SECTION 2 HYDROSTATIC AND HYDRODYNAMIC LOADS

Symbols

L_{WL} : Length at waterline at full load, in m

L_{HULL} : Hull length, as defined in Ch 1, Sec 2, [3.3.1], in m

$M_{WV,H}$: Wave vertical bending moment in hogging condition, in kN.m

$M_{WV,S}$: Wave vertical bending moment in sagging condition, in kN.m

$M_{SW,H}$: Still water vertical bending moment in hogging condition, in kN.m

$M_{SW,S}$: Still water vertical bending moment in sagging condition, in kN.m

Q_{SW} : Still water vertical shear force, in kN

Q_{WV} : Wave vertical shear force, in kN.

1 Still water loads

1.1 General

1.1.1 As a rule, the actual hull lines and lightweight distribution are to be submitted, for determination of longitudinal distribution of still water bending moment and shear force.

A capacity plan, showing localization and volumes of fresh water tanks, diesel oil tanks and water ballast, is also to be submitted.

1.2 Loading conditions

1.2.1 As a rule, the longitudinal distribution of still water bending moments and shear force are to be calculated with the following loading conditions:

- ship with 100% full capacities
- ship with 10% capacities.

Note 1: distribution of M_{sw} is to be the same as M_{wv}

1.3 Still water bending moment and shear force

1.3.1 If the information required in [1.1.1] and [1.2.1] are not defined, at a preliminary design stage, the still water bending moment and shear force (values and conditions) may be taken as per Tab 1.

2 Wave loads

2.1 General

2.1.1 Wave loads are induced by encountered waves in head sea or quartering sea.

The design encountered waves, considered with a probability level of 10^{-5}, may be represented by equivalent static wave as described in [2.1.2] and [2.1.3].

Table 1 : Still water bending moments (SWBM) and still water shear forces (QSW)

Type of yachts	SWBM	QSW
Conventional motor yachts	$M_{SW,H} = 0,8\ M_{WV,H}$	$Q_{SW} = 0,8\ Q_{WV}$
Motor yachts with large transom	$M_{SW,H} = 0,4\ M_{WV,H}$	$Q_{SW} = 0,4\ Q_{WV}$
Multihull motor yacht	$M_{SW,H} = 0,6\ M_{WV,H}$	$Q_{SW} = 0,6\ Q_{WV}$
Monohull sailing yacht	$M_{SW,S} = 0,2\ M_{WV,H}$	$Q_{SW} = 0,2\ Q_{WV}$
Multihull sailing yacht	$M_{SW,H} = 0,6\ M_{WV,H}$	$Q_{SW} = 0,6\ Q_{WV}$

2.1.2 Head sea

For monohull and catamaran type yachts, the characteristics of encountered wave to consider in head sea (equivalent static wave) are as follows:

- sinusoïdal type
- wave length L_W ,in m, with:

  $L_W = 0,5\ (L_{WL} + L_{HULL})$
- wave height C_W crest-to-trough, in m, with:

  $C_W = (118 - 0,36\ L_W)\ L_W\ 10^{-3}$

2.1.3 Quartering sea

Moreover, for catamaran type yacht, the characteristics of encountered waves to consider in quartering sea (equivalent static wave) are as follows:

- sinusoïdal type
- such an incidence that the crest of wave is aligned with forward perpendicular of starboard float hull and aft perpendicular of port float hull, the two next troughs of waves being respectively at aft perpendicular of starboard float hull and fore perpendicular of port float hull (see Fig 3)
- wave length L_{WQ} , in m, resulting from the quartering wave position defined on (see Fig 3)
- wave height C_{WQ} crest-to-trough, in m, with:

  $C_{WQ} = (118 - 0,36\ L_{WQ})\ L_{WQ}\ 10^{-3}$

2.2 Vertical wave bending moment and shear forces - head sea condition

2.2.1 General

The maximum vertical wave bending moment in hogging (resulting in tensile stress at deck) is corresponding to ship sailing in waves with characteristics according to [2.1.2], with crest of wave at midship perpendicular.

The maximum vertical wave bending moment in sagging (resulting in compression stress at deck) is corresponding to ship sailing in waves with characteristics according to [2.1.2], with trough of wave at midship perpendicular.

The following requirements give the Rules vertical wave bending moment and shear force values and corresponding longitudinal distributions, to be considered for monohulls and catamarans (in head sea).

2.2.2 Bending moment and shear force

The maximum value of vertical wave bending moment, in kN.m, and shear force, in kN, are obtained from the following formulas:

$$M_{WV,H} = M_{WV,S} = 0{,}25\ n\ C_W\ L_W^2\ B_W\ C_B\ 0{,}625$$

$$Q_{WV} = 0{,}78\ n\ C_W\ L_W\ B_W\ C_B\ 0{,}625$$

with:

- C_W : Wave height, in m, as defined in [2.1.2]
- L_W : Wave length, in m, as defined in [2.1.2]
- B_W : Maximum breadth at waterline, in m. For catamarans, B_W is to be taken as the sum of maximum breadth at waterline for both floats
- C_B : Block coefficient
- n : Navigation coefficient defined in Ch 4, Sec 2, [3].

2.2.3 Distribution

The longitudinal distribution shown in Fig 1 and Fig 2 may be used for longitudinal distribution of vertical wave bending moment and wave shear force.

Figure 1 : Vertical wave bending moment distribution

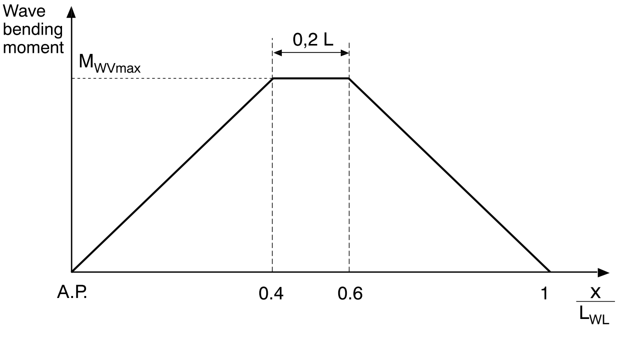
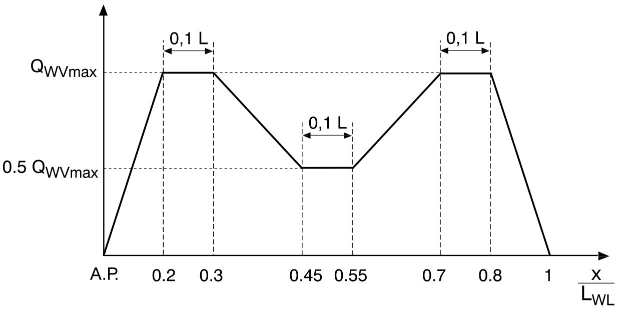


Figure 2 : Vertical wave shear force distribution



2.3 Wave torque - quartering sea for multihull only

2.3.1 General

The maximum wave torque is resulting from ship sailing in waves with characteristics according to [2.1.3], with forward perpendicular of starboard float hull and aft perpendicular of port float hull on crest of wave (see Fig 3).

The maximum wave torque is the torque alongside the transverse horizontal axis, resulting from the action of one float on the other one.

The following requirements give the Rule wave torque value to be considered for catamarans (in quartering seas).

2.3.2 Torque

The maximum value of wave torque moment, in kN.m, is obtained from the following formula:

$$M_{WT} = n\ C_{WQ}\ L_W^2\ B_W\ C_B\ 0{,}625$$

with:

- C_{WQ} : Wave height, in m, as defined in [2.1.3]
- L_W : $L_W = 0{,}5\ (L_{WL} + L_{HULL})$
- B_W : Maximum breadth at waterline of one float, in m
- C_B : Block coefficient
- n : Navigation coefficient defined in Ch 4, Sec 2, [3].

2.4 Alternatives

2.4.1 As an alternative, the Society may consider direct calculation of wave vertical bending moments and shear forces, performed to better take into account the actual hull lines.

In such a case, wave characteristics are to comply with the requirements of [2.1.3] and the calculations are to be submitted to the Society for approval.

Figure 3 : Wave torque on catamarans