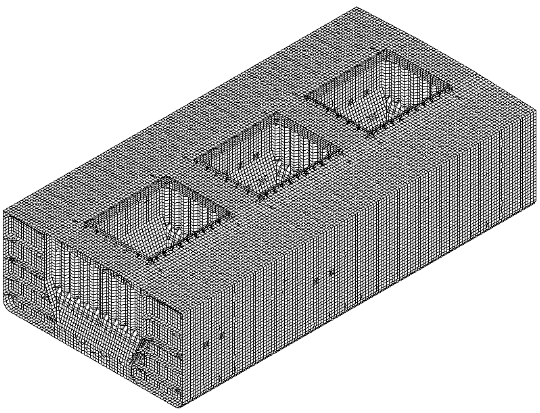


Fig 3 Example of structural modelling

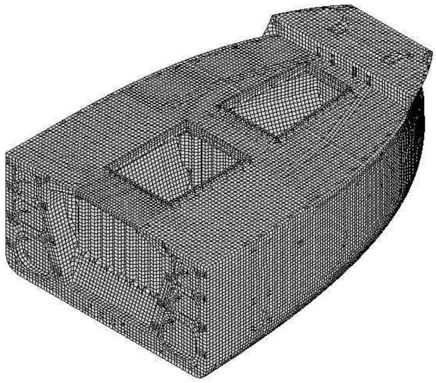


Fig 4 Example of Fwd modelling

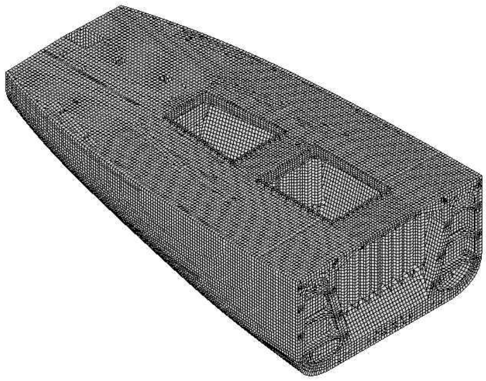


Fig 5 Example of Aft model

(B) Structural modelling

The following (a) to (g) apply to element meshing of structural model.

(a) In meshing, proper sizes of meshes are to be selected by predicting the stress distribution in the model, and the aspect ratio should not exceed 3.
(b) Girders and similar members having stress gradients along their depth are to be so meshed as to enable their discrimination.
(c) The length of the short side of each mesh is to be restricted to longitudinal spacing or thereabouts.
(d) All stiffeners are to be modeled as beam elements with axial, torsional, shear, bending stiffness. Also, an offset beam considering the eccentricity of the stiffener should be used.
(e) The flanges of primary support members and brackets are to be modeled using rods or beam elements.
(f) The coordinate system of the model is used as shown in Table 1.
(g) The method of indicating openings in the web of primary supporting members is to be in accordance with Table 2. If the openings are not modeled, the shear stresses near the openings shall be modified in accordance with the reduction of the shear area along the actual openings. And the modified shear stress should be used to calculate the equivalent stress of the element for verification of the yield criterion.

Table 1 Co-ordinate system

	Direction	Direction Remark
X	Longitudinal	Positive forward
Y	Transverse	Positive to port
Z	Vertical	Positive upwards from the baseline

Table 2 Representation of openings in web of primary support member

$h_0/h < 0.5$ and $g_0 < 2.0$	No need to model the openings
$h_0/h \geq 0.5$ and $g_0 \geq 2.0$	Need to model the openings

Where :

$$g_0 = (1 + \frac{l_0^2}{2.6(h-h_0)^2})$$

l_0 : The length of the opening parallel to the longitudinal direction of the primary support member web. (m, see Fig 6) For continuous openings where the distance d_0 between openings is less than $0.25h$, the length l_0 should be the length across the opening as shown in Fig 7

h_0 : Height of opening parallel to the depth direction of the web (m, see Fig 6 and Fig 7)

h : Height of primary support member web where opening is located (m, see Fig 6 and Fig 7)

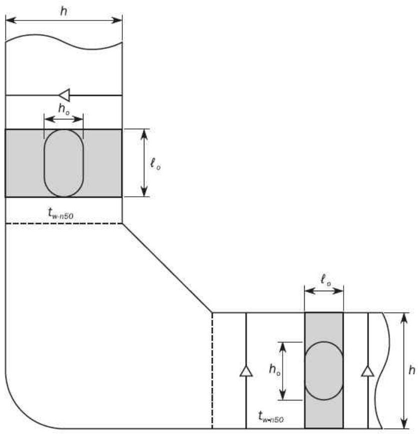


Fig 6 Opening in the web

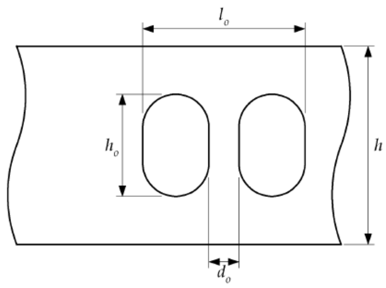


Fig 7 Opening in the web

(3) Boundary condition

(A) The boundary conditions and supporting conditions of the structural model should be able to reasonably implement the behavior of the structural model according to the range of the model. Both ends of the model are simply supported in accordance with **Table 3** and **4**. The joints on the longitudinal strength members at both ends should be rigidly connected to the independent joints on the neutral axis on the ship's centerline as shown in **Table 3**. The independent nodes at both ends should be fixed as shown in **Table 4**.

Table 3 Rigid connections at both ends of the model

Rigid - connection	Displacement			Rotation		
	U_x	U_y	U_z	θ_x	θ_y	θ_z
Longitudinal strength member nodes of front end of model	-	RL	RL	RL	-	-
Longitudinal strength member nodes of after end of model	-	RL	RL	RL	-	-
RL means that the related degrees of freedom of independent nodes are rigidly connected.						

Table 4 Support conditions at model independent nodes

Location of independent nodes	Displacement			Rotation		
	U_x	U_y	U_z	θ_x	θ_y	θ_z
Independent nodes of front end of model	-	Fix	Fix	Fix	-	-
Independent nodes of after end of model	-	Fix	Fix	Fix	-	-
Intersection of centerline and inner bottom plate	Fix					

(4) Applied loads

(A) Internal loads

(a) Loads due to ore cargo, grain cargo, etc. are as follows;

(i) The height and surface of the cargo are to be determined in accordance with below (see **Fig 8**, **9** and **10**)

- The shape of cargo surface is assumed to be horizontal longitudinally and transversely and sloped down straight to the ship's sides with the half angle of repose(ψ). (If the hold is not uniformed in longitudinally and transversely by hopper sloped angle, it is assumed that the middle section of the cargo hold is uniformed in longitudinally.)
- The width of the horizontal part b_{iB} is assumed to be equal to 1/4 of the breadth of the hold.
- The loading height h_c is determined in accordance with the mass, angle of repose and density of the cargo to be loaded. The shape of cargo surface may be assumed to be unchanged for the whole breadth above.
- The density and repose angel of cargo should be considered as follows.

	Density of cargo γ $(\mathrm{ton/m^3})$	Repose angle $\psi(^\circ)$
Low density cargo	M' / V_H (≥1.0)	35
High density cargo	3.0	35[1]
[1] If there is a repose angle other than 35°, this angle should be additionally considered.		

M' : Cargo weight of the cargo hold. The following formula is applied.

$$M' = M + \frac{1}{n} Min(3000,\ 0.1M)\ (t)$$

M : Maximum permissible bulk cargo weight of the cargo hold (t)
n : Minimum number of loading in one cargo hold
V_H : Volume, in m^3, of cargo hold up to level of the intersection of the main deck with the hatch coaming excluding the volume enclosed by hatch coaming.

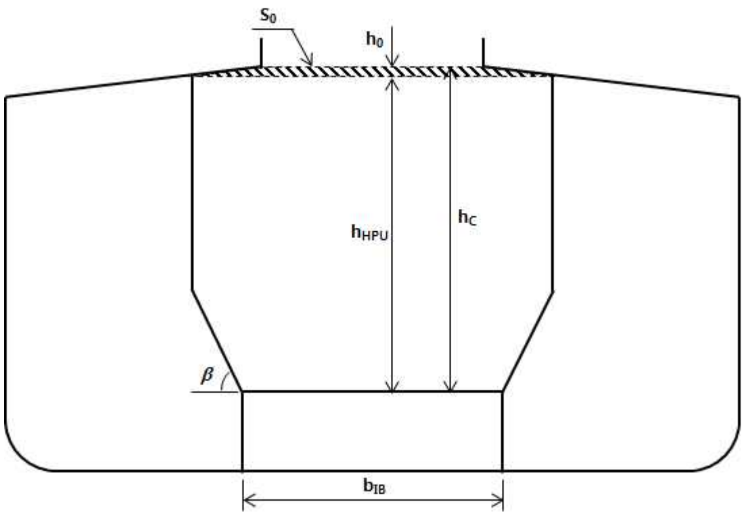


Fig 8 Assumed cargo surface (low density)

(ii) The loads on the vertical walls of the hold are to be determined by the following formula.

$$w = 9.81\gamma h K_C\ (\mathrm{kN/m^2})$$

where;

γ : Density of cargo($\mathrm{kg/m^3}$)
h : Vertical distance from the panel in consideration to the surface of the cargo right above the panel (m)
K_C : $\cos^2\beta + (1-\sin\psi)\sin^2\beta$
β : Angle between slant plating of the bilge hopper and inner bottom plating(see Fig 8)
ψ : Repose angle (see Fig 9)

- The load of low density cargo on the inner wall of the cargo hold is given by the following formula.

$$h_c = h_{HPU} + h_0$$

where;

$$h_0 = \frac{S_A}{B_H}$$

$$S_A = S_o + \frac{V_{HC}}{l_H}$$

h_{HPU}: Vertical distance (m) between inner bottom and lower intersection of top side tank and side shell or inner side

S_o : Shaded area (m^2) above the lower intersection of top side tank and side shell or inner side and up to the upper deck level

V_{HC} : Volume (m^3) enclosed by the hatch coaming

- The load of high density cargo on the inner wall of the cargo hold is given by the following formula.

if $h_1 \geq 0$ (see Fig 9)

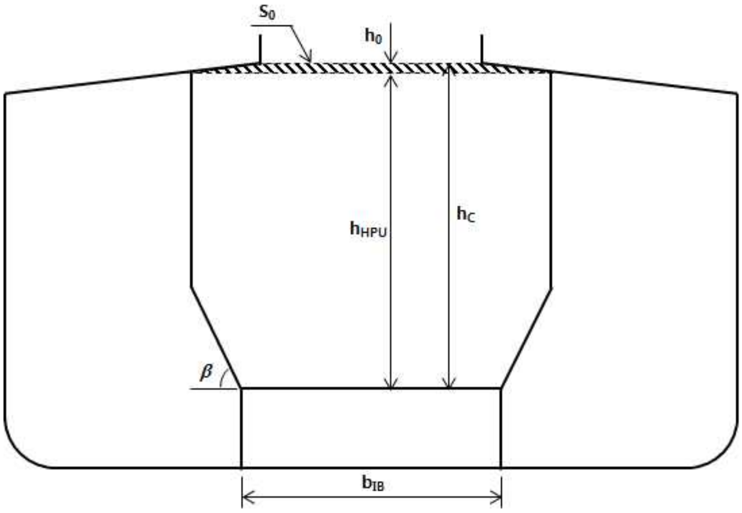


Fig 9 Assumed cargo surface (low density)

$h_C = h_{HPL} + h_1 + h_2$

Where;

h_{HPL} : Vertical distance between inner bottom plate and top intersection of hopper tank and inner plate(m)

h_1 : Vertical distance(m) is as follows;

$$h_1 = \frac{M'}{\rho B_H l_H} - \frac{B_H + b_{IB}}{2B_H} h_{HPL} - \frac{3}{16} B_H \tan\frac{\psi}{2} + \frac{V_{TS}}{B_H l_H}$$

Where;

B_H : Breadth of cargo hold(m)

l_H : Length of cargo hold(m)

b_{IB} : Breadth of double bottom(m)

V_{TS} : The total volume(m^3) of the transverse stool at the bottom of the transverse bulkhead within the cargo hold length, l_H considered. In this volume, the volume of the portion of the hopper tank passing through the transverse bulkhead is excluded.

h_2 : The height(m) of the upper surface of the bulk cargo along the width, as follows;

$$h_2 = \frac{B_H}{4} tan\frac{\psi}{2} \quad , \quad \text{if } 0 \leqq |y| \leqq \frac{B_H}{4}$$
$$h_2 = \left(\frac{B_H}{2} - |y|\right) \tan\frac{\psi}{2}, \quad \text{if } \frac{B_H}{4} \leqq |y| \leqq \frac{B_H}{2}$$

if $h_1 < 0$ (see Fig 10)

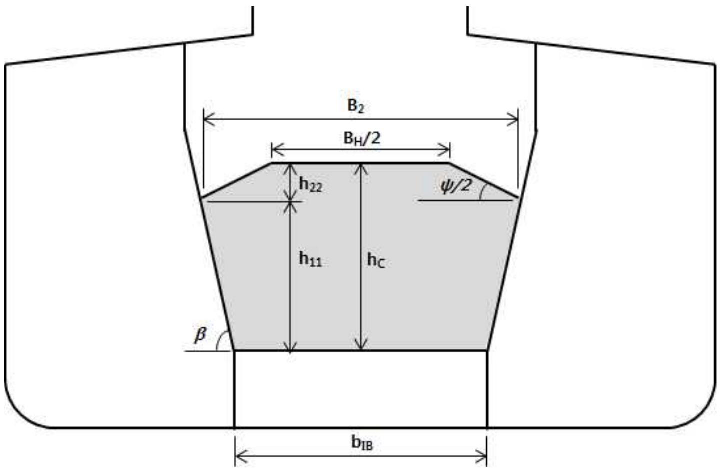


Fig 10 Assumed cargo surface(high density, $h_1 < 0$)

$$h_C = h_{11} + h_{22}$$

Where;

h_{11} : Vertical distance(m) is as follows;

$$h_{11} = h_{HPL}\left(\frac{B_2 - b_{IB}}{B_H - b_{IB}}\right)$$

h_{22} : Vertical distance(m) is as follows;

$$h_{22} = \left(\frac{B_2}{2} - \frac{B_H}{4}\right) \tan\frac{\psi}{2}$$

$$B_2 = \sqrt{\frac{\frac{1}{l_H}\left(\frac{M'}{\rho_c} + V_{TS}\right) + \frac{1}{2}\left(\frac{h_{HPL} \bullet b_{IB}^2}{B_H - b_{IB}}\right) + \frac{B_H^2}{16} tan\frac{\psi}{2}}{\frac{1}{2}\left[\left(\frac{h_{HPL}}{B_H - b_{IB}}\right) + \frac{1}{2} tan\frac{\psi}{2}\right]}}$$

- In order to evaluate the total force in the vertical direction, shear loads acting on the slope plate of the bilge hopper tank and lower stool by bulk dry bulk cargo are to be taken into account. The shear load acting on the sloped members by the ore cargo in the still water is given by the following formula.

$$w_{sh} = 9.81\gamma \frac{(1 - K_C)(h_C + h_{DB} - z)}{\tan\beta} \qquad (\text{kN/m}^2)$$

where;

z : vertical distance from inner bottom plate to considered point

(b) Loads due to ballast water

The water head of the each location in ballast hold is to be determined by the following formula.

$$h_W = \mathrm{Max}(0.85(\mathrm{h} + \triangle \mathrm{h}), \mathrm{h}) \quad (\mathrm{m})$$

where;

h : Vertical distance measured from the position under consideration to 1/2 of overflow pipes(m)

$\triangle h$: The value is to be obtained from following formula;

$\triangle h = 16/L(l_t - 10) + 0.25(b_t - 10)$

l_t : tank length (m). however, where it is less than 10 (m), it is to be taken as 10.

b_t : tank breadth (m). however, where it is less than 10 (m), it is to be taken as 10.

(c) Load under hydrostatic test

The water head of the tank to be subjected to the hydrostatic test should be the tank top + 2.4 m

(B) Hydrostatic pressure

The hydrostatic pressure is to be in accordance with Pt. 3 Annex 3-2, III 1 (8).

(C) Wave loads

The wave loads are to be in accordance with Pt. 3 Annex 3-2, III 1 (9).

(D) Hull weight

Consider the self weight of the hull considering gravitational acceleration.

(E) Load due to upper structure

If the upper structure is included in structural model, the load considered with acceleration of gravity are to be considered. If the upper structure is not included in structural model, loads on upper structure are to be distributed on relevant deck nodes.

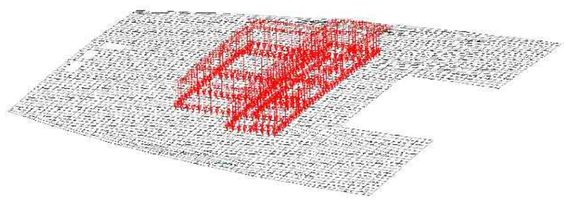


Fig 11 Loads due to upper structure

(F) Load due to the main engine

The loads due to the main engine are to be distributed on relevant nodes of M/E foundation.

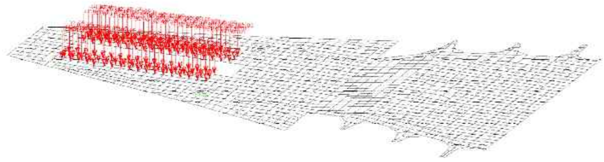


Fig 12 Loads due to main engine

(G) Consideration of hull girder shear force

(a) The hull girder shear force is to be calculated at the position of the transverse bulkhead of the mid hold, and the target value is determined as follows. In addition, the sign in each transverse bulkhead is applied in the same way as the loading conditions in Table 5, 6 and 7.

$$Q_{targ} = F_s + F_w$$

where:

F_s : shear force in still water (kN)

F_w : wave shear force according to Pt 3, Ch. 3, 301.

(b) For mid hold, shear force is to comply with Pt 13, Sub-Pt. 1, Ch. 7 Sec. 2. For Fwd and Aft hold, shear force is to comply with Pt 13, Sub-Pt. 1, Ch. 7 Sec. 2.

(c) The direct calculation of the shear flow is to comply with Pt 13, Sub-Pt. 1, Ch. 5, Annex 1.

(H) Considering of hull girder vertical bending moment

(a) The hull girder vertical bending moment is adjusted after adjusting the shear force.

(b) In the analysis of the vertical bending moment, the target hull girder vertical bending moment is the maximum vertical bending moment that can occur at the center of the mid hold in the finite element model. The target value of the hull girder vertical bending moment is obtained as follows.

$$M_{v-targ} = M_s + M_w$$

where;

M_s : vertical bending moment in still water (kNm)

M_w : wave vertical bending moment according to Pt 3, Ch. 3 Table 3.3.1

(c) The distribution of hull girder vertical bending moments caused by local loads applied to the model is calculated using simple beam theory in accordance with Pt. 13, Sub-Pt. 1, Ch. 7, Sec. 2.

(d) If the target vertical bending moment has to be reached, an additional vertical bending moment should be applied to both ends of the hold model to generate this target value in the center hold of the model. These end vertical bending moments are as follows.

$$M_{Y-aft} = M_{v-targ} - M_{V\_FEM}(x_{v-max})$$

$$M_{Y-fwd} = -M_{Y-aft}$$

where

x_{v-max} : Longitudinal position where maximum bending moment occurs due to local load in mid hold(m)

M_{Y-fwd} : additional vertical bending moments applied to the forward end of the finite element model (kNm)

M_{Y-aft} : additional vertical bending moments applied to the after end of the finite element model (kNm)

M_{V-peak} : maximum or minimum bending moments in the mid hold by local load and shear force adjustment (kNm)

(e) The vertical bending moment adjustment procedure for the fore and aft part structural analysis is to comply with the requirements in Pt. 13, Sub-Pt. 1, Ch. 7 Sec. 2. and 4.4.9.

(l) Load case

The loading conditions to be considered are based on loading (high / low density), ballast loading, multi port loading and port loading. If special load cases are to be expected, such loading conditions are also included in the calculation. The load case for mid hold, aft hold and fwd hold are shown in Table 5, 6 and 7. Load cases may be changed according to loading manual, loading sequence and compartment layout. If there is no multi port cases in the loading manual, the multi port cases in Table 5, 6 and 7 can be omitted and is given the no MP notation.

Table 5 Load case of Mid hold

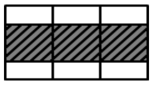
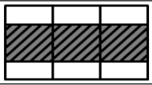
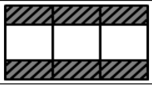
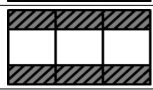
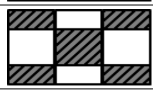
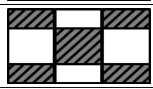
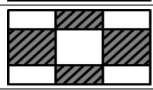
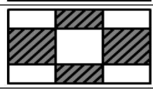
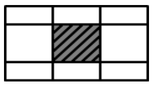
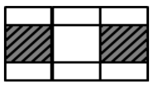
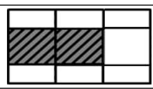
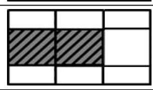
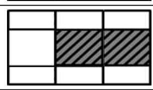
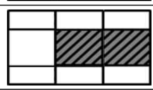
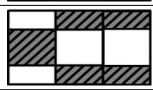
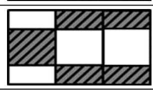
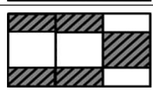
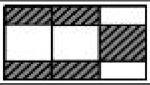
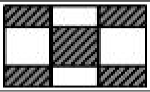
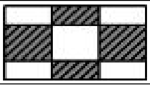
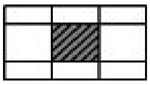
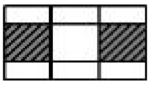
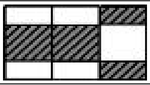
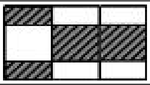
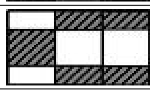
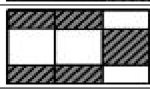
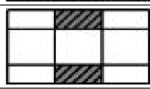
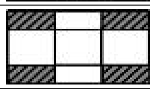
Condition	No	Description	Draft	Wave load	Internal load	Loading pattern	Target bending moment and shear force			
							% of M_s	% of M_w	% of F_s	% of F_w
at sea	1	Full load (1)	T_s	Trough	High/Low density		100% (Sag)	100% (Sag)	-	-
at sea	2	Full load (2)	T_s	Crest	High/Low density		0%[11)]	100% (Hog)	-	-
at sea	3	Ballast (Normal)	T_{bal}	Crest	-		100% (Hog)	100% (Hog)	-	-
at sea	4	Ballast (Heavy)	T_{bar-H}	Crest	-		100% (Hog)	100% (Hog)	-	-
at sea	5	Multi port (1)	$T_{multi-min}$ 1)	Trough	High/Low density		100% (Sag)	100% (Sag)	-	-
at sea	6	Multi port (2)	$T_{multi-min}$ 1)	Crest	High/Low density		0%[11)]	100% (Hog)	-	-
at sea	7	Multi port (3)	$T_{multi-max}$ 2)	Trough	High/Low density		0%[11)]	100% (Sag)	-	-
at sea	8	Multi port (4)	$T_{multi-max}$ 2)	Crest	High/Low density		100% (Hog)	100% (Hog)	-	-
at sea	9	Multi port (5)[7)]	$T_{multi-min}$ 1)	Trough	High/Low density		100% (Sag)	100% (Sag)	Fore[5)] : +100% Aft[6)] : -100%	Fore[5)] : +100% Aft[6)] : -100%
at sea	10	Multi port (6)[8)]	$T_{multi-max}$ 2)	Crest	High/Low density		100% (Hog)	100% (Hog)	Fore[5)] : -100% Aft[6)] : +100%	Fore[5)] : -100% Aft[6)] : +100%
at sea	11	Multi port (7)	$T_{multi-min}$ 1)	Trough	High/Low density		100% (Sag)	100% (Sag)	-	-
at sea	12	Multi port (8)	$T_{multi-min}$ 1)	Crest	High/Low density		0%[11)]	100% (Hog)	-	-
at sea	13	Multi port (9)	$T_{multi-min}$ 1)	Trough	High/Low density		100% (Sag)	100% (Sag)	-	-
at sea	14	Multi port (10)	$T_{multi-min}$ 1)	Crest	High/Low density		0%[11)]	100% (Hog)	-	-
at sea	15	Multi port (11)	$T_{multi-max}$ 2)	Trough	High/Low density		0%[11)]	100% (Sag)	-	-
at sea	16	Multi port (12)	$T_{multi-max}$ 2)	Crest	High/Low density		100% (Hog)	100% (Hog)	-	-
at sea	17	Multi port (13)	$T_{multi-max}$ 2)	Trough	High/Low density		0%[11)]	100% (Sag)	-	-

Table 5 Load case of Mid hold (continued)

Condition	No	Description	Draft	Wave load	Internal load	Loading pattern	Target bending moment and shear force			
							% of M_s	% of M_w	% of F_s	% of F_w
at sea	18	Multi port (14)[7]	$T_{multi-max}$[2]	Crest	High/Low density		100% (Hog)	100% (Hog)	-	-
port	19	Port (1)	$T_{harbour-min}$[3]	Hydrostatic pressure	High/Low density		100% (Sag)	-	-	-
port	20	Port (2)	$T_{harbour-max}$[4]	Hydrostatic pressure	High/Low density		100% (Hog)	-	-	-
port	21	Port (3)[9]	$T_{harbour-min}$[3]	Hydrostatic pressure	High/Low density		100% (Sag)	-	Fore[5] : +100% Aft[6] : -100%	- -
port	22	Port (4)[10]	$T_{harbour-max}$[4]	Hydrostatic pressure	High/Low density		100% (Hog)	-	Fore[5] : -100% Aft[6] : +100%	- -
port	23	Port (5)	$T_{harbour-min}$[3]	Hydrostatic pressure	High/Low density		100% (Sag)	-		
port	24	Port (6)	$T_{harbour-min}$[3]	Hydrostatic pressure	High/Low density		100% (Sag)	-	-	-
port	25	Port (7)	$T_{harbour-max}$[4]	Hydrostatic pressure	High/Low density		100% (Hog)	-	-	-
port	26	Port (8)	$T_{harbour-max}$[4]	Hydrostatic pressure	High/Low density		100% (Hog)	-	-	-
tank	27	Tank test (1)	$T_{sc}/3$	Hydrostatic pressure	-		-	-	-	-
tank	28	Tank test (2)	$T_{sc}/3$	Hydrostatic pressure	-		-	-	-	-

(Note)
The load cases can be changed / added in accordance with the loading manual. If there is no multi port cases in the loading manual, the multi port cases in **Table 5** can be omitted and is given the **no MP** notation.

1) $T_{multi-min}$: meet the maximum allowable cargo mass (see(9))
2) $T_{multi-max}$: meet the minimum required cargo mass (see(9))
3) $T_{harbour-min}$: meet the maximum allowable cargo mass (see(9))
4) $T_{harbour-max}$: meet the minimum allowable cargo mass (see(9))
5) Fore : The sign of the target shear force of forward transverse bulkhead of the center hold
6) Aft : The sign of the target shear force of aftward transverse bulkhead of the center hold
7) If this loading condition is not taken into account, it should be evaluated in the loading condition of the Multi port (1) condition.
8) If this loading condition is not taken into account, it should be evaluated in the loading condition of the Multi port (4) condition.
9) If this loading condition is not taken into account, it should be evaluated in the loading condition of the Port (1) condition.
10) If this loading condition is not taken into account, it should be evaluated in the loading condition of the Port (2) condition.
11) 0%* : Refer to loading manual.

Table 6 Load case of Aft hold

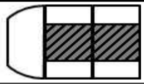
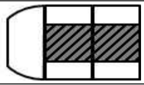
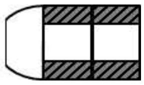
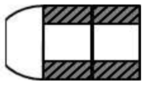
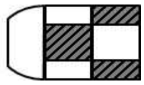
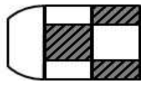
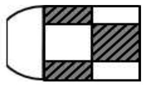
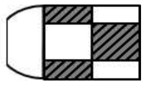
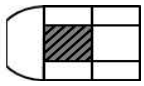
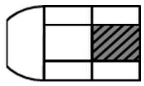
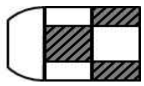
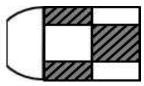
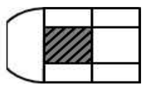
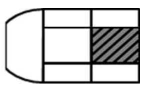
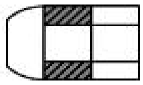
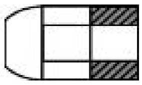
Condition	No	Description	Draft	Wave load	Internal load	Loading pattern	Target bending moment and shear force			
							% of M_s	% of M_w	% of F_s	% of F_w
at sea	1	Full load (1)	T_s	Trough	High/Low density		100% (Sag)	100% (Sag)	-	-
at sea	2	Full load (2)	T_s	Crest	High/Low density		0%[9]	100% (Hog)	-	-
at sea	3	Ballast (Normal)	T_{bal}	Crest	-		100% (Hog)	100% (Hog)	-	-
at sea	4	Ballast (Heavy)	T_{bal-H}	Crest	-		100% (Hog)	100% (Hog)	-	-
at sea	5	Multi port (1)	$T_{multi-min}$[1]	Trough	High/Low density		100% (Sag)	100% (Sag)	-	-
at sea	6	Multi port (2)	$T_{multi-min}$[1]	Crest	High/Low density		0%[9]	100% (Hog)	-	-
at sea	7	Multi port (3)	$T_{multi-max}$[2]	Trough	High/Low density		0%[9]	100% (Sag)	-	-
at sea	8	Multi port (4)	$T_{multi-max}$[2]	Crest	High/Low density		100% (Hog)	100% (Hog)	-	-
at sea	9	Multi port (5)[7]	$T_{multi-min}$[1]	Crest	High/Low density		100% (Sag)	100% (Sag)	Fore[5] : +100% Aft[6] : -100%	Fore[5] : +100% Aft[6] : -100%
at sea	10	Multi port (6)	$T_{multi-max}$[2]	Crest	High/Low density		100% (Hog)	100% (Hog)	-	-
port	11	Port (1)	$T_{harbour-min}$[3]	Hydrostatic pressure	High/Low density		100% (Sag)	-	-	-
port	12	Port (2)	$T_{harbour-max}$[4]	Hydrostatic pressure	High/Low density		100% (Hog)	-	-	-
port	13	Port (3)[8]	$T_{harbour-min}$[3]	Hydrostatic pressure	High/Low density		100% (Sag)	-	Fore[5] : +100% Aft[6] : -100%	- -
port	14	Port (4)	$T_{harbour-max}$[4]	Hydrostatic pressure	High/Low density		100% (Hog)	-	-	-

Table 6 Load case of Aft hold (continued)

Cond ition	No	Description	Draft	Wave load	Internal load	Loading pattern	Target bending moment and shear force			
							% of M_s	% of M_w	% of F_s	% of F_w
tank	15	Tank test (1)	$T_{sc}/3$	Hydrostatic pressure	-		-	-	-	-
tank	16	Tank test (2)	$T_{sc}/3$	Hydrostatic pressure	-		-	-	-	-

(Note)
The load cases can be changed / added in accordance with the loading manual. If there is no multi port cases in the loading manual, the multi port cases in Table 6 can be omitted and is given the no MP notation.

1) $T_{multi-min}$: meet the maximum allowable cargo mass (see(9))
2) $T_{multi-max}$: meet the minimum required cargo mass (see(9))
3) $T_{harbour-min}$: meet the maximum allowable cargo mass (see(9))
4) $T_{harbour-max}$: meet the minimum allowable cargo mass (see(9))
5) Fore : The sign of the target shear force of forward transverse bulkhead of the center hold
6) Aft : The sign of the target shear force of aftward transverse bulkhead of the center hold
7) If this loading condition is not taken into account, it should be evaluated in the loading condition of the Multi port (1) condition.
8) If this loading condition is not taken into account, it should be evaluated in the loading condition of the Port (1) condition.
9) 0%* : Refer to loading manual.

Table 7 Load case of Fwd hold

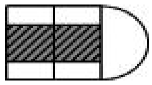
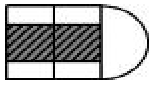
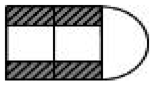
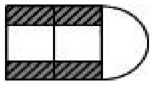
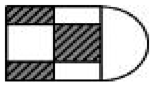
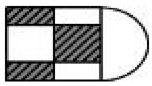
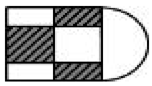
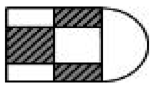
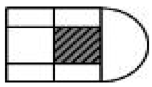
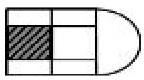
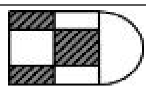
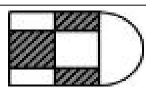
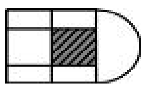
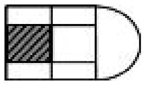
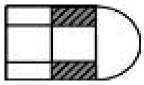
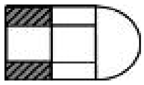
Condition	No	Description	Draft	Wave load	Internal load	Loading pattern	Target bending moment and shear force			
							% of M_s	% of M_w	% of F_s	% of F_w
at sea	1	Full load (1)	T_s	Trough	High/Low density		100% (Sag)	100% (Sag)	-	-
at sea	2	Full load (2)	T_s	Crest	High/Low density		0%[9]	100% (Hog)	-	-
at sea	3	Ballast (Normal)	T_{bal}	Crest	-		100% (Hog)	100% (Hog)	-	-
at sea	4	Ballast (Heavy)	T_{bal-H}	Crest	-		100% (Hog)	100% (Hog)	-	-
at sea	5	Multi port (1)	$T_{multi-min}$[1]	Trough	High/Low density		100% (Sag)	100% (Sag)	-	-
at sea	6	Multi port (2)	$T_{multi-min}$[1]	Crest	High/Low density		0%[9]	100% (Hog)	-	-
at sea	7	Multi port (3)	$T_{multi-max}$[2]	Trough	High/Low density		0%[9]	100% (Sag)	-	-
at sea	8	Multi port (4)	$T_{multi-max}$[2]	Crest	High/Low density		100% (Hog)	100% (Hog)	-	-
at sea	9	Multi port (5)7)	$T_{multi-min}$[1]	Trough	High/Low density		100% (Sag)	-	Fore[5] : +100% Aft[6] : -100%	- -
at sea	10	Multi port (6)	$T_{multi-max}$[1]	Crest	High/Low density		100% (Hog)	-	-	-
port	11	Port (1)	$T_{harbour-min}$[3]	Hydrostatic pressure	High/Low density		100% (Sag)	-	-	-
port	12	Port (2)	$T_{harbour-max}$[4]	Hydrostatic pressure	High/Low density		100% (Hog)	-	-	-
port	13	Port (3)[8]	$T_{harbour-min}$[3]	Hydrostatic pressure	High/Low density		100% (Sag)	-	Fore[5] : +100% Aft[6] : -100%	- -

Table 7 Load case of Fwd hold (continued)

Condition	No	Description	Draft	Wave load	Internal load	Loading pattern	Target bending moment and shear force			
							% of M_s	% of M_w	% of F_s	% of F_w
port	14	Port (4)	$T_{harbour-max}$ 4)	Hydrostatic pressure	High/Low density		100% (Hog)	-	-	-
tank	15	Tank test (1)	$T_{sc}/3$	Hydrostatic pressure	-		-	-	-	-
tank	16	Tank test (2)	$T_{sc}/3$	Hydrostatic pressure	-		-	-	-	-

(Note)
The load cases can be changed / added in accordance with the loading manual. If there is no multi port cases in the loading manual, the multi port cases in Table 7 can be omitted and is given the no MP notation.
1) $T_{multi-min}$: meet the maximum allowable cargo mass (see(9))
2) $T_{multi-max}$: meet the minimum required cargo mass (see(9))
3) $T_{harbour-min}$: meet the maximum allowable cargo mass (see(9))
4) $T_{harbour-max}$: meet the minimum allowable cargo mass (see(9))
5) Fore : The sign of the target shear force of forward transverse bulkhead of the center hold
6) Aft : The sign of the target shear force of aftward transverse bulkhead of the center hold
7) If this loading condition is not taken into account, it should be evaluated in the loading condition of the Multi port (1) condition.
8) If this loading condition is not taken into account, it should be evaluated in the loading condition of the Port (1) condition.
9) 0%* : Refer to loading manual.

(5) Consideration of dynamic shear loads in beam sea condition

(A) General

(a) In order to verify the structural integrity of transverse members under dynamic shear load due to rolling motion and high GM in beam sea condition, BSR and BSP load cases are to be applied as shown in Table 8 and Table 9. BSR and BSP load cases means as follows;

- BSR-1P and BSR-2P: Beam sea EDWs that minimise and maximise the roll motion downward and upward on the port side respectively with waves from the port side.
- BSR-1S and BSR-2S: Beam sea EDWs that maximise and minimise the roll motion downward and upward on the starboard side respectively with waves from the starboard side.
- BSP-1P and BSP-2P: Beam sea EDWs that maximise and minimise the hydrodynamic pressure at the waterline amidships on the port side respectively.
- BSP-1S and BSP-2S: Beam sea EDWs that maximise and minimise the hydrodynamic pressure at the waterline amidships on the starboard side respectively.

(b) These BSR and BSP load cases are to be applied to homogeneous loading with $\gamma = 3.0$ $(\mathrm{ton/m^3})$ of high density cargo for mid hold model only. The loading pattern described in No. 1 condition of Table 5. should be applied.

(B) Applied loads

(a) The symbol's definitions in BSR and BSP load cases are following;

T_θ : The roll period, in s, is to be taken as;

$$T_\theta = \frac{2.3\pi k_r}{\sqrt{g\,GM}}.$$

where;

k_r : Roll radius of gyration, in m, in the considered loading condition. 0.25B is to be adopted unless provided in the loading manual.

GM : Metacentric height, in m, in the considered loading condition. 0.20B is to be adopted unless provided in the loading manual.

g : $9.81\,m/s^2$

θ : The roll angle, in deg, is to be taken as ;

$$\theta = \frac{9000(1.25 - 0.025\,T_\theta)f_{BK}}{(B+75)\pi}$$

where;

f_{BK} : To be taken as:

$f_{BK} = 1.2$ for ships without bilge keel.

$f_{BK} = 1.0$ for ships with bilge keel.

T_ϕ : The pitch period, in s, is to be taken as:

$$T_\phi = \sqrt{\frac{2.6\pi L}{g}}$$

ϕ : The pitch angle, in deg, is to be taken as:

$$\phi = 1350\,L^{-0.94}\left\{1 + \frac{3.0}{\sqrt{gL}}\right\}$$

a_0 : Acceleration parameter, to be taken as:

$$a_0 = (1.58 - 0.47C_B)\left(\frac{2.4}{\sqrt{L}} + \frac{34}{L} - \frac{600}{L^2}\right)$$

x, y, z : X, Y and Z coordinates, in m, of the considered point at the intersection among the longitudinal plane of symmetry of ship, the aft end of L and the baseline.

R : Vertical coordinate, in m, of the ship rotation centre, to be taken as:

$$R = \min\left(\frac{D}{4} + \frac{T_{SC}}{2},\ \frac{D}{2}\right)$$

T_{SC} : Scantling draught

f_β : Heading correction factor, to be taken as:

$f_\beta = 0.8$ for BSR and BSP load cases for the extreme sea loads design load scenario.

Table 6 Ship responses for BSR and BSP load cases

Loadcase	BSR-1P	BSR-2P	BSR-1S	BSR-2S	BSP-1P	BSP-2P	BSP-1S	BSP-2S
EDW	BSR				BSP			
Heading	Beam				Beam			
Effect	Max. roll				Max. pressure at waterline			
VWBM	Sagging	Hogging	Sagging	Hogging	Sagging	Hogging	Sagging	Hogging
VWSF	Negative-aft Positive-fore	Positive-aft Negative-fore	Negative-aft Positive-fore	Positive-aft Negative-fore	Negative-aft Positive-fore	Positive-aft Negative-fore	Negative-aft Positive-fore	Positive-aft Negative-fore
HWBM	Stbd tensile	Port tensile	Port tensile	Stbd tensile	Stbd tensile	Port tensile	Port tensile	Stbd tensile
Surge	-	-	-	-	To bow	To stern	To bow	To stern
a_{surge}	-	-	-	-				
Sway	To starboard	To Portside	To Portside	To starboard	To Portside	To starboard	To starboard	To Portside
a_{sway}	W.S L.S	W.S L.S	L.S W.S	L.S W.S	W.S L.S	W.S L.S	L.S W.S	L.S W.S
Heave	Down	Up	Down	Up	Down	Up	Down	Up
a_{heave}	W.S L.S	W.S L.S	L.S W.S	L.S W.S	W.S L.S	W.S L.S	L.S W.S	L.S W.S
Roll	Portside down	Portside up	Starboard down	Starboard up	Portside up	Portside down	Starboard up	Starboard down
a_{roll}	W.S L.S	W.S L.S	L.S W.S	L.S W.S	W.S L.S	W.S L.S	L.S W.S	L.S W.S
Pitch	Bow up	Bow down	Bow up	Bow down	Bow up	Bow down	Bow up	Bow down
a_{pitch}								

Note)
VWBM & VWSF : Vertical bending moment and shear force are to be taken as defined in Pt. 3, Ch 3.
HWBM : Horizontal bending moment is to be taken as defined in (B)
WS : Weather side, side of the ship exposed to the incoming waves.
LS : Lee side, sheltered side of the ship away from the incoming waves.

(b) The accelerations due to ship motion are follows;
Surge acceleration due to surge, in m/s^2, is to be taken as:

$$a_{surge} = 0.25\ a_0\, g$$

Sway acceleration due to sway, in m/s^2, is to be taken as:

$$a_{sway} = 0.55\ a_0\, g$$

Heave (vertical) acceleration due to heave, in m/s^2, is to be taken as:

$$a_{heave} = a_0\, g$$

Table 9 Load combination factors, LCFs for BSR and BSP load cases

Load component		LCF	BSR-1P	BSR-2P	BSR-1S	BSR-2S	BSP-1P	BSP-2P	BSP-1S	BSP-2S
Hull girder loads	M_{wv}	C_{WV}	-0.1	0.1	-0.1	0.1	-0.4	0.4	-0.4	0.4
	Q_{wv}	C_{QW}	0.1	-0.1	0.1	-0.1	0.3	-0.3	0.3	-0.3
	M_{wh}	C_{WH}	0.4	-0.4	-0.4	0.4	0.4	-0.4	-0.4	0.4
Longitudinal accelerations	a_{surge}	C_{XS}	0.0	0.0	0.0	0.0	-0.15	0.15	-0.15	0.15
	$a_{pitch-x}$	C_{XP}	0.4	-0.4	0.4	-0.4	0.45	-0.45	0.45	-0.45
	$g\sin\phi$	C_{XG}	-0.3	0.3	-0.3	0.3	-0.25	0.25	-0.25	0.25
Transverse accelerations	a_{sway}	C_{YS}	0.5	-0.5	-0.5	0.5	0.4	-0.4	-0.4	0.4
	a_{roll-y}	C_{YR}	1.0	-1.0	-1.0	1.0	1.0	-1.0	-1.0	1.0
	$g\sin\theta$	C_{YG}	-1.0	1.0	1.0	-1.0	-0.9	0.9	0.9	-0.9
Vertical accelerations	a_{heave}	C_{ZH}	-0.25	0.25	-0.25	0.25	0.5	-0.5	0.5	-0.5
	a_{roll-z}	C_{ZR}	1.0	-1.0	1.0	-1.0	1.0	-1.0	-1.0	1.0
	$a_{pitch-z}$	C_{ZP}	0.4	-0.4	0.4	-0.4	0.45	-0.45	0.45	-0.45

Roll acceleration, a_{roll}, in $\mathrm{rad/s^2}$, is to be taken as:

$$a_{roll} = \theta \frac{\pi}{180}\left(\frac{2\pi}{T_\theta}\right)^2 .$$

Pitch acceleration, a_{pitch}, in $\mathrm{rad/s^2}$, is to be taken as:

$$a_{pitch} = 1.5\,\phi \frac{\pi}{180}\left(\frac{2\pi}{T_\phi}\right)^2$$

The accelerations used to derive the inertial loads at any position are defined with respect to the ship fixed coordinate system. Hence the acceleration values include the gravitational acceleration components due to the instantaneous roll angles.

The longitudinal acceleration at any position for each dynamic load case, in $\mathrm{m/s^2}$, is to be taken as:

$$a_X = -C_{XG}\, g \sin\phi + C_{XS}\, a_{surge} + C_{XP}\, a_{pitch}(z-R)$$

The transverse acceleration at any position for each dynamic load case, in $\mathrm{m/s^2}$, is to be taken as:

$$a_Y = C_{YG}\, g \sin\theta + C_{YS}\, a_{sway} - C_{YR}\, a_{roll}(z-R)$$

The vertical acceleration at any position for each dynamic load case, in $\mathrm{m/s^2}$, is to be taken as:

$$a_Z = C_{ZH}\, a_{heave} + C_{ZR}\, a_{roll}\, y - C_{ZP}\, a_{pitch}(x-0.45L)$$

(c) Hull girder loads

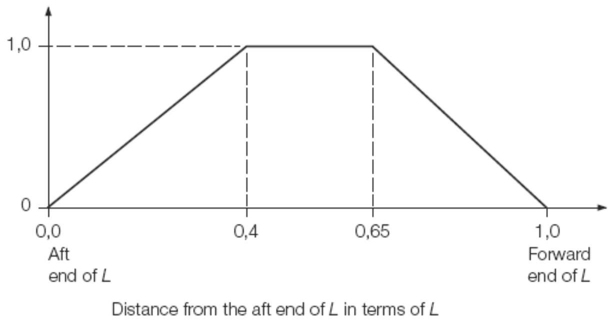
The wave induced vertical bending moment and shear force are to be taken as defined in (G) and (H) in (4). The horizontal wave bending moment at any longitudinal position, in kNm, is to be taken as:

$$M_{wh} = f_{nlh}\left(0.31 + \frac{L}{2800}\right) f_m C_w L^2 T_{SC} C_B$$

where:

f_{nlh} : Coefficient considering nonlinear effect to be taken as: $f_{nlh} = 0.9$

f_m : Distribution factor is to be taken as;



C_w : Wave coefficient, in m, to be taken as:

$$C_w = 10.75 - \left(\frac{300 - L}{100}\right)^{1.5} \quad \text{for } 90 \le L \le 300$$

$$C_w = 10.75 \quad \text{for } 300 < L \le 350$$

$$C_w = 10.75 - \left(\frac{L - 350}{150}\right)^{1.5} \quad \text{for } 350 < L \le 500$$

(d) Hydrodynamic pressure for BSR load cases

The wave pressures, P_W, for BSR-1 and BSR-2 load cases, at any load point, in $\mathrm{kN/m^2}$, are to be obtained from Table 10, Fig 13 and 14. Total external pressure is to be calculated by $P_S + P_W$, P_S means still water hydrostatic pressure for considered loading condition.

Table 10 Hydrodynamic pressures for BSR load cases

	Wave pressure, in $\mathrm{kN/m^2}$		
Load case	$z \le T_{SC}$	$T_{SC} < z \le h_W + T_{SC}$	$z > h_W + T_{SC}$
BSR-1P	$P_W = \max\left(P_{BSR},\ \rho g (z - T_{SC})\right)$	$P_W = P_{W,WL} - \rho g (z - T_{SC})$	$P_W = 0.0$
BSR-2P	$P_W = \max\left(-P_{BSR},\ \rho g (z - T_{SC})\right)$		
BSR-1S	$P_W = \max\left(P_{BSR},\ \rho g (z - T_{SC})\right)$		
BSR-2S	$P_W = \max\left(-P_{BSR},\ \rho g (z - T_{SC})\right)$		

where;

For BSR-1P and BSR-2P load cases:

$$P_{BSR} = f_\beta f_R f_{nl} k_a k_p \left[9 y \sin\theta + \left(-0.95 f_{yB} - 2 f_{zT} - 0.2\right) C_W \sqrt{\frac{L + \lambda - 125}{L}}\right]$$

For BSR-1S and BSR-2S load cases:

$$P_{BSR} = f_\beta f_R f_{nl} k_a k_p \left[-9 y \sin\theta + (-0.95 f_{yB} - 2 f_{zT} - 0.2) C_W \sqrt{\frac{L+\lambda-125}{L}} \right]$$

f_R : Factor related to the operational profile, to be taken as :

$$f_R = 0.85$$

f_{nl} : Coefficient considering non-linear effect, to be taken as :

$$f_{nl} = 1.0$$

$$k_a = k_{a-WL} f_{yB} + k_{a-CL} (1 - f_{yB})$$

$$k_p = k_{p-WL} f_{yB} + k_{p-CL} (1 - f_{yB})$$

Phase coefficient, k_{a-WL}, k_{a-CL}, k_{p-WL} and k_{p-CL} are to be taken as following; Intermediate values are to be interpolated.

- Port side of BSR-1P and BSR-2P or starboard side BSR-1S and BSR-2S

f_{xL}	0.0	0.2	0.35	0.5	0.7	1.0
k_{a-WL}	0.4	0.9	1.05	1.0	0.9	0.6

f_{xL}	0.0	0.15	0.3	0.6	0.85	1.0
k_{p-WL}	2.0	2.0	1.6	1.0	1.0	-1.0

- Port side of BSR-1S and BSR-2S or starboard side BSR-1P and BSR-2P

f_{xL}	0	0.3	0.5	0.65	0.8	1.0
k_{a-WL}	0.2	0.75	1.	1.1	1.0	0.8

f_{xL}	0.0	0.1	0.2	0.4	0.6	0.8	1.0
k_{p-WL}	0.95	0.9	0.7	1.0	1.0	0.9	1.0

- Center line

f_{xL}	0.0	0.2	0.4	0.6	0.85	1.0
k_{a-CL}	1.5	1.5	1.0	1.0	2.0	2.0

f_{xL}	0.0	0.2	0.5	0.7	1.0
k_{p-CL}	-0.5	-0.5	1.0	1.0	1.0

f_{xL} : Ratio between X-coordinate of the load point and L, to be taken as:

$f_{xL} = \frac{x}{L}$, but not to be taken less than 0.0 or greater than 1.0.

f_{zT} : Ratio between Z-coordinate of the load point and T_{SC}, to be taken as:

$f_{zT} = \frac{z}{T_{SC}}$, but not greater than 1.0.

f_{yB} : Ratio between Y-coordinate of the load point and B, to be taken as:

$f_{yB} = \frac{|2y|}{B_x}$, but not greater than 1.0.

$f_{yB}=0$, when $B_x=0$

B_x : Moulded breadth at the waterline, in m, at the considered cross section.

λ : Wave length of the BSR load case, in m, to be taken as:

$$\lambda=\frac{g}{2\pi}T_\theta^2$$

$P_{W,WL}$: Wave pressure at the waterline, $\mathrm{kN/m^2}$, for the considered dynamic load case. $P_{W,WL}=P_{BSR}$ for $y=B_x/2$ and $z=T_{SC}$

h_W : Water head equivalent to the pressure at waterline, in m, to be taken as:

$$h_w=\frac{P_{W,WL}}{\rho g}$$

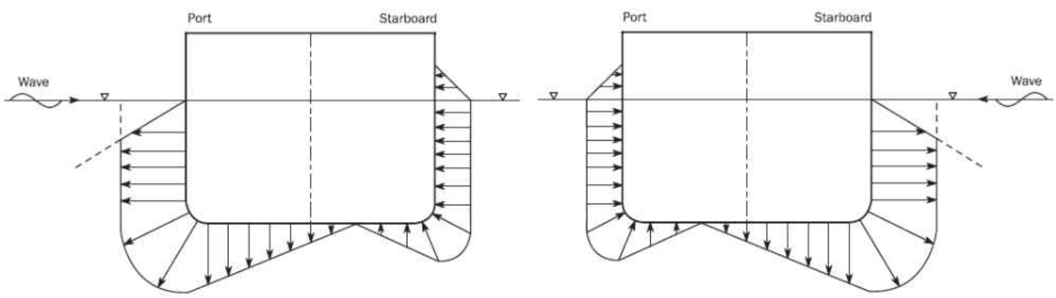


Fig 13 Transverse distribution of dynamic pressure for BSR-1P(right)와 BSR-1S(left) load cases

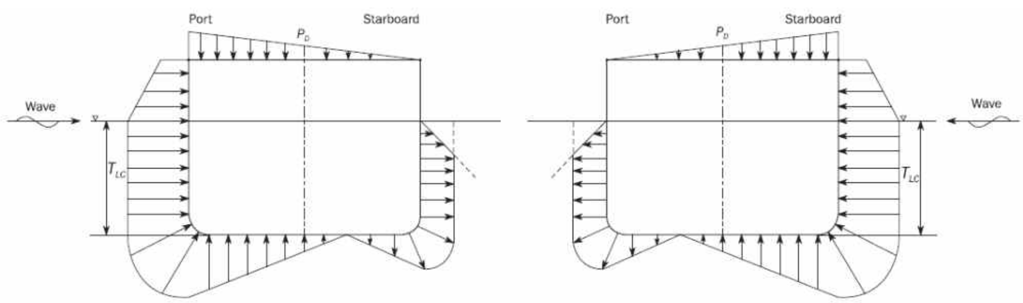


Fig 14 Transverse distribution of dynamic pressure for BSR-2P(right)와 BSR-2S(left) load cases

(e) Hydrodynamic pressure for BSP load cases

The wave pressures, P_W, for BSP-1 and BSP-2 load cases, at any load point, in $\mathrm{kN/m^2}$, are to be obtained from Table 11, Fig 16 and 17. Total external pressure is to be calculated by P_S+P_W , P_S means still water hydrostatic pressure for considered loading condition.

Table 11 Hydrodynamic pressures for BSP load cases

	Wave pressure, in kN/m^2		
Load case	$z \le T_{SC}$	$T_{SC} < z \le h_W + T_{SC}$	$z > h_W + T_{SC}$
BSP-1P	$P_W = \max(P_{BSP}, \rho g(z - T_{SC}))$	$P_W = P_{W,WL} - \rho g(z - T_{SC})$	$P_W = 0.0$
BSP-2P	$P_W = \max(-P_{BSP}, \rho g(z - T_{SC}))$		
BSP-1S	$P_W = \max(P_{BSP}, \rho g(z - T_{SC}))$		
BSP-2S	$P_W = \max(-P_{BSP}, \rho g(z - T_{SC}))$		

where;

$$P_{BSP} = 1.25 f_\beta f_R f_{nl} k_a k_p f_{yz} C_W \sqrt{\frac{L + \lambda - 125}{L}}$$

f_R : Factor related to the operational profile, is defined in (d)

f_{nl} : Coefficient considering non-linear effect, to be taken as :
- For extreme sea loads design load scenario :
  $f_{nl} = 0.6$ at $f_{xL} = 0$
  $f_{nl} = 0.8$ at $f_{xL} = 0.3$
  $f_{nl} = 0.8$ at $f_{xL} = 0.7$
  $f_{nl} = 0.6$ at $f_{xL} = 1$

Transverse Position	BSP-1P and BSP-2P	BSP-1S and BSP-2S
$y \ge 0$	$f_{yz} = 10\frac{z}{T_{SC}} + 8.5 f_{yB} + 0.1$	$f_{yz} = -1.3\frac{z}{T_{SC}} - 4 f_{yB} + 0.1$
$y < 0$	$f_{yz} = -1.3\frac{z}{T_{SC}} - 4 f_{yB} + 0.1$	$f_{yz} = 10\frac{z}{T_{SC}} + 8.5 f_{yB} + 0.1$

λ : Wave length of the BSP load case, in m, to be taken as:

$$\lambda = 0.5L$$

$$k_a = k_{a-WL} f_{yB} + k_{a-CL}(1 - f_{yB})$$

$$k_p = k_{p-WL} f_{yB} + k_{p-CL}(1 - f_{yB})$$

Phase coefficient, k_{a-WL}, k_{a-CL}, k_{p-WL} and k_{p-CL} are to be taken as following; Intermediate values are to be interpolated.

- Port side of BSP-1P and BSP-2P or starboard side BSP-1S and BSP-2S

f_{xL}	0.0	0.2	0.35	0.5	0.6	0.8	0.9	1
k_{a-WL}	0.3	0.9	1.1	1.0	0.9	0.9	0.7	0.5

f_{xL}	0.0	0.2	0.4	0.9	1.0
k_{p-WL}	1.0	0.9	1.0	1.0	0.5

- Port side of BSP-1S and BSP-2S or starboard side BSP-1P and BSP-2P

f_{xL}	0	0.1	0.2	0.3	0.5	0.7	0.8	1.0
k_{a-WL}	0.2	0.3	0.5	0.8	1.0	1.15	1.1	0.9

f_{xL}	0.0	0.05	0.2	0.3	0.4	0.5	0.6	0.8	0.9	1.0
k_{p-WL}	0.5	1.2	-0.4	-0.1	0.6	1.0	0.9	0.3	0.8	1.0

- Center line

f_{xL}	0.0	0.2	0.4	0.6	0.85	1.0
k_{a-CL}	1.0	1.0	1.0	1.0	2.0	2.0

f_{xL}	0.0	0.35	0.5	0.8	1.0
k_{p-CL}	1.6	1.6	1.0	1.5	1.0

$P_{W,WL}$: Wave pressure at the waterline, $\mathrm{kN/m^2}$, for the considered dynamic load case. $P_{W,WL} = P_{BSP}$ for $y = B_x/2$ and $z = T_{SC}$

Other parametric symbols are defined in (d).

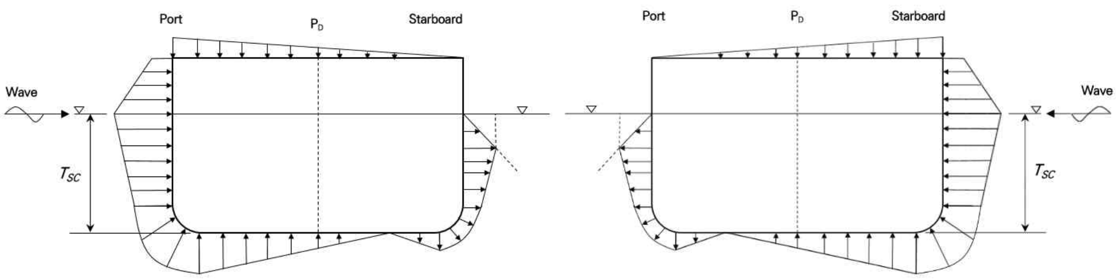


Figure 15 Transverse distribution of dynamic pressure for BSP-1P(left)와 BSP-1S(right) load cases

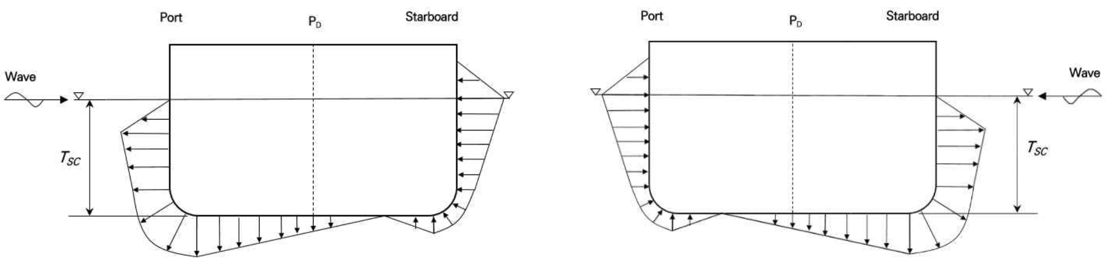


Figure 16 Transverse distribution of dynamic pressure for BSP-2P(left)와 BSP-2S(right) load cases

(f) Internal cargo loads

The cargo pressure due to ore cargo acting on any load point of a cargo hold boundary, in kN/m^2, is to be taken as:

$$P_{in} = w + P_{bd}$$

Static pressure, w in kN/m^2, due to ore cargo is defined in (4), (A), (a) (ii). Dynamic pressure, P_{bd} in kN/m^2, due to ore cargo for BSR load cases is to be taken as:

$$P_{bd} = f_\beta \gamma [0.25 a_x (x_G - x) + 0.25 a_y (y_G - y) + K_C a_z (z_C - z)] \quad (kN/m^2)$$

for $z < z_C$

$$P_{bd} = 0 \quad (kNm^2), \quad \text{for } z > z_C$$

where;

a_x, a_y, a_z : Longitudinal, transverse and vertical accelerations, in m/s^2, at x_G, y_G, z_G.

x_G, y_G, z_G : X, Y and Z coordinates, in m, of the volumetric centre of gravity of fully filled cargo hold, i.e. V_{Full}, considered with respect to the reference coordinate system. In case of partially filled cargo hold, x_G, y_G, z_G to be taken as follows;

x_G, y_G : Volumetric centre of gravity of the cargo hold.
$z_G = h_{DB} + h_C/2$, h_{DB} and h_c are defined in (4), (A), (a).

V_{Full} : Volume, in m^3, of cargo hold up to top of the hatch coaming, taken as:

$V_{Full} = V_H + V_{HC}$, V_H and V_{HC} are defined in (4), (A), (a).

z_c : Height of the upper surface of the cargo above the baseline in way of the load point, in m, to be taken as:

$$z_c = h_{DB} + h_c$$

K_C : Coefficient is defined in (4), (A), (a) (ii).

The shear load pressures, $P_{bs-s} + P_{bs-d}$, are to be considered for the hopper tank and the lower stool plating in addition to the ore cargo pressures when the load point elevation, z, is lower or equal to z_c. Static shear load, P_{bs-s}, due to gravitational forces acting on hopper tanks and lower stools plating, is defined as w_{sh} of (4), (A), (a) (ii).

The dynamic shear load pressure, P_{bs-d} (positive downward to the plating) due to ore cargo forces on the hopper tank and lower stool plating, in kN/m^2, is to be taken as:

$$P_{bs-d} = f_\beta \gamma a_z \frac{(1 - K_C)(z_C - z)}{\tan\beta}$$

Additionally, the dynamic shear load pressures, P_{bs-dx} and P_{bs-dy}, due to ore cargo forces acting along the inner bottom plating, in kN/m^2, are to be taken as:

$P_{bs-dx} = -0.75 f_\beta \gamma a_x h_C$, in the longitudinal direction (positive to bow)

$P_{bs-dy} = -0.75 f_\beta \gamma a_y h_C$, in the transverse direction (positive to port)

(6) Allowable stresses
The stress calculated by the direct strength analysis using the dimension including the corrosion margin should meet the following criteria, and the evaluation range is shown in Fig 17.

$$\sigma_{act} < \sigma_{allow}$$

$$\sigma_{act} = \sqrt{\sigma_x^2 + \sigma_y^2 - \sigma_x \sigma_y + 3\tau^2}$$

$$\sigma_{allow} = \eta \sigma_{yield}$$

$$\sigma_{yield} = 235/K (\mathrm{N/mm^2})$$

where;

η : Yield strength correction factor
$\eta = 0.9$: for longitudinal strength member of port condition and sea going condition defined in (4) and for all structural members of load conditions defined in (5).
$\eta = 0.72$: transverse strength member of port condition and sea going condition except load cases defined in (5).

K : Material factor (see Pt.3 Annex 3-2 Table 5)
σ_x : Normal stress in x-direction of element coordinate system
σ_y : Normal stress in y-direction of element coordinate system\
τ : Shear stress on the face in x-y direction of element coordinate system

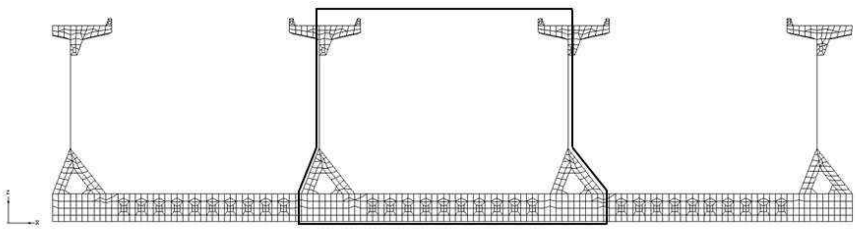


Fig 17 Evaluation range

(7) Buckling
The plate panel of hull structure is to be modelled as stiffened panel, SP or unstiffened panel, UP. Method A and Method B as defined in Pt. 13, Sub-Pt 1, Ch. 8 are to be used according to Fig 18 to Fig 19. The detailed calculation of buckling strength is to be in accordance with Pt. 13, Sub-Pt 1, Ch. 8. Sec 4 ~ 5 and the corrosion addition and judgments of buckling strength for buckling evaluation are as shown in Table 12 and 13. The 1.0 of buckling factor should be applied to all structural members for load cases to reflect dynamic shear loads in beam sea condition defined in (5).

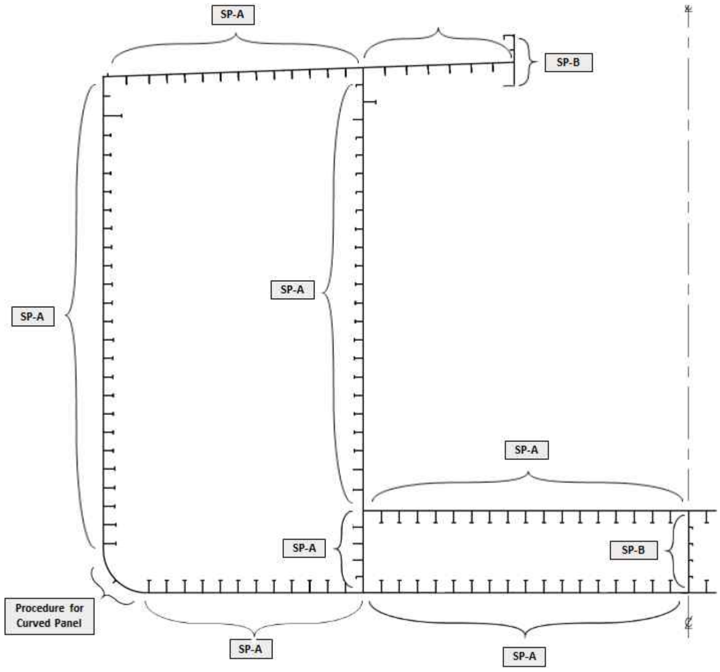


Fig 18 Longitudinal plate panel in VLOC

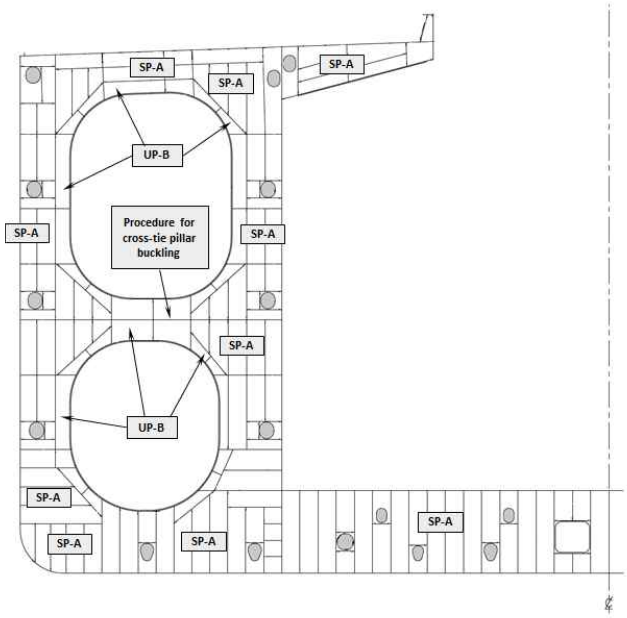


Fig 19 Plate panel of transverse web frame in VLOC

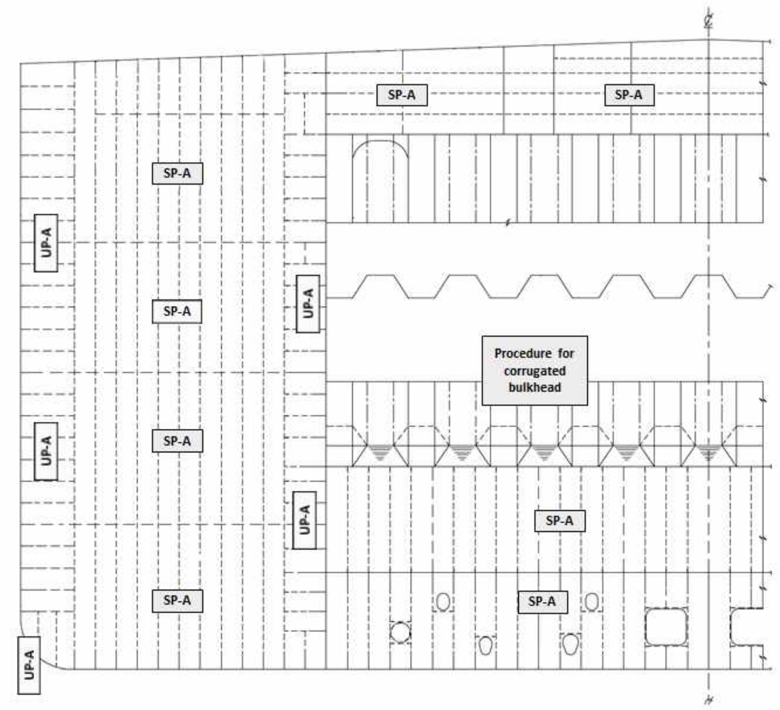


Fig 20 Plate panel of transverse bulkhead in VLOC

Table 12 Corrosion addition

Location	Corrosion addition
When both sides are in contact with seawater	2.5 mm
When one side is in contact with seawater	2.0 mm
When both sides are not in contact with seawater	1.5 mm

Table 13 Judgement of buckling strength

Member	Buckling factor
Cross Deck, Hatch End Beam and Upper Stool	0.8
Others	1.0

(8) Local fine mesh analysis
(A) Application
(a) The list of structural details of the fine mesh analysis are as follows.
- hopper knuckle
- openings
- connection between transverse bulkhead and longitudinal stiffener of deck and double bottom
- connection of corrugated bulkhead and the adjacent structure
- hatch corner

(b) For other high stress areas in which the stress (σ_{act}) calculated by direct strength analysis is greater than 95% of the allowable stress (σ_{allow}), additional analysis should be performed at the discretion of the Society.

(B) Fine mesh of the structure
(a) The range of the local fine mesh analysis should be at least 10 elements in all directions from the area under consideration.
(b) All plates and stiffeners within the local fine mesh analysis range should be represented by shell elements.
(c) For element corners, crooked elements less than 45 degrees or greater than 135 degrees should be avoided.
(d) The aspect ratio of the element should be kept as close as possible to 1, and should be less than 3.
(e) Mesh size of local fine mesh analysis should be such that it is capable of expressing the structure well and is less than the longitudinal spacing.
(f) When performing local fine mesh analysis for openings, the elements of the first two layers of the perimeter elements of the opening should be modeled to a size of 50 x 50 mm or less. End stiffeners directly welded to the opening end should be modeled as shell elements. The web stiffener near the opening is located at least 50 mm from the end of the opening and can be modeled using a rod or beam element.

(C) Allowable stress for local fine mesh analysis
(a) Allowable stresses for local fine mesh analysis should meet the following criteria.

$$\sigma_{act\_l} < \sigma_{allow\_l}$$

$$\sigma_{act\_l} = \sqrt{\sigma_{x\_l}^2 + \sigma_{y\_l}^2 - \sigma_{x\_l}\sigma_{y\_l} + 3\tau_l^2}$$

$$\sigma_{allow\_l} = \eta\,\eta_{local}\sigma_{yield\_l}$$

$$\sigma_{yield\_l} = 235/K \quad (\mathrm{N/mm^2})$$

where;

η : Yield strength correction factor as defined in **(6)**
η_{allow} : Local fine mesh analysis correction factor
$\eta_{allow} = 1.00$, element size ≤ longitudinal spacing (mm)
$\eta_{allow} = 1.15$, element size ≤ 200 x 200 (mm)
$\eta_{allow} = 1.25$, element size ≤ 100 x 100 (mm)
$\eta_{allow} = 1.50$, element size ≤ 50 x 50 (mm)

K : Material factor (see **Pt 3, Annex 3-2, Table 5**)
σ_{x_l} : Normal stress in x-direction of element coordinate system $(\mathrm{N/mm^2})$
σ_{y_l} : Normal stress in y-direction of element coordinate system $(\mathrm{N/mm^2})$
τ_l : Shear stress on the face in x-y direction of element coordinate system $(\mathrm{N/mm^2})$

(b) When evaluating the corner of the opening, the average stress can be evaluated as follows.(see **Fig 21**)

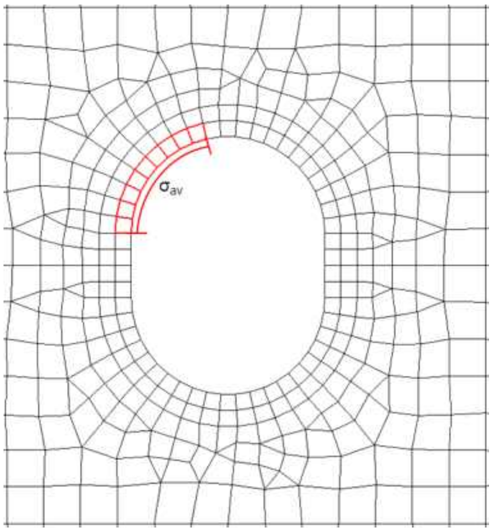


Fig 21 Opening

$$\sigma_{act} < \sigma_{allow}$$

where;

$$\sigma_{act} = \frac{\sum_{1}^{n} A_l \sigma_l}{\sum_{1}^{n} A_l}$$

σ_{allow} : Allowable stresses in direct strength analysis (N/mm^2)
σ_{act} : Mean stress in the considered range (N/mm^2)
σ_l : Each element stress in the considered range(N/mm^2)
A_l : Each element area in the considered range (mm^2)
n : Number of elements in the considered range

(9) Cargo Mass Curves

(A) The maximum and minimum drafts which are satisfied with maximum allowable cargo mass and the minimum required cargo mass for the each cargo hold are to be given by the following equations. In finite element analysis of middle cargo hold, holds No. 2 to n-1 are to be satisfied. The draft of fore end part is to be satisfied with maximum allowable cargo mass and the minimum required cargo mass of No. 1 cargo hold and the draft of aft end part is to be satisfied with maximum allowable cargo mass and the minimum required cargo mass of No. n cargo hold. (see Fig 22)

Maximum allowable cargo mass

Curve 1 : $W_{MAX,SEA}(T_{LC}) = M - 1.025LB(T_{MIN,SEA} - T_{LC})$ $(\le M)$ (ton)
Curve 2 : $W_{MAX,HAR}(T_{LC}) = M - 1.025LB(T_{MIN,HAR} - T_{LC})$ $(\le M)$(ton)

Minimum required cargo mass

Curve 3 : $W_{MIN}(T_{LC}) = M - 1.025LB(T_{LC} - T_{multi-max})$ (ton)
Curve 4 : $W_{MIN,HAR}(T_{LC}) = 1.025LB(T_{LC} - T_{MAX,HAR})$ (≥ 0) (ton)

$W_{MAX,SEA}(T_{LC})$: Maximum allowable mass with draft, T_{LC} at sea going condition (ton)
$W_{MAX,HAR}(T_{LC})$: Maximum allowable mass with draft, T_{LC} at harbour (ton)
$W_{MIN,SEA}(T_{LC})$: Minimum required mass with draft, T_{LC} at sea going condition (ton)
$W_{MIN,HAR}(T_{LC})$: Minimum required mass with draft, T_{LC} at harbour (ton)
M : Maximum allowable mass of considered cargo hold (ton)
$T_{MIN,SEA}$: Minimum draft (m) at sea going condition which the maximum allowable cargo weight of the cargo hold is applied. But minimum draft at multi port condition subtracting 0.2m (considering the trim)
$T_{MAX,SEA}$: Maximum draft (m) at sea going condition which the minimum allowable cargo weight of the cargo hold is applied. But maximum draft at multi port condition including 0.2m (considering the trim)
$T_{MIN,HAR}$: Minimum draft (m) at the port state to which the maximum allowable cargo weight(M) of the cargo hold is applied. If the minimum draft in the port condition is not ascertained, an evaluation of the strength should be made by the following formula

$$T_{MIN,HAR} = T_{MIN,SEA} - (1.15M - W_{MAX,SEA}(T_{LC}))/(1.025LB)$$

L : length of the considered cargo hold (m)
B : mean breadth of the considered cargo hold (m)
$T_{MAX,HAR}$: Maximum draft (m) at port condition to which the minimum allowable cargo weight (M_{AD}) of cargo holds is applied

(B) The maximum and minimum drafts which are satisfied with maximum allowable cargo mass and the minimum required cargo mass for adjacent 2 cargo hold are to be given by the following equations. In finite element analysis of middle cargo hold, holds No. 2 and 3 to n-2 and n-1 are to be satisfied. The draft of fore end part is to be satisfied with maximum allowable cargo mass and the minimum required cargo mass of No. 1 and 2 cargo holds and the draft of aft end part are to be satisfied with maximum allowable cargo mass and the minimum required cargo mass of No. n-2 and n-1 cargo holds. (see Fig 19)

Maximum allowable cargo mass
Curve 1: $W_{MAX,SEA\_AD}(T_{LC}) = M_{AD} - 1.025L_{AD}B_{AD}(T_{MIN,SEA\_AD} - T_{LC})$ $(\leq M_{AD})$ (ton)
Curve 2: $W_{MAX,HAR\_AD}(T_{LC}) = M_{AD} - 1.025L_{AD}B_{AD}(T_{MIN,HAR\_AD} - T_{LC})$ $(\leq M_{AD})$ (ton)

Minimum required cargo mass
Curve 3: $W_{MIN,SEA\_AD}(T_{LC}) = 1.025L_{AD}B_{AD}(T_{LC} - T_{MAX,SEA\_AD})$ (≥ 0) (ton)
Curve 4: $W_{MIN,HAR\_AD}(T_{LC}) = 1.025L_{AD}B_{AD}(T_{LC} - T_{MAX,HAR\_AD})$ (≥ 0) (ton)

$W_{MAX,SEA\_AD}(T_{LC})$: Maximum allowable mass of adjacent 2 cargo holds with draft, T_{LC} at sea going condition (ton)
$W_{MAX,HAR\_AD}(T_{LC})$: Maximum allowable mass of adjacent 2 cargo holds with draft, T_{LC} at port (ton)
$W_{MIN,SEA\_AD}(T_{LC})$: Required cargo mass of adjacent 2 cargo holds with draft, T_{LC} at sea going condition (ton)
$W_{MIN,HAR\_AD}(T_{LC})$: Required cargo mass of adjacent 2 cargo holds with draft, T_{LC} at port (ton)
T_{MIN,SEA_AD} : Minimum draft (m) in the sea going condition to which the maximum allowable cargo weight (M_{AD}) of adjacent 2 cargo holds is applied
T_{MAX,SEA_AD} : Maximum draft (m) in the sea going condition to which the minimum allowable cargo weight (M_{AD}) of adjacent 2 cargo holds is applied

T_{MIN,HAR_AD} : Minimum draft (m) at the port state to which the maximum allowable cargo weight(M_{AD}) of the cargo hold is applied. If the minimum draft in the port condition is not ascertained, an evaluation of the strength should be made by the following formula.

$$T_{MIN,HAR\_AD} = T_{MIN,SEA\_AD} - (1.15M_{AD} - W_{MAX,SEA\_AD}(T_{LC}))/(1.025L_{AD}B_{AD})$$

M_{AD} : Maximum allowable mass of adjacent 2 cargo holds (ton)
L_{AD} : length of the considered cargo holds (m)
B_{AD} : mean breadth of the considered cargo holds (m)
T_{MAX,HAR_AD} : Maximum draft (m) at port condition to which the minimum allowable cargo weight (M_{AD}) of adjacent 2 cargo holds is applied ⚓

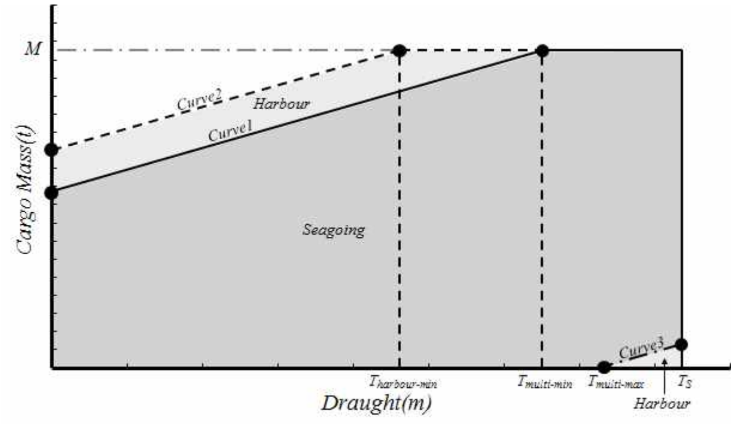


Fig 22 Cargo mass curves

GUIDANCE RELATING TO THE RULES FOR THE CLASSIFICATION OF STEEL SHIPS

(Guidance Part 7 Ships of Special Service(Ch 1-4, 7-10))

2019. 08.

Hull Rule Development Team

- Main Amendments -

(1) Enter into force on 1 January 2020 (the contract date for ship construction)

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

<table>
<tr><th>Present</th><th>Amendment</th><th>reason</th></tr>
<tr>
<td>
Annex 7-8 Instruction for Use of Extremely Thick Steel in Container Ships

1. ~ 2. 〈Omitted〉

3. <s>Periodic NDT after delivery</s>(Measure No.2 of [5])
<s>(1) Where periodic NDT after delivery is required as a safety measure option B of 5, the NDT is to be in accordance with Table 1.</s>

<s>Table 1 : Locations, extent and timing of UT</s>
<table>
<tr><th><s>Locations</s></th><th><s>Extent</s></th><th><s>Timing</s></th></tr>
<tr><td><s>all block to block butt joints of all upper flange longitudinal structural members in the cargo hold region</s></td><td><s>100% UT</s></td><td><s>No. 2 Special Survey and every even Special Survey after that(e.g. No.4, No.6, etc.)</s></td></tr>
</table>
<s>(2) Testing procedure and acceptance criteria of UT not specified in this Instruction are to comply with the requirements in 2.</s>

4. 〈Omitted〉

5. Measures for Extremely Thick Steel Plates
The thickness and the yield strength shown in the Table 2 apply to the hatch coaming structure and are the controlling parameters for the application of countermeasures. If the as built thickness of the hatch coaming structure is below the values contained in the table, countermeasures are not necessary regardless of the thickness and yield strength of the upper deck.

Table 2.

6. 〈Omitted〉
</td>
<td>
Annex 7-8 Instruction for Use of Extremely Thick Steel in Container Ships

1. ~ 2. 〈Same as the present Rules〉

3. <u>Welding to increase toughness</u>(Measure No.2 of [5])
<u>3.1 Welding to increase toughness is to be carried out when B option in [5] is selected as a safety measure to identify and prevent brittle fracture.</u>
<u>3.2 Impact specimens are to be taken in accordance with 3.2.1.</u>
<u>3.2.1 Impact specimens are to be taken from the weld center “WM”, fusion line “FL”, heat affected zone of 2mm from fusion line, heat affected zone of 5mm from fusion line.</u>
<u>3.3 Impact specimens are to meet the criteria for absorbed energy of base material at impact test temperature of base material.</u>

4. 〈Same as the present Rules〉

5. Measures for Extremely Thick Steel Plates
The thickness and the yield strength shown in the Table 2 apply to the hatch coaming structure and are the controlling parameters for the application of countermeasures. If the as built thickness of the hatch coaming structure is below the values contained in the table, countermeasures are not necessary regardless of the thickness and yield strength of the upper deck.

Table 2

6. 〈Same as the present Rules〉
</td>
<td>
* Request for Establishment/Revision of Classification Technical Rules(HUC4100-730-2019) is reflected.

* Since many pipes/electronics are installed above 2nd Deck and additional platform is needed for NDT, it is practically impossible to apply NDT to regular inspection of existing ships.
</td>
</tr>
</table>

<Present>

Table 2

Yield Strength (kgf/mm2)	Thickness (mm)	Option	Measures			
			1	2	3+4	5
36	$50<t\leq 85$	-	NA	NA	NA	NA
	$85<t\leq 100$	-	O	NA	NA	NA
40	$50<t\leq 85$	-	O	NA	NA	NA
	$85<t\leq 100$	A	O	NA	O	O
		B	O*	O**	NA	O
47(FCAW)	$50<t\leq 100$	A	O	NA	O	O
		B	O*	O**	NA	O
47(EGW)	$50<t\leq 100$	-	O	NA	O	O

Measures:

No.	Measures
1	NDT other than visual inspection on all target block joints(during construction) 2.
2	~~Periodic NDT other than visual inspection on all target block joints(after delivery)~~ 3.
3	Brittle crack arrest design against straight propagation of brittle crack along weld line to be taken(during construction) See 4(3)(B), (C) or (D) of this Instruction.
4	Brittle crack arrest design against deviation of brittle crack from weldline(during construction) See 4(3)(A).
5	Brittle crack arrest design against propagation of cracks from other weld areas such as fillets and attachment welds(during construction) See 4(3)(A).

Symbols:

(a) “O” means “To be applied”.

(b) “N.A” means "Need not to be applied“.

(c) Selectable from option “A” and "B”.

Note:

*: See 4(3)(E)

**: See 3.

<Amendment>

Table 2

Yield Strength (kgf/mm2)	Thickness (mm)	Option	Measures			
			1	2	3+4	5
36	50〈t≤85	-	NA	NA	NA	NA
	85〈t≤100	-	O	NA	NA	NA
40	50〈t≤85	-	O	NA	NA	NA
	85〈t≤100	A	O	NA	O	O
		B	O*	O**	NA	O
47(FCAW)	50〈t≤100	A	O	NA	O	O
		B	O*	O**	NA	O
47(EGW)	50〈t≤100	-	O	NA	O	O

Measures:

No.	Measures
1	NDT other than visual inspection on all target block joints(during construction) 2.
2	Welding to increase toughness(during construction) See 3.
3	Brittle crack arrest design against straight propagation of brittle crack along weld line to be taken(during construction) See 4(3)(B), (C) or (D) of this Instruction.
4	Brittle crack arrest design against deviation of brittle crack from weldline(during construction) See 4(3)(A).
5	Brittle crack arrest design against propagation of cracks from other weld areas such as fillets and attachment welds(during construction) See 4(3)(A).

Symbols:

(a) "O" means "To be applied".

(b) "N.A" means "Need not to be applied".

(c) Selectable from option "A" and "B".

Note:

*: See 4(3)(E)

**: See 3.

GUIDANCE RELATING TO THE RULES FOR CLASSIFICATION OF STEEL SHIPS

(Development Review : For external opinion inquiry)

Part 7 Ships of Special Service

2019. 11.

KOREAN REGISTER

Machinery Rule Development Team

- Main Amendments -

(1) Effective date : 1 Jan. 2020 (Date of which the contract for construction is signed)

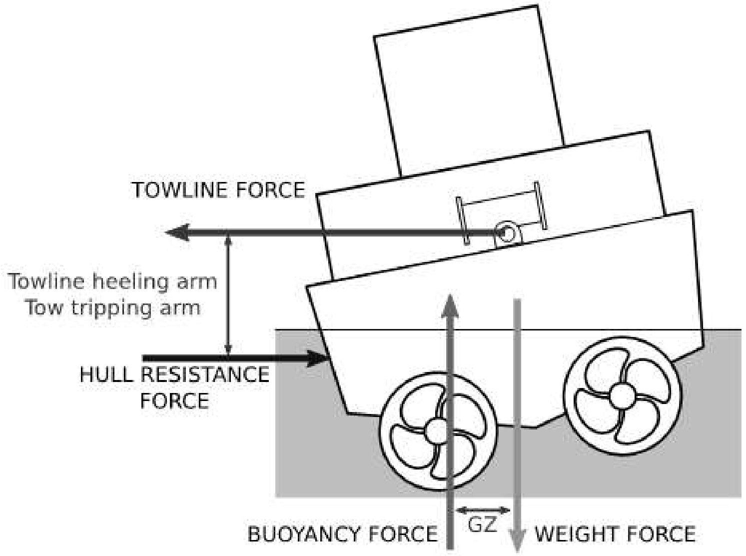
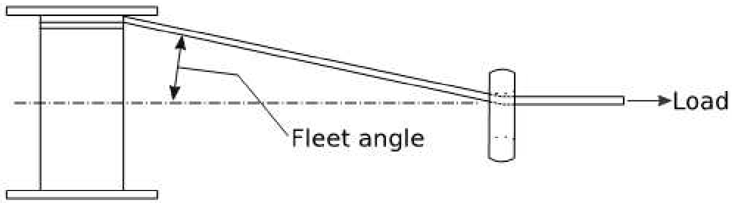
◉ It has been reflected to IACS UR M79 (New Oct 2018) for towing winch's emergency release device.

(2) Effective date : 1 July. 2020 (Date of which the contract for construction is signed)

◉ It has been added requirements related to ventilation system for cargo tanks.

Present	Amendment	Remark
CHAPTER 1 OIL TANKERS [Omitted] **Section 10 Piping Systems and Venting Systems for Oil Tankers** [Omitted] **1002. Cargo oil pumps and cargo oil piping systems, pipings in cargo oil tank, etc.** [Omitted] **3.** In application to **1002. 4** of the Rules, Piping systems to be connected to cargo oil piping are to be dealt with under the following requirements; **【See Rule】** [Omitted] (2) In case where the cargo oil piping system is connected to; (A) Tank vent pipes : The requirements in Guidance **Pt 8. Appendix 8-5 2** (10)(g) & (h) are to be complied with. Ventilating fans except inert gas blowers, are to be installed within the dangerous spaces. [Omitted]	**CHAPTER 1 OIL TANKERS** [Same as present] **Section 10 Piping Systems and Venting Systems for Oil Tankers** [Same as present] **1002. Cargo oil pumps and cargo oil piping systems, pipings in cargo oil tank, etc.** [Same as present] **3.** In application to **1002. 4** of the Rules, Piping systems to be connected to cargo oil piping are to be dealt with under the following requirements; **【See Rule】** [Same as present] (2) In case where the cargo oil piping system is connected to; (A) Tank vent pipes : The requirements in Guidance **Pt 8. Appendix 8-5 2** (10)(g) & (h) are to be complied with. Ventilating fans except inert gas blowers, are to be installed within the dangerous spaces. Where the ventilators are located in a enclosded non-hazardous area, it is to comply with the following requirements. a) The air supply piping from the ventilator is to have automatically actuated shut-off valve and non-return valve in series. b) The valves of a) above are to be located at the bulkhead where the air supply piping leaves the non-hazardous area, with at least the non-return valve on the outside. c) Shut-off valve is to be opened after the ventilator has started, and automatically closed after the ventilator has stopped. Procedures for the operation of ventilators and valves are to be posted near the place of operation. d) The intake of the ventilator is to be derived from a safe place (eg open deck) outside the ventilated space. e) Ventilators is to be of non-sparking type. [Same as present]	(amendment) - It has benn requested from environment & piping team(ENP1000-979-19), where ventilator is located in safe area, related safety requirement has been added.

Present	Amendment	Remark
<New>	**CHAPTER 9 TUGS** **Section 8 Towing Winch Emergency Release Systems** **801. General** **1.** Scope (1) This Section defines minimum safety standards for winch emergency release systems provided on towing winches that are used on towing ships within close quarters, ports or terminals. (2) This Section is not intended to cover towing winches on board ships used solely for long distance ocean towage, anchor handling or similar offshore activities. **2.** Definitions (1) Emergency release system refers to the mechanism and associated control arrangements that are used to release the load on the towline in a controlled manner under both normal and dead-ship conditions. (2) Maximum design load is the maximum load that can be held by the winch as defined by the manufacturer (the manufacturer's rating). (3) Girting means the capsize of a tug when in the act of towage as a result of the towline force acting transversely to the tug (in beam direction) as a consequence of an unexpected event (could be loss of propulsion/steering or otherwise), whereby the resulting couple generated by offset and opposing transverse forces (towline force is opposed by thrust or hull resistance force) causes the tug to heel and, ultimately, to capsize. This may also be referred to as 'girthing, 'girding' or 'tripping'. See **Fig 1** which shows the forces acting during towage operations. (4) Fleet angle is the angle between the applied load (towline force) and the towline as it is wound onto the winch drum, see **Fig 2**.	(Amendment) - Reflect IACS UR M79 (New Oct 2018) <application date: the date of contract for construction on or after 1 Jan 2020> - Reflect UR M79 1

Present	Amendment	Remark
	 **Fig 1 Force during towing**  **Figure 2: Towline 'fleet angle'** **802. General requirements** **1.** The in-board end of the towline is to be attached to the winch drum with a weak link or similar arrangement that is designed to release the towline at low load. **2.** All towing winches are to be fitted with an emergency release system.	- Reflect UR M79 2

Present	Amendment	Remark
	803. Emergency release system requirements **1.** Performance requirements (1) The emergency release system is to operate across the full range of towline load, fleet angle and ship heel angle under all normal and reasonably foreseeable abnormal conditions (these may include, but are not limited to, the following: vessel electrical failure, variable towline load (for example due to heavy weather), etc.). (2) The emergency release system shall be capable of operating with towline loads up to at least 100 % of the maximum design load. (3) The emergency release system is to function as quickly as is reasonably practicable and within a maximum of three seconds after activation. (4) The emergency release system is to allow the winch drum to rotate and the towline to pay out in a controlled manner such that, when the emergency release system is activated, there is sufficient resistance to rotation to avoid uncontrolled unwinding of the towline from the drum. Spinning (free, uncontrolled rotation) of the winch drum is to be avoided, as this could cause the towline to get stuck and disable the release function of the winch. (5) Once the emergency release is activated, the towline load required to rotate the winch drum is to be no greater than: (A) the lesser of 5 tonnes or 5 % of the maximum design load when two layers of towline are on the drum, or (B) 15 % of the maximum design load where it is demonstrated that this resistance to rotation does not exceed 25 % of the force that will result in listing sufficient for the immersion of the lowest unprotected opening. (6) An alternative source of energy is to be provided such that normal operation of the emergency release system can be sustained under dead-ship conditions. (7) The alternative source of energy required by (6) is to be sufficient to achieve the most onerous of the following conditions (as applicable): (A) sufficient for at least three attempts to release the towline (i.e. three activations of the emergency release system). Where the system provides energy for more than one winch it is to be sufficient for three activations of the most demanding winch connected to it. (B) Where the winch design is such that the drum release mechanism requires continuous application of power (e.g. where the brake is applied by spring tension and released using hydraulic or pneumatic power) sufficient power is to be provided to operate the emergency release system (e.g. hold the brake open and allow release of the towline) in a dead-ship situation for a minimum of five minutes. This may be reduced to the time required for the full length of the towline to feed off the winch drum at the load specified in (5) if this is less than five minutes.	- Reflect UR M79 3

Present	Amendment	Remark
	2. Operational requirements (A) Emergency release operation must be possible from the bridge and from the winch control station on deck. The winch control station on deck is to be in a safe location. (2) The emergency release control is to be located in close proximity to the emergency stop button for winch operation and both should be clearly identifiable, clearly visible, easily accessible and positioned to allow safe operability. (3) The emergency release function is to take priority over any emergency stop function. Activation of the winch emergency stop from any location is not to inhibit operation of the emergency release system from any location. (4) Emergency release system control buttons are to require positive action to cancel, the positive action may be made at a different control position from the one where the emergency release was activated. It must always be possible to cancel the emergency release from the bridge regardless of the activation location and without manual intervention on the working deck. (5) Controls for emergency use are to be protected against accidental use. (6) Indications are to be provided on the bridge for all power supply and/or pressure levels related to the normal operation of the emergency release system. Alarms are to activate automatically if any level falls outside of the limits within which the emergency release system is fully operational. (7) Wherever practicable, control of the emergency release system is to be provided by a hard-wired system, fully independent of programmable electronic systems. (8) Computer based systems that operate or may affect the control of emergency release systems are to meet the requirements for Category III systems of **KR Rules Pt 6, Sec 4.** (9) Components critical for the safe operation of the emergency release system are to be identified by the manufacturer. (10) The method for annual survey of the winch is to be documented. (11) Where necessary for conducting the annual survey of the winch, adequately sized strong points are to be provided on deck.	- Reflect UR M79 3

Present	Amendment	Remark
	804. Test requirements **1.** General (1) All testing defined within this paragraph is to be witnessed by a Classification Society surveyor. (2) For each emergency release system or type thereof, the performance requirements of **803.1** are to be verified either at the manufacturer's works or as part of the commissioning of the towing winch when it is installed on board. Where verification solely through testing is impracticable (e.g. due to health and safety), testing may be combined with inspection, analysis or demonstration in agreement with the Society. (3) The performance capabilities and operating instructions of the emergency release system are to be documented and made available on board the ship on which the winch has been installed. **2.** Installation trials (1) The full functionality of the emergency release system is to be tested as part of the shipboard commissioning trials to the satisfaction of the surveyor. Testing may be conducted either during a bollard pull test or by applying the towline load against a strong point on the deck of the tug that is certified to the appropriate load. (2) Where the performance of the winch in accordance with **803.1** has previously been verified, the load applied for the installation trials is to be at least the lesser of 30 % of the maximum design load or 80 % of vessel bollard pull.	- Reflect UR M79 4