RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

Part C Hull Construction and Equipment

RULES

2019 AMENDMENT NO.1

Rule No.39 14 June 2019

Resolved by Technical Committee on 30 January 2019

An asterisk (*) after the title of a requirement indicates that there is also relevant information in the corresponding Guidance.

Rule No.39 14 June 2019
AMENDMENT TO THE RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

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

Part C HULL CONSTRUCTION AND EQUIPMENT

Amendment 1-1

Chapter 31A ADDITIONAL REQUIREMENTS FOR NEW BULK CARRIERS

31A.5 Longitudinal Strength in Flooded Condition

Paragraph 31A.5.3 has been amended as follows.

31A.5.3 Strength Criteria*

(-1 and -2 are omitted.)

3 The thickness t of side shell plating for bulk carriers of single-side skin construction under consideration is to be not less than the value obtained from the following formulae in order to have sufficient strength after flooding in all specific loading and ballast conditions:

$$t = 0.455\left|F_{sf} + 0.8F_w(+)\right|\frac{m}{I} \quad (mm)$$

$$t = 0.455\left|F_{sf} + 0.8F_w(-)\right|\frac{m}{I} \quad (mm)$$

Where:

F_{sf} : Still water shear force (kN) in the flooded condition for the section under consideration See **15.3.1** for calculation method.

F_w : Wave induced shear force (kN) for the section under consideration, as given in **15.3.1-1**.

I and m : As specified in **15.3.1-1**

4 The thicknesses of side shell plating and longitudinal bulkhead plating for bulk carriers of double-side skin construction under consideration is to be in accordance with **15.3.2** in order to have sufficient strength after flooding in all specific loading and ballast conditions. In this case, the still water shear force F_s (kN), and the wave induced shear forces $F_w(+)$ and $F_w(-)$ (kN) specified in **15.3.2** are to be in accordance with the following **(1)** and **(2)**.

(1) The still water shear force F_{sf} (kN) in the flooded condition given in **-3** above is to be substituted for the still water shear force F_s (kN).

(2) The wave induced shear forces $F_w(+)$ and $F_w(-)$ (kN) given in **15.3.2** multiplied by 0.8 are to be substituted for the wave induced shear forces $F_w(+)$ and $F_w(-)$ (kN).

~~4~~5 When calculating bending and shearing strength after flooding, the damaged structure is assumed to remain fully effective in resisting the applied load.

~~5~~6 Axial stress buckling stress is to be assessed in accordance with **15.4.1**.

EFFECTIVE DATE AND APPLICATION (Amendment 1-1)

1. The effective date of the amendments is 14 June 2019.

Amendment 1-2

Chapter 1 GENERAL

1.1 General

1.1.12 Special Requirements for Application of Steels*

Sub-paragraph -4 has been added as follows.

4 For ships other than liquefied gas carriers, intended to be loaded with cold liquid cargoes, the application of steels used for cargo tank boundary plating is to be suitable for the design minimum cargo temperature, regardless of the requirements specified in **Table C1.1** and **Table C1.2**. In this case, the design minimum cargo temperature (T_C) of the cold liquid cargoes is to be determined.

Chapter 2 STEMS AND STERN FRAMES

2.2 Stern Frames

2.2.5 Rudder Horns*

Sub-paragraph -4 has been amended as follows.

4 The thickness of the rudder horn side plating is not to be less than:

~~$2.4\sqrt{LK}$~~ $2.4\sqrt{L_1 K_{rh}}$ (mm)

L_1: Length (m) of ship specified in **2.1.2, Part A** or 0.97 *times* the length of ship on the designed maximum load line, whichever is smaller.

K_{rh}: As specified in **-1(1)**

2.2.8 Rudder trunk

Sub-paragraph -1 has been amended as follows.

1 Materials, welding and connection to hull

This requirement applies to both trunk configurations (extending or not below stern frame).

The steel used for the rudder trunk is to be of weldable quality, with a carbon content not exceeding 0.23% on ladle analysis ~~and~~ or a carbon equivalent C_{EQ} not exceeding 0.41%.

The weld at the connection between the rudder trunk and the shell or the bottom of the skeg is to be full penetration.

The fillet shoulder radius r (mm) (*See* **Fig.C2.4**) is to be as large as practicable and to comply with the following formulae:

$r = 60$ when $\sigma \geq 40 / K_s$ (N/mm^2)

$r = 0.1 d_l$, without being less than 30, when $\sigma < 40 / K_s$ (N/mm^2)

Where

d_l: rudder stock diameter axis defined in **3.5.2**.

σ: bending stress in the rudder trunk (N/mm^2).

K_s: material factor as given in **3.1.2**.

The radius may be obtained by grinding. If disk grinding is carried out, score marks are to be avoided in the direction of the weld. The radius is to be checked with a template for accuracy. Four profiles at least are to be checked. A report is to be submitted to the Surveyor.

Rudder trunks comprising of materials other than steel are to be specially considered by the Society.

Chapter 3 RUDDERS

3.6 Rudder Plates, Rudder Frames and Rudder Main Pieces

3.6.3 Rudder Main Pieces*

Sub-paragraph -3 has been amended as follows.

3 The section modulus and the web area of horizontal sections of the main piece are to be such that bending stress, shear stress, and equivalent stress should not exceed the following values.

(1) In general, except in way of rudder recess sections where **(2)** applies

Bending stress: $\sigma_b = \dfrac{110}{K_m}$ (N/mm^2)

Shear stress: $\tau = \dfrac{50}{K_m}$ (N/mm^2)

Equivalent stress: $\sigma_e = \sqrt{\sigma_b{}^2 + 3\tau^2} = \dfrac{120}{K_m}$ (N/mm^2)

Where:

K_m: Material factor for the rudder main piece as given in **3.1.2**

(2) In way of the recess for the rudder horn pintle on Type *A*, *D* and *E* rudders

~~In the cases of Type *A*, *D* and *E* rudders, however, the section modulus and the web area of a horizontal section of the main piece in way of cutouts are to be such that bending stress, shear stress, and equivalent stress should not exceed the following values regardless of high tensile or ordinary steels.~~

Bending stress: $\sigma_b = 75$ (N/mm^2)

Shear stress: $\tau = 50$ (N/mm^2)

Equivalent stress: $\sigma_e = \sqrt{\sigma_b{}^2 + 3\tau^2} = 100$ (N/mm^2)

Note: The stresses in **(2)** apply equally to high tensile and ordinary steels.

3.7 Connections of Rudder Blade Structure with Solid Parts

Paragraph 3.7.1 has been amended as follows.

3.7.1 Solid Part Protrusions

Solid parts in forged or cast steel, which house the rudder stock or the pintle, are ~~normally~~ to be provided with protrusions, except where not required as indicated below.

These protrusions are not required when the web plate thickness is less than:

- 10 *mm* for web plates welded to the solid part on which the lower pintle of Type *A*, *D* and *E* rudders is housed and for vertical web plates welded to the solid part of the rudder stock coupling of Type *C* rudders.
- 20 *mm* for other web plates.

3.8 Couplings between Rudder Stocks and Main Pieces

3.8.4 Cone Couplings with Special Arrangements for Mounting and Dismounting the Couplings

Sub-paragraphs -2 and -3 have been amended as follows.

2 Push-up pressure

The push-up pressure is not to be less than the greater of the two following values:

$$p_{req1} = \frac{2M_Y}{d_m^2 \ell \pi \mu_0} 10^3 \quad (N/mm^2)$$

$$p_{req2} = \frac{6M_b}{\ell^2 d_m} 10^3 \quad (N/mm^2)$$

Where:

M_Y : Design yield moment of rudder stock, as defined in **3.8.3-2** (*N-m*)

d_m : Mean cone diameter (*mm*) (*See* **Fig. C3.7**)

ℓ : Cone length (*mm*)

μ_0 : Frictional coefficient, equal to 0.15

M_b : Bending moment in the cone coupling (e.g. in case of spade rudders) (*N-m*)

It has to be proved by the designer that the push-up pressure does not exceed the permissible surface pressure in the cone. The permissible surface pressure is to be determined by the following formula:

~~$p_{perm} = \frac{0.8\sigma_Y(1-\alpha^2)}{\sqrt{3+\alpha^4}}$~~

$$p_{perm} = \frac{0.95\sigma_Y(1-\alpha^2)}{\sqrt{3+\alpha^4}} - p_b$$

$$p_b = \frac{3.5M_b}{d_m \ell^2} 10^3$$

Where:

σ_Y : Minimum yield stress (N/mm^2) of the material of the gudgeon

$$\alpha = \frac{d_m}{d_a}$$

d_m : Mean cone diameter (*mm*) (*See* **Fig. C3.7**)

d_a : Outer diameter of the gudgeon (*See* **Fig. C3.7**) (*mm*) ~~to be not less than 1.5 d_m.~~

The outer diameter of the gudgeon is not to be less than 1.25 d_0, with d_0 defined in **Fig. C3.7**.

3 Push-up length

The push-up length $\Delta\ell$ (*mm*) is to comply with the following formula:

$$\Delta\ell_1 \le \Delta\ell \le \Delta\ell_2$$

Where:

$$\Delta\ell_1 = \frac{p_{req} d_m}{E\left(\frac{1-\alpha^2}{2}\right)c} + \frac{0.8R_{tm}}{c}$$

~~$\Delta\ell_2 = \frac{1.6\sigma_Y d_m}{\sqrt{3+\alpha^4}Ec} + \frac{0.8R_{tm}}{c}$~~ <u>$\Delta\ell_2 = \frac{p_{perm} d_m}{E\left(\frac{1-\alpha^2}{2}\right)c} + \frac{0.8R_{tm}}{c}$</u>

R_{tm} : Mean roughness (*mm*) taken equal to about 0.01 *mm*
c : Taper on diameter according to ~~**3.8.4-1**~~<u>**3.8.3-1**</u>
<u>E : Young's modulus (N/mm^2), to be taken as 2.06×10^5</u>

~~Notwithstanding the above, the push up length is not to be less than 2 *mm*.~~

Note: In case of hydraulic pressure connections the required push-up force P_e for the cone (*N*) may be determined by the following formula:

$$P_e = p_{req}\, d_m \pi\, \ell\left(\frac{c}{2}+0.02\right)$$

The value 0.02 is a reference for the friction coefficient using oil pressure. It varies and depends on the mechanical treatment and roughness of the details to be fixed.
Where due to the fitting procedure a partial push-up effect caused by the rudder weight is given, this may be taken into account when fixing the required push-up length, subject to approval by the Society.

3.9 Pintles

3.9.2 Construction of Pintles*

Sub-paragraph -2 has been amended as follows.

2 Push-up pressure for pintle ~~bearings~~

The required push-up pressure for pintle ~~bearings~~ (N/mm^2) is to be determined by the following formula:

$$p_{req} = 0.4\frac{Bd_0}{d_m^2\,\ell}$$

Where:

B : As defined in **3.9.1**
d_m, ℓ : As defined in **3.8.4-2**
d_0 : Pintle diameter (*mm*) (*See* **Fig. C3.7**)

The push up length is to be calculated similarly as in **3.8.4-3**, using required push-up pressure and properties for the pintle ~~bearing~~.

EFFECTIVE DATE AND APPLICATION (Amendment 1-2)

1. The effective date of the amendments is 1 July 2019.

2. Notwithstanding the amendments to the Rules, the current requirements apply to ships for which the date of contract for construction* is before the effective date.

* "contract for construction" is defined in the latest version of IACS Procedural Requirement (PR) No.29.

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

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

2. The date of "contract for construction" of a series of vessels, including specified optional vessels for which the option is ultimately exercised, is the date on which the contract to build the series is signed between the prospective owner and the shipbuilder.

For the purpose of this Procedural Requirement, vessels built under a single contract for construction are considered a "series of vessels" if they are built to the same approved plans for classification purposes. However, vessels within a series may have design alterations from the original design provided:

(1) such alterations do not affect matters related to classification, or

(2) If the alterations are subject to classification requirements, these alterations are to comply with the classification requirements in effect on the date on which the alterations are contracted between the prospective owner and the shipbuilder or, in the absence of the alteration contract, comply with the classification requirements in effect on the date on which the alterations are submitted to the Society for approval.

The optional vessels will be considered part of the same series of vessels if the option is exercised not later than 1 year after the contract to build the series was signed.

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

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

Note:
This Procedural Requirement applies from 1 July 2009.

GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

Part C Hull Construction and Equipment

GUIDANCE

2019 AMENDMENT NO.1

Notice No.26 14 June 2019
Resolved by Technical Committee on 30 January 2019

Notice No.26 14 June 2019
AMENDMENT TO THE GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

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

Part C HULL CONSTRUCTION AND EQUIPMENT

Amendment 1-1

C7 FRAMES

C7.1 General

C7.1.8 Consideration of Bow Impact Pressure

Sub-paragraphs -1 and -2 have been amended as follows.

1 For ~~pure car carriers~~ ships with large bow flares that operate at high speed (car carriers, ro-ro cargo ships, LNG carriers or refrigerated LPG carriers, etc.), the thickness t_w of web plates and the plastic section modulus Z_p of transverse frames and side longitudinals, which are fitted where the bow flare located above the load line and forward of 0.2*L* is considered to endure large wave impact pressure, are not to be less than those obtained from the following formulae.

(Omitted)

2 For ~~pure car carriers~~ ships with large bow flares that operate at high speed (car carriers, ro-ro cargo ships, LNG carriers or refrigerated LPG carriers, etc.), the scantling of web frames supporting side longitudinals, which are fitted where the bow flare located above the load line and forward of 0.2*L* is considered to endure large wave impact pressure is to be in accordance with the requirements of side stringers supporting transverse frames in **C8.1.4**.

C8 WEB FRAMES AND SIDE STRINGERS

C8.1 General

C8.1.4 Consideration of Bow Impact Pressure

Sub-paragraph -1 has been amended as follows.

1 For ~~pure car carriers~~ ships with large bow flares that operate at high speed (car carriers, ro-ro cargo ships, LNG carriers or refrigerated LPG carriers, etc.), the thickness t_{wG} of web plates and the section modulus Z_G of side stringers supporting transverse frames and the web frames supporting these side stringers fitted where the bow flare located above the load line and forward of 0.2*L* is considered to endure large wave impact pressure are not to be less than those obtained from the following formulae.
(Omitted)

C16 PLATE KEELS AND SHELL PLATING

C16.4 Special Requirements for Shell Plating

C16.4.1 Consideration of Bow Impact Pressure

Sub-paragraph -1 has been amended as follows.

1 For ~~pure car carriers~~ ships with large bow flares that operate at high speed (car carriers, ro-ro cargo ships, LNG carriers or refrigerated LPG carriers, etc.), the thickness of shell plating above the load line for 0.2*L* forward is not to be less than that obtained from the following formula:
(Omitted)

EFFECTIVE DATE AND APPLICATION (Amendment 1-1)

1. The effective date of the amendments is 14 June 2019.

Amendment 1-2

C1 GENERAL

C1.1 General

C1.1.12 Special Requirements for Application of Steels

Table C1.1.12-1(1) has been amended as follows.

Table C1.1.12-1(1) Design Temperature Category

Range of Design Temperature (T_D) (°C)	Design Temperature Category
-15 ≦ T_D < -10	T_{Da}
-25 ≦ T_D < ~~-20~~ -15	T_D~~a~~b
-35 ≦ T_D < -25	T_D~~b~~c
-45 ≦ T_D < -35	T_D~~c~~d
-55 ≦ T_D < -45	T_D~~d~~e

Table C1.1.12-1(2) has been amended as follows.

Table C1.1.12-1(2) Application of Steels Exposed to the Atmosphere used on Ships Intended to Operate in Areas of Low Temperatures or Cold Liquid Cargo

Structural Member	Material Class	
	Within 0.4*L* Amidships	Outside 0.4*L* Amidship
・Deck plating exposed to weather, in general ・Side plating above *BWL*(1) ・Transverse bulkheads above *BWL*(1) (2) ・Cargo tank boundary plating exposed to cold liquid cargoes(3)	I	I
(Omitted)		

Notes:

(1) *BWL*: Ballast water line is the water line at the lowest draught condition during navigation and includes single strakes that cross it.

(2) Applicable to plating attached to hull envelope plating exposed to low air temperatures. At least one strake is to be considered in the same way as exposed plating with the strake width at least 600 *mm*.

(3) Ships other than liquefied gas carriers.

Fig. C1.1.12-1(2) has been amended as follows.

Fig. C1.1.12-1(2) Material Grade for Mild Steel Corresponding to Design Temperature Category (Material symbols in this figure are indicated in Note (1) of **Table C1.1** and **Table C1.2**, **Part C of the Rules**.)

<table>
<tr><td rowspan="2"></td><td colspan="5">Design Temperature Category</td><td colspan="6">Thickness t (mm)</td></tr>
<tr><td>T_{Da}</td><td>T_{D}~~a~~b</td><td>T_{D}~~b~~c</td><td>T_{D}~~c~~d</td><td>T_{D}~~d~~e</td><td>t≦10</td><td>10＜t≦20</td><td>20＜t≦30</td><td>30＜t≦40</td><td>40＜t ≦45</td><td>45＜t ≦50</td></tr>
<tr><td rowspan="7">Material Class</td><td>I</td><td></td><td></td><td></td><td></td><td colspan="2">A</td><td>B</td><td colspan="3">D</td></tr>
<tr><td>II</td><td>I</td><td></td><td></td><td></td><td>A</td><td>B</td><td colspan="2">D</td><td colspan="2">E*3</td></tr>
<tr><td>III</td><td>II</td><td>I</td><td></td><td></td><td>B*1</td><td colspan="2">D</td><td colspan="3">E*~~3~~4</td></tr>
<tr><td></td><td>III</td><td>II</td><td>I</td><td></td><td colspan="2">D*2</td><td colspan="2">E*~~4~~5</td><td colspan="2">*~~6~~7,*~~8~~9</td></tr>
<tr><td></td><td></td><td>III</td><td>II</td><td>I</td><td>D*2</td><td colspan="2">E*~~5~~6</td><td colspan="3">*~~7~~8,*~~8~~9</td></tr>
<tr><td></td><td></td><td></td><td>III</td><td>II</td><td colspan="2">E</td><td colspan="4">*~~8~~9</td></tr>
<tr><td></td><td></td><td></td><td></td><td>III</td><td>E</td><td colspan="5">*~~8~~9</td></tr>
</table>

Notes

*1 Web and face plate of continuous longitudinal hatch coamings above strength deck except within 0.4*L* amidships are to be of grade *D* or higher.

*2 Sheer strake at strength deck and deck stringer in strength deck within 0.4*L* amidships with length exceeding 250 ~~*metres*~~ *m* are to be of grade *E* or higher.

*3 For material class I, grade *D* may be used up to 45 *mm*.

*~~3~~4 For material class I, grade *D* may be used up to 35 *mm*.

*~~4~~5 For material class I, grade *D* may be used up to 25 *mm*.

*~~5~~6 For material class I, grade *D* may be used up to 15 *mm*.

*~~6~~7 For material class I, grade *E* may be used up to 45 *mm*.

*~~7~~8 For material class I, grade *E* may be used up to 35 *mm*.

*~~8~~9 Steels to the satisfaction of the Society may be used.

Fig. C1.1.12-1(3) has been amended as follows.

Fig. C1.1.12-1(3) Material Grade for High Tensile Steel Corresponding to Design Temperature Category
(Material symbols in this figure are indicated in Note (1) of **Table C1.1** and **Table C1.2**, **Part C of the Rules**.)

<table>
<tr><td rowspan="2"></td><td colspan="5">Design Temperature Category</td><td colspan="6">Thickness t (mm)</td></tr>
<tr><td>T_{Da}</td><td>T_{Dab}</td><td>T_{Dbc}</td><td>T_{Dcd}</td><td>T_{Dde}</td><td>t≦10</td><td>10＜t≦20</td><td>20＜t≦30</td><td>30＜t≦40</td><td>40＜t ≦45</td><td>45＜t ≦50</td></tr>
<tr><td rowspan="7">Material Class</td><td>I</td><td></td><td></td><td></td><td></td><td colspan="3">AH</td><td colspan="3">DH</td></tr>
<tr><td>II</td><td>I</td><td></td><td></td><td></td><td colspan="2">AH</td><td colspan="2">DH</td><td colspan="2">EH*3</td></tr>
<tr><td>III</td><td>II</td><td>I</td><td></td><td></td><td>AH*1</td><td colspan="2">DH</td><td colspan="3">EH*34</td></tr>
<tr><td></td><td>III</td><td>II</td><td>I</td><td></td><td colspan="2">DH*2</td><td colspan="2">EH*45</td><td colspan="2">FH*67</td></tr>
<tr><td></td><td></td><td>III</td><td>II</td><td>I</td><td>DH*2</td><td colspan="2">EH*56</td><td colspan="3">FH*78</td></tr>
<tr><td></td><td></td><td></td><td>III</td><td>II</td><td colspan="2">EH</td><td colspan="2">FH</td><td colspan="2">*89</td></tr>
<tr><td></td><td></td><td></td><td></td><td>III</td><td>EH</td><td colspan="2">FH</td><td colspan="3">*89</td></tr>
</table>

Notes

*1 Web and face plate of continuous longitudinal hatch coamings above strength deck except within 0.4*L* amidships are to be of grade *DH* or higher.

*2 Sheer strake at strength deck and deck stringer in strength deck within 0.4*L* amidships of ship with length exceeding 250 *m* are to be of grade *EH* or higher.

*3 For material class I, grade *DH* may be used up to 45 *mm*.

*34 For material class I, grade *DH* may be used up to 35 *mm*.

*45 For material class I, grade *DH* may be used up to 25 *mm*.

*56 For material class I, grade *DH* may be used up to 15 *mm*.

*67 For material class I, grade *EH* may be used up to 45 *mm*.

*78 For material class I, grade *EH* may be used up to 35 *mm*.

*89 Steels to the satisfaction of the Society may be used.

Sub-paragraph -3 has been added as follows.

3 Application of steels for ships intended to be loaded with cold liquid cargoes other than liquefied gas carriers

For ships other than liquefied gas carriers, intended to be loaded with cold liquid cargoes, application of steels used for cargo tank boundary plating exposed to cold liquid cargoes is subject to **Table C1.1.12-1(2)**. In this case, details of material class are subject to **Fig. C1.1.12-1(2)** and **Fig. C1.1.12-1(3)** corresponding to the design minimum cargo temperature (T_C), which category is subject to **Table C1.1.12-1(1)**. The design minimum cargo temperature (T_C) is to be specified in the loading manual.

C2 STEMS AND STERN FRAMES

C2.2 Stern Frames

C2.2.5 Rudder Horns

Sub-paragraph (2) has been amended as follows.

In the application of **2.2.5**, **Part C of the Rules**, the bending moment, shear force, torque and stresses to be considered are to be determined by direct calculation or by a simplified approximation method. For direct calculation, the data to be used is to be according to **C3.4.1**. A simplified approximation method is to be as specified in the following **(1)** or **(2)**:

(1) Rudder horn of 1 elastic support
((a) to (c) are omitted.)

(2) Rudder horn of 2 conjugate elastic support
((a) to (c) are omitted.)

(d) Shear stress and ~~tortional~~ torsional stress calculation

i) For a generic section of the rudder horn, located between its lower and upper bearings, the following stresses are to be calculated:

τ : Shear stress (N/mm^2) to be obtained from the following formula:

$$\tau = \frac{F_{A1}}{A_h}$$

τ_t : Torsional stress (N/mm^2) to be obtained for hollow rudder horn from the following formula:

~~$\tau_t = \frac{T_h 10^3}{2F_T t_h}$~~ $\tau_t = \frac{T_h 10^{-3}}{2F_T t_h}$

For solid rudder horn, τ_T is to be considered by the Society on a case by case basis.

ii) For a generic section of the rudder horn, located in the region above its upper bearing, the following stresses are to be calculated:

τ : Shear stress (N/mm^2) to be obtained from the following formula:

$$\tau = \frac{F_{A1} + F_{A2}}{A_h}$$

τ_t : Torsional stress (N/mm^2) to be obtained for hollow rudder horn from the following formula:

~~$\tau_t = \frac{T_h 10^3}{2F_T t_h}$~~ $\tau_t = \frac{T_h 10^{-3}}{2F_T t_h}$

For solid rudder horn, τ_t is to be considered by the Society on a case by case basis

Where:

F_{A1}, F_{A2}: Support forces (N)

A_h: Effective shear sectional area of the rudder horn (mm^2) in Y-direction

T_h: Torque (N-m)

F_T: Mean of areas enclosed by outer and inner boundaries of the thin walled section of rudder horn (m^2)

t_h: Plate thickness of rudder horn (*mm*). For a given cross section of the rudder horn, the maximum value of τ_t is obtained at the minimum value of t_h.

((e) is omitted.)

C3 RUDDERS

C3.1 General

Paragraph C3.1.4 has been added as follows.

C3.1.4 Equivalence

Where steel castings with a yield stress of less than 205 N/mm^2 are used for rudder main pieces according to the provisions of **3.1.4**, **Part C of the Rules**, the Society may require that consideration be given to the yield stress of such castings with respect to the application of the allowable stress of rudder main pieces in way of the recesses specified in **3.6.3-3(2)**, **Part C of the Rules**.

C3.4 Rudder Strength Calculation

C3.4.1 Rudder Strength Calculation

Sub-paragraph -3(3) has been amended as follows.

3 Method of evaluating moments and forces

The method of evaluating moments and forces is to be as in the following **(1)** to **(3)** below. Notwithstanding the above, for Type *D* rudders with 2-conjugate elastic supports by rudder horns, the method of evaluating moments and forces is to be as in **-4**.

((1) and (2) are omitted.)

(3) Simplified method

The moments and forces for rudders of each type may be obtained from the following formulae.

((a) and (b) are omitted.)

(c) Type *C* rudders

$M_b = F_R h_c \quad (N\text{-}m)$

$B_2 = F_R + B_3 \quad (N)$

$B_3 = \frac{M_b}{l_{40}} \quad (N)$

Notwithstanding the above, the value is as follow, for rudders with rudder trunks supporting rudder stocks.

M_R is the greatest of the following values:

~~$M_R = C_{R2} (\ell_{10} - CG_{2Z})$~~ $M_{FR1} = F_{R1} (CG_{1Z} - \ell_{10})$

~~$M_R = C_{R1} (CG_{1Z} - \ell_{10})$~~ $M_{FR2} = F_{R2} (\ell_{10} - CG_{2Z})$

where A_1 and A_2 are the rudder blade area which are above the lower bearing and below respectively and symbols are as follows (*See* **Fig. C3.4.6**)

F_{R1} : Rudder force over the rudder blade area A_1

F_{R2} : Rudder force over the rudder blade area A_2

CG_{1Z}: Vertical position of the centre of gravity of the rudder blade area A_1 from base

CG_{2Z}: Vertical position of the centre of gravity of the rudder blade area A_2 from base

$F_R = F_{R1} + F_{R2}$

~~$M_b = F_{R2}(\ell_{10} - CG_{2Z})$~~

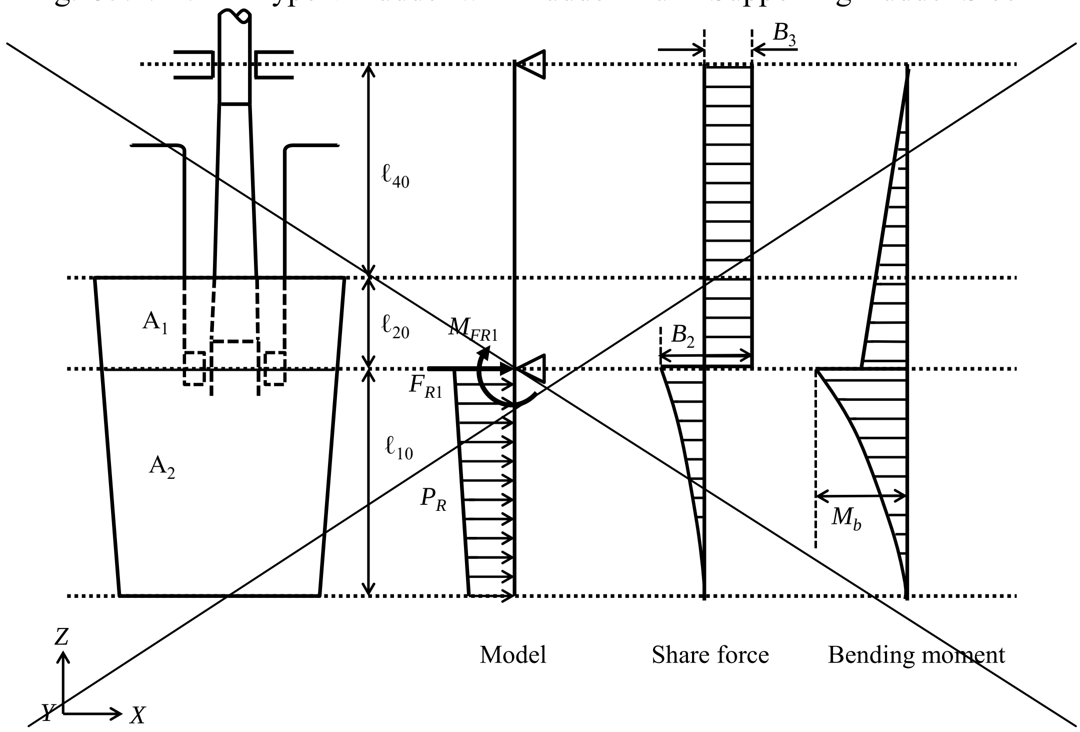
$B_2 = F_R + B_3$

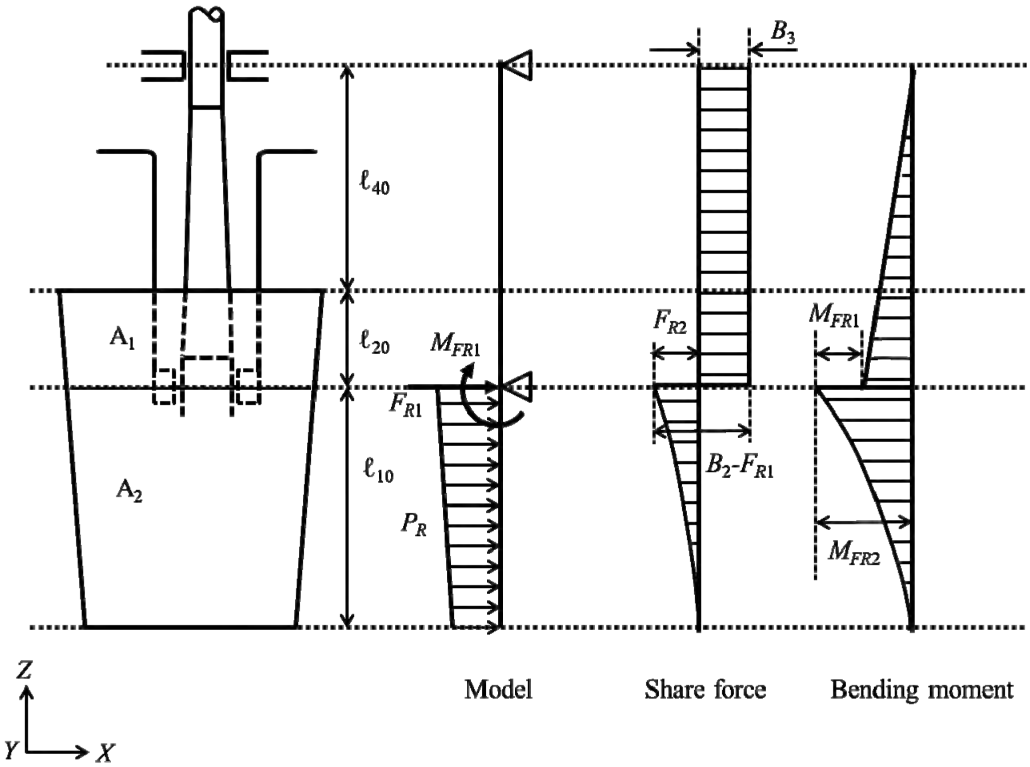
~~$B_3 = \frac{M_b + M_{FR1}}{\ell_{20} + \ell_{40}}$~~ $B_3 = \frac{M_{FR2} - M_{FR1}}{\ell_{20} + \ell_{40}}$

((d) and (e) are omitted.)

Fig.C3.4.1-6 has been amended as follows.

Fig. C3.4.1-6 Type *C* Rudder with Rudder Trunk Supporting Rudder Stock





EFFECTIVE DATE AND APPLICATION (Amendment 1-2)

1. The effective date of the amendments is 1 July 2019.

2. Notwithstanding the amendments to the Guidance, the current requirements apply to ships for which the date of contract for construction* is before the effective date.

* "contract for construction" is defined in the latest version of IACS Procedural Requirement (PR) No.29.

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

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

2. The date of "contract for construction" of a series of vessels, including specified optional vessels for which the option is ultimately exercised, is the date on which the contract to build the series is signed between the prospective owner and the shipbuilder.

For the purpose of this Procedural Requirement, vessels built under a single contract for construction are considered a "series of vessels" if they are built to the same approved plans for classification purposes. However, vessels within a series may have design alterations from the original design provided:

(1) such alterations do not affect matters related to classification, or

(2) If the alterations are subject to classification requirements, these alterations are to comply with the classification requirements in effect on the date on which the alterations are contracted between the prospective owner and the shipbuilder or, in the absence of the alteration contract, comply with the classification requirements in effect on the date on which the alterations are submitted to the Society for approval.

The optional vessels will be considered part of the same series of vessels if the option is exercised not later than 1 year after the contract to build the series was signed.

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

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

Note:
This Procedural Requirement applies from 1 July 2009.