SECTION 3 SPECIFIC GLOBAL LOADS

1 General

1.1 Application

1.1.1 The specific global loads of this Section are applicable to sailing yacht (monohull or catamaran) and to catamarans (sailing yachts or motor yachts).

1.1.2 The multihulls with more than two floats are not covered by the present Section and are to be submitted to a special examination.

1.1.3 Other requirements may be considered for such specific global loads, in case of yachts having unusual particulars.

2 Rig loads

2.1 General

2.1.1 The rig global loadings described in that Section are generally to be considered for yachts featuring:

- a sailing configuration where mast, stays, shrouds and backstay induce significant loads in the hull girder
- a deck with large openings or significant structural discontinuity
- a deck with transverse framing system.

2.1.2 The rig global loads inducing a hull girder bending effect are to be combined with still water and wave global loads as indicated in Ch 6, Sec 4.

2.1.3 The rig loads to be considered in the present Section are the forces induced by the standing rigging:

- stays
- vertical shrouds and lower shrouds
- backstay.

The loads induced by the standing rigging during normal navigation conditions are to be indicated by the Yard and/or by the Designer, for the various navigation conditions taking account of:

- sails reduction versus apparent wind speed
- sails configuration for all wind heading from head wind to down wind.

2.1.4 The combination calculations are carried out without any trim and list.

2.1.5 The Society reserves the right to determine the rig loads from the sizing of the shrouds. In such case, the forces are corresponding to the breaking strength of the shroud under consideration, divided by a coefficient of 2,5 (this coefficient is generally the safety factor on breaking strength used for the design of shrouds in the scantling riggings).

The Society may consider a different value for this coefficient, on a case by case basis, upon satisfactory justification given by the Yard and/or the Designer.

2.2 Sailing monohull with one mast

2.2.1 The maximum hull girder bending moment M_{RIG} , in kN.m, induced by the standing rigging, is the mean value of fore rig induced hull girder bending moment M_{RIGF} and aft rig induced hull girder bending moment M_{RIGA} , defined as follows:

- where only the forestay is loaded:

  $M_{RIGF} = F_E \sin \alpha_E \ L_E$
- where only the baby stay is loaded:

  $M_{RIGF} = F_{BE} \sin \alpha_{BE} \ L_{BE}$
- where both the main stay and the baby stay are loaded simultaneously:

  $M_{RIGF} = F_E \sin \alpha_E \ L_E + F_{BE} \sin \alpha_{BE} \ L_{BE}$
- $M_{RIGA} = M_P + M_{V1} + M_{D1}$

  where:

  $M_P = F_P \sin \alpha_P \ L_P$

  $M_{V1} = F_{V1} \ L_{V1}$

  $M_{D1} = F_{D1} \sin \alpha_{D1} \ L_{D1}$

The symbols are shown on Fig 1, where:

F_P	:	Load on backstay, in kN
F_{V1}	:	Load on vertical shroud, in kN
F_{D1}	:	Load on lower shroud, in kN
F_E	:	Load on forestay, in kN
F_{BE}	:	Load on baby stay, in kN
α_I	:	Angle from the horizontal, in °, as shown on Fig 1
L_I	:	Horizontal distance from mast foot, in m, as shown on Fig 1.

2.2.2 The maximum hull girder vertical shear force Q_{RIG} , in kN, induced by the standing rigging, is the mean value of fore rig induced hull girder vertical shear force Q_{RIGF} and aft rig induced hull girder vertical shear force Q_{RIGA} , defined as follows:

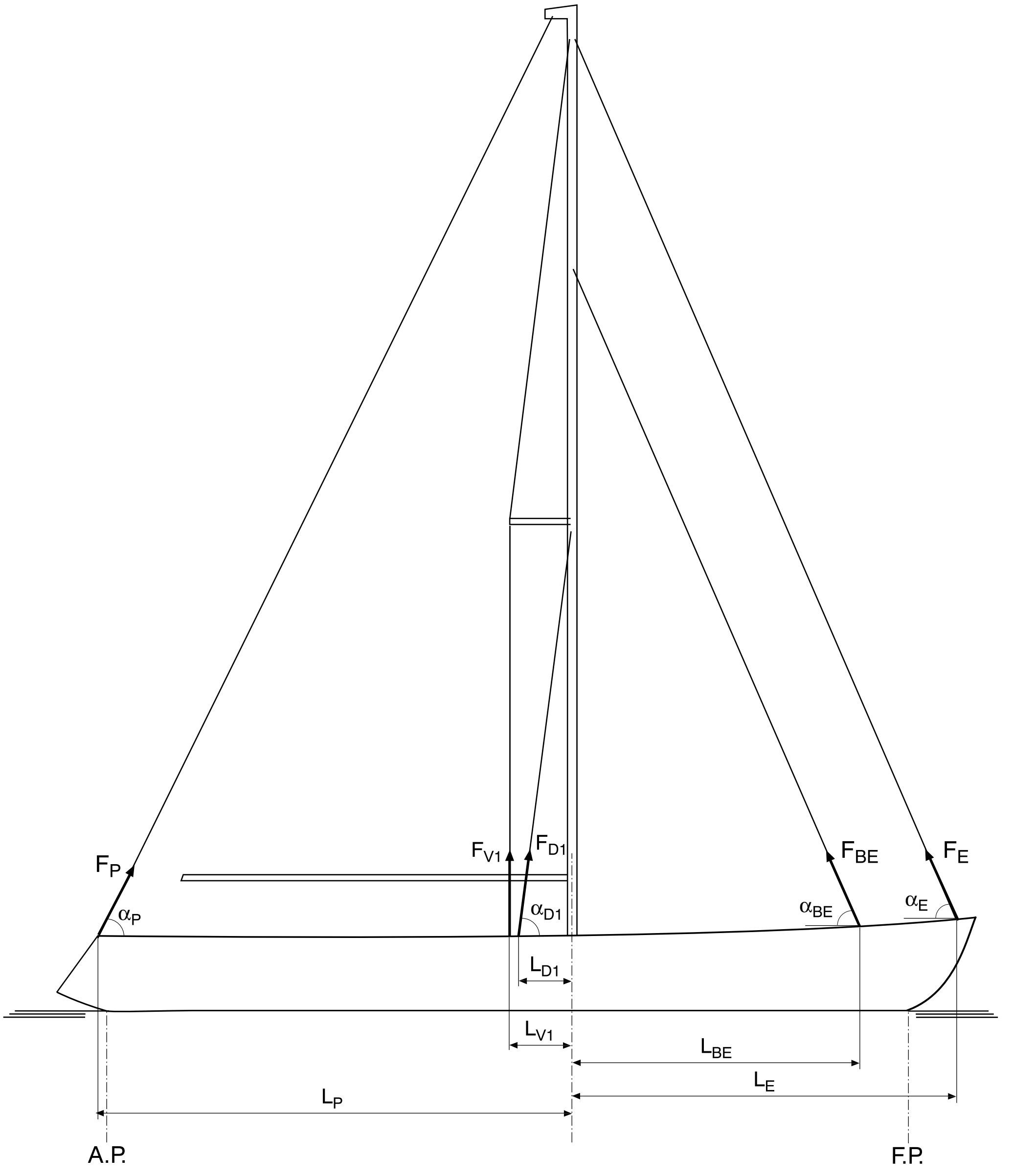
- where only the main stay is loaded:

  $Q_{RIGF} = F_E \sin \alpha_E$
- where only the baby stay is loaded:

  $Q_{RIGF} = F_{BE} \sin \alpha_{BE}$
- where both the main stay and the baby stay are loaded simultaneously:

  $Q_{RIGF} = F_E \sin \alpha_E + F_{BE} \sin \alpha_{BE}$

Figure 1 : Rig loads designation



- $Q_{RIGA} = Q_P + Q_{V1} + Q_{D1}$

  where:

  $Q_P = F_P \sin \alpha_P$

  $Q_{V1} = F_{V1}$

  $Q_{D1} = F_{D1} \sin \alpha_{D1}$

The symbols are defined in [2.2.1].

2.3 Sailing monohull with several masts

2.3.1 In case of sailing monohull with more than one mast, the hull girder bending moments and shear forces induced by the standing rigging are determined from a direct calculation.

This calculation is to be carried out with following assumptions:

- the hull is considered as a series of beams of constant inertia, fixed in way of each mast (see Fig 3)
- this beam is vertically loaded by the various forces exerted by the standing rigging (see Fig 2).

The hull girder is then analysed by steps, bending moments and shear forces being calculated individually for each span between masts.

The hull girder rig bending moments and shear forces are generally calculated in way of each mast.

The design value of the hull girder rig bending moment in way of each mast is the mean value of the bending moments calculated either side of the mast under consideration.

The design value of the hull girder rig shear force in way of each mast is the mean value of the shear forces calculated either side of the mast under consideration.

2.3.2 The actual distribution of hull girder bending moments and shear forces may be calculated by means of beam analysis.

2.3.3 Where the top of masts are attached to each other by an horizontal shroud, the rig loads will be subject to special examination.

Figure 2 : Rig loads designation for sailing yachts with several masts

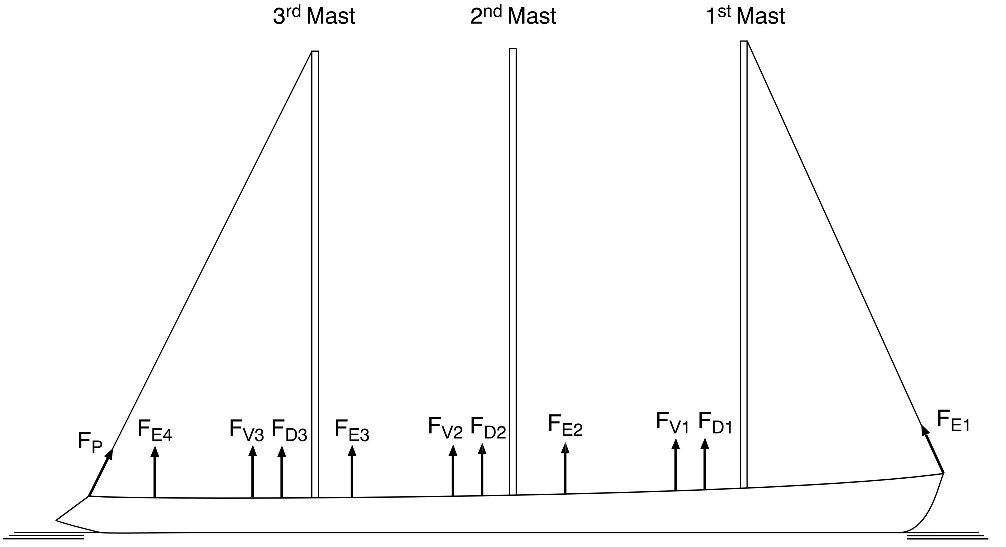
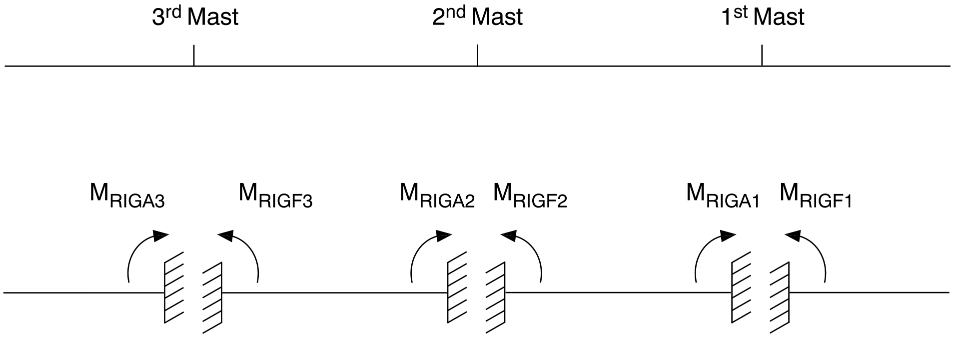


Figure 3 : Hull girder analysis



2.4 Sailing catamarans with one mast or more than one mast

2.4.1 General

The rig loads considered in the present sub-article may induce:

- a global vertical bending moment
- a global torsional connecting moment (rig torque).

The loads induced by the standing rigging during normal navigation conditions are to be indicated by the Yard and/or by the Designer, for the various navigation conditions taking account of:

- sails reduction versus apparent wind speed
- sails configuration for all wind heading from head wind to down wind.

The Society reserves the right to determine the rig loads from the sizing of the shrouds. In such case, the forces are corresponding to the breaking strength of the shroud under consideration, divided by a coefficient of 2,5 (this coefficient is generally the safety factor on breaking strength used for the design of shrouds in the scantling riggings).

The Society may consider a different value for this coefficient, on a case by case basis, upon satisfactory justification given by the Yard and/or the Designer.

2.4.2 Vertical bending moment induced by rig

The hull girder bending moment induced by the standing rigging, M_{RIG}, is to be calculated according to sub-article [2.2].

2.4.3 Torque induced by rig

The rig loads considered in the present requirement are the rig forces that induce a torsional connecting moment in the cross deck between the floats. These forces are non-symetrical with respect to longitudinal axis, and are:

- the forces exerted by the vertical shrouds and lower shrouds
- the forces exerted by the backstay.

The hull girder torsque bending moment induced by the standing rigging, M_{RIGT}, is equal to:

$$M_{RIGT} = F_{V1}\ L_{V1}' + F_{D1}\ L_{D1}'\ \sin\alpha_{D1} + F_P\ L_P'\ \sin\alpha_P$$

where L_{V1}', L_{D1}' and L_P' are the horizontal distances from respectively vertical shroud chain plate, lower shroud chain plate and side backstay chain plate to cross deck center of rotation, determined as indicated in Ch 8, Sec 2 for steel and aluminium yachts, or Ch 9, Sec 2 for composites yachts.

3 Loading induced by deck diving into waves (broaching)

3.1 General

3.1.1 This type of loading corresponds the situation where the catamaran sails in quartering head seas and has the fore end of the floats burying themselves into the encountered waves.

3.1.2 The assumptions considered to determine the corresponding global loads are the following one:

- 10° longitudinal trim
- 10° tranverse list
- 1g broaching horizontal deceleration
- the float getting the bigger broaching effect is submerged from the extreme fore end to the forward part of the forward cross deck structure.

3.2 Loads and stresses

3.2.1 Vertical and horizontal forces to be applied on the fore part of the floats, in kN, are defined as follows.

The vertical force F′, in kN, induced by Archimedian overpressure resulting from the deck diving, is to be calculated according to the following formula:

$$F' = \frac{1,8 \cdot 9,807 \cdot \Delta \cdot d \cdot \sin 10^{\circ}}{\delta_1 + \delta_2}$$

The horizontal force F″, in kN, induced by Archimedian overpressure resulting from the deck diving, is to be calculated according to the following formula:

$F'' = F' \cos 80°$

where:

- Δ : Full load diplacement, in T, of the catamaran
- d : Horizontal distance between the extreme fore end of each float and the forward part of the forward cross beam
- δ_1, δ_2 : Sinkages, in m, of a point located at mid-distance between the extreme fore end of each float and the fore stem of the forward cross deck structure (at d/2)

$$\delta_1 = \frac{3}{8} \cdot L_{WL} \cdot \tan 10^{\circ}$$

$$\delta_2 = \frac{1}{8} \cdot L_{WL} \cdot \tan 16^{\circ}$$

- L_{WL} : Length of each float, in m, at full load waterline.

3.2.2 Load distribution

The distribution of the loads on the fore part of the floats may be considered as linear load applied according to Fig 4.

3.2.3 For non conventional loaction of the fore part of the cross deck between hulls, the Society may decide to consider another load distribution, on a case by case basis.

3.2.4 Bending moment M_E and shear force Q_E

The bending moments and shear forces induced in the cross deck by this type of loads are to be determined according to Ch 8, Sec 2 for steel or aluminium yacht and Ch 9, Sec 2 for composite yacht.

3.2.5 Admissibles stresses

The admissible stresses to be considered for the cross deck scantlings under this type of loading are defined in Ch 4, Sec 3.

Figure 4 : Loading of catamarans due to digging in