Rules for the Classification of High Speed and Light Crafts (Draft)

(External Opinion Inquiry)

Hull Rule Development Team

- Main Amendments -

(1) Effective date : 1 July 2023

◉ Rules Part 3, Ch 2. Sec 4.
- 402.2 has been amended.

◉ Guidance Part 3 Annex 3-1
- “4. Direct strength calculation of catamaran” is newly added.

<table>
<tr><th>Current</th><th>Amendment</th><th>Reason</th></tr>
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Rules for the Classification of High Speed and Light Crafts

Part 3 Hull Structures

Chapter 2 Design loads

Section 4 Hull Girder Loads

401. 〈omitted〉

402. (1) 〈omitted〉

(2) For craft with $L \geq 50\,\mathrm{m}$, the twinhull transverse bending moment is to be the greater of following formula. B_{WL} can here be taken as the waterline breadth at $L/2$ and $V/\sqrt{L}$ needs not to be taken greater than 3.

$M_S = M_{SO}(1+a_{cg}/g_o) \quad (\mathrm{kN \cdot m})$

$\cancel{M_S = M_{SO} + F_y(z - 0.75d) \quad (\mathrm{kN \cdot m})}$

M_{SO} : transverse bending moment in still water $(\mathrm{kN \cdot m})$ 【See Guidance】

F_y : horizontal split force on immersed hull, as following formula.

$$\cancel{F_y = 0.1L^2 C_1 C_2\left(1+0.1\frac{V}{\sqrt{L}}\right)\left(53-\frac{L}{0.5B_{WL}}\right) \quad (\mathrm{kN})}$$

$$\cancel{C_1 = 1.6 - \frac{6}{\sqrt{L}}}$$

$$\cancel{C_2 = \frac{70}{\left(\frac{L}{d}\right)^{1.5}}}$$

~~z :height (m) from base line to wet deck (top of the tunnel).~~

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$M_S = M_{SO}(1+a_{cg}/g_o) \quad (\mathrm{kN \cdot m})$

$M_S = M_{SO} + F_y(z - 0.5d) \quad (\mathrm{kN \cdot m})$

M_{SO} : transverse bending moment in still water $(\mathrm{kN \cdot m})$ 【See Guidance】

F_y : horizontal split force on immersed hull, as following formula.

$$F_y = 3.25\left(1+0.0172\frac{V}{\sqrt{L}}\right)L^{1.05}d^{1.3}(0.5B_{WL})^{0.146}\left(1-\frac{L_{BMAX}}{L}+\frac{L_{BMAX}}{L}\left(\frac{B_{MAX}}{B_{WL}}\right)^{2.1}\right) H_1$$

H_1 = minimum of 0.143B and $H_{(S,MAX)}$

B_{WL} = maximum width (m) in water line (sum of both hulls)

B_{MAX} = maximum width (m) of submerged part (sum of both hulls)

L_{BMAX} = length in metres where B_{MAX}/B_{WL} 〉 1

$H_{(S,MAX)}$ = maximum significant wave height in which the vessel is allowed to operate (m)

B = beam over all (m)

z : height from base line to neutral axis of cross structure (m).

$\frac{V}{\sqrt{L}}$ need not to be taken greater than 3.

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<td>Amendment of horizontal split force</td>
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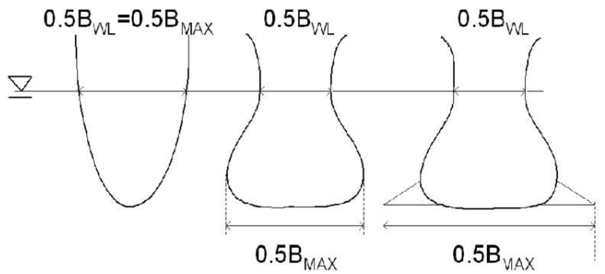
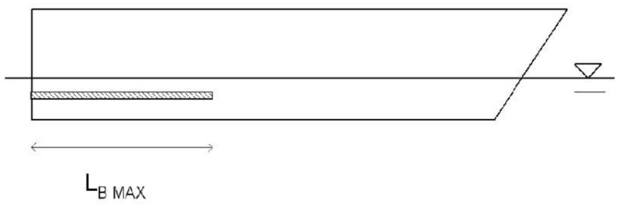
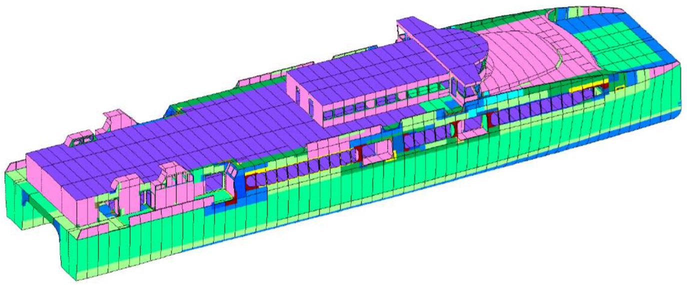
Current	Amendment	Reason
⟨omitted⟩	  Definition of parameters in case of different sectional shapes ⟨omitted⟩	

Current	Amendment	Reason
Guidance for the Classification of High Speed and Light Crafts **Part 3 Hull Structures** Chapter 1. Design in General 〈omitted〉 Annex 3-1 Guidance for the Direct Strength Assessment 1. ~ 3. 〈omitted〉 4. 〈New〉	**Guidance for the Classification of High Speed and Light Crafts** **Part 3 Hull Structures** Chapter 1. Design in General 〈same as present〉 Annex 3-1 Guidance for the Direct Strength Assessment 1. ~ 3. 〈same as present〉 4. Direct strength calculation of catamaran (2022) (1) General (A) This regulation applies to catamarans. (B) When determining the scantling of structural members of catamarans by direct strength calculation, the data necessary for direct strength calculation are to be submitted and approved in advance by the Society. (C) The allowable stress criteria and buckling strength evaluation criteria according to the materials are in accordance with 1. to 3. of this annex and Annex 3-2.	Newly added

Current	Amendment	Reason
	(2) Direct strength calculation of full ship structure (A) Structural modeling a) The direct strength calculation is to be applied for the hull structure that contributes to the hull girder strength. b) In case of modeling with plate or shell element, in principle, the finite element division is divided into two or more elements between adjacent web frames in the longitudinal direction and by the spacing of longitudinals in the width direction. An example of the full ship structure model is shown in Figure 3.1.1. c) In case aluminum extruded members are used as structural members, the orthotropic elements or composed model with plate and stiffener elements should be used for the members.  Figure 3.1.1 An example of the full ship structural model	

Current	Amendment	Reason
	(B) Boundary conditions For the boundary condition given to the full ship analysis model, a simple support can be applied to reflect the actual structural behavior, or an inertia relief condition can be applied with the center of gravity of the hull as the reference point in consideration of the geometric characteristics of the catamaran. (C) Load conditions a) Full ship analysis is to be performed for the load cases derived from ship motion analysis acceptable to the Society. If the hull girder loads in Pt 3, Ch 2, Sec 4 of the Rules is applied instead of the loads from ship motion analysis, the strength evaluation can be performed for the load cases shown in Table 3-6. b) In accordance with Pt 3, Ch 2, Sec 3 304.~ 307. of the Rules, the hull weight, cargo/passenger load and sea water pressure are to be applied in the structural model in advance applying the hull girder load. c) For vertical bending moment, the larger moment is to be used compared with the bending moment (M_B) due to impact load in Pt 3, Ch 2, Sec 4, 401.2 of the Rules and the hogging/sagging moment (M_{hog}, M_{sag}) in 401.4. In order to apply the vertical bending moment defined in the above regulation to the full ship model, the weight and buoyancy can be distributed in way of longitudinal direction of the hull as shown in the example in Figure 3.1.2. In the case of weight, the distributed loads can be applied to the deck by frame spacing, and in the case of buoyancy, the concentrated loads can be applied to the keel position by frame spacing as shown in Figure 3.1.3. d) For the transverse bending moment (M_S), the horizontal split force (F_y) of Pt 3, Ch 2, Sec 4, 402.2.(2) of the Rules can be applied as shown in Figure 3.1.4. e) The longitudinal/transverse torsional moment of Pt 3, Ch 2, Sec 4 402.3 and 4 of the Rules can be applied to the bulkhead deck or keel by using pitch connecting force(F_p) as shown in Figure 3.1.5. This force is as follows. $F_P = 0.5 B_{CL} \frac{M_T}{n_{Fr}}$, where n_{Fr} is number of frames	

Current	Amendment	Reason

Table 3-6 Load cases for longitudinal strength evaluation of catamaran

No.	Load cases		Pt 3, Ch 2 of the Rules
1	Vertical bending moment (Hogging)	Max(M_{hog} , M_B)	401.2.(2) ,401.4.(2)
2	Vertical bending moment (Sagging)	Max(M_{sag} , M_B)	401.2.(3), 401.4.(2)
3	Transverse bending moment	M_S	402.2.(2)
4	Longitudinal/transverse torsional moment	M_P + M_T	402.3 및 402.4
5	Load combination 1	0.8 Max(M_{sag} , M_B) + 0.6(M_P + M_T)	
6	Load combination 2	0.6 Max(M_{sag} , M_B) + 0.8(M_P + M_T)	
7	Load combination 3	0.7M_s + (M_P + M_T)	
8	Load combination 4	M_s + 0.7(M_P + Mt)	

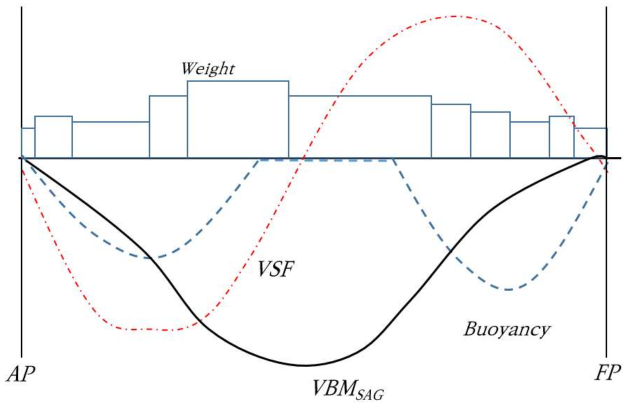


Figure 3.1.2 An example of weight, buoyancy, shear force and bending moment diagram (refer to Figure 3.2.11 of the Rules)

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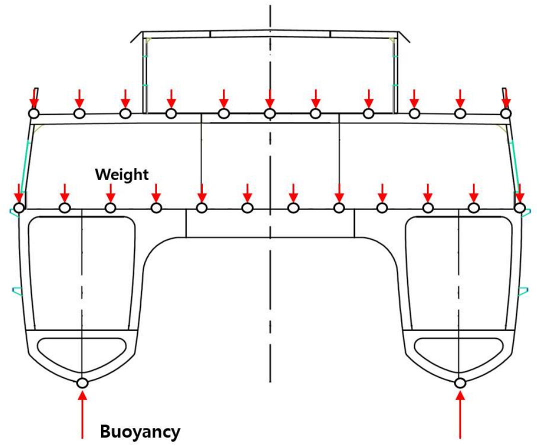

Figure 3.1.3 An example for application of weight and buoyancy

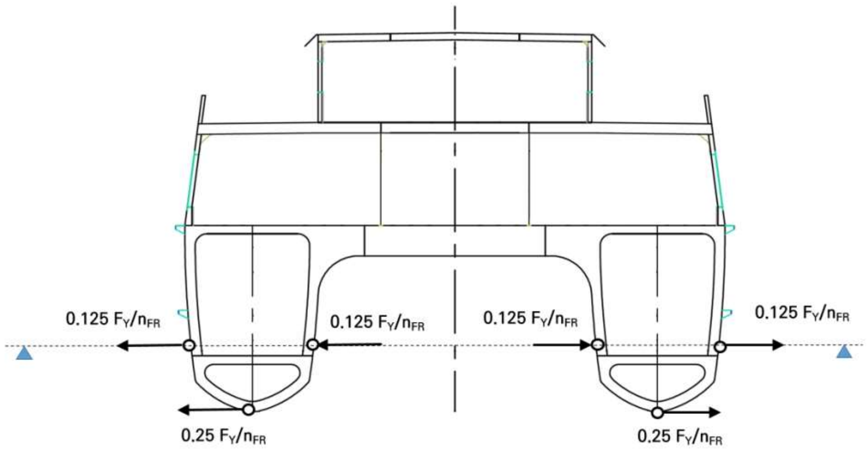

Figure 3.1.4 Application of horizontal split force for transverse bending moment (n_{Fr} is no. of frames)
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	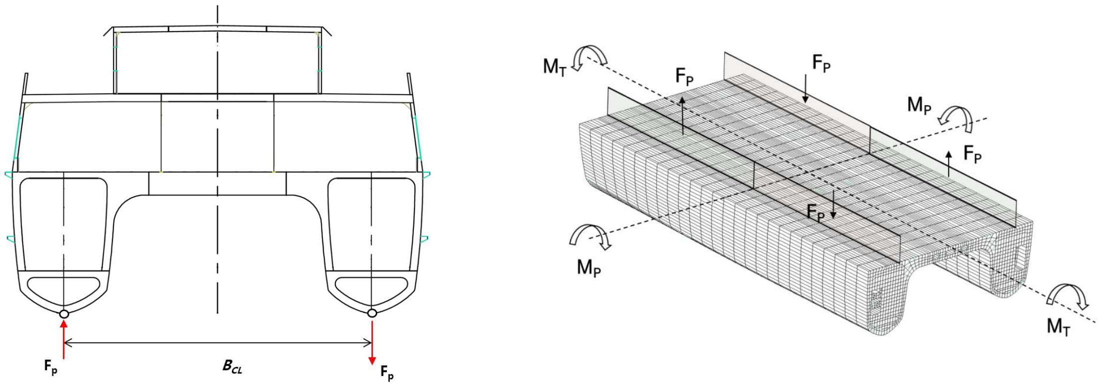 Figure 3.1.5 Application of pitch connecting force for longitudinal/transverse torsional moment	