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Sailboat examples with « Gene-Hull Sailboat 3.2 »

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« Gene-Hull Sailboat » spreadsheet application, in its new proposed version 3.2, is in line and upgraded from the previous version 3.1.

Gene-Hull sailboat 3.2 is here below illustrated by the generation of some reference boats proposed as a starting point for a project + also various hulls inspired by existing or historical boats.

The corresponding hulls input data are stored in the « Hulls storage » sheet of the application, inc. the input data for the keel, the rudder, the sailplan, the mass spreadsheet and the loading. So you can reproduce them by copy/paste the corresponding data from the « Hulls storage » sheet to the « Gene-Hull » one.

Examples with Gene-Hull sailboat 3,2 :

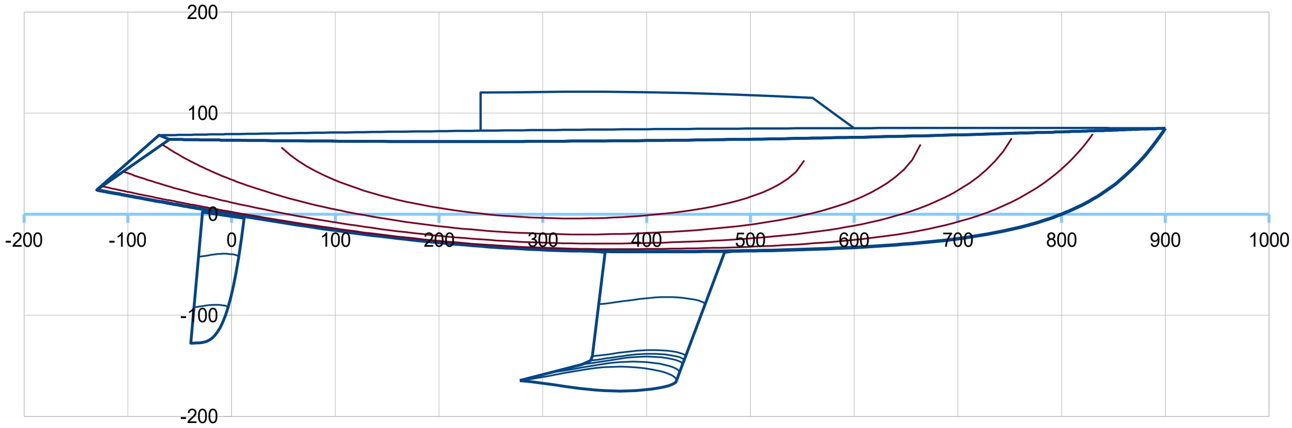
- **V1 reference modern classic sailboat :** all functions are detailed for this example (Hull and Appendages, Hydrostatics data, Sailplan, Mass spreadsheet, Stability and righting moment with a loading)
- **V1,1 variant -** modified bow line
- **V1,2 variant –** with V sections only
- **V1,3 variant –** with some tumblehome in the sections
- **U1 reference modern sailboat**
- **U1,1 variant –** with a scow bow
- **B52**, inspired by « Bojar » flush deck cutter 1937 / Johan Anker
- **Classic 6m JI**, inspired by this metric class with a classic approach
- **S30**, inspired by S30 / Knud Reimers
- **T37**, inspired by Tina / Dick Carter
- **M32**, inspired by Melges 32 / Reichel Pugh
- **Blue Water 39,** inspired by Corbin 39 / Robert Dufour - Marius Corbin
- **T10**, inspired by Tofinou 10 / Joubert-Nivelt
- **I60** , inspired by Imoca 60 designs
- **Keel boat 15**, inspired by 15m2 SNS swiss class.
- **Dolfi 32S**, inspired by Beneteau Figaro III / VPLP
- **ULDB 40**, inspired by Santa-Cruz ULDB designs / Bill Lee
- **Syd 38**, inspired by Sydney 38 / Murray Burns Dovell

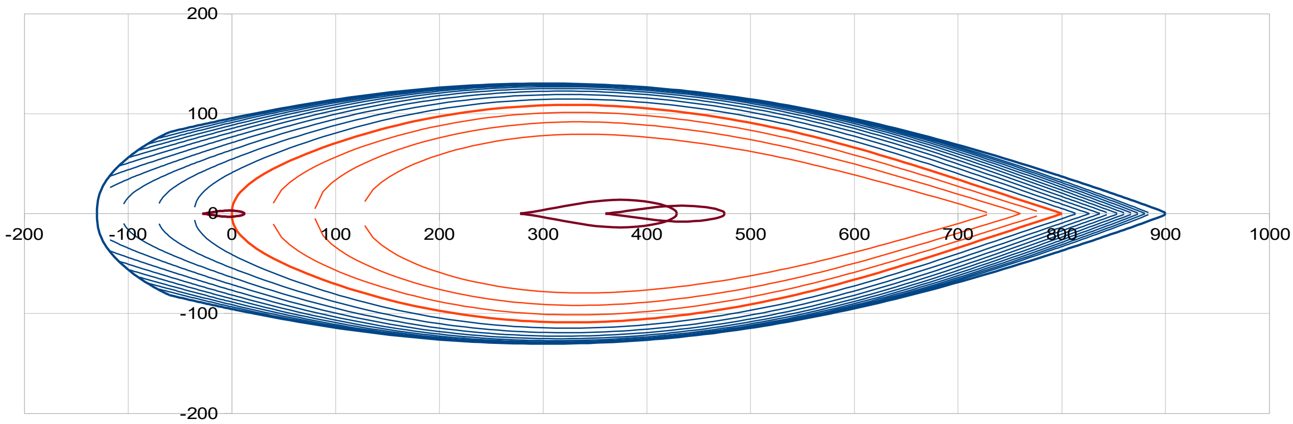
Boat V1 modern classic daysailer

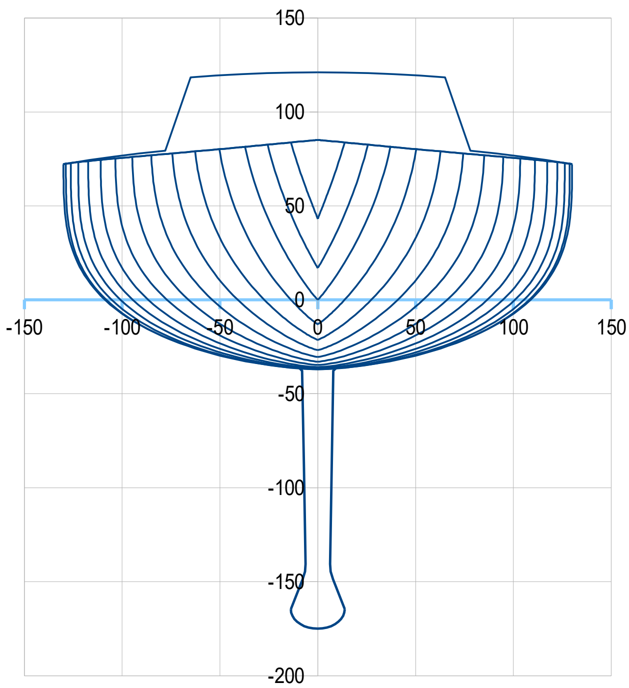
Boat V1 - Step 1 : Hull and appendages

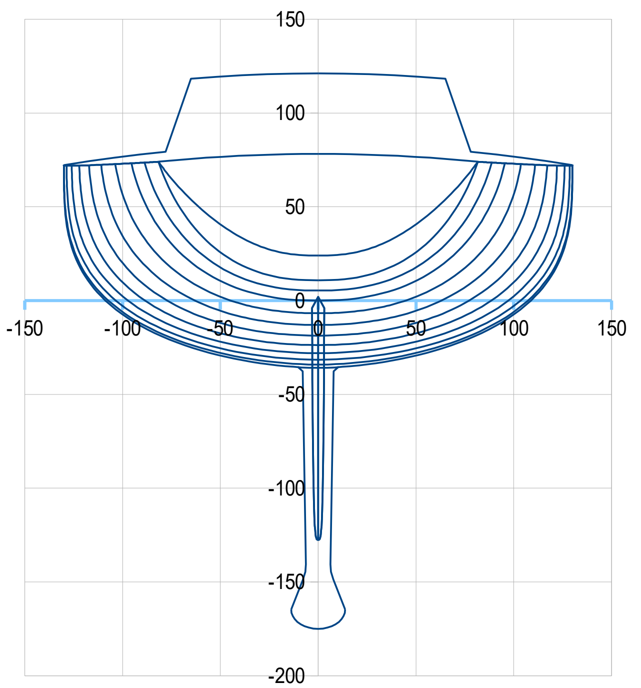
Loa 10,30 m ; Lwl 8,00 m ; B 2,60 m ; Draft 1,75 m ; Displacement : 2642 kg ; Keel-bulb 1090 kg

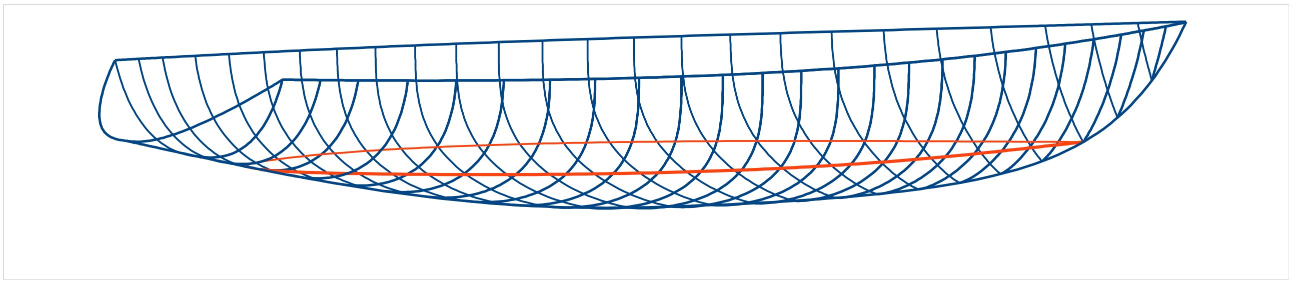
>> LCB hull 47,29 %Lwl ; Cp hull : 0,547 ; Sw : 17,33 m2 ;   DLR : 144 ;   Ballast ratio : 41,3 %











2. Data sum-up and results of hydrostatic and surfaces calculations

2.1 Hull

Loa (m)	10,30	Lwl (m)	8,00		> Hull speed (Knots)	6,9	at Froude 0,4	
>> ft	33,79		26,25					
Boa (m)	2,60	at X (% Lwl)	38,0	Bsheer (m)	2,60	at X (% Lwl)	38,0	
>> ft	8,53							
Bwl (m)	2,18	at X (% Lwl)	41,0	> Bwl / Boa	0,837			
>> ft	7,14				Freeboards (m) >	Aft	Midship	Fore
Tc (m)	0,370	at X (%Lwl)	50			0,74	0,72	0,85
>> ft	1,21				>> ft	2,43	2,36	2,79
	Displacement at H0 (m3)	2,41293	at LCB (m)	3,783	LCB (%Lwl)	47,29	ZCB (m)	-0,130
	>> lbs	5453	w. seawater	1025	kg/m3		>> ft	-0,43
Cp	0,547							
Sf (m2)	11,81	at LCF (m)	3,601	LCF (%Lwl)	45,01		>>> LCB – LCF (%Lwl)	2,28
>> ft2	127,10	>> ft	11,81					
Angle Freeboard/Half beam		29,0	(°), at section C4 (40% Lwl)					
Sw (m2)	12,75	>Sw/D^(2/3)	7,09					
>> ft2	137,29							
Shull (m2)	29,52	at X (m)	3,634	Z (m)	0,094			
>> ft2	317,80	>> ft	11,92	>> ft	0,31			
Sdeck (m2)	18,39	at X (m)	3,482	Z (m)	0,79			
>> ft2	197,90	>> ft	11,42	>> ft	2,59			

2.2 Keel

Vol. keel(m3)	0,14938	at X (m)	4,019	X (%Lwl)	50,23	Z (m)	-1,098	
		>> ft	13,18			>> ft	-3,60	
Ballast (kg)	1090,5	at X (m)	4,019	X (%Lwl)	50,23	Z (m)	-1,098	
>> lbs	2404	>> ft	13,18			>> ft	-3,60	
Draft oa (m)	1,75		Sw (m2)	3,66		Sxz (m2)	1,36	
>> ft	5,74		>> ft2	39,45		>> ft2	14,61	
CLR (m)	4,34	CLR (%Lwl)	54,23	*CLR = Center of Lateral Resistance*				
>> ft	14,23	method: keel profile extended to the waterline, CLR at Z 45% draft and					25,00	% chord

2.3 Rudder(s)

Number	1							
Volume (m3)	0,01486	at X (m)	-0,12	X (%Lwl)	-1,47	Z (m)	-0,54	
Sw (m2)	0,91	>> ft	-0,39			Sxz (m2)	0,44	per rudder
>> ft2	9,80					>> ft2	4,71	

2.4 Hull + Keel + Rudder(s)

	Displacement at H0 (m3)	2,57717	at LCB (m)	3,774	LCB (%Lwl)	47,18	at ZCB (m)	-0,188
	(kg)	2642	>> ft	12,38			>> ft	-0,62
	>> lbs	5824						
	, of wich Ballast (kg)	1090	at Xg (m)	4,019	Xg (%Lwl)	50,23	at Zg (m)	-1,098
	>> lbs	2404	>> ft	13,18			>> ft	-3,60
	>> % Ballast	41,3						
	Sw (m2)	17,33	>Sw/D^(2/3)	9,22	Lwl/D^(1/3)	5,84		
	>> ft2	186,55			**DLR**	**144**	M(lbs/2240)/(Lwl(ft)/100)^3	

Some more information on the hydrostatics data :

In 2.1 Hull :

Hull speed V at Froude 0,4 : is based on the following formula : 0,4 = V / (g Lwl)^0,5
>>> it is the speed that usually can be reached in displacement mode, e.g. when beam reaching or downwind sailing providing there is sufficient wind and sail area.

Boa (overall) and Bsheer (at sheer line) : can be different in case of tumblehome sections. Then Boa can be slightly greater than Bsheer

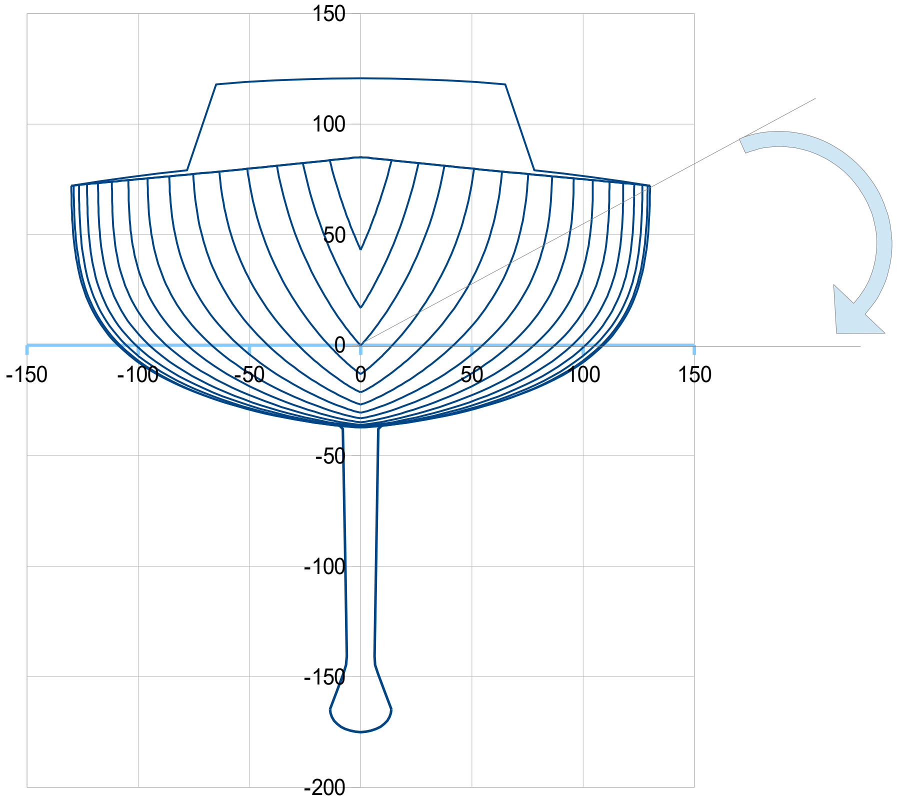
Tc (m) : hull body maximum draft (it is an input data)

Hull body / LCB (Longitudinal Center of Buoyancy) **and Cp** (Prismatic coefficient) : optimal values are proposed by L. Larsson and Rolf E Eliasson in « Principles of yacht Design », based on Delft series of parent models :

- Optimal LCB can be choosen preferably in the 46% - 47% zone to minimize the residuary drag for the Froude range 0,3 to 0,4
- Optimal Cp choice depends of the Froude objective for the design : ~ 0,50 for Froude 0,3 ; ~ 0,56 for Froude 0,35 ; ~ 0,60 for Froude 0,4 ; ~ 0,62 for Froude 0,45

Sf and its longitudinal position Xf : Sf it is the floatation waterplane area. Xf is usually behind LCB and LCB-Xf (%Lwl) is also given as an indication. In the stability ouput data (here after), Xf with heel is compared to Xf upright, the lower the difference, the better the expected balance when heeling.

Angle Free-board / half beam : this geometrical data is given at that preliminary stage (before the stability with load following study) to help appreciate the heel angle which could put the sheer line in the water. Usually, due to the exact computation of the heeled hull, if an heel angle > 30° is your objective for such occurrence, a geometrical angle of around 26° to 29° leads to this objective.



Sw is the wetted surface.
Shull is the total surface of the hull body and X,Z its geometrical center, **Sdeck** is the total surface of the deck assumed flush (the roof is not taken into account) and X,Z its geometrical geometry. These data are used in the mass spreadsheet preliminary estimation.

In 2,2 Keel :

Ballast (kg) = it is the mass of the keel taking into account the two input densities, for the wing and for the bulb, in that case of « keel with bulb » type. In the example above, the two densities are 7,3 / Font material . If we change the Bulb density to 11,35 / Lead material, that changes not only the ballast weight but also its X, Z position :

Density Wing	**7,30**
Density Bulb	**7,30**

>>>

Ballast (kg)	**1090,5**	**at X (m)**	**4,019**	**X (%Lwl)**	**50,23**	**Z (m)**	**-1,098**

Density Wing	**7,30**
Density Bulb	**11,35**

>>>

Ballast (kg)	**1300,7**	**at X (m)**	**3,979**	**X (%Lwl)**	**49,74**	**Z (m)**	**-1,180**

For the « keel without bulb » type, we consider only one material density.

Sxz : it is the projected area of the keel profile in the vertical plan of symmetry. This data is used in the sailplan sheet for the design ratio « **Skeel / St (%)** » where Skeel is this Sxz and St the area of the two sail triangles main and fore, in order to appreciate if there is enough keel area to provide the lateral resistance. An average of 3,5% ± 0,75 % is proposed for this ratio by L. Larsson and Rolf E Eliasson in « Principles of yacht Design ».

CLR : it is the Center of Lateral Ressitance, estimated by the metod of the keel profile extended to the waterline, as proposed by L. Larsson and Rolf E Eliasson in « Principles of yacht Design ». This data is used in the Sailplan sheet, to estimate the Lead = CE – CLR (%Lwl), more details are given here after for the Sailplan issue. The CLR is estimated à Z 45% and Chord 25% to 35% depending of the angle of the keel wing leading edge in order to cover the fin keel to long keel range of shapes.

In 2,3 Rudder :

Sxz : it is the projected area of the rudder profile in the vertical plan of symmetry. This data is used in the sailplan sheet for the design ratio « **Srudder / St (%)** » where Srudder is this Sxz and St the area of the two sail triangles main and fore, in order to appreciate if there is enough rudder area to provide the lateral resistance. An average of 1,4% (inc. the skeg area if any) is proposed for this ratio by L. Larsson and Rolf E Eliasson in « Principles of yacht Design », with 1% the lower limit and 2% the upper limit. In case of twin rudders, the area of one rudder is taken into account for this criteria.

In 2,4 Hull + Keel + Rudder(s)

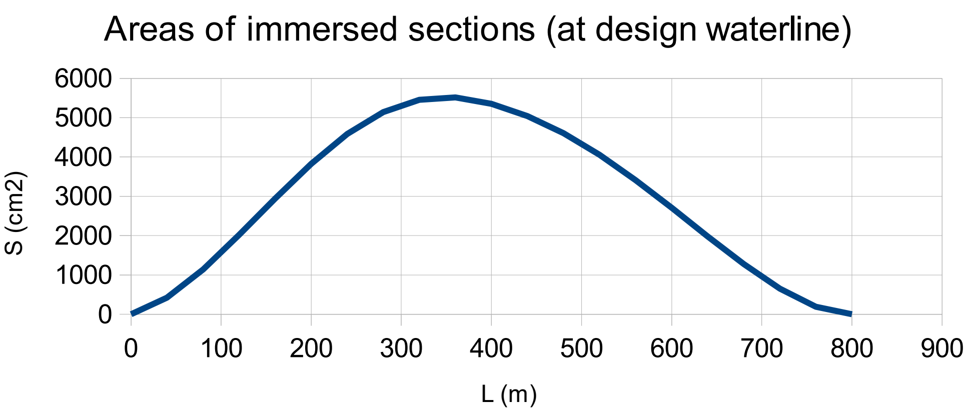
DLR : the Displacement/Length ratio is of first importance, its value should be an objective for the naval architect in relation with the type of yachts he wants to design. The classification, as proposed by various authors, can be as follows :

Boat Type	DLR
Ultra-light ocean racer	60 - 100
Very light ocean racer	100 - 150
Light ocean racer	150 - 200
Light ocean cruiser	200 - 250
Average ocean cruiser	250 - 300
Moderately heavy ocean cruiser	300 - 350
Heavy ocean cruiser	350 - 400+

To note that the ability of planning is considered beginning around DLR < 125 .

For the Displacement, one can use either the light ship weight or the loaded weight, to see the evolution of the DLR with the weight, especially for small boats where the crew weight is important in %.

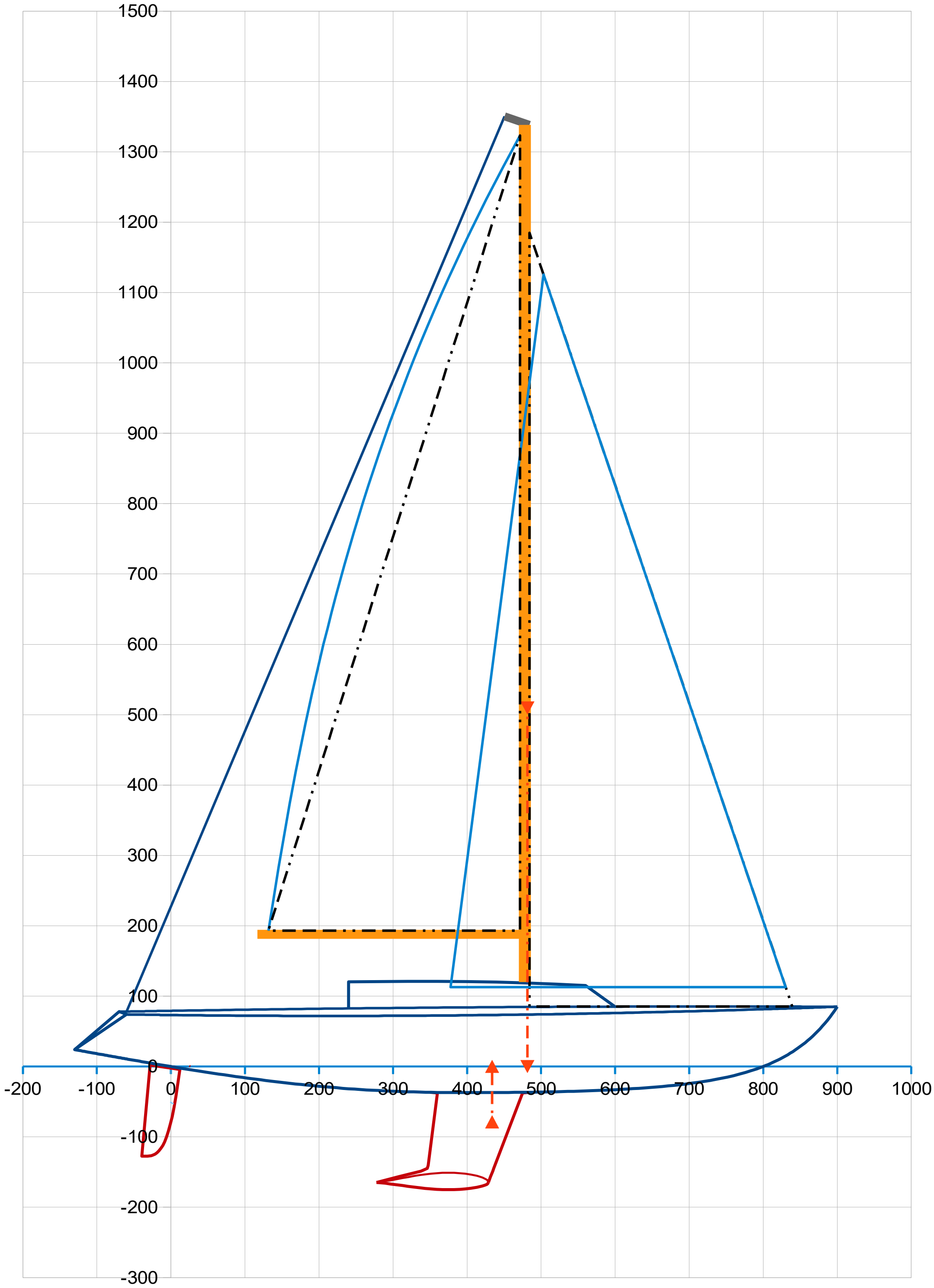
A DLR objective means a more or less heavy scantlings for the hull structure, a more or less heavy accomodations inside the cabin, etc … Once a DLR objective is given to guide the design process, the mass spreadsheet and the construction technology should be in tune and reflect the reality of this figure. Practically, a preliminary inquiry of existing equivalent boats and their DLR can give clue of the relevance of your choice.



Boat V1 - Step 2 sailplan : Input data for a 2D Sailplan early stage definition, according to your criteria about the Lead, Skeel/St, Srudder/St , St/Sw, St/D^(2/3).

Data to enter		>> in feet
Xmast (m)	**4,78**	*15,68*
Zboom(m)	**1,88**	*6,17*
I (m)	**11,00**	*36,09*
J (m)	**3,55**	*11,65*
P (m)	**11,30**	*37,07*
E (m)	**3,40**	*11,15*
Jib overlap	**130**	%

Results considering St = fore + main triangles and its geometrical center CE for the Lead estimation							
Surface triangles St (m2)	38,7	*416,94*	*sqft*			Main (%)	49,6
XCE (m)	4,81	ZCE (m)	5,10			Fore (%)	50,4
Lead (CE – CLR) (% Lwl)	**6,0**	CE geometrical center of the 2 triangles, CLR see Gene-Hull sheet					
Skeel / St (%)	3,50	ratio keel surface / triangles surface				**St/Sw**	**2,24**
Srudder / St (%)	1,13	ratio rudder surface / triangles surface				**St/D^(2/3)**	**20,61**
Results considering SA = jib + mainsail for an upwind sailing							
SA (m2)	**48,0**	*516,36*	*sqft*				
Xsa (m)	4,58	Zsa (m)	5,29	Geometrical center of the real sails			
>> SA/Sw	2,77	ratio sails surface / wetted surface					
>> SA/D^(2/3)	25,52	ratio sails surface / displacement^(2/3)					



Some extra information on the sailplan output data :

Main (%) and Fore (%) : it is the distribution between the two triangles, 50/50 being an average value.

Lead (CE – CLR) (%Lwl) : it is the criteria to consider for a good balance when heeled sailing, to avoid either too much weather helm or lee helm.Pratically, that guides the relative position of the mast and the sailplan with regard the keel wing. According to L. Larsson and Rolf E Eliasson in « Principles of yacht Design », for the extended keel method, the recommeded range of values is :

Sloop with Masthead rig : 5% - 9%
Sloop with Fractional rig : 3% - 7%

To note that, to take into account the low aspect ratio of heavy fin keel shape typical of some cruising yachts, the center of effort can be move from 25% to 35% to better suits with experimental experiences done on models. This value is ouput in the hydrostatics data.

The Skeel / St (%) and Srudder / St (%) were already mentiond above.

The St/Sw (%) or SA/Sw (%) ratio, is the Sail area (St triangles or SA real main + jib) versus wetted surface ratio. When considering St, according to L. Larsson and Rolf E Eliasson in « Principles of yacht Design », statistics give a value between 2 and 2,5, with an average at 2,25 (>>> ~ 2,5 to 3,0 if you consider SA).

The **St/D^(2/3)** or SA/D^(2/3) ratio, is the Sail area (St triangles or SA real main + jib) versus Displacement ratio. When considering St, according to L. Larsson and Rolf E Eliasson in « Principles of yacht Design », statistics give a value between 15 and 22, with an average at 19 (>>> ~ 18,5 to 27,5, average 23,5 if you consider SA).

Boat V1 - Step 3 mass spreadsheet : Hull, keel, rudder(s), sailplan being preliminary defined within a DLR objective, a Displacement and a LCB are provided in the output data. This next step is to adjust the mass units in the mass spreadsheet so that the light boat weight can fit with this displacement and LCB data, i.e. introducing the following input data :

- an overall weight per m2 for the Hull structure
- an overall weight per m2 for the Deck structure
- an overall % of the displacement dedicated to the Rig and Sails
- an overall % of the displacement for the accomodation and motor
- an overall % of the displacement for the rudder(s) system

That's a preliminary step of course : if your mass units and % on which you can rely due to your proper experience lead to boat light weight that cannot match the displacement (i.e. your initial DLR objective), then you have to iterate on the hull geometry, and etc … back and forth iterations up to light weight = displacement and Xg equal or close to LCB.

Mass and Xg, Zg position – early stage estimation	Input data L or S or V	 mass unit	Results Mass	 Xg	 M Xg	 Zg	 M Zg
Data to enter : in yellow cells	m or m2 or m3	or % Disp.	(kg)	(m)		(m)	
Hull (skin, structure, keel interface)	29,52	**19,00**	560,97	3,63	2038,56	0,02	13,53
, with S, Xs and Zs from Gene-Hull sheet		(kg/m2)					
Deck – roof – cockpit (skin and structure)	18,39	**13,50**	248,21	3,48	864,16	0,79	196,09
, with S, Xs and Zs from Gene-Hull sheet		(kg/m2)					
Rig, sails and deck fittings		**8,60**	227,18	4,40	999,04	3,21	729,61
		(% Disp.)					
Cabin accomodation and motor		**18,00**	475,49	3,60	1711,76	0,09	44,54
		(% Disp.)					
Keel			1090,49	4,02	4382,17	-1,10	-1197,40
Rudder		**1,50**	39,62	-0,12	-4,65	-0,54	-21,48
		(% Disp.)					
	Results : Light weight boat >>>		**2642,0**	**3,782**	9991,04	**-0,089**	-235,11

Here we show the final iteration : with these mass units and % (the input data in the yellow cells), that leads to a weight of 2622 kg which match with the displacement, and a Xg 3,78 m very close to the LCB 3,77 m. The Zg value will be of first importance in the next step stability and righting moment. These results are automatically reported at the end of the hydrostatics data :

2.5 Data from the mass spreadsheet								
Light boat:	**M (kg)**	**2642**	**at Xg (m)**	**3,782**	**Xg (%Lwl)**	**47,27**	**at Zg (m)**	**-0,089**

… and in the sub-section 5,1 for the next step here after with a loading :

	Mass	Xg	Zg	Yg	(in the coordinates of the 2D
Data to enter : yellow cells	**(kg)**	**(m)**	**(m)**	**(m)**	
Boat light weight (kg)	*2641,95*	*3,782*	*-0,089*	*0*	*from the mass spreadsheet*

Boat V1 - Step 4 stability and righting moment with a loading :

In the sections 5.1 and 5.2, a design loading can be introduced and the resulting sinkage, trim, stability (GZ) and righting moment (RM) can be computed for every heel angle.

At first, to input the loading data in the sub-section 5,1 « Mass spreadsheet with input of a load ».

Example here below : 300 kg at Xg 2,00 m, Yg = 0 m; Zg 0,85 m (Crew at center) or Yg = 1,0 m ; Zg 0,85 m (Crew sit windward)

5.1 Mass spreadsheet with input of a load					
	Mass	**Xg**	**Zg**	**Yg**	(in the coordinates of the 2D
Data to enter : yellow cells	**(kg)**	**(m)**	**(m)**	**(m)**	
Boat light weight (kg)	*2641,95*	*3,782*	*-0,089*	*0*	*from the mass spreadsheet*
Load (kg)	**300,00**	**2,00**	**0,85**	**0,00**	Crew at center
			0,85	**1,00**	Crew sit windward
Total >>> Mass (kg)	**2941,95**	**3,600**	**0,007**	**0,000**	**Crew at center**
Disp. (m3)	**2,87020**		**0,007**	**0,102**	**Crew sit windward**

The resulting data (in dark red) are used in the computation of the hydrostatic equilibrium in the sub-section 5,2 : for a given heel angle (inc. when heel = 0) , the user iterates on height and trim up to reach both weight = displacement and Xc (LCB) = Xg.

This sub-routine can be used for various investigations :

The case Heel = 0° inform on the draft and trim for the given loading :

5.2 Computation, by input of an Heel angle, and iteration on Height and Trim up to Displacement equality and Xc (LCB) = Xg

Data to enter : yellow cells		Results				Specific results			
Heel (°)	0	Disp. (m3)	2,87020	/ Disp. (m3)	2,87020	Relevant only when heel = 0°		DLR	145
Height (cm)	-2,1465	Xc heel (m)	3,600	/ Xg (m)	3,600	Lwl (m)	8,27	Z fore (cm)	2,2
Trim (°)	0,585	Yc heel (m)	0,000	Yg heel (m)	0,102	Bwl (m)	2,23	Z aft (cm)	-6,0
		Zc heel (m)	-0,190	> GZ (m)	0,102	Tc (m)	0,39	Trim (°)	0,59
		Sw heel(m2)	18,21	RM (kN.m)	2,943	Cp Hull	0,540	LCB Hull (%)	47,55
		Bwl heel (m)	2,23	FB mini (cm)	67,1	Relevant only when heel = 1°			
		LCB – LCF (%Lwl)	2,11	Obliquity (°)	0,0	Yg heel (m)	0,000	with crew at center	

The relevant results are the ones in black + in blue (when heel = 0°) >>> under this loading :
** Lwl = 8,27 m ; Bwl 2,23 m ; Trim = 0,59° (> 0 = nose up) leading to an elevation at fore perpendicular Z fore = 2,2 cm and a sinking at aft perpendicular Z aft = -6,0 cm (Z<0 = sinking).
** Sw = 18,21 m2 ; Free-Booard minimum = 67,1 cm ; DLR = 145 in charge

The case Heel = 1° give the metacentric center GM1° representative of the initial stability when the loading is Y-centered (the pink results are with Yg = 0) :

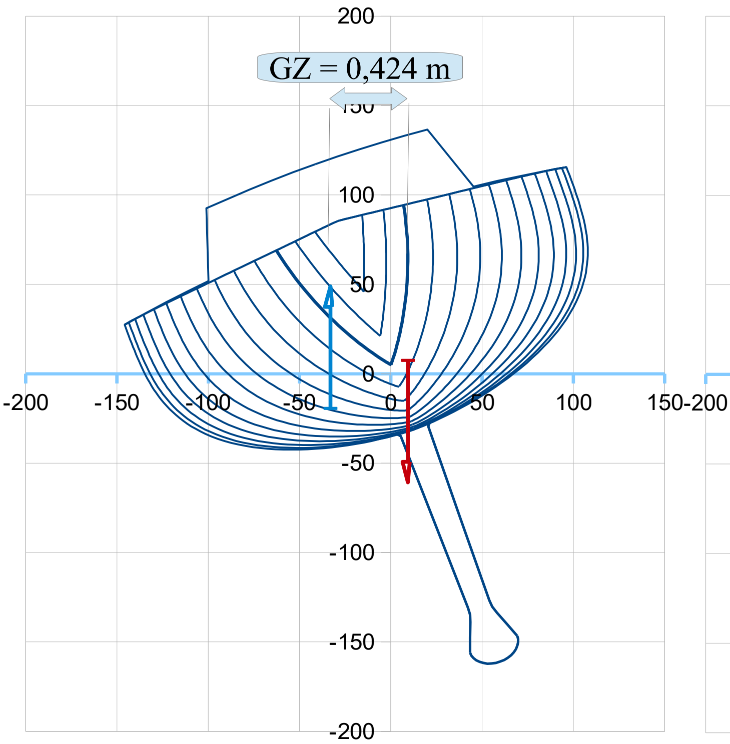
Data to enter : yellow cells		Results				Specific results			
Heel (°)	1	Disp. (m3)	2,87020	/ Disp. (m3)	2,87020	Relevant only when heel = 0°		DLR	145
Height (cm)	-2,1317	Xc heel (m)	3,600	/ Xg (m)	3,600	Lwl (m)	8,27	Z fore (cm)	2,2
Trim (°)	0,585	Yc heel (m)	-0,019	Yg heel (m)	0,102	Bwl (m)	2,23	Z aft (cm)	-6,0
		Zc heel (m)	-0,190	> GZ (m)	0,120	Tc (m)	0,39	Trim (°)	0,59
		Sw heel(m2)	18,23	RM (kN.m)	3,475	Cp Hull	0,540	LCB Hull (%)	47,54
		Bwl heel (m)	2,23	FB mini (cm)	65,3	Relevant only when heel = 1°			
		LCB – LCF (%Lwl)	2,11	Obliquity (°)	0,1	Yg heel (m)	0,000	with crew at center	
						Gz (m)	0,018		
						> GM1° (m)	1,06		

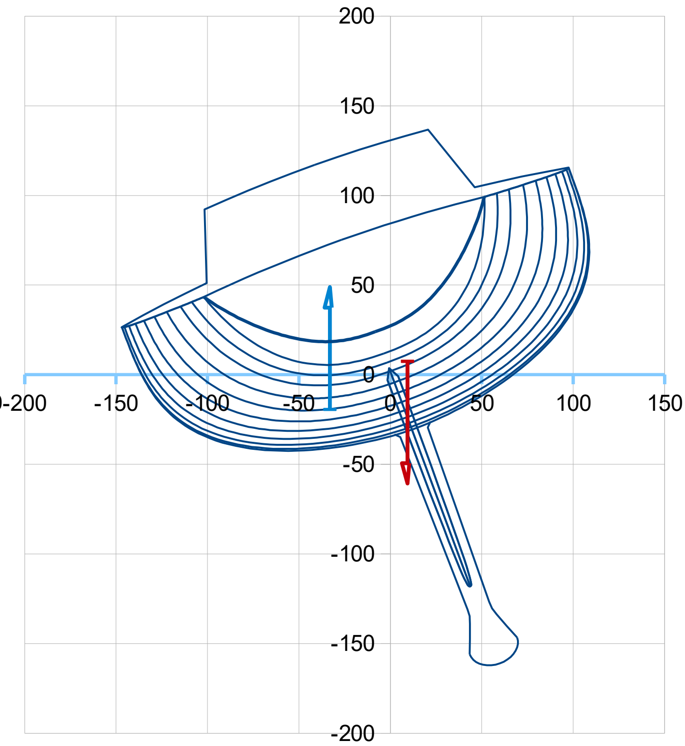
>>> Here, the relevant result is in pink : **GM1° = 1,06 m**

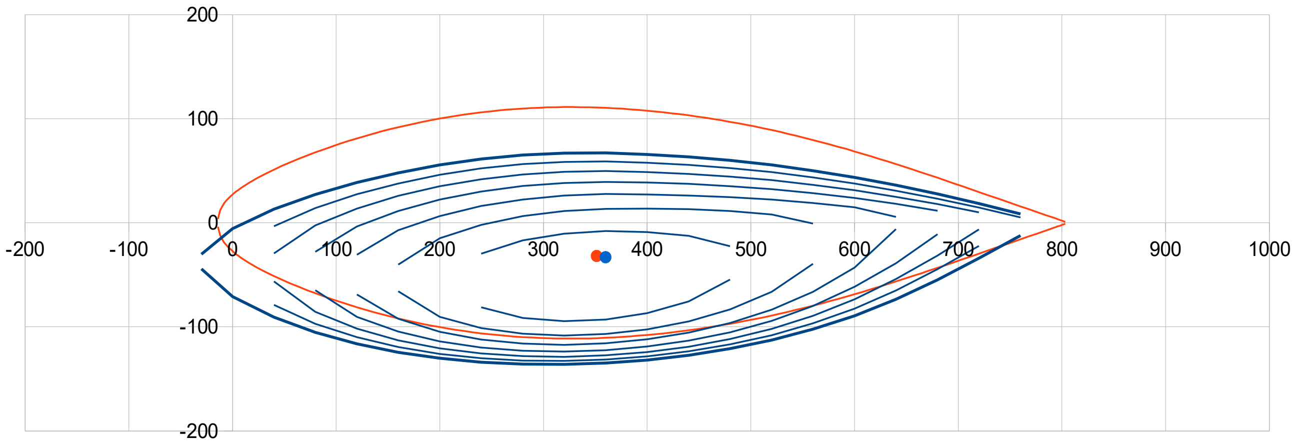
The case Heel = 20° can give the boat attitude and the RM for an usual sailing :

Data to enter : yellow cells		Results			
Heel (°)	20	Disp. (m3)	2,87020	/ Disp. (m3)	2,87020
Height (cm)	3,4555	Xc heel (m)	3,600	/ Xg (m)	3,600
Trim (°)	0,230	Yc heel (m)	-0,331	Yg heel (m)	0,094
		Zc heel (m)	-0,194	> GZ (m)	0,424
		Sw heel(m2)	17,51	RM (kN.m)	12,239
		Bwl heel (m)	2,03	FB mini (cm)	26,3
		LCB – LCF (%Lwl)	1,08	Obliquity (°)	2,8

>>> RM = 12,24 kN.m ; Sw = 17,51 m2 ; Free-board minimum : 26,3 cm
>>> Trim = +0,23°





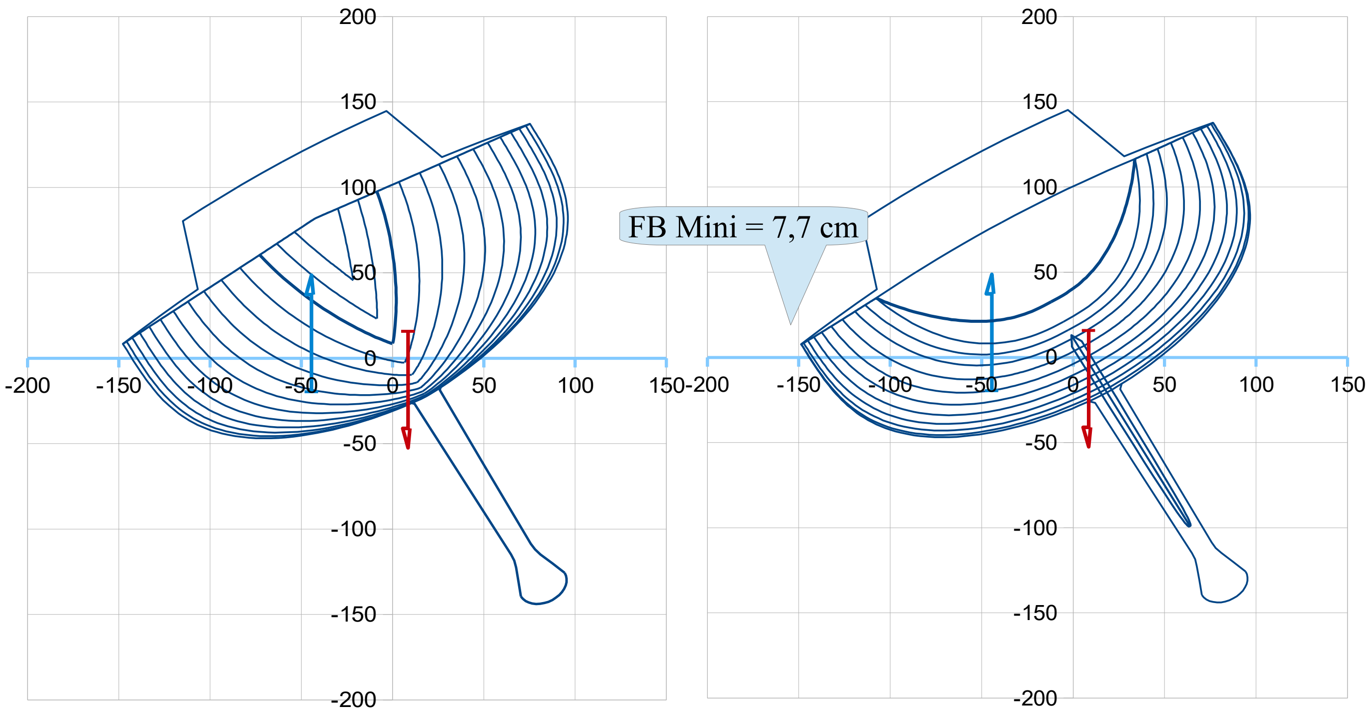


The red line is the floatation waterline when upright with the loading
The blue lines are the waterlines of the heeled hull, the blie point is the center of buoyancy, the red point is the center of floatation.

The case Heel = 30° give the design RM30° useful to dimension the rig, and the minimum free-board versus the sheer line :

Data to enter : yellow cells		Results			
Heel (°)	30	Disp. (m3)	2,87020	/ Disp. (m3)	2,87020
Height (cm)	9,9885	Xc heel (m)	3,600	/ Xg (m)	3,600
Trim (°)	-0,198	Yc heel (m)	-0,445	Yg heel (m)	0,085
		Zc heel (m)	-0,196	> GZ (m)	0,529
		Sw heel(m2)	17,09	RM (kN.m)	15,281
		Bwl heel (m)	1,92	FB mini (cm)	7,7
		LCB – LCF (%Lwl)	0,24	Obliquity (°)	3,9

>>> **RM30° = 15,3 kN.m** ; Sw = 17,09 m2 ; Free-board minimum : 7,7 cm



The Sw and RM results for heel = 0°, 20° and 30° are used to complete the table of input data for the « Gene-VPP » application, by recopy / special paste the Sw and RM results from sub-section 5,2 for each heel angle (0°, 20°, 30°) into the table located in sub-section 5,3 :

Righting Moment RM (kN.m)		
RM0°	RM20°	RM30°
2,943	12,239	15,281

Wetted surface Sw (m2)		
Sw0°	Sw20°	Sw30°
18,21	17,51	17,09

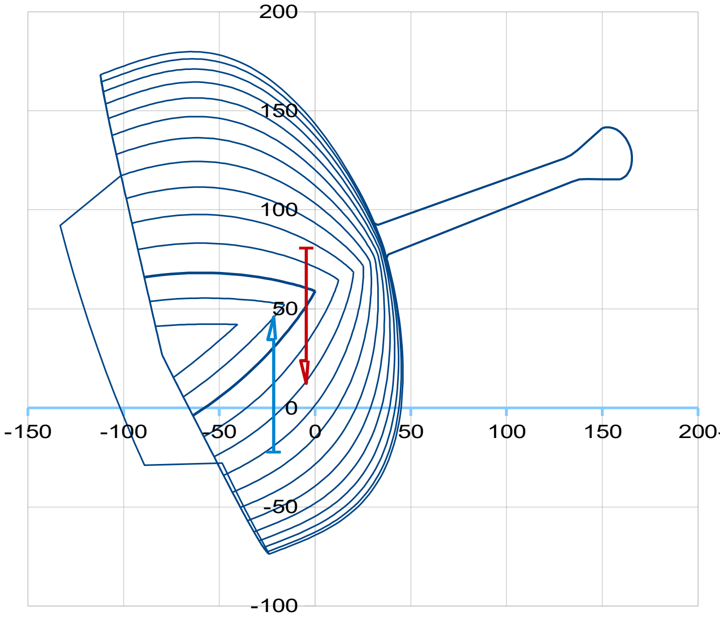
(More information on Gene-VPP in its specific User guide and Examples)

The computation can also be done for heel > 30°, up to 180°, although due to the need of manual iterations for each equilibrium, it is not easy for the building of the Gz Curve. Now that the Gene-Stab post-application has been developed for such task with a direct use of the data provided by Gene-Hull, we recommend to use it instead (see its specific User Guide).

Nevertheless, the current subroutine within the sub-section 5,2 of Gene-Hull can be used to explore some « beyond 30° » case, still with manual iterations on height and trim to reach the equilibrium. Here is an example with heel 110° :

Data to enter : yellow cells	
Heel (°)	110
Height (cm)	71,5017
Trim (°)	-1,705

Results			
Disp. (m3)	2,87020	/ Disp. (m3)	2,87020
Xc heel (m)	3,600	/ Xg (m)	3,600
Yc heel (m)	-0,217	Yg heel (m)	-0,041
Zc heel (m)	-0,223	> GZ (m)	0,175
Sw heel(m2)	17,56	RM (kN.m)	5,062
Bwl heel (m)	1,47	FB mini (cm)	-73,8
LCB – LCF (%Lwl)	-1,36	Obliquity (°)	-2,1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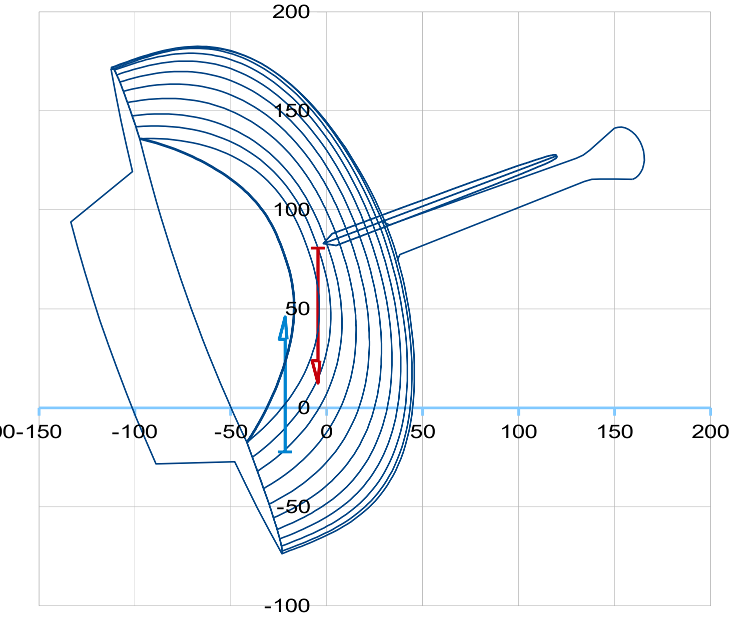
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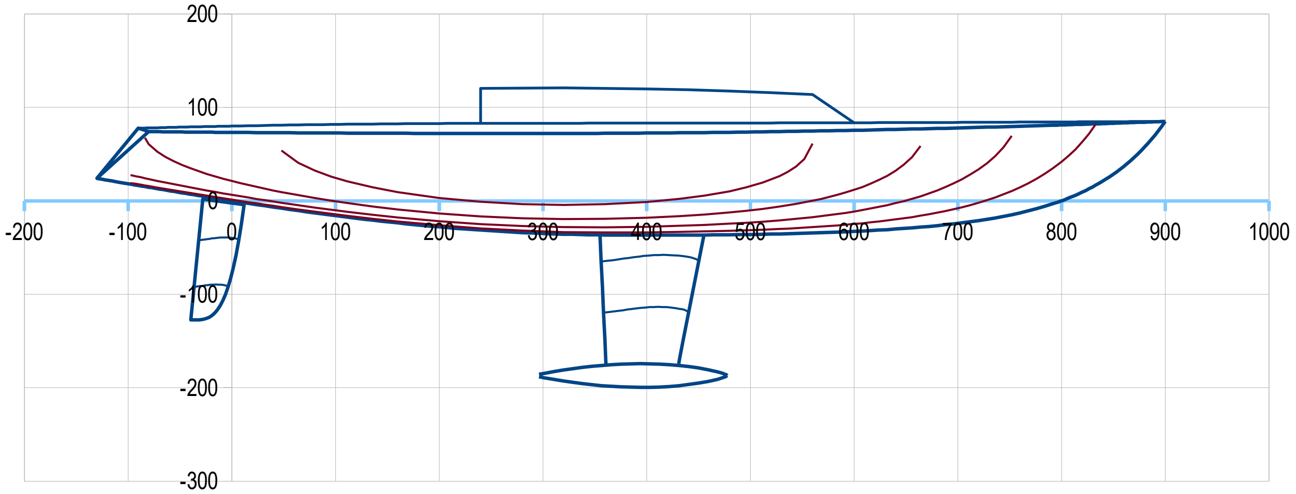
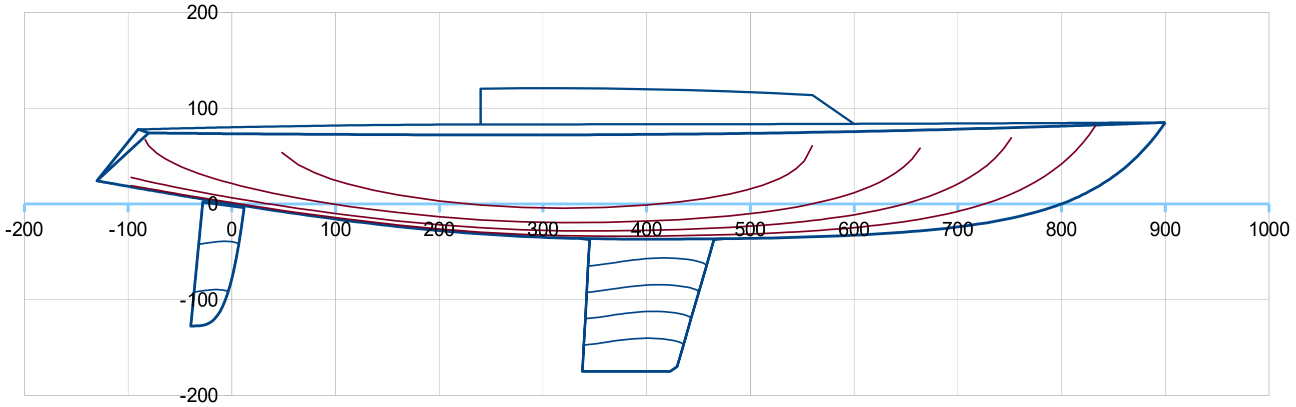
Boat V1 – Other options : « Inverted T keel », « Keel without bulb » , « rudder with skeg »

These two options can be introduced by putting Type = 1 for them (and 0 for the previous ones) and input the requested data. Some examples :

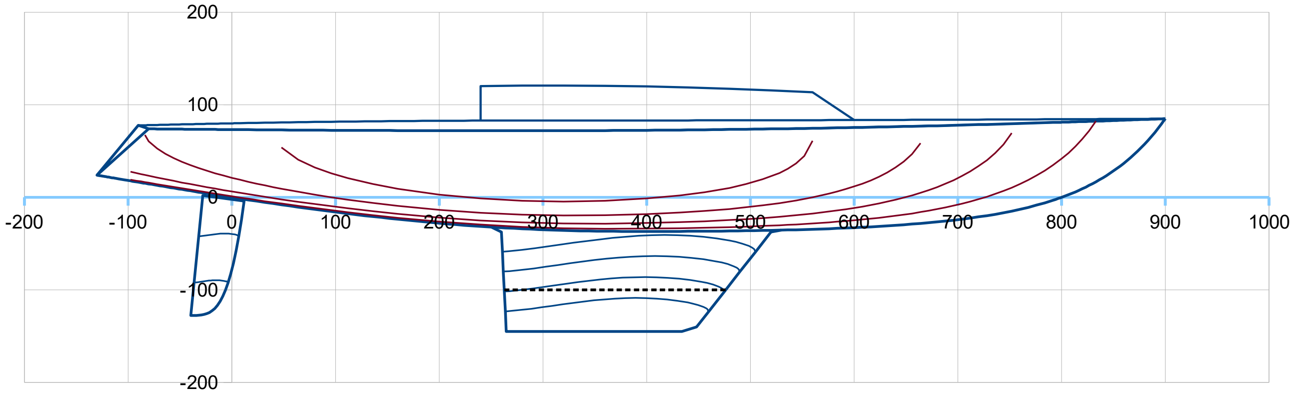
With an inverted T keel :



>>> with a fin keel without bulb :



>>> with a low aspect ratio keel without bulb (the dashed line represents the upper surface of the ballast)

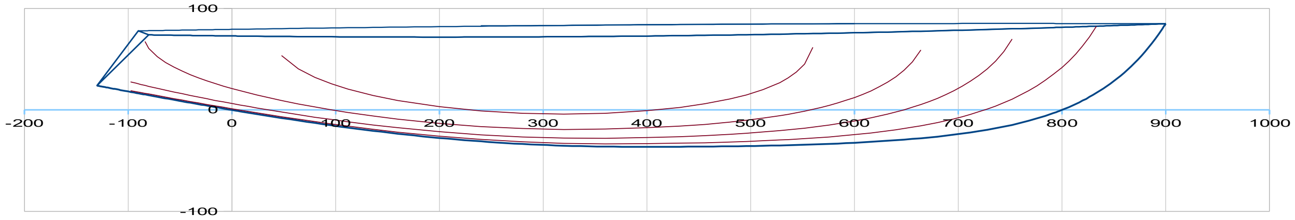


>>> etc..., and then you can do the same steps of design and computation as described above.

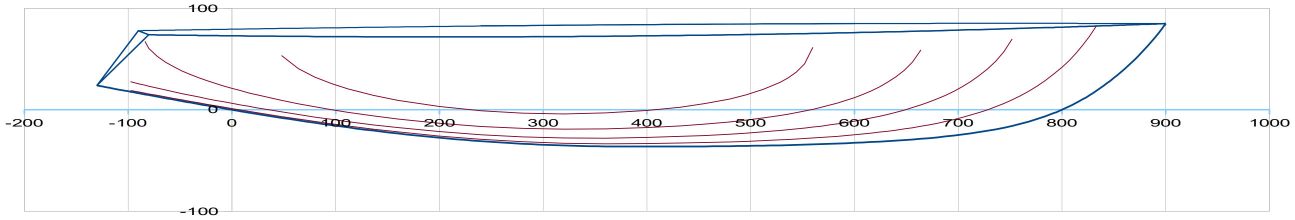
Boat V1 variant >>> V1,1 with a modified bow line

A bow fine shaping can be done by using the parameter **Kbrion.** At first, demonstration by images of its influence :

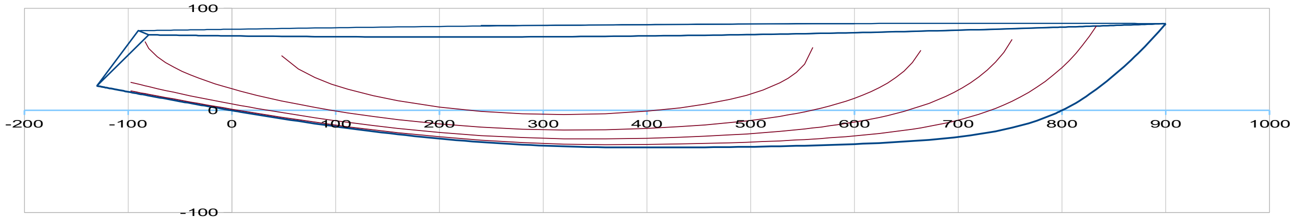
Kbrion = 0 - the initial V1 version



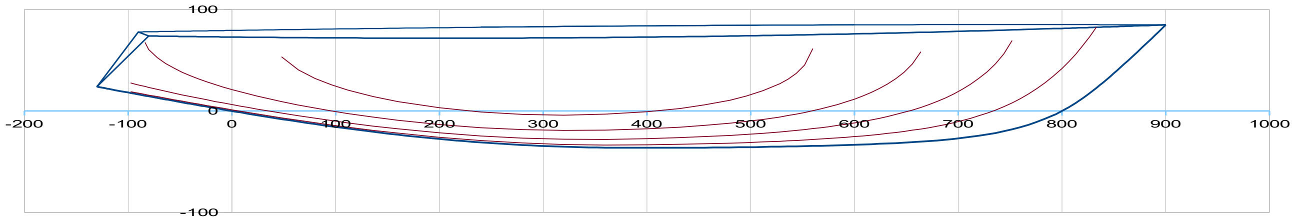
Kbrion = 0,05



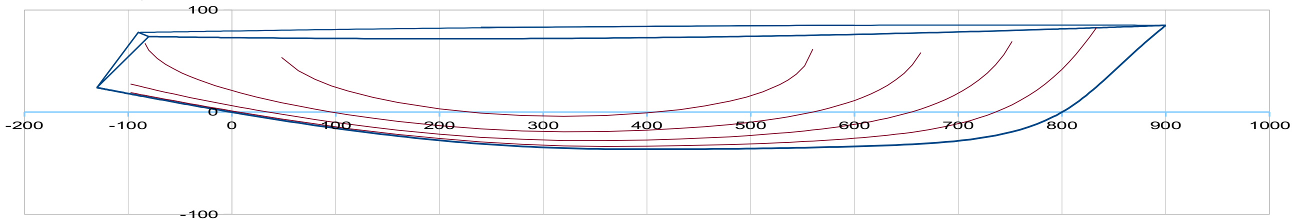
Kbrion = 0,10



Kbrion = 0,15



Kbrion = 0,20

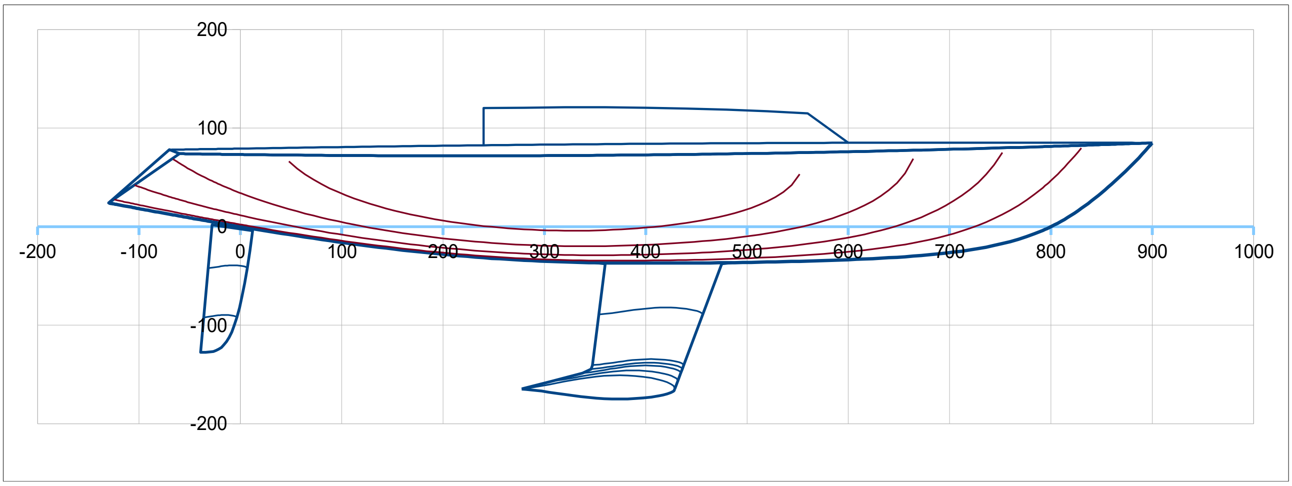


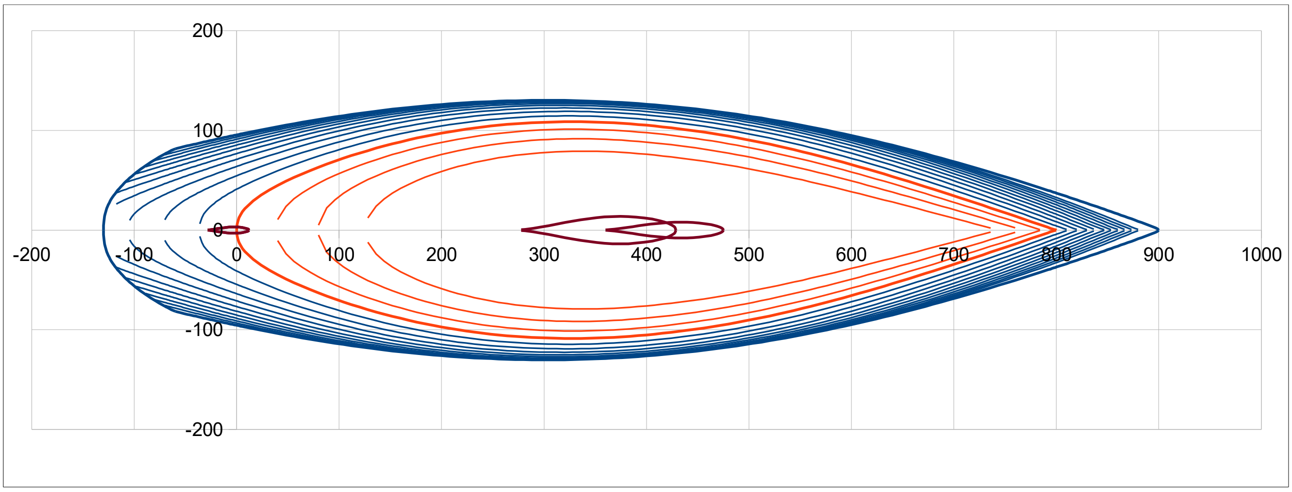
Kbrion > 0 straigthens the bow shape above the water and accentuates the knuckle below, giving a bit more fore volume.

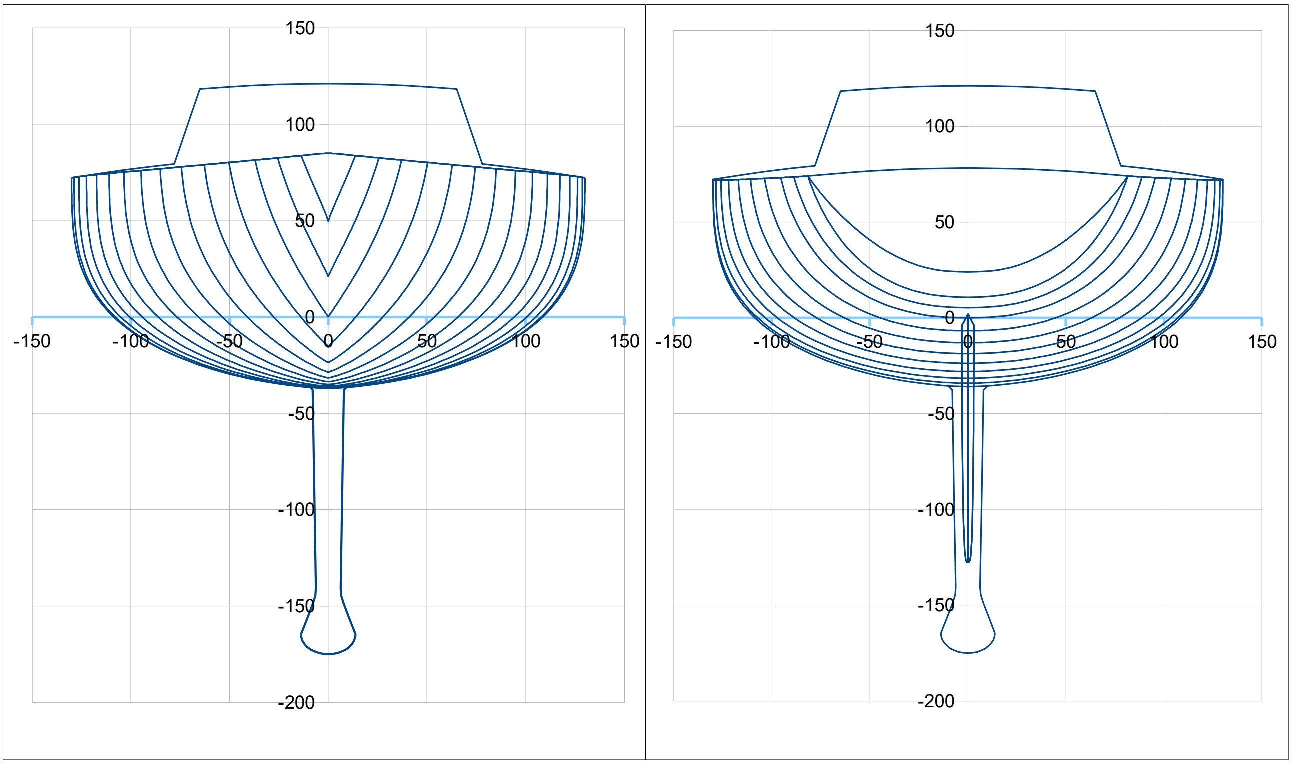
From this screening, one can choose Kbrion = 0,10 for the boat V1,1 version, and some sections parameters are slightly adapted to this new shape and to maintain displacement = weight.

>>> V1,1 version :

Loa 10,30 m ; Lwl 8,00 m ; B 2,60 m ; Draft 1,75 m ; Displacement : 2641 kg ; Keel-bulb 1090 kg
>> LCB hull 47,39 %Lwl ; Cp hull : 0,549 ; Sw : 17,35 m2 ; DLR : 144 ; Ballast ratio : 41,3 %



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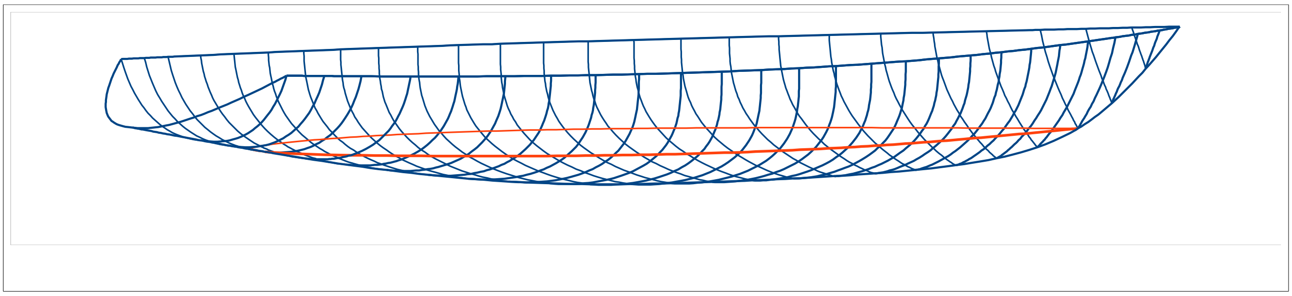


Boat V1,1 hydrostatics data :

2. Data sum-up and results of hydrostatic and surfaces calculations

2.1 Hull

Loa (m)	10,30	Lwl (m)	8,00		> Hull speed (Knots)	6,9	at Froude 0,4	
>> ft	33,79		26,25					
Boa (m)	2,60	at X (% Lwl)	38,0	Bsheer (m)	2,60	at X (% Lwl)	38,0	
>> ft	8,53							
Bwl (m)	2,17	at X (% Lwl)	41,0	> Bwl / Boa	0,836			
>> ft	7,13				Freeboards (m) >	Aft	Midship	Fore
Tc (m)	0,370	at X (%Lwl)	50			0,74	0,72	0,85
>> ft	1,21				>> ft	2,43	2,36	2,79
	Displacement at H0 (m3)	2,41236	at LCB (m)	3,791	LCB (%Lwl)	47,39	ZCB (m)	-0,130
	>> lbs	5451	w. seawater	1025	kg/m3		>> ft	-0,43
Cp	0,549							
Sf (m2)	11,79	at LCF (m)	3,600	LCF (%Lwl)	44,99		>>> LCB – LCF (%Lwl)	2,39
>> ft2	126,93	>> ft	11,81					
Angle Freeboard/Half beam		29,0	(°), at section C4 (40% Lwl)					
Sw (m2)	12,77	>Sw/D^(2/3)	7,10					
>> ft2	137,50							
Shull (m2)	29,50	at X (m)	3,630	Z (m)	0,093			
>> ft2	317,54	>> ft	11,91	>> ft	0,31			
Sdeck (m2)	18,39	at X (m)	3,482	Z (m)	0,79			
>> ft2	197,90	>> ft	11,42	>> ft	2,59			

2.2 Keel

Vol. keel(m3)	0,14938	at X (m)	4,019	X (%Lwl)	50,23	Z (m)	-1,098	
		>> ft	13,18			>> ft	-3,60	
Ballast (kg)	1090,5	at X (m)	4,019	X (%Lwl)	50,23	Z (m)	-1,098	
>> lbs	2404	>> ft	13,18			>> ft	-3,60	
Draft oa (m)	1,75		Sw (m2)	3,66		Sxz (m2)	1,36	
>> ft	5,74		>> ft2	39,45		>> ft2	14,60	
CLR (m)	4,34	CLR (%Lwl)	54,23	*CLR = Center of Lateral Resistance*				
>> ft	14,23	method: keel profile extended to the waterline, CLR at Z 45% draft and					25,00	% chord

2.3 Rudder(s)

Number	1							
Volume (m3)	0,01486	at X (m)	-0,12	X (%Lwl)	-1,47	Z (m)	-0,54	
Sw (m2)	0,91	>> ft	-0,39			Sxz (m2)	0,44	per rudder
>> ft2	9,80					>> ft2	4,71	

2.4 Hull + Keel + Rudder(s)

	Displacement at H0 (m3)	2,57660	at LCB (m)	3,782	LCB (%Lwl)	47,27	at ZCB (m)	-0,188
	(kg)	2641	>> ft	12,41			>> ft	-0,62
	>> lbs	5822						
	, of wich Ballast (kg)	1090	at Xg (m)	4,019	Xg (%Lwl)	50,23	at Zg (m)	-1,098
	>> lbs	2404	>> ft	13,18			>> ft	-3,60
	>> % Ballast	41,3						
	Sw (m2)	17,35	>Sw/D^(2/3)	9,23	Lwl/D^(1/3)	5,84		
	>> ft2	186,76			**DLR**	**144**	M(lbs/2240)/(Lwl(ft)/100)^3	

2.5 Data from the mass spreadsheet

Light boat:	M (kg)	2641	at Xg (m)	3,781	Xg (%Lwl)	47,26	at Zg (m)	-0,089

Boat V1 variant >>> V1,2 with V sections only

V sections only are obtained by just put 1 for all PE2 parameters. Then , you have to adjust the other sections parameters and the hull draft Tc to maintain the displacement = weight. Here, one solution is :

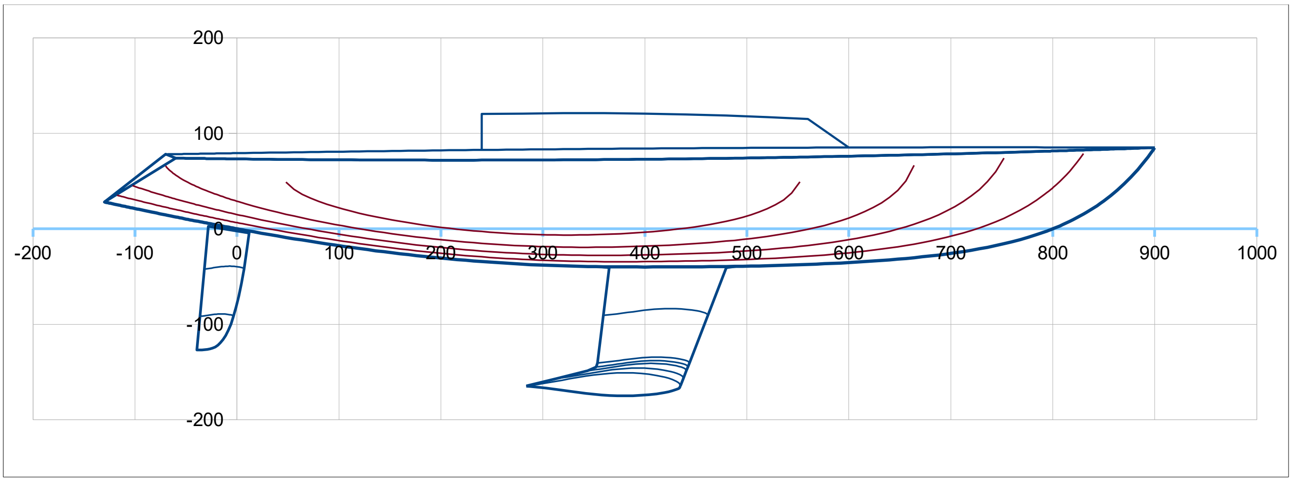
	PE1	C PE1	PE2
Fore	2,000	2,000	1,000
Mid	4,742	1,000	1,000
Aft	3,000	1,200	1,000

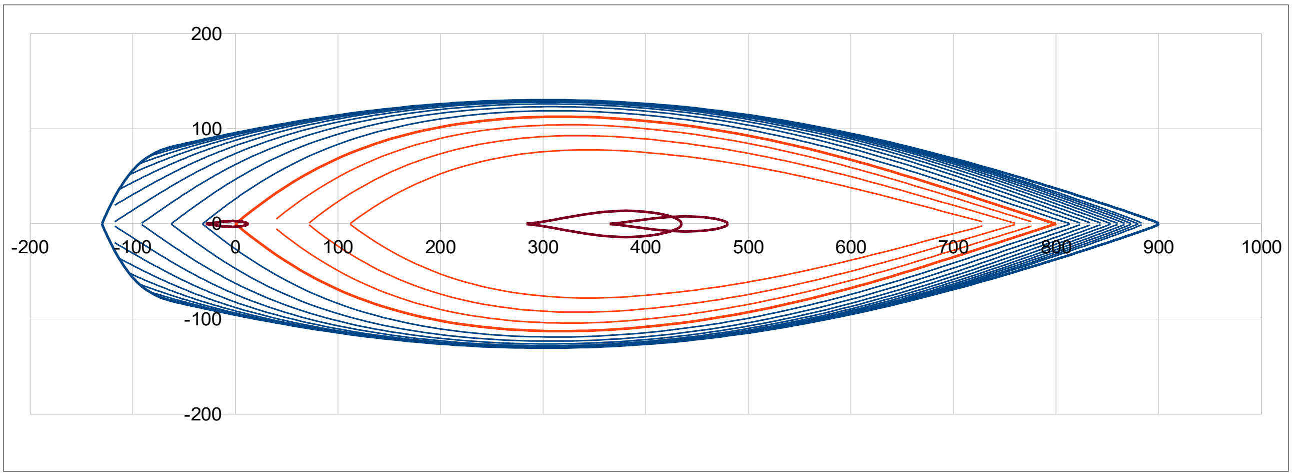
, associated with a h_ull body draft Tc = 0,4 m :

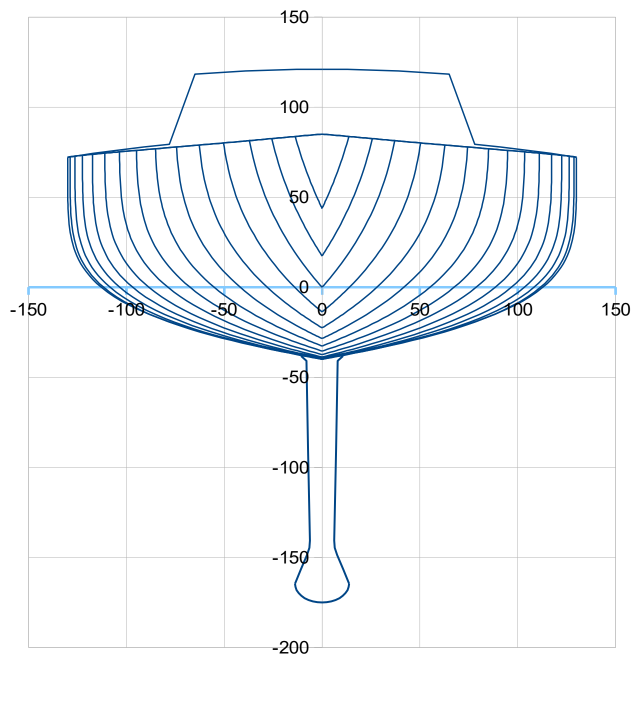
Tc (m)	0,4000

, leading to an equilibrium at 2623 kg for this variant **V1,2** of V1 :

Loa 10,60 m ; Lwl 8,00 m ; B 2,60 m ; Draft 1,75 m ; Displacement : 2623 kg ; Keel-bulb 1069 kg >> LCB hull 47,84 %Lwl ; Cp hull (%): 0,541 ; Sw : 17,45 m2 ; DLR : 143 ; Ballast ratio : 40,8 %



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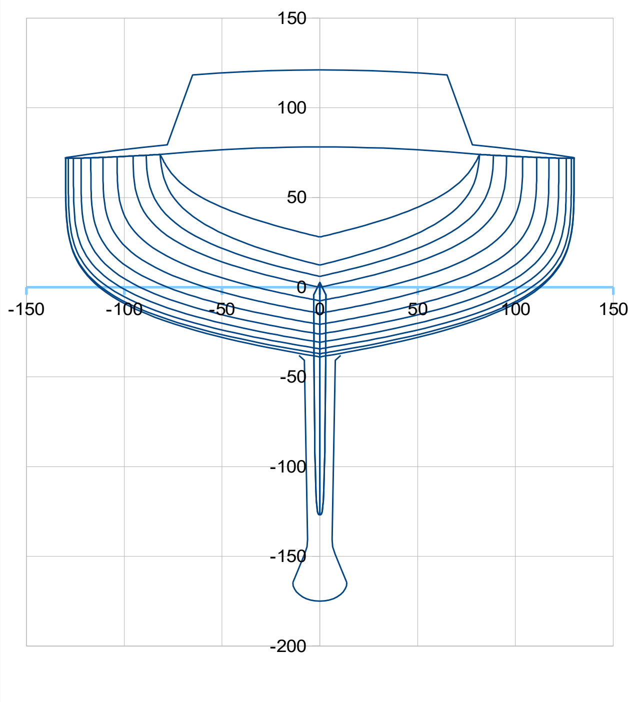
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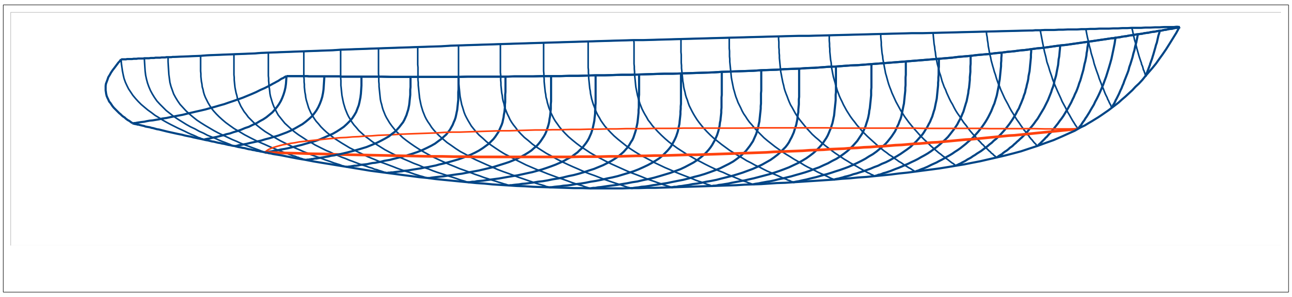


Boat V1,2 hydrostatics data :

2. Data sum-up and results of hydrostatic and surfaces calculations

2.1 Hull

Loa (m)	10,30	Lwl (m)	8,00	> Hull speed (Knots)		6,9	at Froude 0,4		
>> ft	*33,79*		*26,25*						
Boa (m)	2,60	at X (% Lwl)	38,0	Bsheer (m)	2,60	at X (% Lwl)	38,0		
>> ft	*8,53*								
Bwl (m)	2,26	at X (% Lwl)	40,0	> Bwl / Boa	0,867				
>> ft	*7,40*			Freeboards (m) >		Aft	Midship	Fore	
Tc (m)	0,400	at X (%Lwl)	50			0,74	0,72	0,85	
>> ft	*1,31*				*>> ft*	*2,43*	*2,36*	*2,79*	
Displacement at H0 (m3)		2,39769	at LCB (m)	3,827	LCB (%Lwl)	47,84	ZCB (m)	-0,130	
	>> lbs	*5418*	*w. seawater*	*1025*	*kg/m3*		*>> ft*	*-0,43*	
Cp	0,541								
Sf (m2)	11,94	at LCF (m)	3,650	LCF (%Lwl)	45,63	>>> LCB – LCF (%Lwl)		2,20	
>> ft2	*128,56*	*>> ft*	*11,98*						
Angle Freeboard/Half beam		29,0	(°), at section C4 (40% Lwl)						
Sw (m2)	12,94	>Sw/D^(2/3)	7,22						
>> ft2	*139,25*								
Shull (m2)	29,91	at X (m)	3,626	Z (m)	0,093				
>> ft2	*321,95*	*>> ft*	*11,90*	*>> ft*	*0,30*				
Sdeck (m2)	18,39	at X (m)	3,482	Z (m)	0,79				
>> ft2	*197,90*	*>> ft*	*11,42*	*>> ft*	*2,59*				

2.2 Keel

Vol. keel(m3)	0,14648	at X (m)	4,023	X (%Lwl)	50,29	Z (m)	-1,114	
		>> ft	*13,20*			*>> ft*	*-3,66*	
Ballast (kg)	1069,3	at X (m)	4,023	X (%Lwl)	50,29	Z (m)	-1,114	
>> lbs	*2357*	*>> ft*	*13,20*			*>> ft*	*-3,66*	
Draft oa (m)	1,75		Sw (m2)	3,60		Sxz (m2)	1,33	
>> ft	*5,74*		*>> ft2*	*38,76*		*>> ft2*	*14,28*	
CLR (m)	4,35	CLR (%Lwl)	54,35	*CLR = Center of Lateral Resistance*				
>> ft	*14,27*	method: keel profile extended to the waterline, CLR at Z 45% draft and					25,00	% chord

2.3 Rudder(s)

Number	1							
Volume (m3)	0,01478	at X (m)	-0,12	X (%Lwl)	-1,47	Z (m)	-0,54	
Sw (m2)	0,91	*>> ft*	*-0,39*			Sxz (m2)	0,44	per rudder
>> ft2	*9,78*					*>> ft2*	*4,70*	

2.4 Hull + Keel + Rudder(s)

Displacement at H0 (m3)	2,55896	at LCB (m)	3,815	LCB (%Lwl)	47,69	at ZCB (m)	-0,189
(kg)	2623	*>> ft*	*12,52*			*>> ft*	*-0,62*
>> lbs	*5783*						
, of wich Ballast (kg)	1069	at Xg (m)	4,023	Xg (%Lwl)	50,29	at Zg (m)	-1,114
>> lbs	*2357*	*>> ft*	*13,20*			*>> ft*	*-3,66*
>> % Ballast	40,8						
Sw (m2)	17,45	>Sw/D^(2/3)	9,33	Lwl/D^(1/3)	5,85		
>> ft2	*187,80*			***DLR***	***143***	*M(lbs/2240)/(Lwl(ft)/100)^3*	

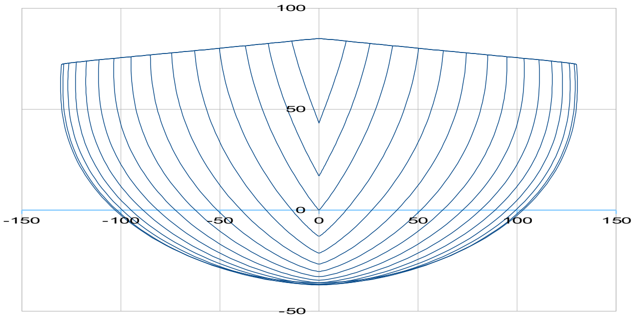
2.5 Data from the mass spreadsheet

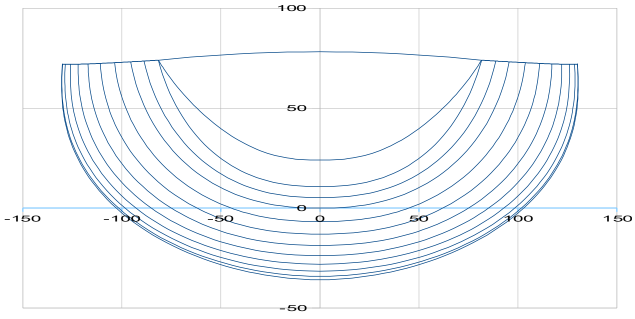
Light boat:	M (kg)	2623	at Xg (m)	3,780	Xg (%Lwl)	47,25	at Zg (m)	-0,091

Boat V1 variant >>> V1,3 with some tumblehome in the sections

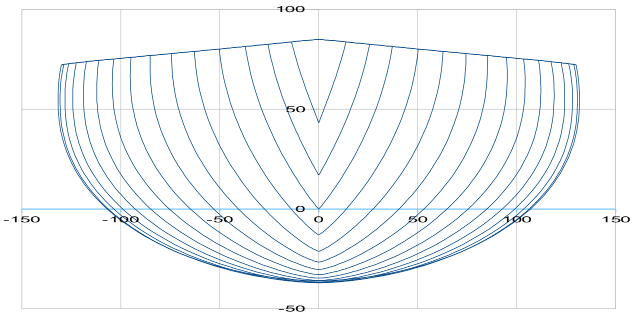
It is an extension of the sections shape formulation, where adimensional parameters « C PE1», and especially the C PE1 value set at midship, can be < 1 and that gives a tumblehome effect. At first, demonstration of its influence by the images :

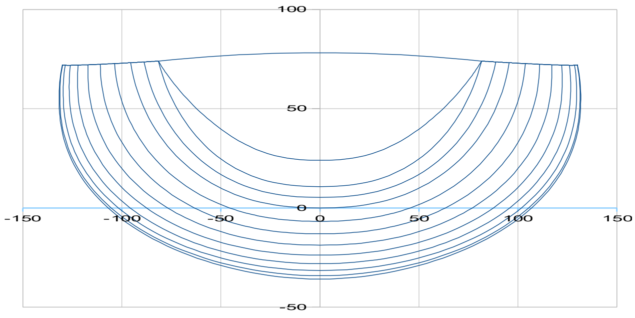
C PE1 at Mid = 0,85



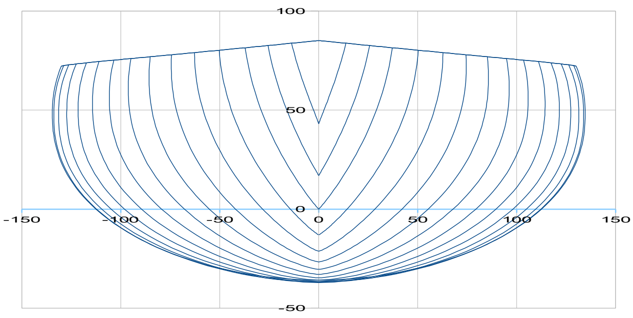


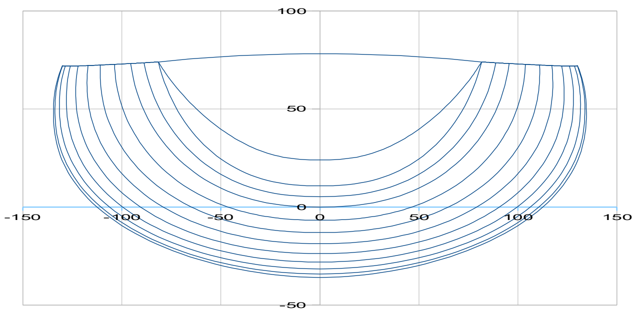
C PE1 at Mid = 0,75



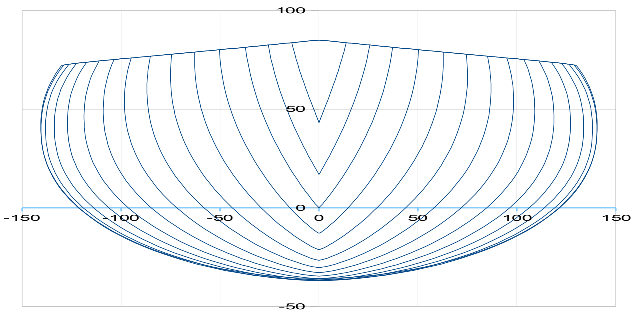


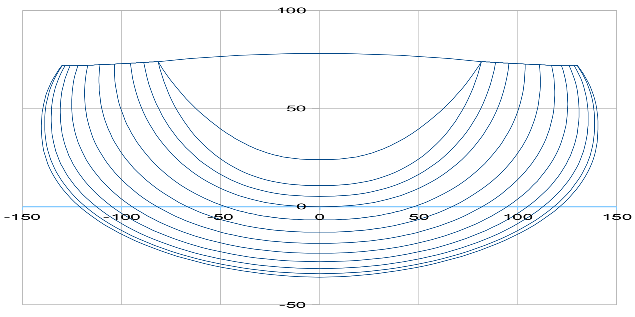
C PE1 at Mid = 0,65





C PE1 at Mid = 0,55





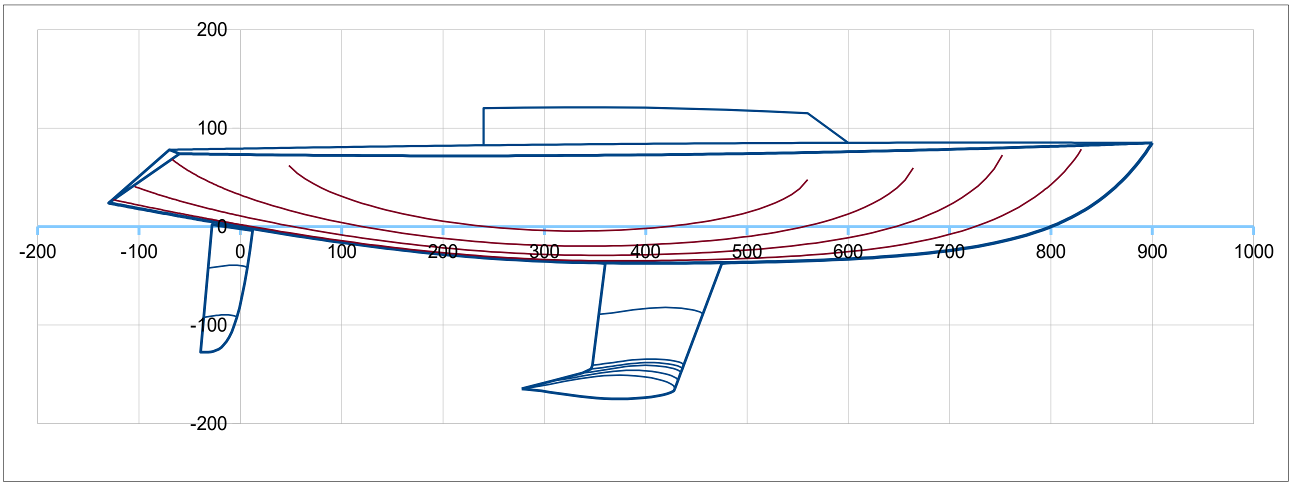
>>> V1,3 version

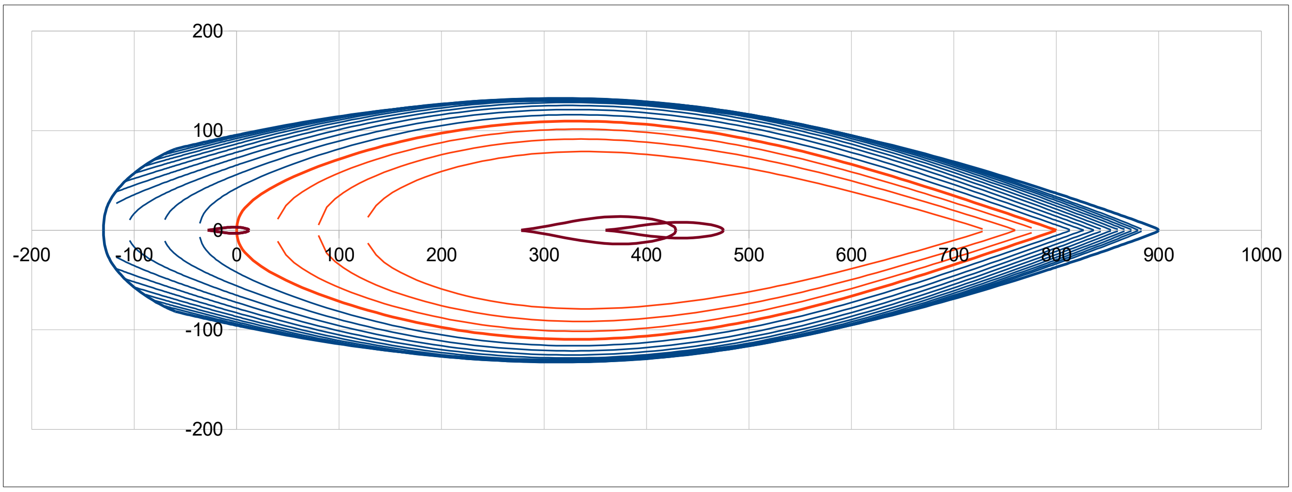
, obtained with C PE1 Mid = 0,7 and others parameters (in red) adjusted to maintain displacement = weight :

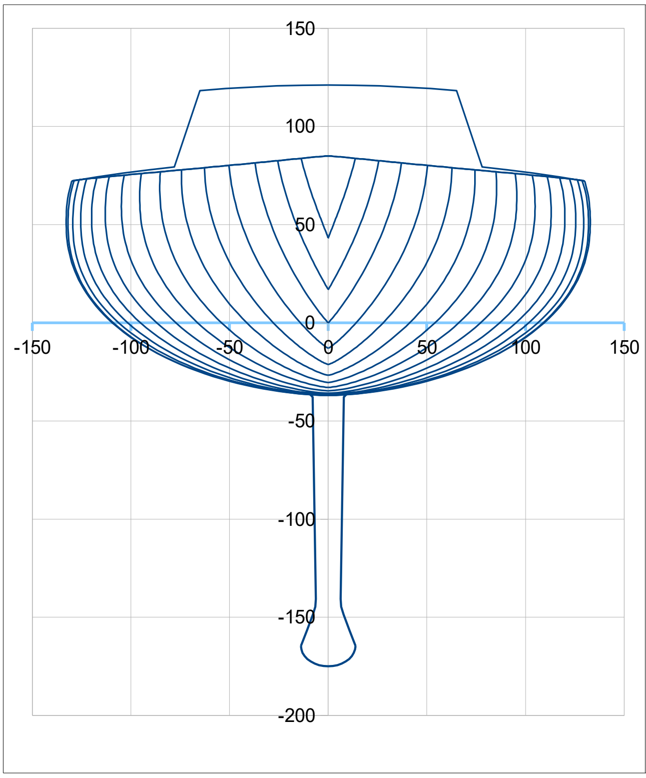
	PE1	C PE1	PE2
Fore	1,750	1,500	0,870
Mid	2,252	0,700	1,750
Aft	1,750	1,500	2,500

Loa 10,30 m ; Lwl 8,00 m ; Boa 2,66 m (Bsheer 2,60 m) ; Draft 1,75 m ; Displacement : 2649 kg ; Keel-bulb 1090 kg (Ballast ratio : 41,2 %)

>> LCB hull 47,27 %Lwl ; Cp hull (%): 0,548 ; Sw : 17,40 m2 ; DLR : 144 ;



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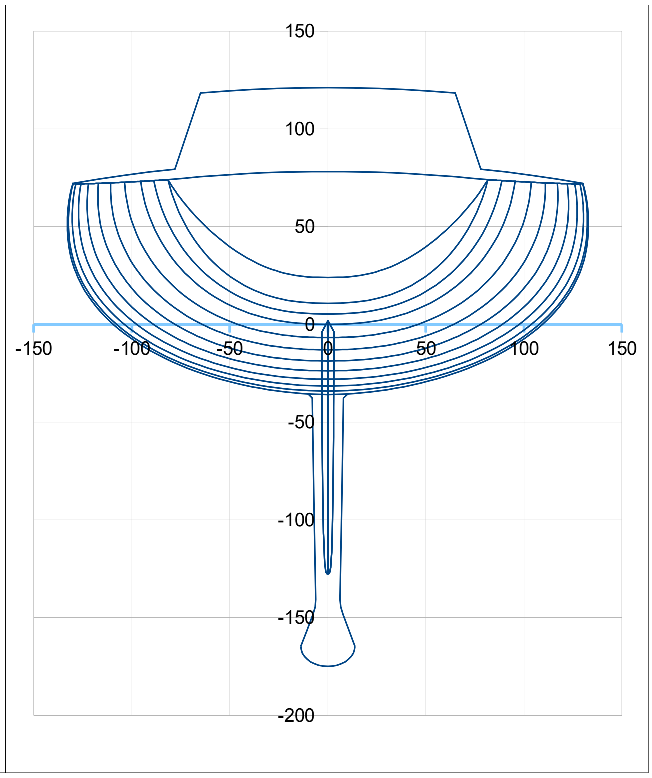
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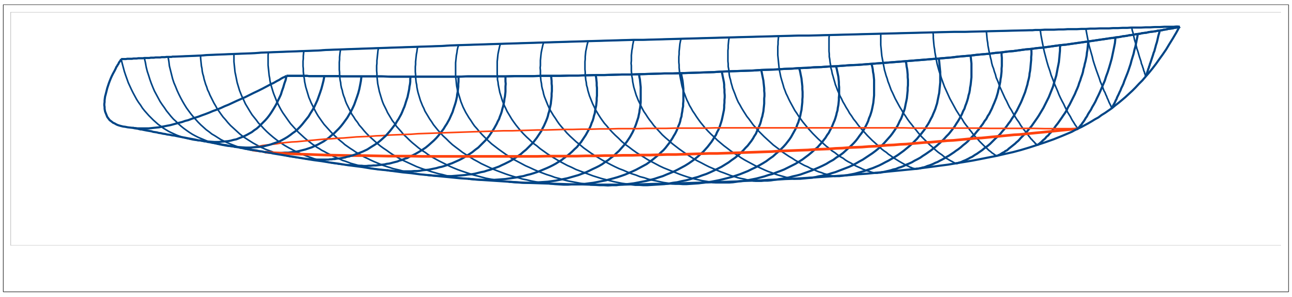


Boat V1,3 hydrostatics data :

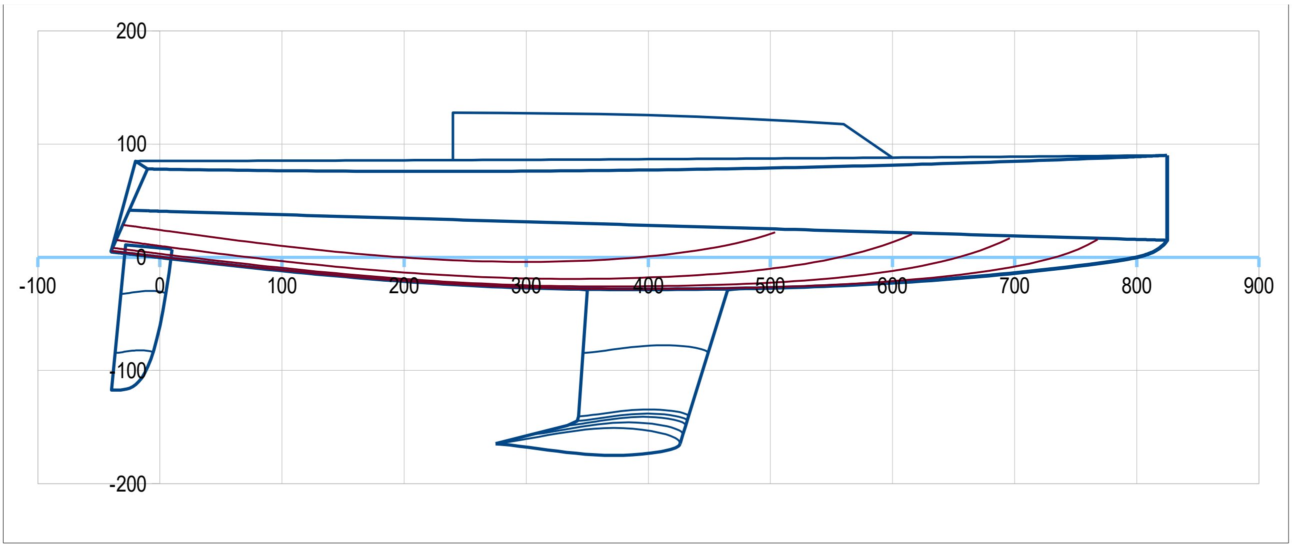
2. Data sum-up and results of hydrostatic and surfaces calculations

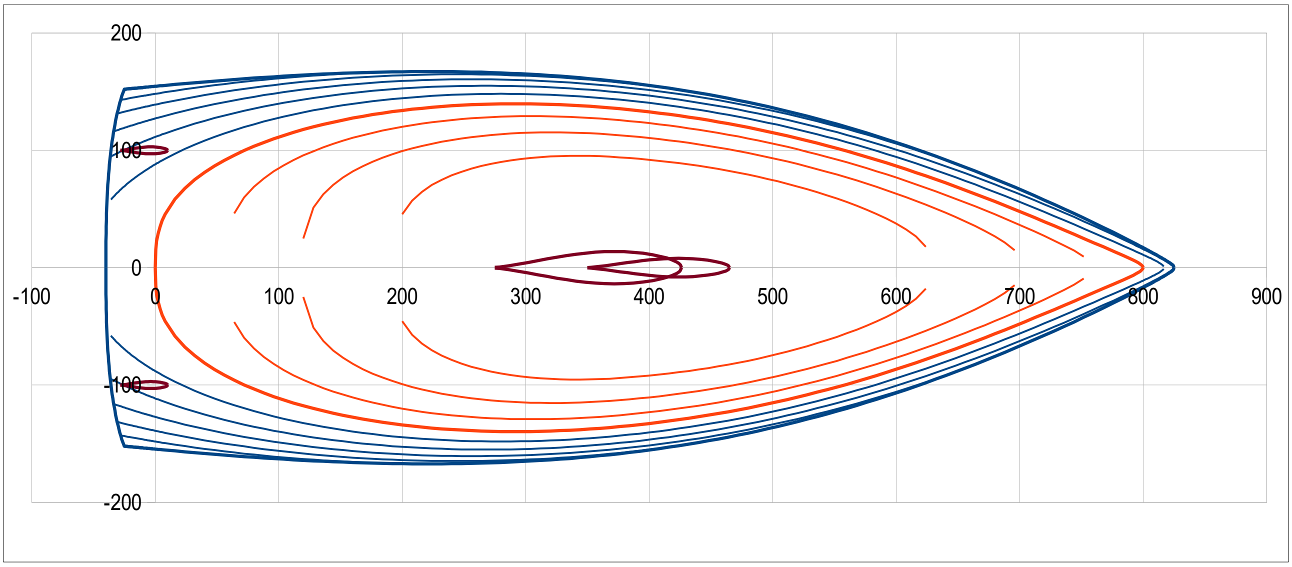
2.1 Hull								
Loa (m)	10,30	Lwl (m)	8,00	> Hull speed (Knots)		6,9	at Froude 0,4	
>> ft	33,79		26,25					
Boa (m)	2,66	at X (% Lwl)	38,0	Bsheer (m)	2,60	at X (% Lwl)	38,0	
>> ft	8,72							
Bwl (m)	2,19	at X (% Lwl)	41,0	> Bwl / Boa	0,824			
>> ft	7,19				Freeboards (m) >	Aft	Midship	Fore
Tc (m)	0,370	at X (%Lwl)	50			0,74	0,72	0,85
>> ft	1,21				>> ft	2,43	2,36	2,79
	Displacement at H0 (m3)	2,42012	at LCB (m)	3,782	LCB (%Lwl)	47,27	ZCB (m)	-0,130
	>> lbs	5469	w. seawater	1025	kg/m3		>> ft	-0,43
Cp	0,548							
Sf (m2)	11,89	at LCF (m)	3,598	LCF (%Lwl)	44,98	>>> LCB – LCF (%Lwl)		2,29
>> ft2	128,03	>> ft	11,81					
Angle Freeboard/Half beam		29,0	(°), at section C4 (40% Lwl)					
Sw (m2)	12,82	>Sw/D^(2/3)	7,11					
>> ft2	138,05							
Shull (m2)	29,78	at X (m)	3,632	Z (m)	0,093			
>> ft2	320,53	>> ft	11,92	>> ft	0,31			
Sdeck (m2)	18,39	at X (m)	3,482	Z (m)	0,79			
>> ft2	197,90	>> ft	11,42	>> ft	2,59			
2.2 Keel								
Vol. keel(m3)	0,14938	at X (m)	4,019	X (%Lwl)	50,23	Z (m)	-1,098	
		>> ft	13,18			>> ft	-3,60	
Ballast (kg)	1090,5	at X (m)	4,019	X (%Lwl)	50,23	Z (m)	-1,098	
>> lbs	2404	>> ft	13,18			>> ft	-3,60	
Draft oa (m)	1,75		Sw (m2)	3,66		Sxz (m2)	1,36	
>> ft	5,74		>> ft2	39,45		>> ft2	14,61	
CLR (m)	4,34	CLR (%Lwl)	54,23	CLR = Center of Lateral Resistance				
>> ft	14,23	method: keel profile extended to the waterline, CLR at Z 45% draft and					25,00	% chord
2.3 Rudder(s)								
Number	1							
Volume (m3)	0,01486	at X (m)	-0,12	X (%Lwl)	-1,47	Z (m)	-0,54	
Sw (m2)	0,91	>> ft	-0,39			Sxz (m2)	0,44	per rudder
>> ft2	9,80					>> ft2	4,71	
2.4 Hull + Keel + Rudder(s)								
	Displacement at H0 (m3)	2,58436	at LCB (m)	3,773	LCB (%Lwl)	47,16	at ZCB (m)	-0,188
	(kg)	2649	>> ft	12,38			>> ft	-0,62
	>> lbs	5840						
	, of wich Ballast (kg)	1090	at Xg (m)	4,019	Xg (%Lwl)	50,23	at Zg (m)	-1,098
	>> lbs	2404	>> ft	13,18			>> ft	-3,60
	>> % Ballast	41,2						
	Sw (m2)	17,40	>Sw/D^(2/3)	9,24	Lwl/D^(1/3)	5,83		
	>> ft2	187,30			DLR	144	M(lbs/2240)/(Lwl(ft)/100)^3	
2.5 Data from the mass spreadsheet								
Light boat:	M (kg)	2649	at Xg (m)	3,781	Xg (%Lwl)	47,26	at Zg (m)	-0,088

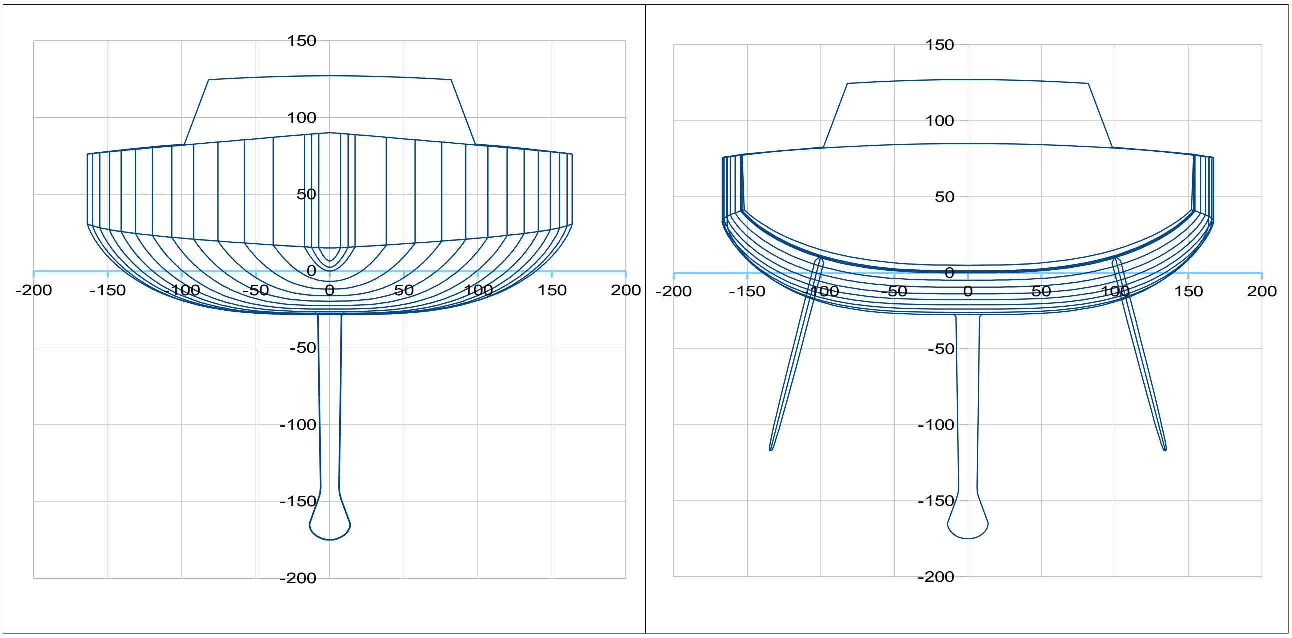
Boat U1 : modern style sailboat

Loa 8,65 m ; Lwl 8,00 m ; Boa 3,34 m ; Draft 1,75 m ; Displacement : 2937 kg ; Keel-bulb 1152 kg (Ballast ratio : 39,3 %)

>> LCB hull 46,57 %Lwl ; Cp hull (%): 0,556 ; Sw : 22,08 m2 ; DLR : 160



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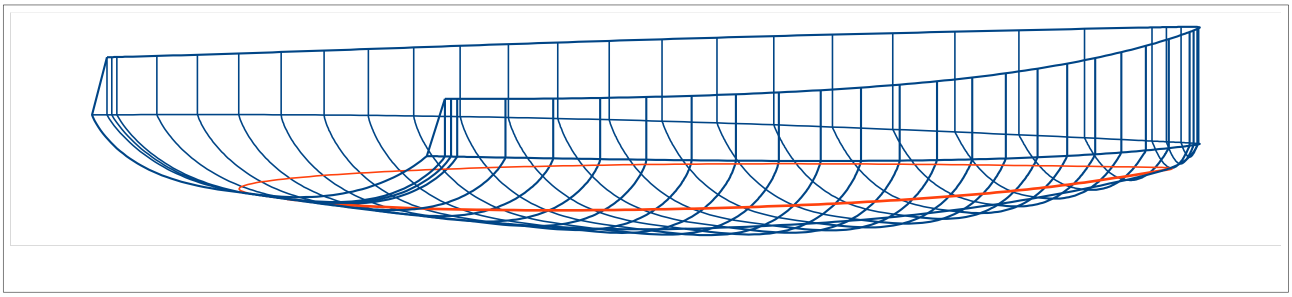

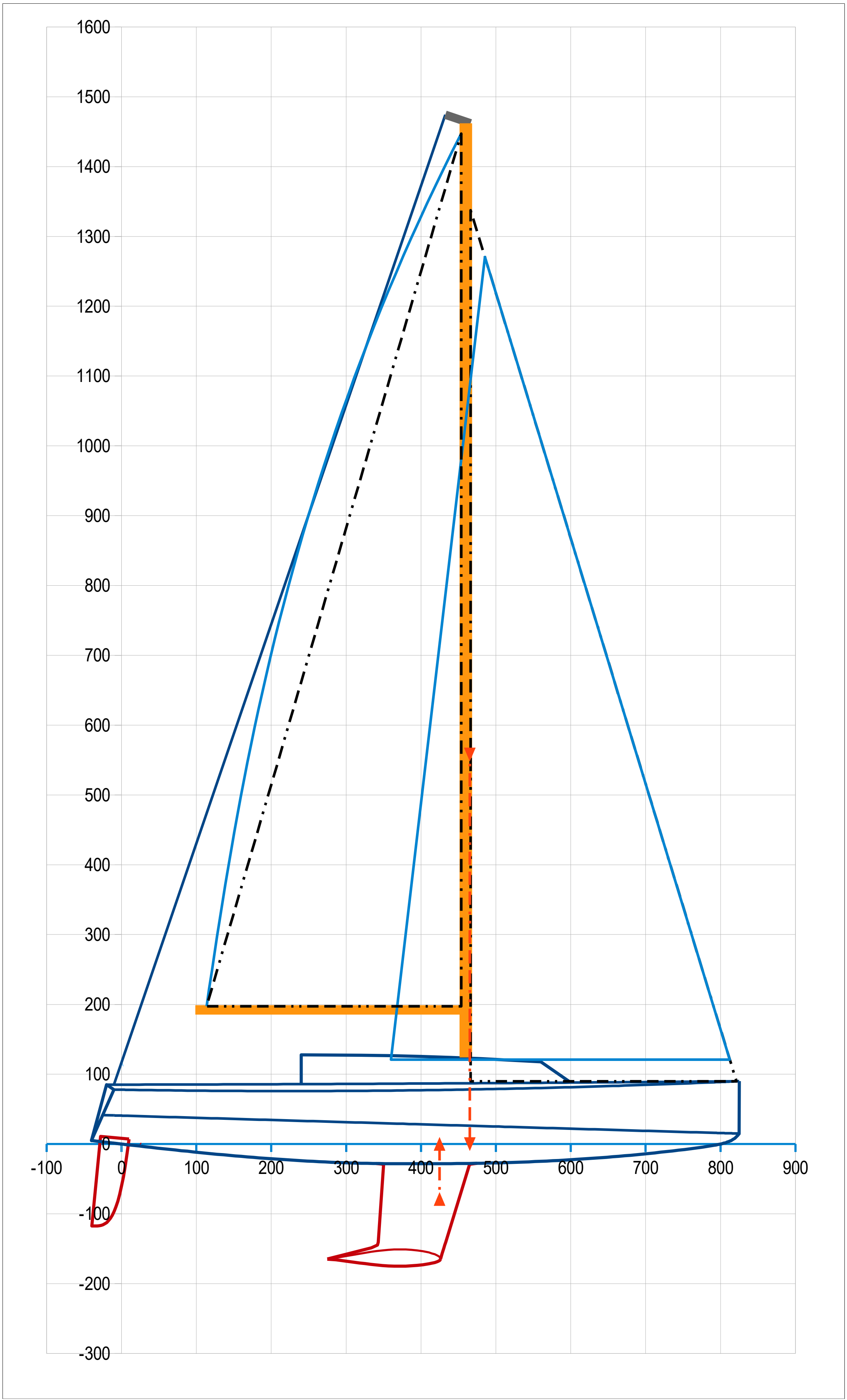
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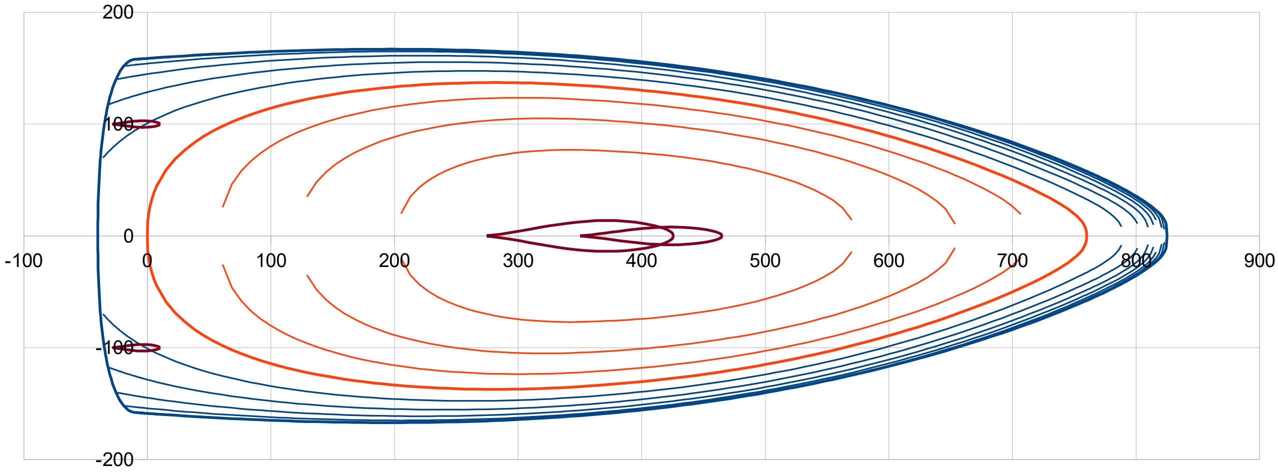
Boat U1 hydrostatics data :

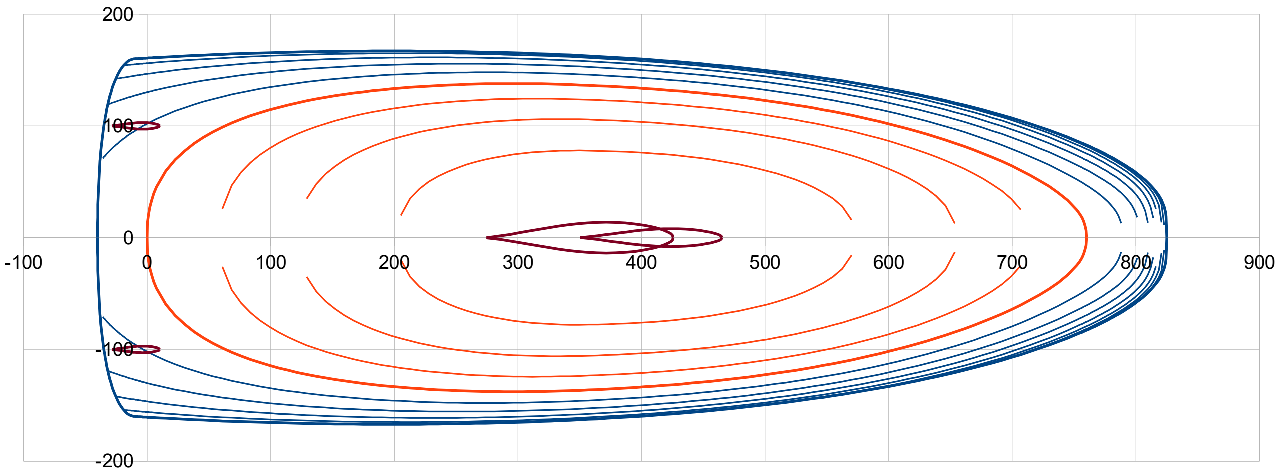
2. Data sum-up and results of hydrostatic and surfaces calculations									
2.1 Hull									
Loa (m)	**8,65**		**Lwl (m)**	**8,00**		> Hull speed (Knots)	6,9	at Froude 0,4	
>> ft	*28,38*			*26,25*					
Boa (m)	**3,34**		**at X (% Lwl)**	**28,0**	Bsheer (m)	3,34	at X (% Lwl)	28,0	
>> ft	*10,96*								
Bwl (m)	**2,79**		**at X (% Lwl)**	**37,0**	> Bwl / Boa	0,836			
>> ft	*9,16*					**Freeboards (m) >**	**Aft**	**Midship**	**Fore**
Tc (m)	**0,283**		**at X (%Lwl)**	**48,5**			**0,78**	**0,76**	**0,9**
>> ft	*0,93*					*>> ft*	*2,56*	*2,49*	*2,95*
Displacement at H0 (m3)		**2,67910**	**at LCB (m)**		**3,725**	**LCB (%Lwl)**	**46,57**	**ZCB (m)**	**-0,105**
	>> lbs	*6054*	*w. seawater*		*1025*	*kg/m3*		*>> ft*	*-0,34*
Cp	**0,556**								
Sf (m2)	**16,05**		**at LCF (m)**	**3,497**	**LCF (%Lwl)**	**43,71**	>>> LCB – LCF (%Lwl)		2,85
>> ft2	*172,76*		*>> ft*	*11,47*					
Angle Freeboard/Half beam		25,0	(°), at section C4 (40% Lwl)						
Sw (m2)	**16,44**		>Sw/D^(2/3)	8,52					
>> ft2	*176,97*								
Shull (m2)	**33,00**		**at X (m)**	**3,596**	**Z (m)**	**0,082**			
>> ft2	*355,24*		*>> ft*	*11,80*	*>> ft*	*0,27*			
Sdeck (m2)	**21,41**		**at X (m)**	**3,309**	**Z (m)**	**0,83**			
>> ft2	*230,44*		*>> ft*	*10,85*	*>> ft*	*2,74*			
2.2 Keel									
Vol. keel(m3)	**0,15779**		**at X (m)**	**3,964**	**X (%Lwl)**	**49,55**	**Z (m)**	**-1,050**	
			>> ft	*13,00*			*>> ft*	*-3,45*	
Ballast (kg)	**1151,9**		**at X (m)**	**3,964**	**X (%Lwl)**	**49,55**	**Z (m)**	**-1,050**	
>> lbs	*2539*		*>> ft*	*13,00*			*>> ft*	*-3,45*	
Draft oa (m)	**1,75**			**Sw (m2)**	**3,85**		**Sxz (m2)**	**1,45**	
>> ft	*5,74*			*>> ft2*	*41,45*		*>> ft2*	*15,59*	
CLR (m)	**4,25**		**CLR (%Lwl)**	**53,09**	*CLR = Center of Lateral Resistance*				
>> ft	*13,93*	method: keel profile extended to the waterline, CLR at Z 45% draft and						25,00	% chord
2.3 Rudder(s)									
Number	**2**								
Volume (m3)	**0,02815**		**at X (m)**	**-0,13**	**X (%Lwl)**	**-1,60**	**Z (m)**	**-0,45**	
Sw (m2)	**1,79**		*>> ft*	*-0,42*			**Sxz (m2)**	**0,43**	per rudder
>> ft2	*19,29*						*>> ft2*	*4,64*	
2.4 Hull + Keel + Rudder(s)									
Displacement at H0 (m3)		**2,86504**	**at LCB (m)**		**3,701**	**LCB (%Lwl)**	**46,26**	**at ZCB (m)**	**-0,160**
(kg)		**2937**	*>> ft*		*12,14*			*>> ft*	*-0,53*
>> lbs		*6474*							
, of wich Ballast (kg)		**1152**	**at Xg (m)**		**3,964**	**Xg (%Lwl)**	**49,55**	**at Zg (m)**	**-1,050**
>> lbs		*2539*	*>> ft*		*13,00*			*>> ft*	*-3,45*
>> % Ballast		39,2							
Sw (m2)		**22,08**	>Sw/D^(2/3)		10,95	Lwl/D^(1/3)	5,63		
>> ft2		*237,70*				***DLR***	***160***	*M(lbs/2240)/(Lwl(ft)/100)^3*	
2.5 Data from the mass spreadsheet									
Light boat:	**M (kg)**	**2937**	**at Xg (m)**		**3,656**	**Xg (%Lwl)**	**45,70**	**at Zg (m)**	**-0,020**

Boat U1 variant >>> **U1,1** is an U1 evolution with a scow bow, **by using the parameter Scow.** At first, a demonstration by images of Scow influence :

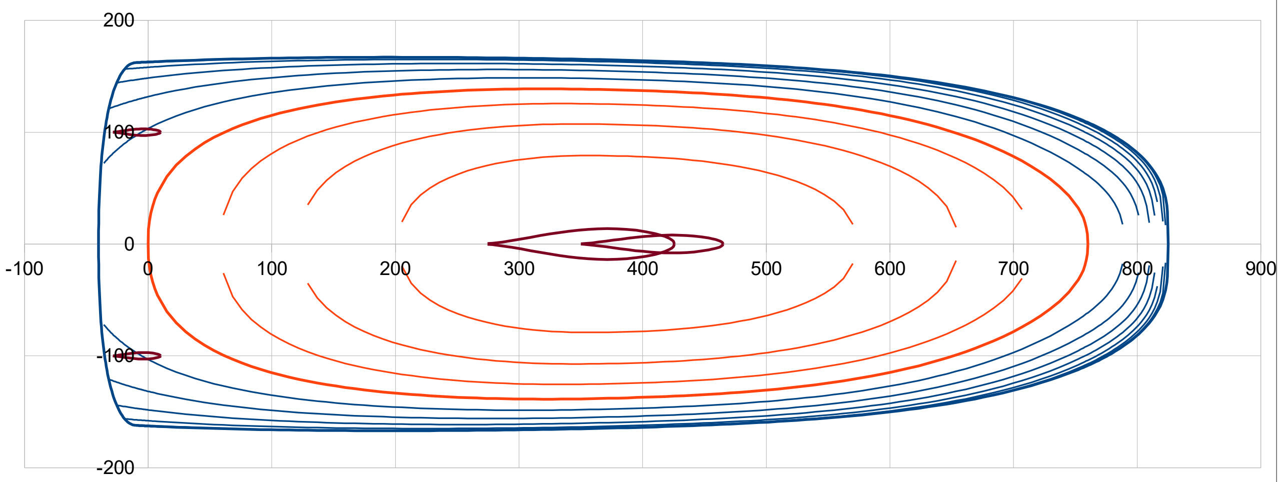
Scow = 0,33 (and Pui Scow = 0,25)



Scow = 0,66 (and Pui Scow = 0,25)



Scow = 1,00 (and Pui Scow = 0,25)



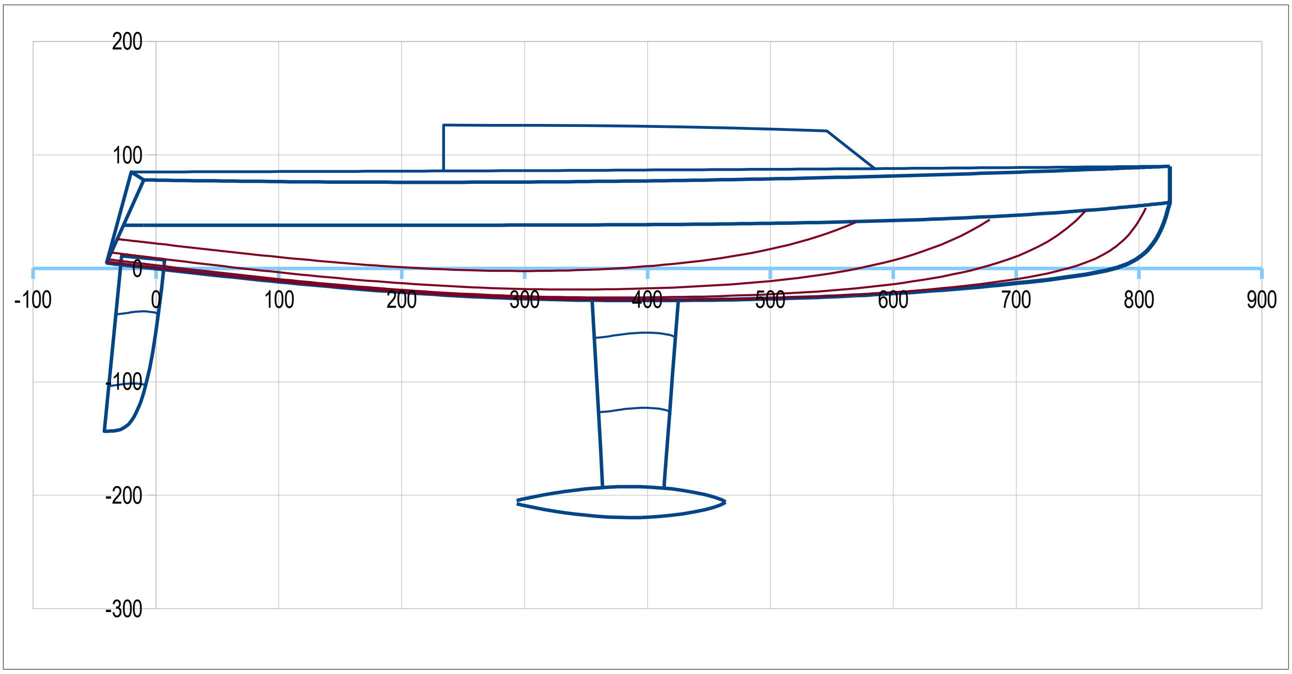
>>> Boat U1,1

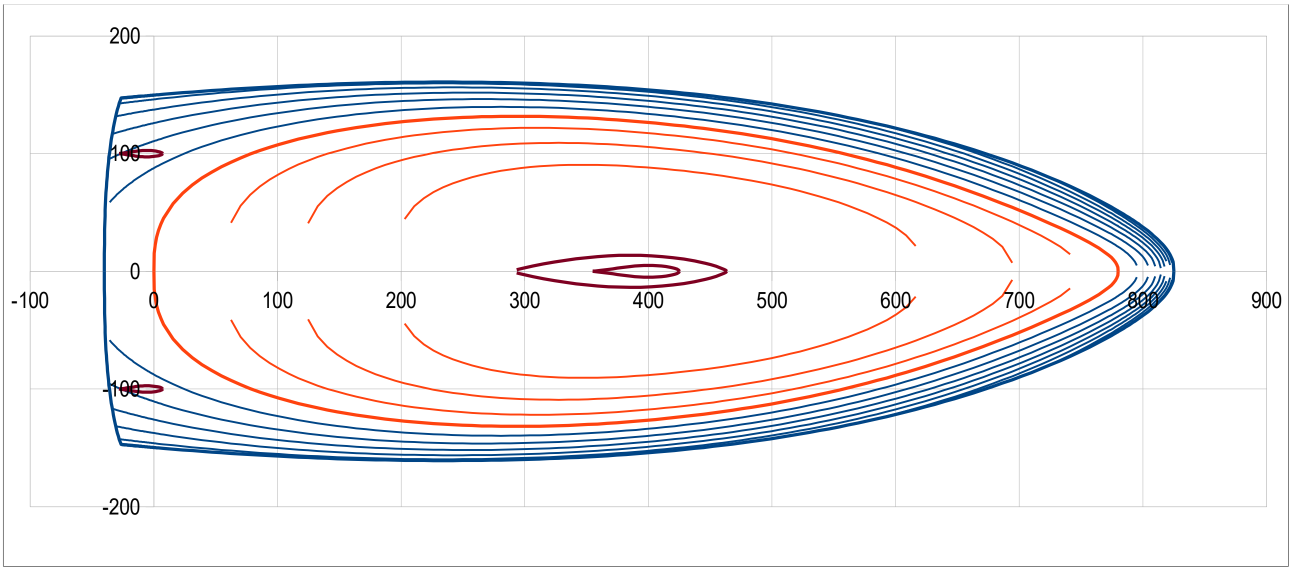
Here we show a Mid-Scow variant , with Scow = 0,5 and Pui scow = 0,35 :

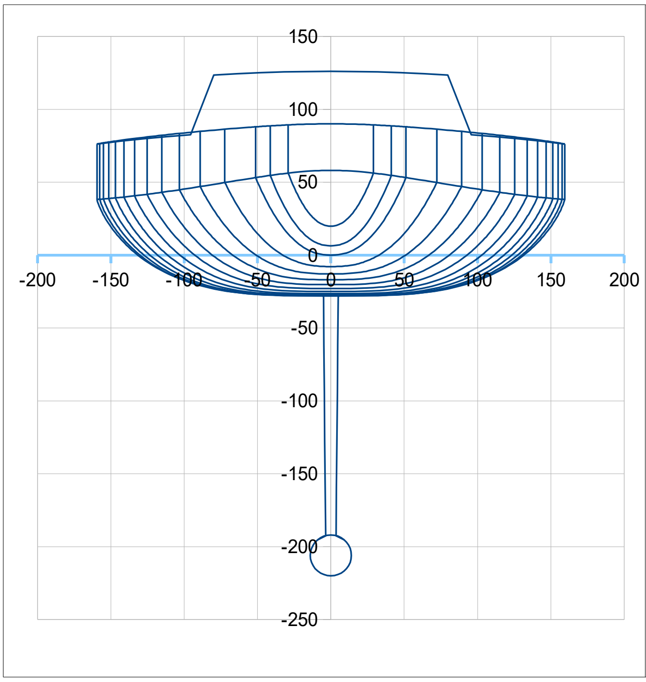
Scow	**0,50**
Pui Scow	**0,35**

, an inverted T keel and twin suspended rudders :

Loa 8,65 m ; Lwl 7,80 m ; B 3,22 m ; Draft 2,2 m ; Displacement : 2785 kg ; Keel-bulb 1041 kg
>> LCB hull 48,13 %Lwl ; Cp hull : 0,580 ; Sw : 21,00 m2 ;   DLR : 164 ;   Ballast ratio : 37,4 %



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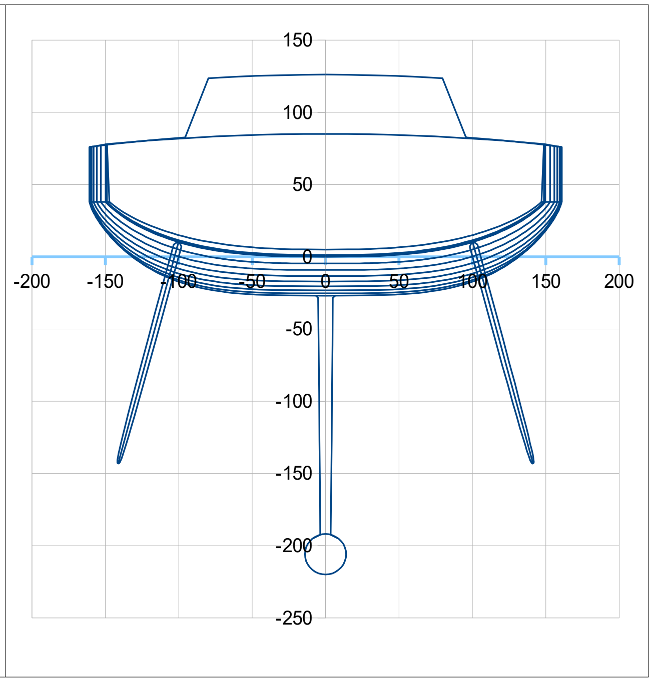
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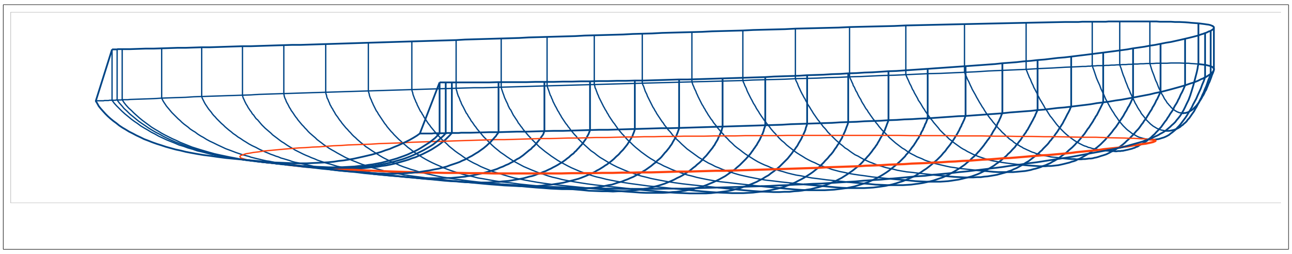

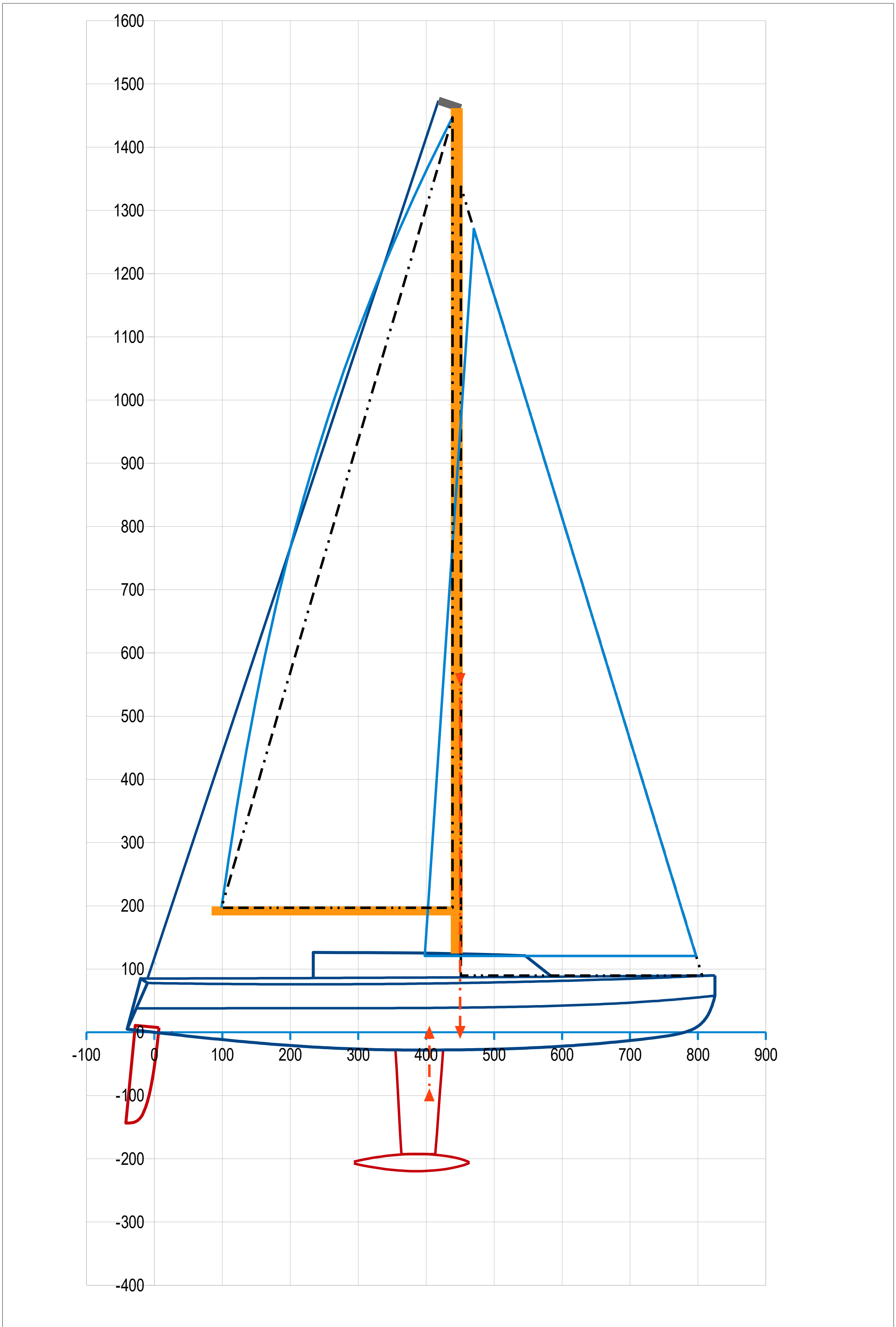

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Boat U1,1 hydrostatics data :

2. Data sum-up and results of hydrostatic and surfaces calculations

2.1 Hull

Loa (m)	**8,65**	**Lwl (m)**	**7,80**	> Hull speed (Knots)	6,8	at Froude 0,4			
>> ft	*28,38*		*25,59*						
Boa (m)	**3,22**	**at X (% Lwl)**	**30,0**	Bsheer (m)	3,22	at X (% Lwl)	30,0		
>> ft	*10,55*								
Bwl (m)	**2,64**	**at X (% Lwl)**	**38,0**	> Bwl / Boa	0,819				
>> ft	*8,65*			**Freeboards (m) >**		**Aft**	**Midship**	**Fore**	
Tc (m)	**0,280**	**at X (%Lwl)**	**50**			**0,78**	**0,76**	**0,9**	
>> ft	*0,92*			*>> ft*		*2,56*	*2,49*	*2,95*	
Displacement at H0 (m3)	**2,57532**	**at LCB (m)**	**3,754**	**LCB (%Lwl)**	**48,13**	**ZCB (m)**	**-0,104**		
>> lbs	*5819*	*w. seawater*	*1025*	*kg/m3*		*>> ft*	*-0,34*		
Cp	**0,580**								
Sf (m2)	**15,57**	**at LCF (m)**	**3,532**	**LCF (%Lwl)**	**45,29**	>>> LCB – LCF (%Lwl)	2,84		
>> ft2	*167,62*	*>> ft*	*11,59*						
Angle Freeboard/Half beam	25,5	(°), at section C4 (40% Lwl)							
Sw (m2)	**15,95**	>Sw/D^(2/3)	8,49						
>> ft2	*171,64*								
Shull (m2)	**32,68**	**at X (m)**	**3,636**	**Z (m)**	**0,088**				
>> ft2	*351,82*	*>> ft*	*11,93*	*>> ft*	*0,29*				
Sdeck (m2)	**22,11**	**at X (m)**	**3,512**	**Z (m)**	**0,83**				
>> ft2	*238,01*	*>> ft*	*11,52*	*>> ft*	*2,74*				

2.2 Keel

Vol. keel(m3)	**0,11139**	**at X (m)**	**3,883**	**X (%Lwl)**	**49,78**	**Z (m)**	**-1,537**		
		>> ft	*12,74*			*>> ft*	*-5,04*		
Ballast (kg)	**1040,8**	**at X (m)**	**3,870**	**X (%Lwl)**	**49,62**	**Z (m)**	**-1,651**		
>> lbs	*2294*	*>> ft*	*12,70*			*>> ft*	*-5,42*		
Draft oa (m)	**2,20**			**Sw (m2)**	**3,01**	**Sxz (m2)**	**1,31**		
>> ft	*7,22*			*>> ft2*	*32,38*	*>> ft2*	*14,14*		
CLR (m)	**4,05**	**CLR (%Lwl)**	**51,89**	*CLR = Center of Lateral Resistance*					
>> ft	*13,28*	method: keel profile extended to the waterline, CLR at Z 45% draft and					25,00	% chord	

2.3 Rudder(s)

Number	**2**								
Volume (m3)	**0,03052**	**at X (m)**	**-0,15**	**X (%Lwl)**	**-1,93**	**Z (m)**	**-0,58**		
Sw (m2)	**2,05**	*>> ft*	*-0,49*			**Sxz (m2)**	**0,49**	per rudder	
>> ft2	*22,07*					*>> ft2*	*5,30*		

2.4 Hull + Keel + Rudder(s)

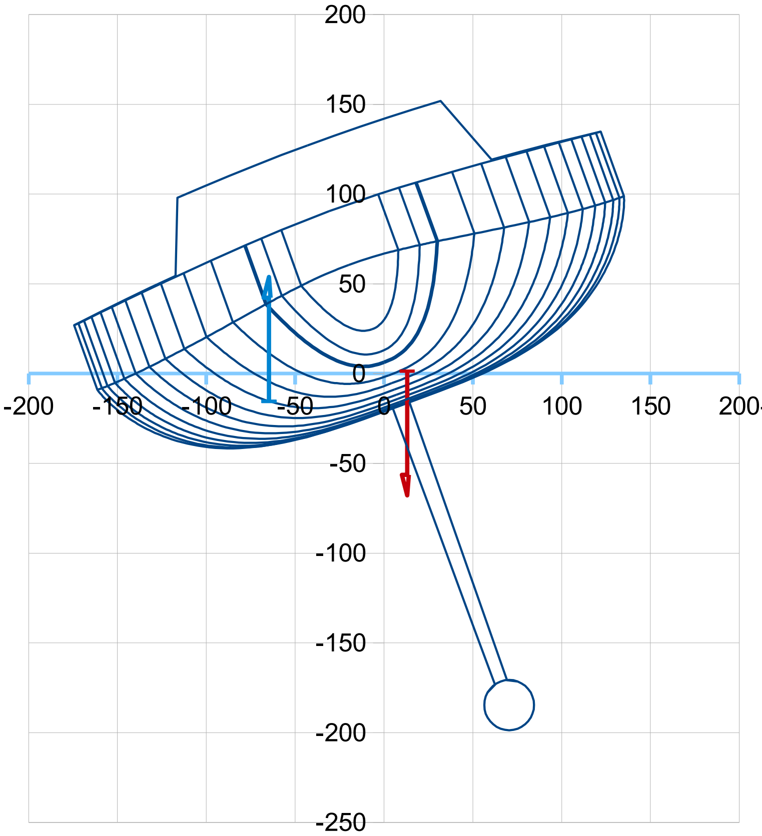
Displacement at H0 (m3)	**2,71723**	**at LCB (m)**	**3,715**	**LCB (%Lwl)**	**47,63**	**at ZCB (m)**	**-0,168**		
(kg)	**2785**	*>> ft*	*12,19*			*>> ft*	*-0,55*		
>> lbs	*6140*								
, of wich Ballast (kg)	**1041**	**at Xg (m)**	**3,870**	**Xg (%Lwl)**	**49,62**	**at Zg (m)**	**-1,651**		
>> lbs	*2294*	*>> ft*	*12,70*			*>> ft*	*-5,42*		
>> % Ballast	37,4								
Sw (m2)	**21,00**	>Sw/D^(2/3)	10,79	Lwl/D^(1/3)	5,59				
>> ft2	*226,09*			***DLR***	***164***	*M(lbs/2240)/(Lwl(ft)/100)^3*			

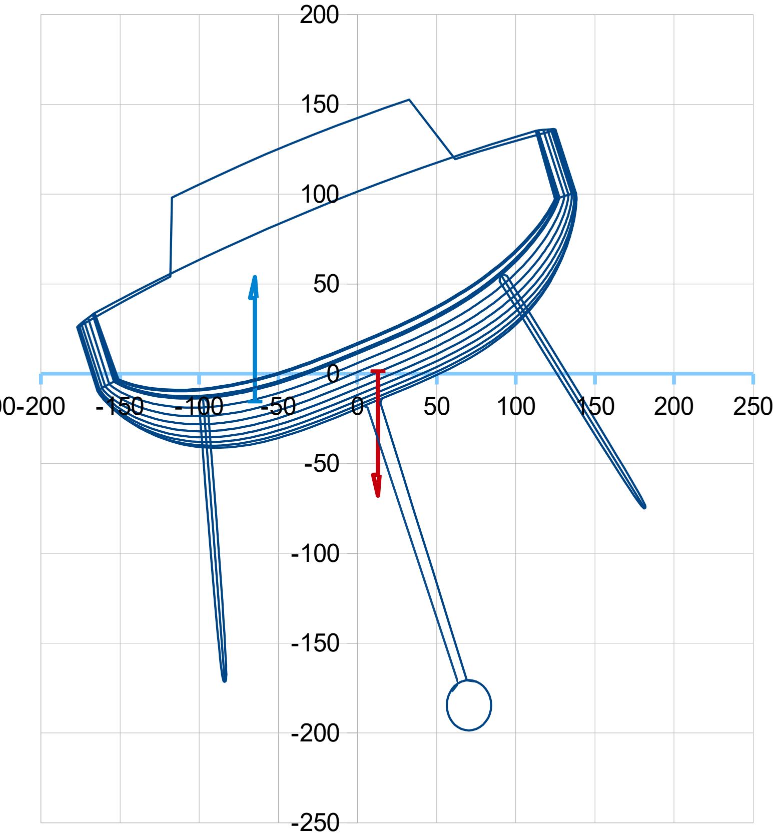
2.5 Data from the mass spreadsheet

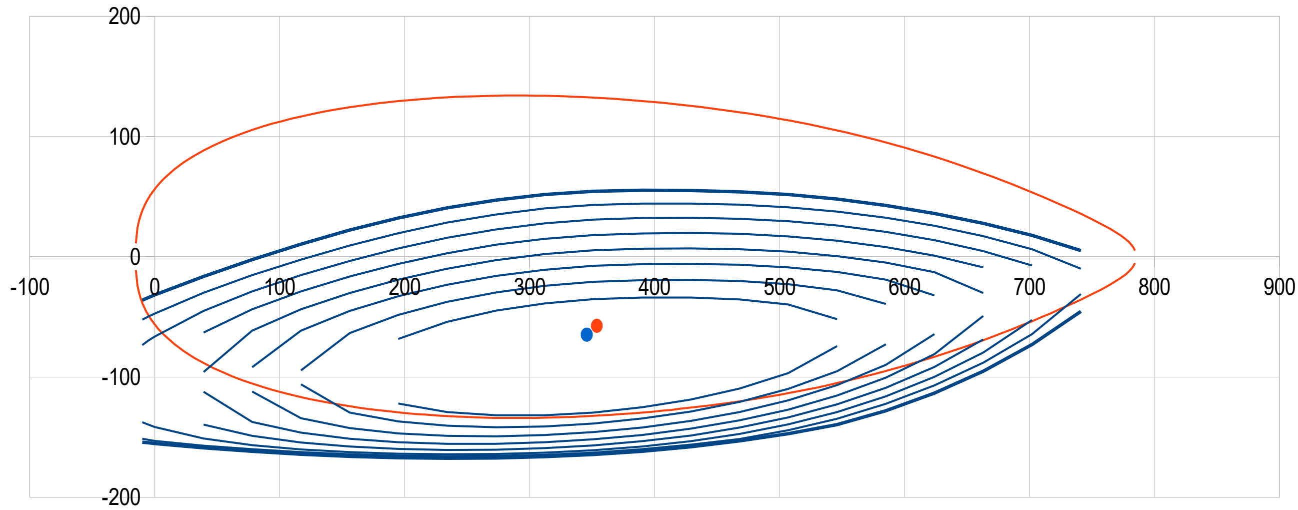
Light boat:	**M (kg)**	**2785**	**at Xg (m)**	**3,613**	**Xg (%Lwl)**	**46,32**	**at Zg (m)**	**-0,220**	

At heel 20° , with a loading of 300 kg :

Data to enter : yellow cells		Results			
Heel (°)	20	Disp. (m3)	3,00947	/ Disp. (m3)	3,00947
Height (cm)	8,7956	Xc heel (m)	3,457	/ Xg (m)	3,456
Trim (°)	-0,359	Yc heel (m)	-0,648	Yg heel (m)	0,131
		Zc heel (m)	-0,155	> GZ (m)	0,779
		Sw heel(m2)	19,15	RM (kN.m)	23,565
		Bwl heel (m)	2,19	FB mini (cm)	25,9
		LCB – LCF (%Lwl)	-1,05	Obliquity (°)	5,0







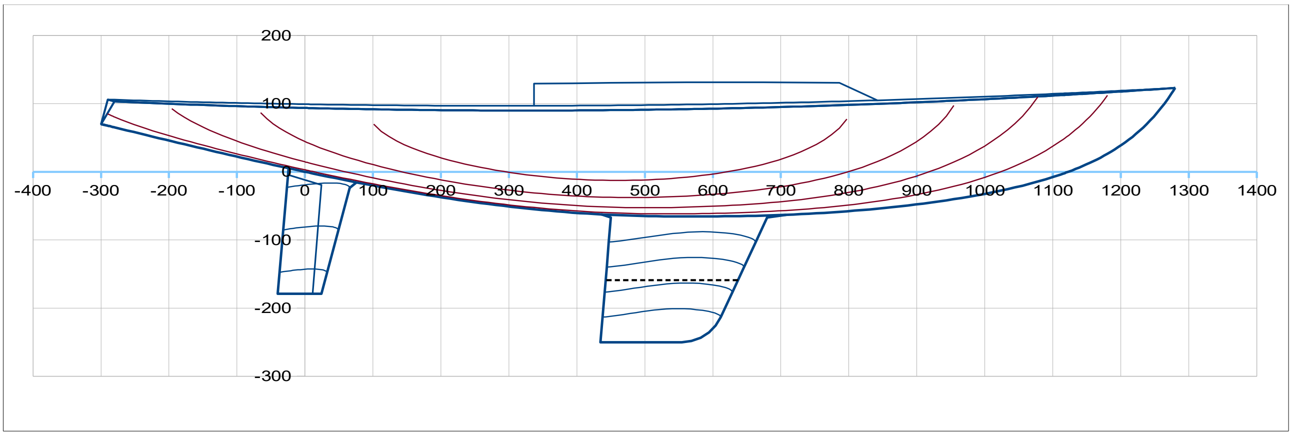
Other examples inspired by historical or recent designs

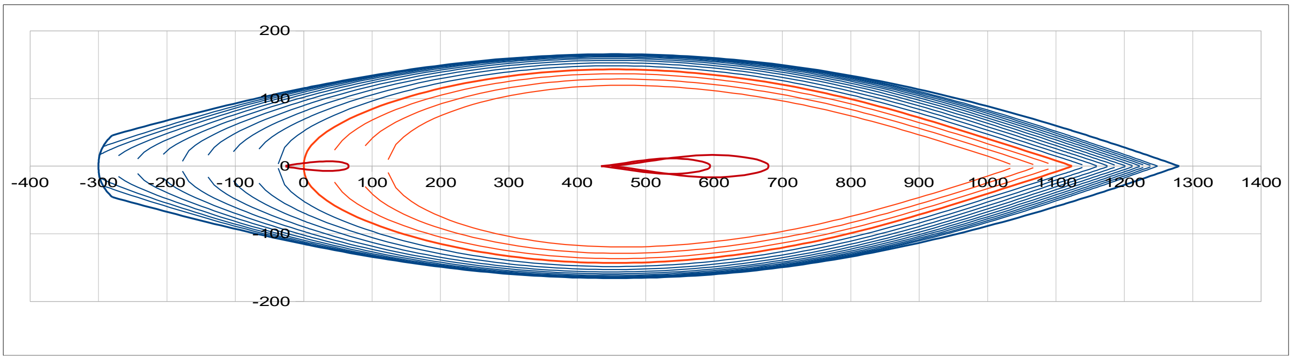
In complement, for a better information on Gene-Hull capacity, I take advantage of each example to also demonstrate the influence of one of the input data.

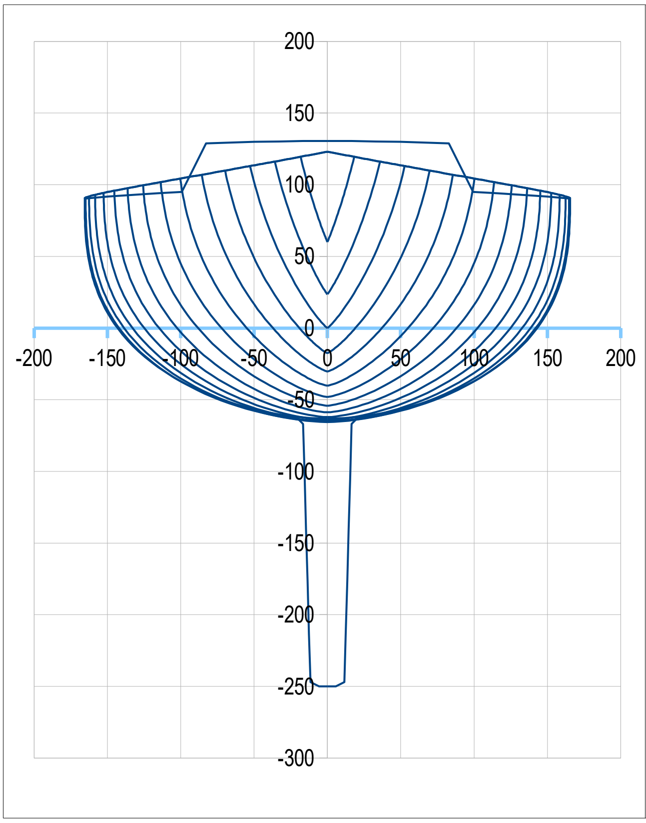
B52, inspired by « Bojar » flush deck cutter 1937 / Johan Anker

Loa 15,80 m ; Lwl 11,23 m ; B 3,31 m ; Draft 2,50 m ; Displacement : 8847 kg ; Ballast : 3038 kg

>> LCB hull 46,81 %Lwl ; Cp hull : 0,542 ; Sw : 35,36 m2 ; DLR : 174 ; Ballast ratio : 34,3 %



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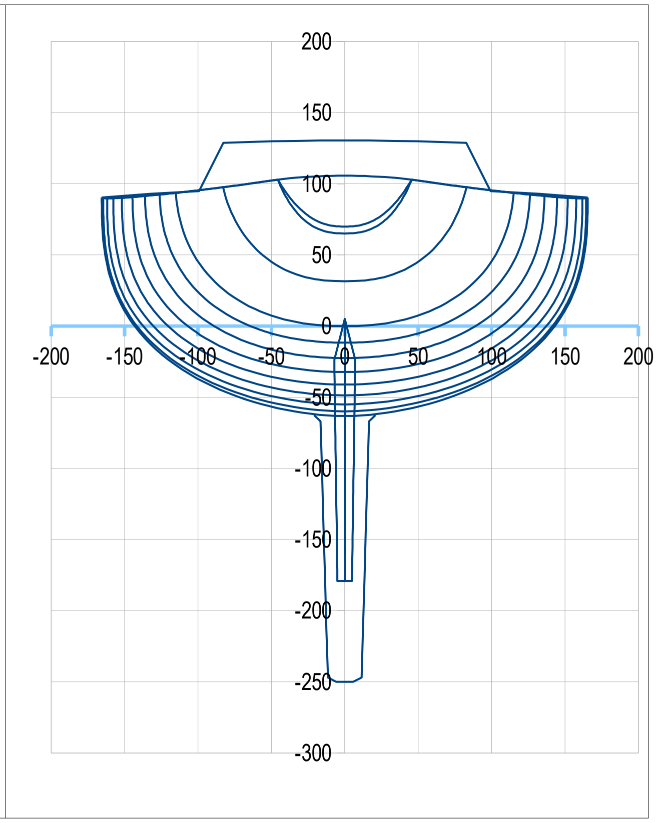
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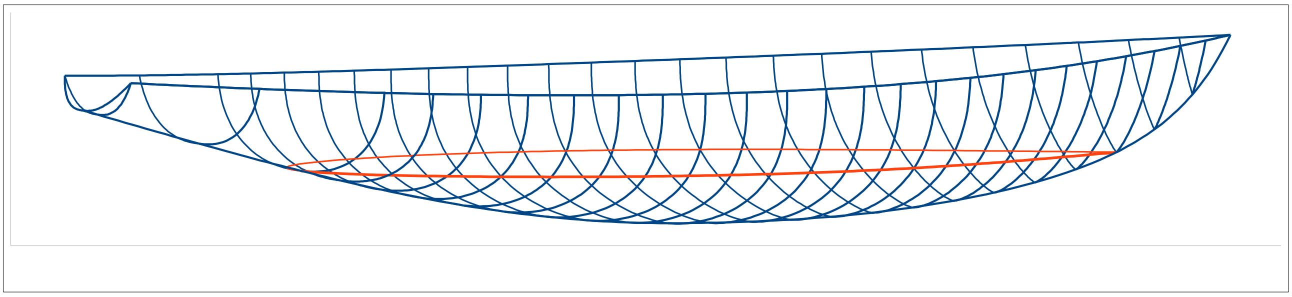

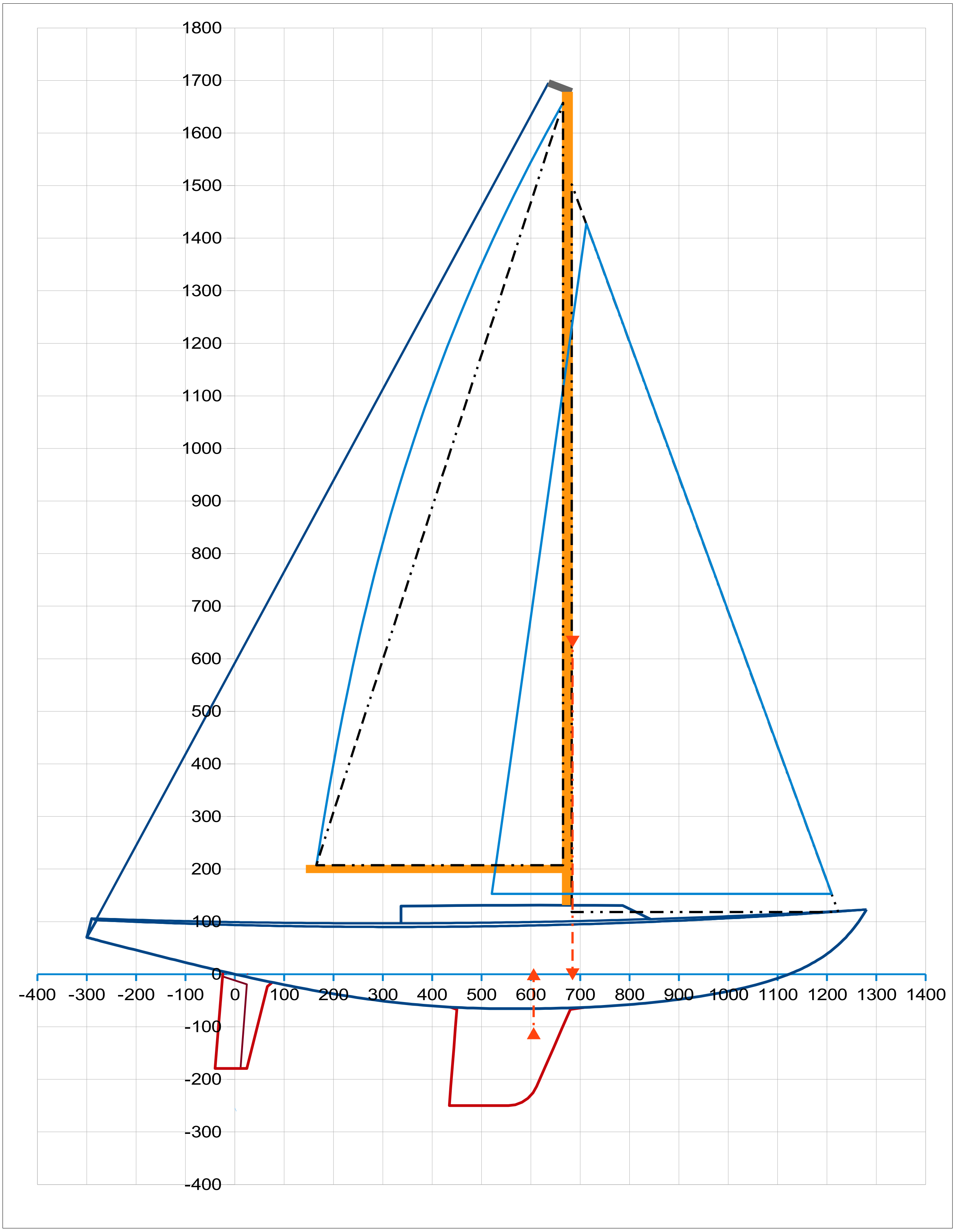

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Boat B52 hydrostatics data :

2. Data sum-up and results of hydrostatic and surfaces calculations

2.1 Hull

Loa (m)	15,80	Lwl (m)	11,23	> Hull speed (Knots)		8,2	at Froude 0,4		
>> ft	51,84		36,84						
Boa (m)	3,31	at X (% Lwl)	41,0	Bsheer (m)	3,31	at X (% Lwl)	41,0		
>> ft	10,86								
Bwl (m)	2,86	at X (% Lwl)	41,0	> Bwl / Boa	0,865				
>> ft	9,39				Freeboards (m) >	Aft	Midship		Fore
Tc (m)	0,656	at X (%Lwl)	50			1,03	0,90		1,23
>> ft	2,15				>> ft	3,38	2,95		4,04
Displacement at H0 (m3)	7,85613	at LCB (m)	5,256	LCB (%Lwl)		46,81		ZCB (m)	-0,226
>> lbs	17753	w. seawater	1025	kg/m3				>> ft	-0,74
Cp	0,542								
Sf (m2)	22,20	at LCF (m)	5,027	LCF (%Lwl)	44,76	>>> LCB – LCF (%Lwl)			2,05
>> ft2	238,94	>> ft	16,49						
Angle Freeboard/Half beam	28,6	(°), at section C4 (40% Lwl)							
Sw (m2)	25,02	>Sw/D^(2/3)	6,33						
>> ft2	269,31								
Shull (m2)	57,59	at X (m)	4,873	Z (m)	0,092				
>> ft2	619,94	>> ft	15,99	>> ft	0,30				
Sdeck (m2)	35,76	at X (m)	4,492	Z (m)	1,04				
>> ft2	384,96	>> ft	14,74	>> ft	3,40				

2.2 Keel

Vol. keel(m3)	0,66009	at X (m)	5,592	X (%Lwl)	49,79	Z (m)	-1,459		
		>> ft	18,35			>> ft	-4,79		
Ballast (kg)	3037,8	at X (m)	5,439	X (%Lwl)	48,43	Z (m)	-1,957		
>> lbs	6697	>> ft	17,84			>> ft	-6,42		
Draft oa (m)	2,50		Sw (m2)	7,53		Sxz (m2)	3,67		
>> ft	8,20		>> ft2	81,05		>> ft2	39,46		
CLR (m)	6,06	CLR (%Lwl)	53,93	CLR = Center of Lateral Resistance					
>> ft	19,87	method: keel profile extended to the waterline, CLR at Z 45% draft and					25,00	% chord	

2.3 Rudder(s)

Number	1								
Volume (m3)	0,11516	at X (m)	0,13	X (%Lwl)	1,15	Z (m)	-0,84		
Sw (m2)	2,82	>> ft	0,42			Sxz (m2)	1,35	per rudder	
>> ft2	30,31					>> ft2	14,57		

2.4 Hull + Keel + Rudder(s)

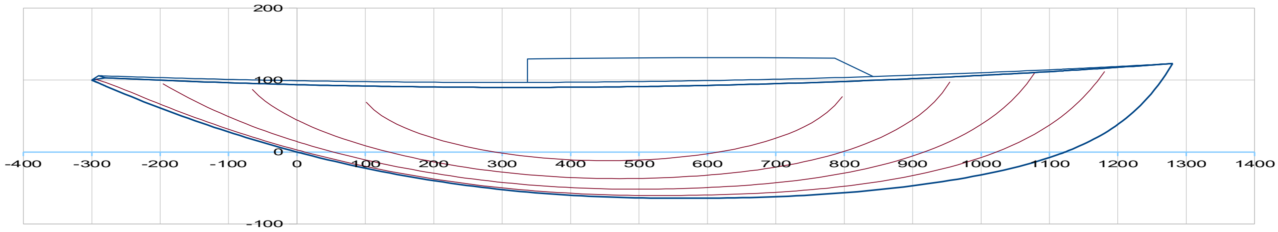
Displacement at H0 (m3)	8,63139	at LCB (m)	5,214	LCB (%Lwl)	46,43	at ZCB (m)	-0,329		
(kg)	8847	>> ft	17,10			>> ft	-1,08		
>> lbs	19504								
, of wich Ballast (kg)	3038	at Xg (m)	5,439	Xg (%Lwl)	48,43	at Zg (m)	-1,957		
>> lbs	6697	>> ft	17,84			>> ft	-6,42		
>> % Ballast	34,3								
Sw (m2)	35,36	>Sw/D^(2/3)	8,40	Lwl/D^(1/3)	5,47				
>> ft2	380,66			DLR	174	M(lbs/2240)/(Lwl(ft)/100)^3			

2.5 Data from the mass spreadsheet

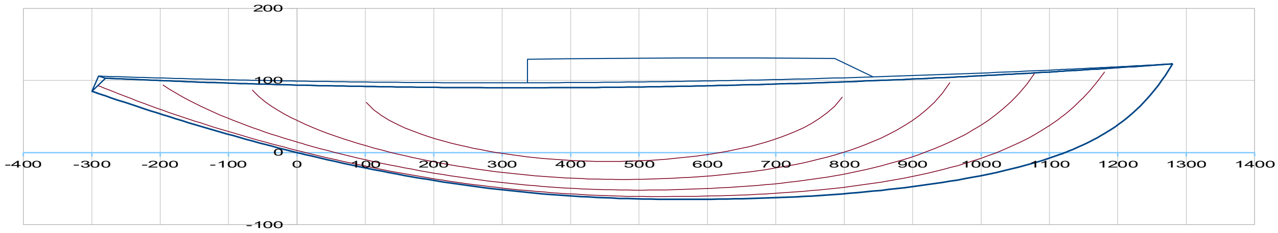
Light boat:	M (kg)	8847	at Xg (m)	5,123	Xg (%Lwl)	45,62	at Zg (m)	-0,125	

Within B52, demonstration by images of the **rear transom « Z tab ar » influence** (i.e. the height of the transom tip end) + slight adjustement of hull draft Tc to stay at same displacement :

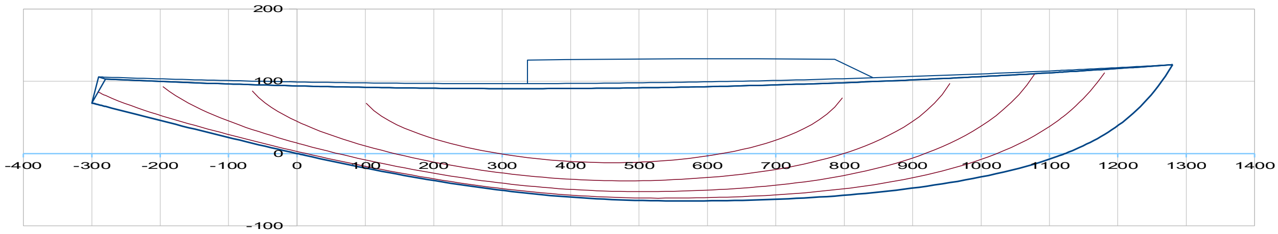
Z tab ar = 1 m >>> consequence : LCB hull : 46,14 % Lwl ; Cp hull : 0,554



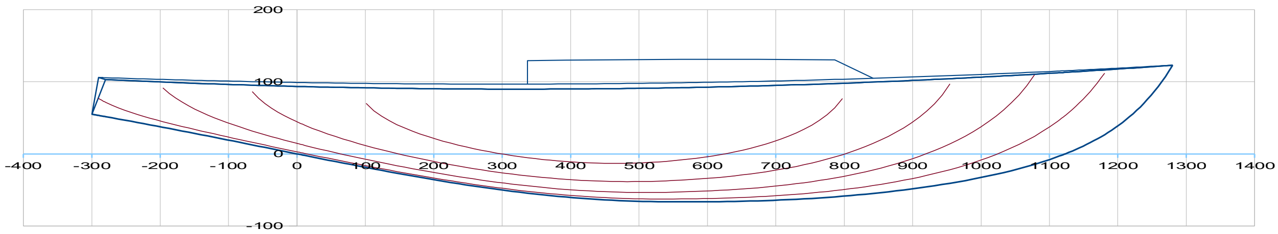
Z tab ar = 0,85 m >>> consequence : LCB hull : 46,55 % Lwl ; Cp hull : 0,549



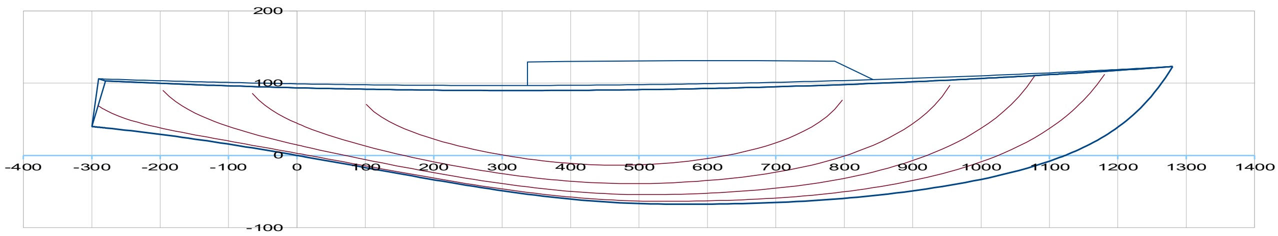
Z tab ar = 0,70 m **(B52 case)** >>> consequence : LCB hull : 46,81 % Lwl ; Cp hull : 0,542



Z tab ar = 0,55 m >>> consequence : LCB hull : 47,24 % Lwl ; Cp hull : 0,534

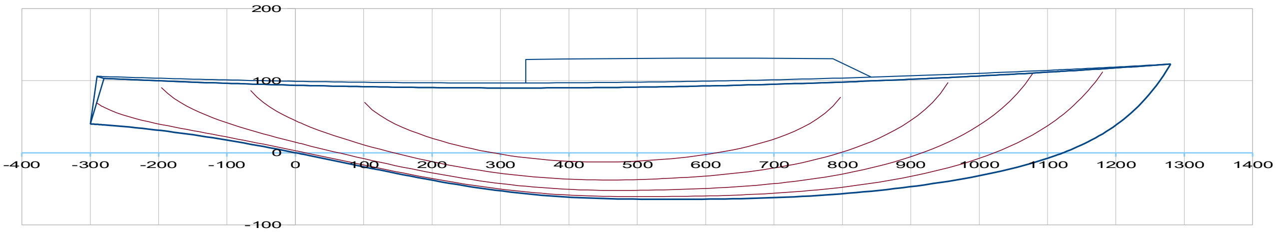


Z tab ar = 0,40 m >>> consequence : LCB hull : 47,77 % Lwl ; Cp hull : 0,524



From the last case, one can compensate for the advancement of LCB and the decrease of Cp by using the **Pui q ar** parameter : its increase from 2,2 to 3,2 gives more hull volume on the rear

half :
Z tab ar = 0,40 m and Pui q ar = 3,2 >>> consequence LCB hull : 46,47 % Lwl ; Cp hull : 0,545

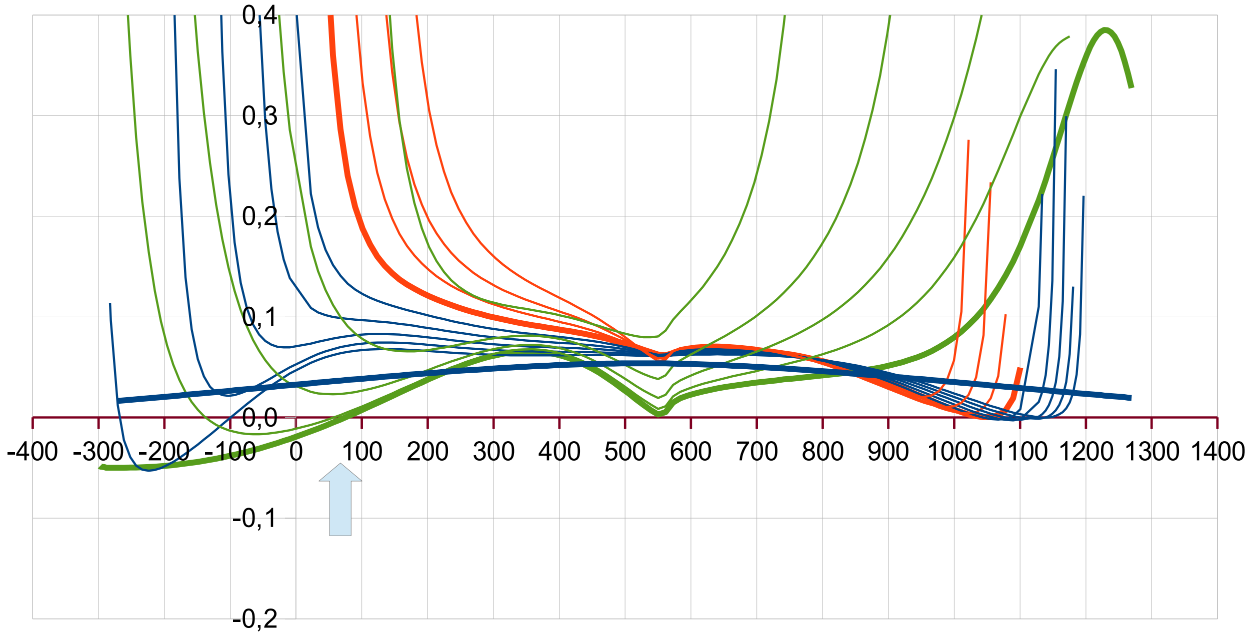


It is of course possible to do such compensation for all other cases, if the goal is to fix LCB and Cp.

For the last case with Z tab ar = 0,40 m and Pui q ar = 3,2 , here below the curvatures 1/R :

Curvatures 1/R

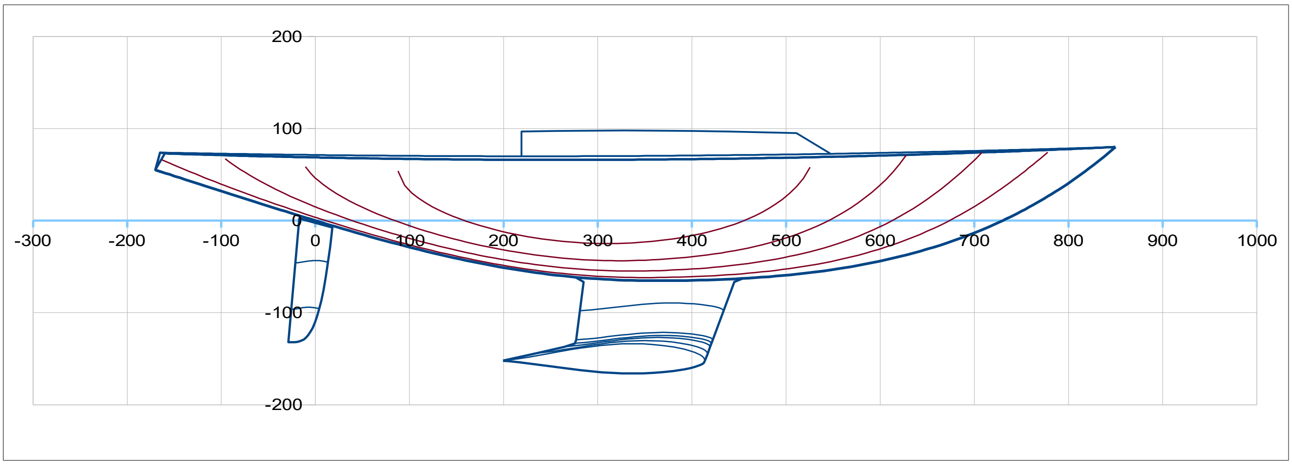
Red : waterlines below H0 (thick red = H0) ; Blue : waterlines above H0 (thick blue = sheer line)
green : keel and buttock lines (thick green = keel line)

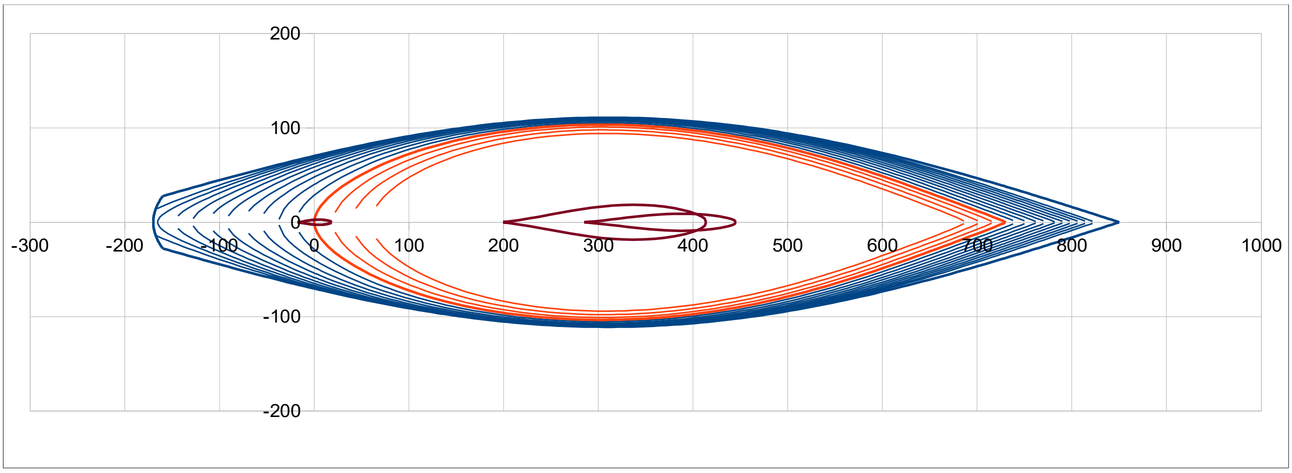


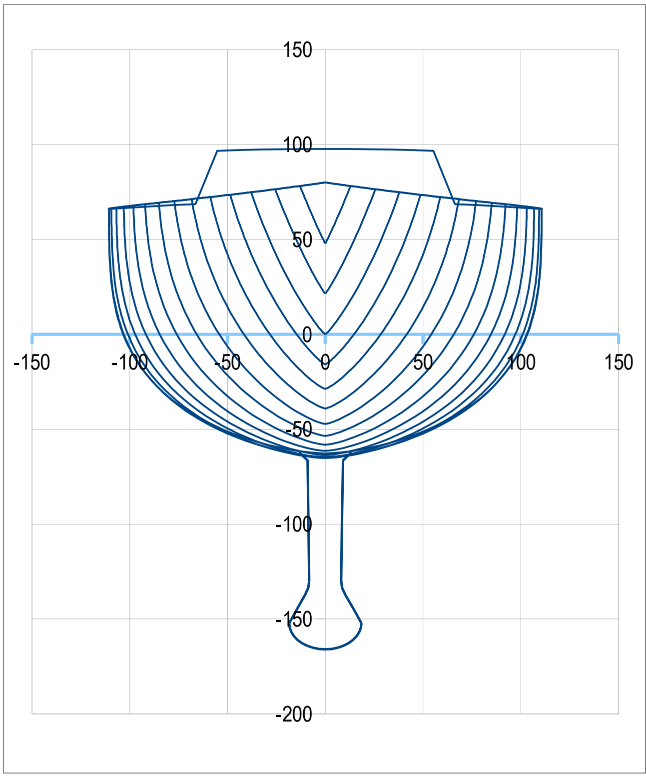
Negative 1/R means concavity, here we can see that the keel line (thick green line) becomes concav at X ~ 80

Classic 6m JI, inspired by this metric class with a classic approach

Loa 10,20 m ; Lwl 7,30 m ; B 2,21 m ; Draft 1,66 m ; Displacement : 4046 kg ; Ballast : 2018 kg
>> LCB hull 47,25 %Lwl ; Cp hull : 0,534 ; Sw : 18,14 m2 ; DLR : 290 ; Ballast ratio : 49,9 %



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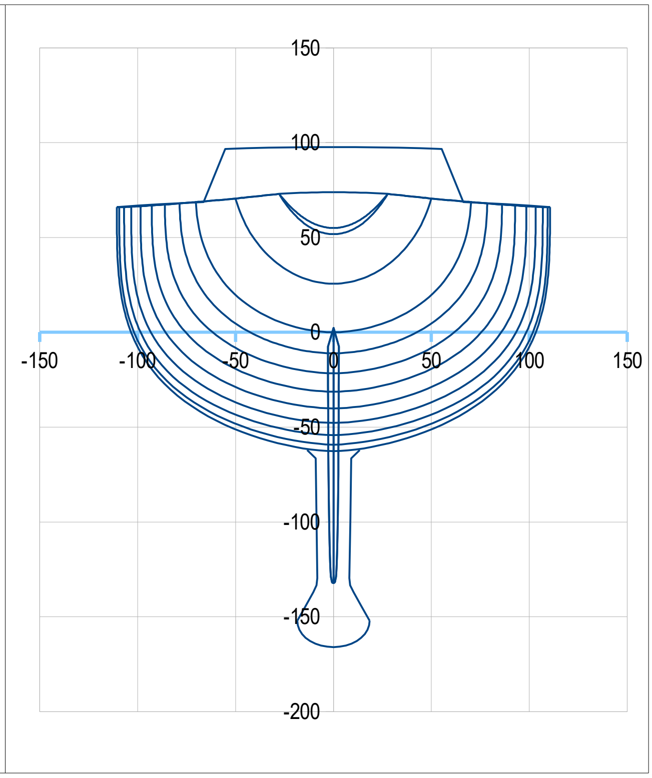
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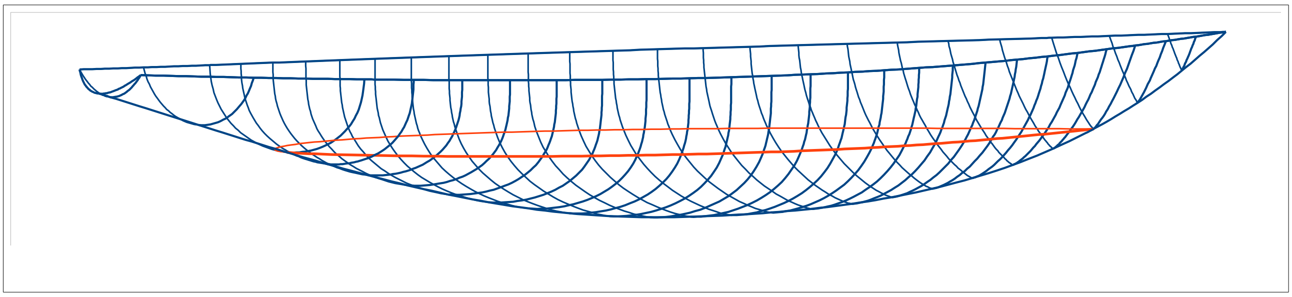

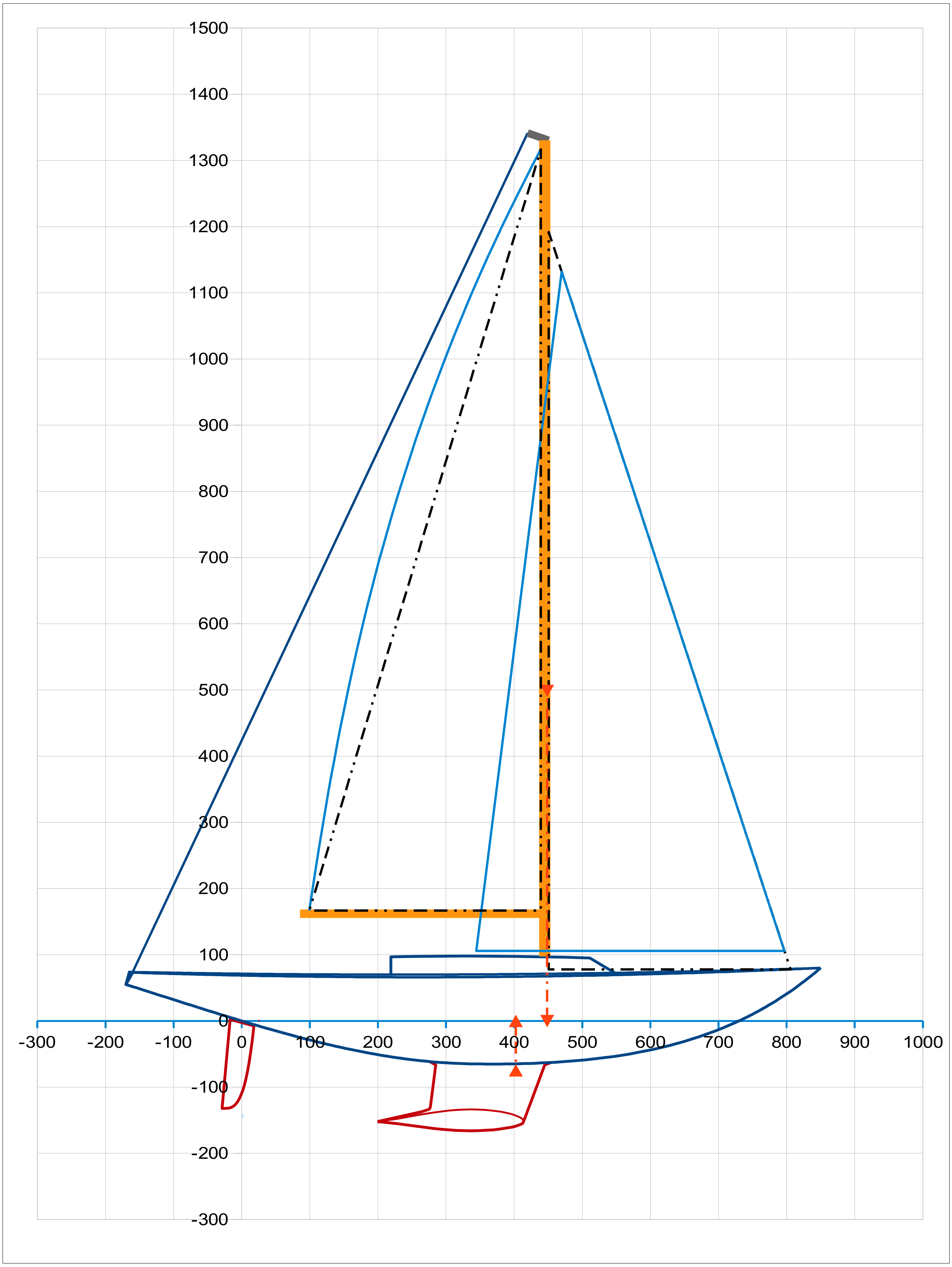
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Boat Classic 6m JI hydrostatics data :

2. Data sum-up and results of hydrostatic and surfaces calculations

2.1 Hull

Loa (m)	**10,20**	**Lwl (m)**	**7,30**		> Hull speed (Knots)	6,6	at Froude 0,4	
>> ft	*33,46*		*23,95*					
Boa (m)	**2,21**	**at X (% Lwl)**	**43,0**	Bsheer (m)	2,22	at X (% Lwl)	43,0	
>> ft	*7,26*							
Bwl (m)	**2,07**	**at X (% Lwl)**	**42,0**	> Bwl / Boa	0,935			
>> ft	*6,79*				**Freeboards (m) >**	**Aft**	**Midship**	**Fore**
Tc (m)	**0,652**	**at X (%Lwl)**	**50**			**0,73**	**0,66**	**0,8**
>> ft	*2,14*				*>> ft*	*2,40*	*2,17*	*2,62*
	Displacement at H0 (m3)	**3,71897**	**at LCB (m)**	**3,450**	**LCB (%Lwl)**	**47,25**	**ZCB (m)**	**-0,225**
	>> lbs	*8404*	*w. seawater*	*1025*	*kg/m3*		*>> ft*	*-0,74*
Cp	**0,534**							
Sf (m2)	**10,44**	**at LCF (m)**	**3,313**	**LCF (%Lwl)**	**45,39**		>>> LCB – LCF (%Lwl)	1,87
>> ft2	*112,35*	*>> ft*	*10,87*					
Angle Freeboard/Half beam		30,8	(°), at section C4 (40% Lwl)					
Sw (m2)	**12,81**	>Sw/D^(2/3)	5,34					
>> ft2	*137,88*							
Shull (m2)	**26,78**	**at X (m)**	**3,310**	**Z (m)**	**0,007**			
>> ft2	*288,21*	*>> ft*	*10,86*	*>> ft*	*0,02*			
Sdeck (m2)	**15,13**	**at X (m)**	**3,099**	**Z (m)**	**0,72**			
>> ft2	*162,90*	*>> ft*	*10,17*	*>> ft*	*2,37*			

2.2 Keel

Vol. keel(m3)	**0,21599**	**at X (m)**	**3,500**	**X (%Lwl)**	**47,94**	**Z (m)**	**-1,288**	
		>> ft	*11,48*			*>> ft*	*-4,23*	
Ballast (kg)	**2017,5**	**at X (m)**	**3,500**	**X (%Lwl)**	**47,94**	**Z (m)**	**-1,288**	
>> lbs	*4448*	*>> ft*	*11,48*			*>> ft*	*-4,23*	
Draft oa (m)	**1,66**		**Sw (m2)**	**4,49**		**Sxz (m2)**	**1,43**	
>> ft	*5,45*		*>> ft2*	*48,33*		*>> ft2*	*15,42*	
CLR (m)	**4,03**	**CLR (%Lwl)**	**55,14**	*CLR = Center of Lateral Resistance*				
>> ft	*13,21*	method: keel profile extended to the waterline, CLR at Z 45% draft and					25,00	% chord

2.3 Rudder(s)

Number	**1**							
Volume (m3)	**0,01200**	**at X (m)**	**-0,03**	**X (%Lwl)**	**-0,47**	**Z (m)**	**-0,59**	
Sw (m2)	**0,84**	*>> ft*	*-0,11*			**Sxz (m2)**	**0,40**	per rudder
>> ft2	*9,00*					*>> ft2*	*4,33*	

2.4 Hull + Keel + Rudder(s)

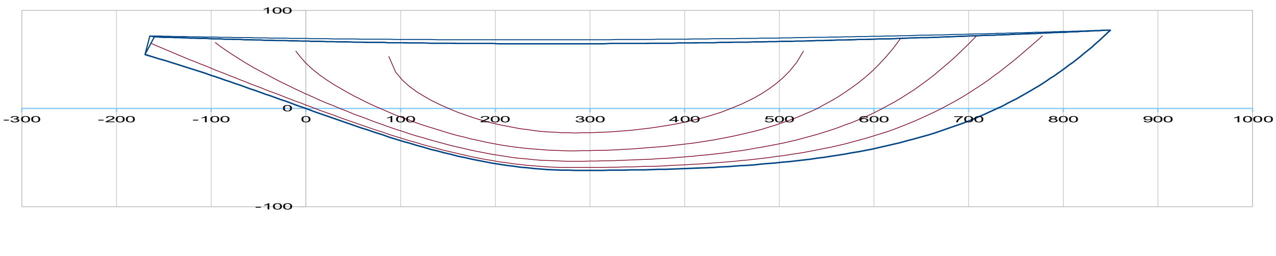
	Displacement at H0 (m3)	**3,94696**	**at LCB (m)**	**3,442**	**LCB (%Lwl)**	**47,15**	**at ZCB (m)**	**-0,285**
	(kg)	**4046**	*>> ft*	*11,29*			*>> ft*	*-0,93*
	>> lbs	*8919*						
	, of wich Ballast (kg)	**2018**	**at Xg (m)**	**3,500**	**Xg (%Lwl)**	**47,94**	**at Zg (m)**	**-1,288**
	>> lbs	*4448*	*>> ft*	*11,48*			*>> ft*	*-4,23*
	>> % Ballast	49,9						
	Sw (m2)	**18,14**	>Sw/D^(2/3)	7,26	Lwl/D^(1/3)	4,62		
	>> ft2	*195,21*			***DLR***	***290***	*M(lbs/2240)/(Lwl(ft)/100)^3*	

2.5 Data from the mass spreadsheet

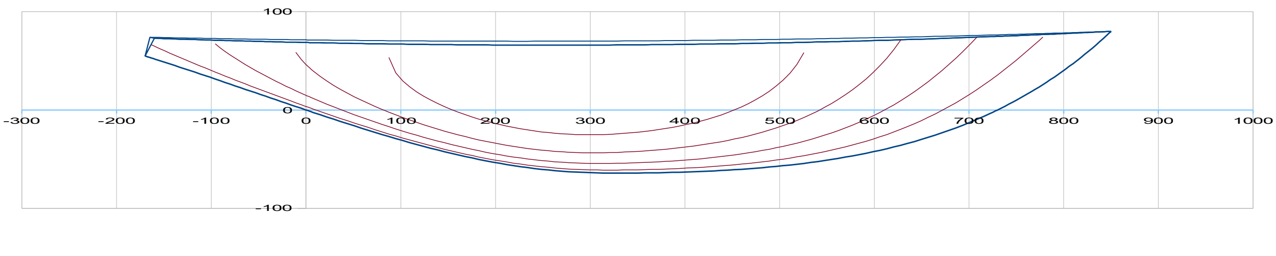
Light boat:	**M (kg)**	**4046**	**at Xg (m)**	**3,474**	**Xg (%Lwl)**	**47,59**	**at Zg (m)**	**-0,115**

Within Classic 6m JI, demonstration by images of the **« X Tc (%Lwl) » influence** , the longitudinal position of the maximum draft Tc of the hull body (with adjustment of Tc to maintain constant the displacement).

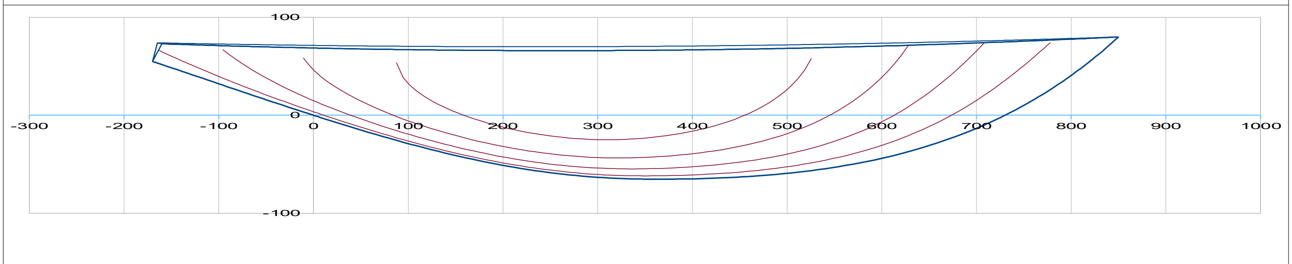
X Tc : 40 %Lwl >>> consequence : LCB hull : 45,60 % Lwl ; Cp hull : 0,540



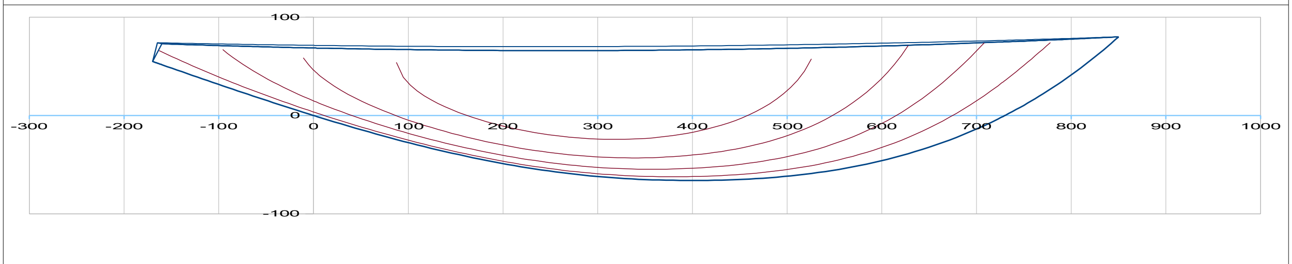
X Tc : 45 %Lwl >>> consequence : LCB hull : 46,44 % Lwl ; Cp hull : 0,536



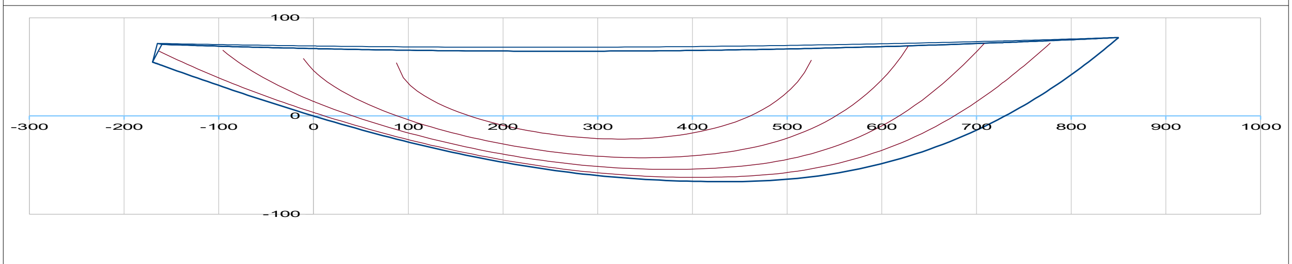
X Tc : 50 %Lwl >>> consequence : LCB hull : 47,25 % Lwl ; Cp hull : 0,534



X Tc : 55 %Lwl >>> consequence : LCB hull : 48,06 % Lwl ; Cp hull : 0,539



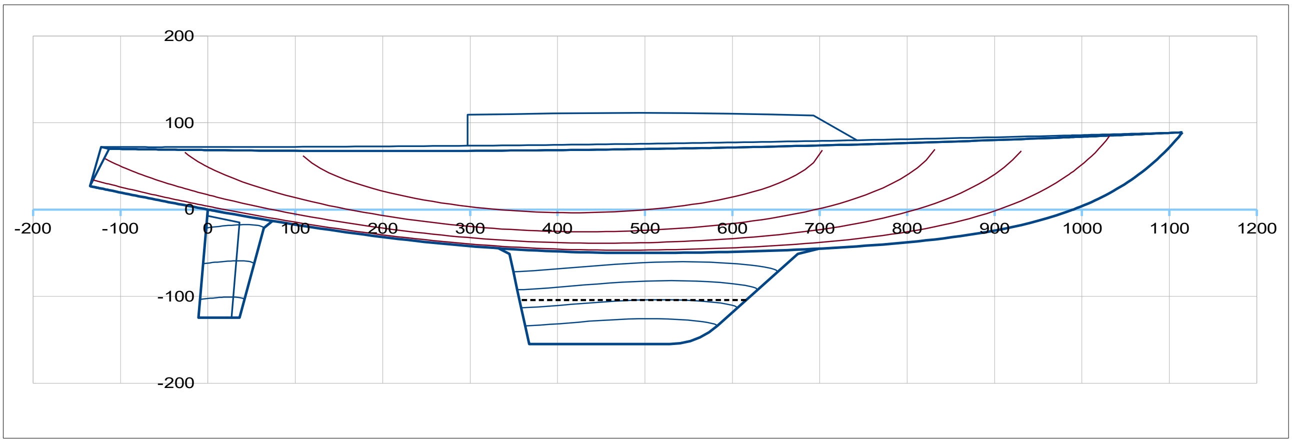
X Tc : 60 %Lwl >>> consequence : LCB hull : 48,85 % Lwl ; Cp hull : 0,545

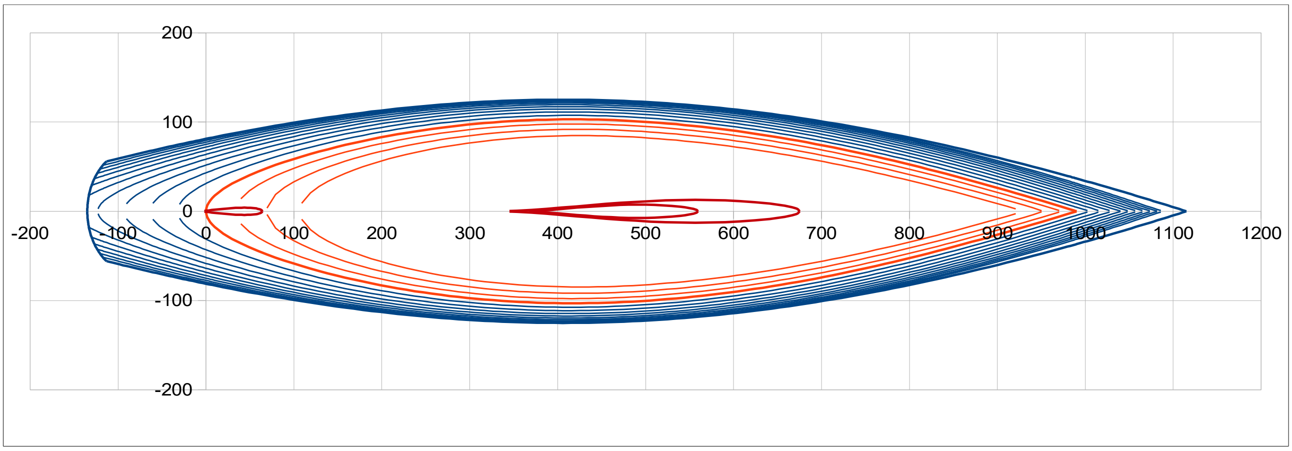


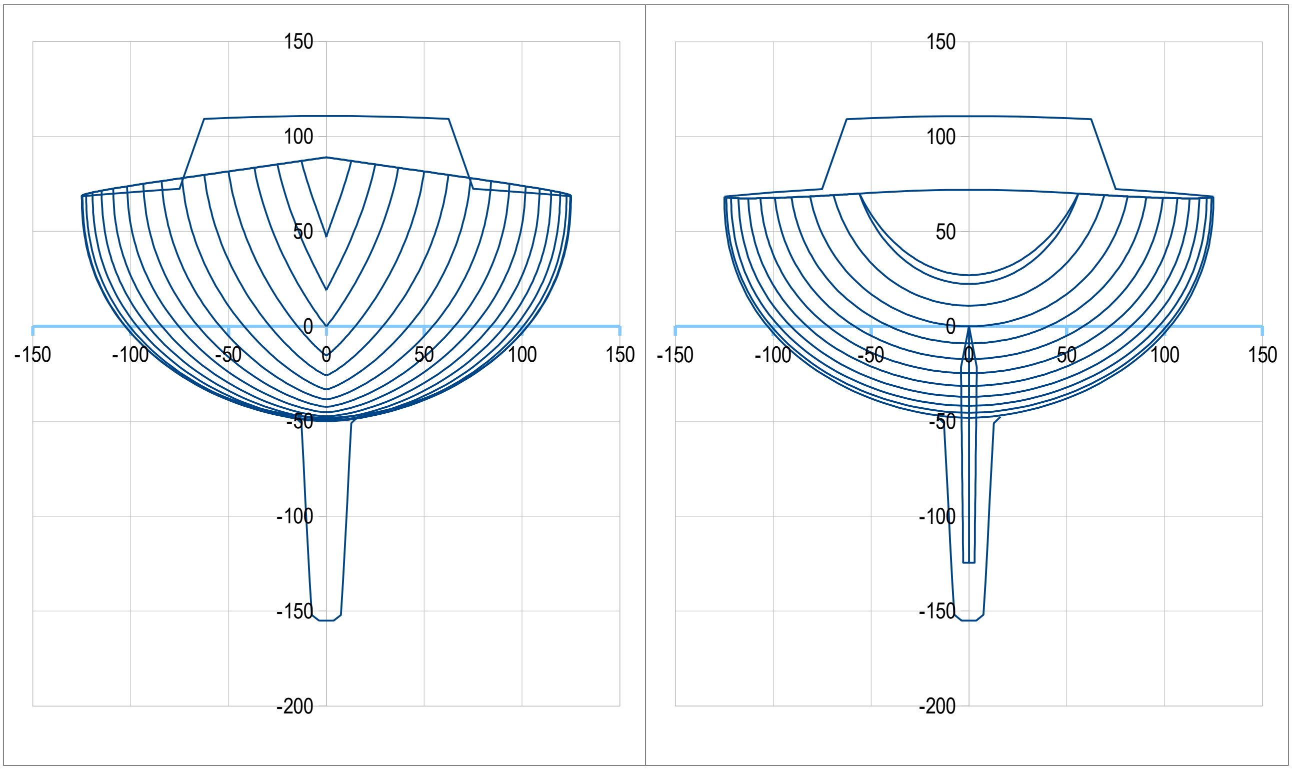
For the boat Classic 6m JI , « X Tc » is set to 50 %Lwl

S30, inspired by the S30 / Knud Reimers

Loa 12,50 m ; Lwl 9,9 m ; Boa 2,50 m ; Draft 1,55 m ; Displacement : 4269 kg ; Ballast : 1501 kg
>> LCB hull 47,73 %Lwl ; Cp hull : 0,543 ; Sw : 23,00 m2 ;   DLR : 123 ;   Ballast ratio : 35,2 %



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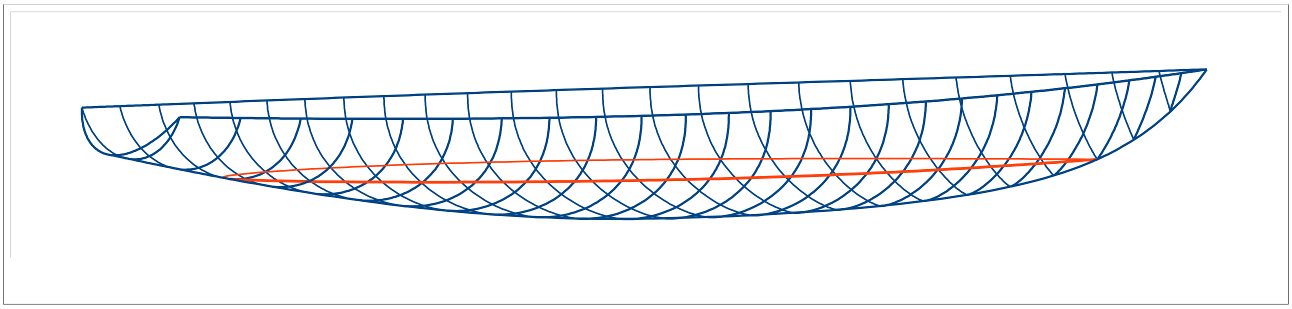

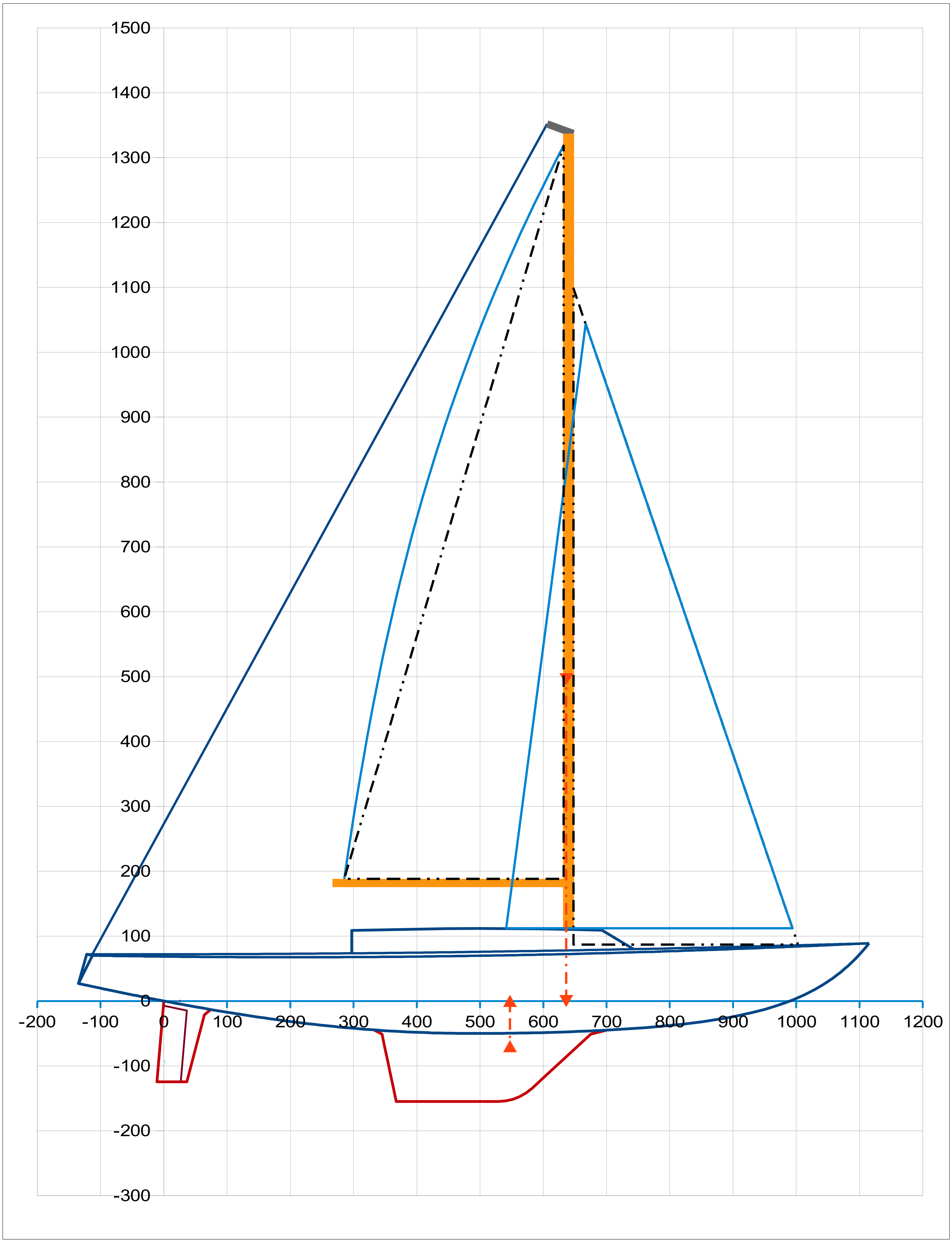
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Boat S30 hydrostatics data :

2. Data sum-up and results of hydrostatic and surfaces calculations

2.1 Hull

Loa (m)	**12,50**	**Lwl (m)**	**9,90**	> Hull speed (Knots)		7,7	at Froude 0,4	
>> ft	*41,01*		*32,48*					
Boa (m)	**2,50**	**at X (% Lwl)**	**41,0**	Bsheer (m)	2,50	at X (% Lwl)	41,0	
>> ft	*8,20*							
Bwl (m)	**2,06**	**at X (% Lwl)**	**42,0**	> Bwl / Boa	0,824			
>> ft	*6,76*				**Freeboards (m) >**	**Aft**	**Midship**	**Fore**
Tc (m)	**0,500**	**at X (%Lwl)**	**50**			**0,70**	**0,68**	**0,89**
>> ft	*1,64*				*>> ft*	*2,30*	*2,23*	*2,92*
	Displacement at H0 (m3)	**3,76325**	**at LCB (m)**	**4,725**	**LCB (%Lwl)**	**47,73**	**ZCB (m)**	**-0,173**
	>> lbs	*8504*	*w. seawater*	*1025*	*kg/m3*		*>> ft*	*-0,57*
Cp	**0,543**							
Sf (m2)	**13,96**	**at LCF (m)**	**4,526**	**LCF (%Lwl)**	**45,72**	>>> LCB – LCF (%Lwl)		2,01
>> ft2	*150,31*	*>> ft*	*14,85*					
Angle Freeboard/Half beam		28,7	(°), at section C4 (40% Lwl)					
Sw (m2)	**15,99**	>Sw/D^(2/3)	6,61					
>> ft2	*172,09*							
Shull (m2)	**35,46**	**at X (m)**	**4,642**	**Z (m)**	**0,062**			
>> ft2	*381,67*	*>> ft*	*15,23*	*>> ft*	*0,20*			
Sdeck (m2)	**21,93**	**at X (m)**	**4,316**	**Z (m)**	**0,76**			
>> ft2	*236,06*	*>> ft*	*14,16*	*>> ft*	*2,48*			

2.2 Keel

Vol. keel(m3)	**0,36903**	**at X (m)**	**5,133**	**X (%Lwl)**	**51,84**	**Z (m)**	**-0,927**	
		>> ft	*16,84*			*>> ft*	*-3,04*	
Ballast (kg)	**1501,3**	**at X (m)**	**4,969**	**X (%Lwl)**	**50,19**	**Z (m)**	**-1,221**	
>> lbs	*3310*	*>> ft*	*16,30*			*>> ft*	*-4,01*	
Draft oa (m)	**1,55**		**Sw (m2)**	**5,65**		**Sxz (m2)**	**2,93**	
>> ft	*5,09*		*>> ft2*	*60,83*		*>> ft2*	*31,49*	
CLR (m)	**5,47**	**CLR (%Lwl)**	**55,29**	*CLR = Center of Lateral Resistance*				
>> ft	*17,96*	method: keel profile extended to the waterline, CLR at Z 45% draft and					35,00	% chord

2.3 Rudder(s)

Number	**1**							
Volume (m3)	**0,03269**	**at X (m)**	**0,27**	**X (%Lwl)**	**2,69**	**Z (m)**	**-0,60**	
Sw (m2)	**1,36**	*>> ft*	*0,87*			**Sxz (m2)**	**0,65**	per rudder
>> ft2	*14,64*					*>> ft2*	*7,04*	

2.4 Hull + Keel + Rudder(s)

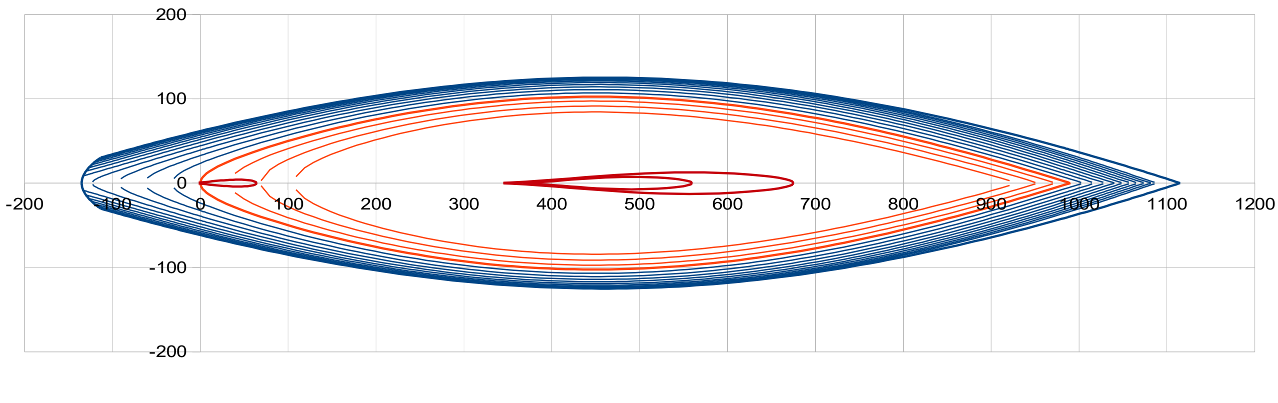
	Displacement at H0 (m3)	**4,16497**	**at LCB (m)**	**4,726**	**LCB (%Lwl)**	**47,74**	**at ZCB (m)**	**-0,243**
	(kg)	**4269**	*>> ft*	*15,51*			*>> ft*	*-0,80*
	>> lbs	*9412*						
	, of wich Ballast (kg)	**1501**	**at Xg (m)**	**4,969**	**Xg (%Lwl)**	**50,19**	**at Zg (m)**	**-1,221**
	>> lbs	*3310*	*>> ft*	*16,30*			*>> ft*	*-4,01*
	>> % Ballast	35,2						
	Sw (m2)	**23,00**	>Sw/D^(2/3)	8,88	Lwl/D^(1/3)	6,15		
	>> ft2	*247,56*			***DLR***	***123***	*M(lbs/2240)/(Lwl(ft)/100)^3*	

2.5 Data from the mass spreadsheet

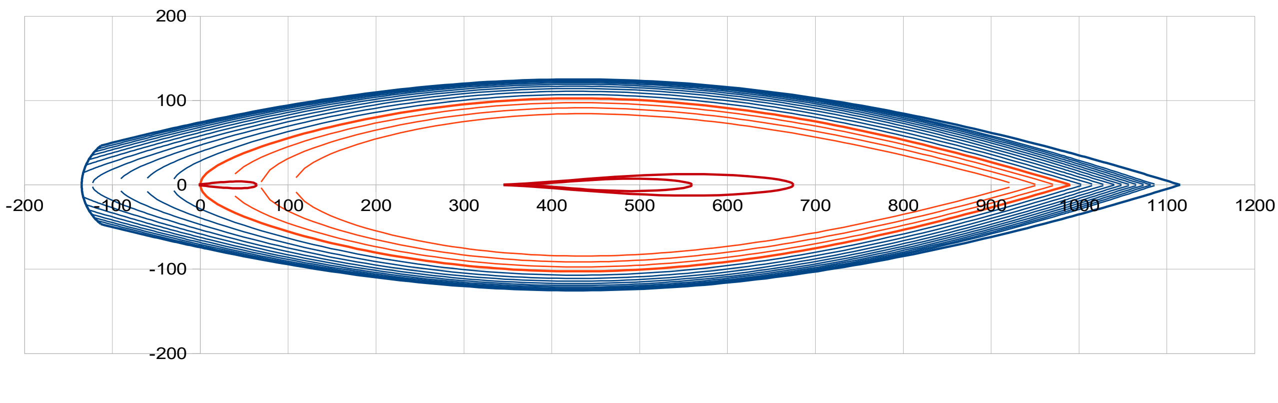
Light boat:	**M (kg)**	**4269**	**at Xg (m)**	**4,725**	**Xg (%Lwl)**	**47,72**	**at Zg (m)**	**-0,088**

Within S30, demonstration by images of the **« X Bg (%Lwl) » influence** , the longitudinal position of the maximum beam Bg of the generic hull **+ Bg slight adjustement** to maintain Boa = 2,50m .

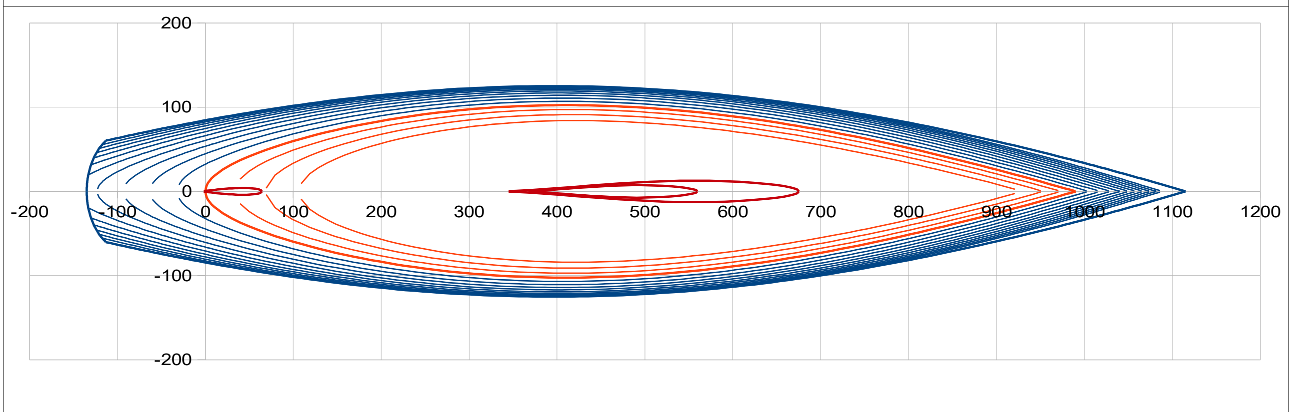
X Bg = 48 % Lwl & Bg 2,354 m >> Boa = 2,50 m ; X Boa = 46 % Lwl ; LCB = 48,66 % Lwl ; Cp = 0,540



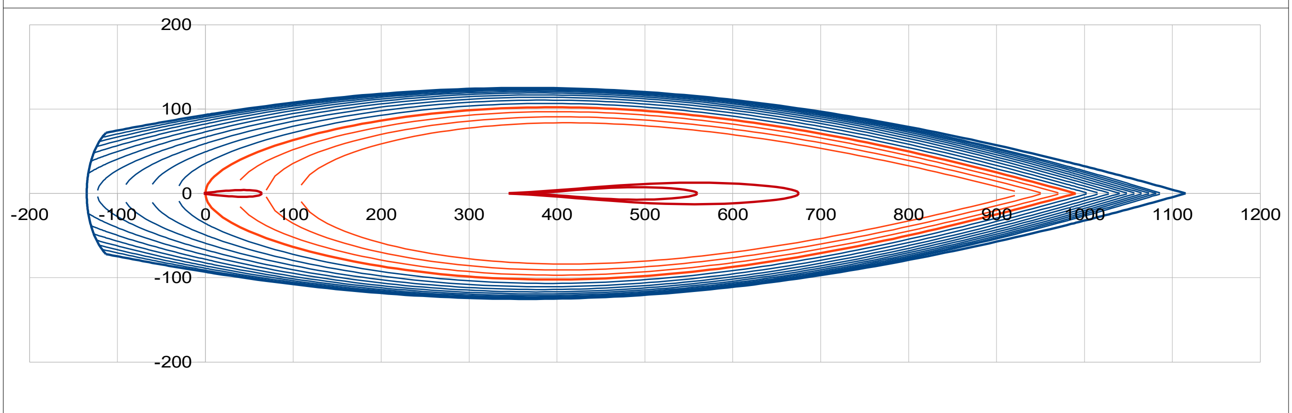
X Bg = 45 % Lwl & Bg 2,348 m >> Boa = 2,50 m ; X Boa = 43 % Lwl ; LCB = 48,06 % Lwl ; Cp = 0,542



X Bg = 42 % Lwl & Bg 2,339 m >> Boa = 2,50 m ; X Boa = 40 % Lwl ; LCB = 47,55 % Lwl ; Cp = 0,544

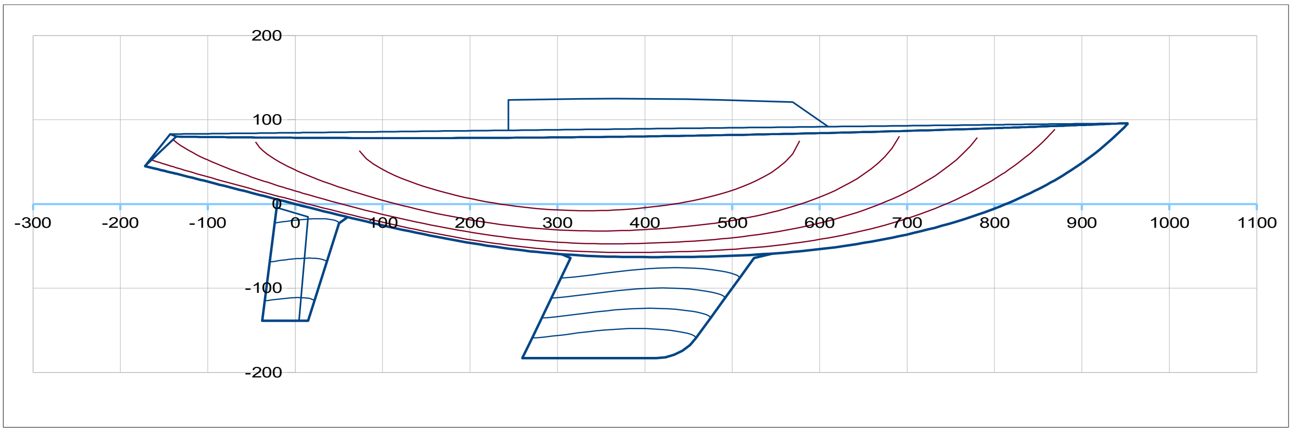


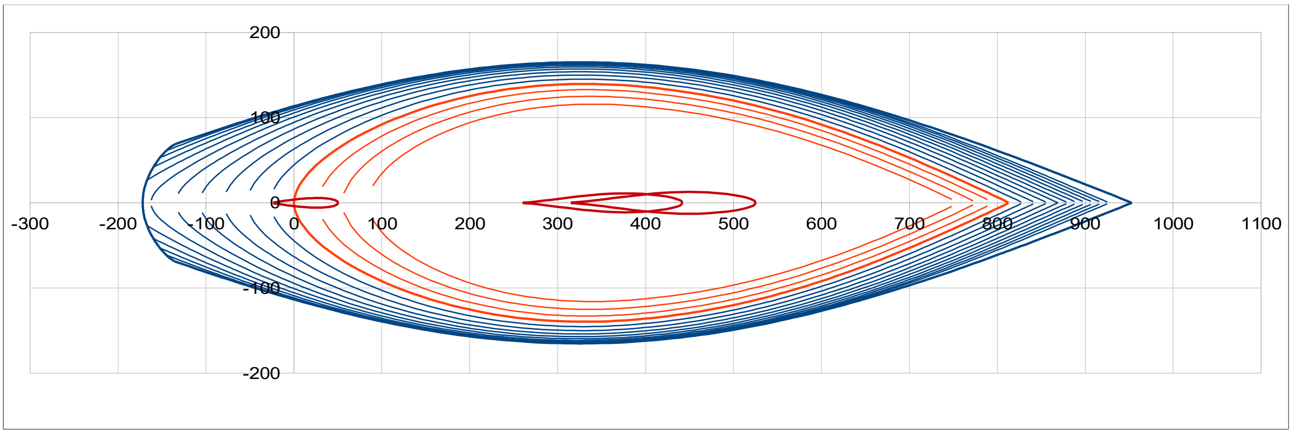
X Bg = 39 % Lwl & Bg 2,334 m >> Boa = 2,50 m ; X Boa = 37 % Lwl ; LCB = 47,12 % Lwl ; Cp = 0,546

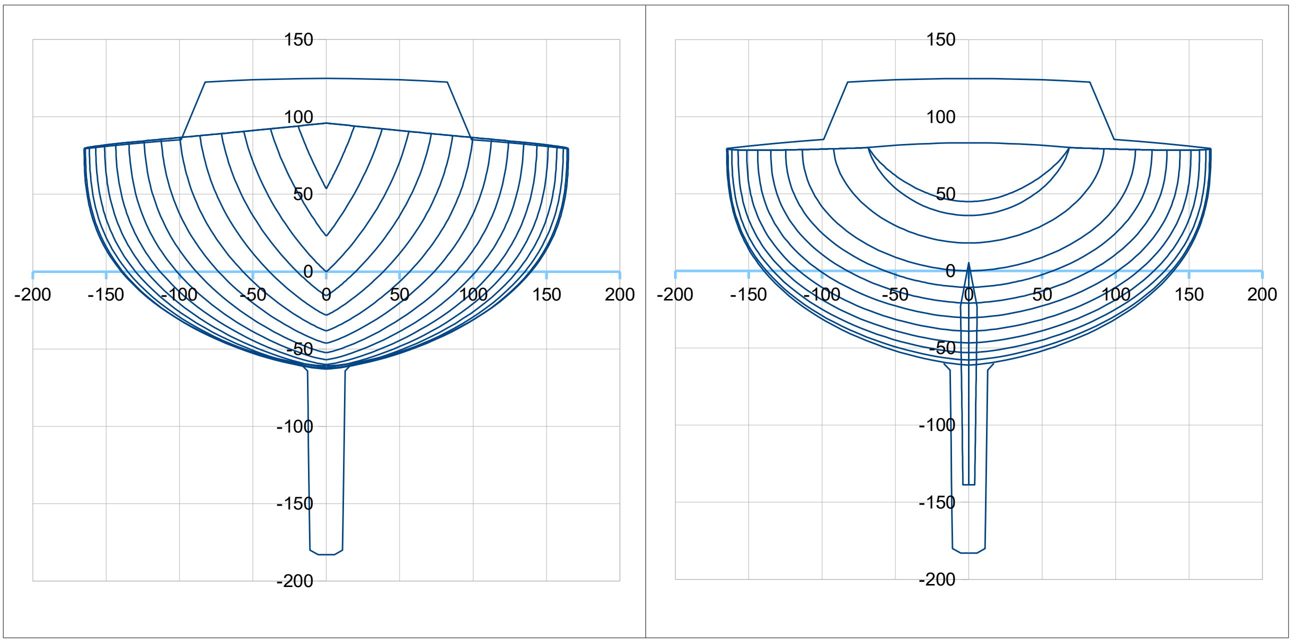


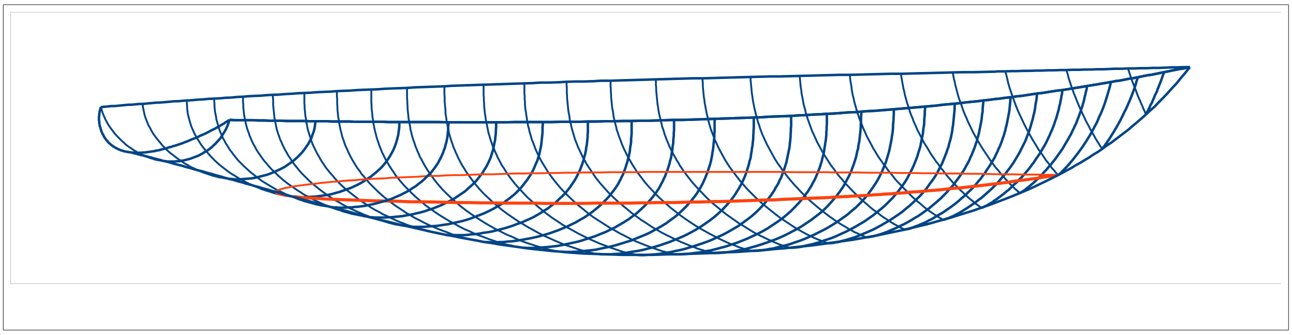
T37, inspired by Tina / Dick Carter

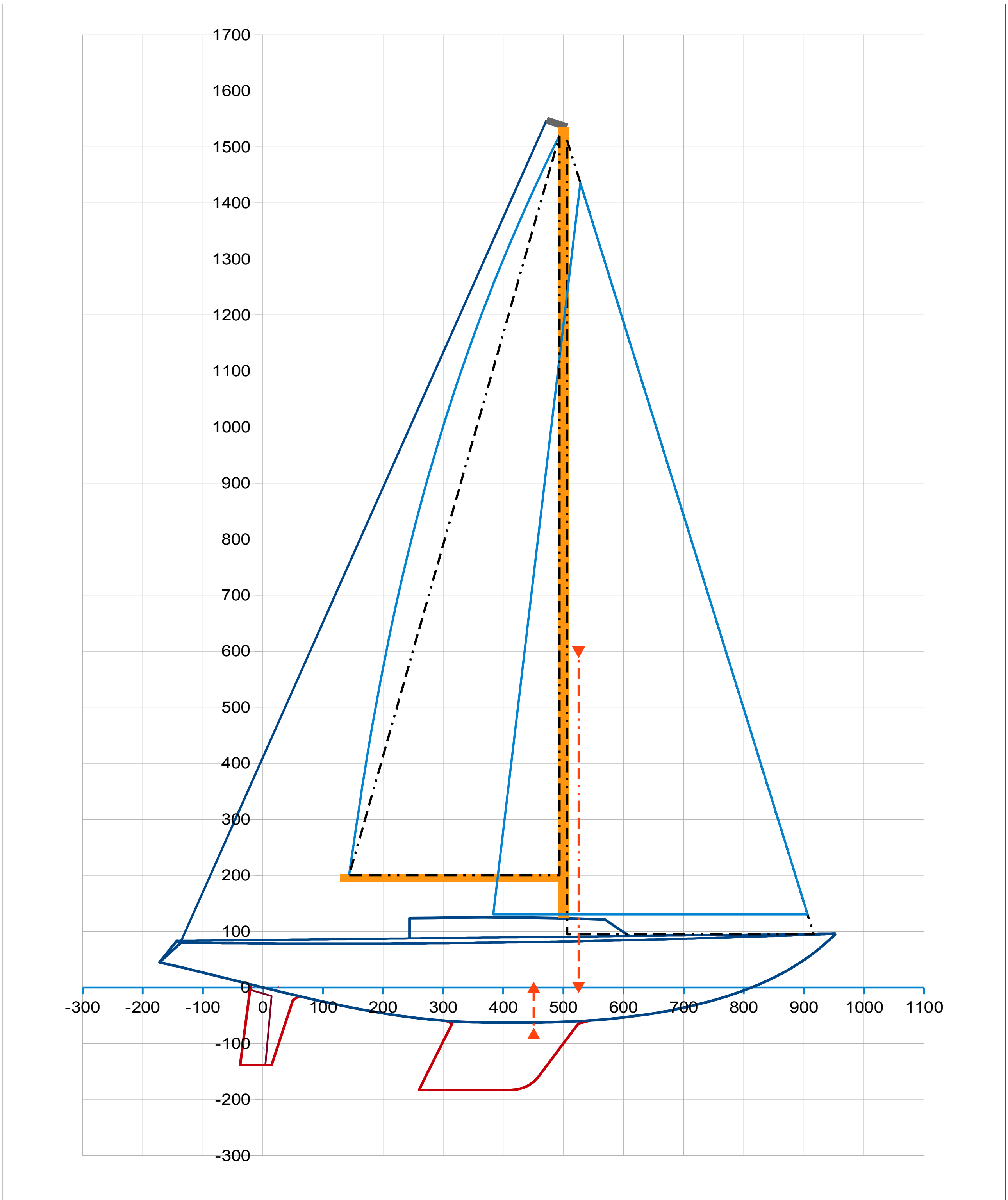
Loa 11,25 m ; Lwl 8,13 m ; B 3,30 m ; Draft 1,83 m ; Displacement : 5647 kg ; Ballast : 2669 kg
>> LCB hull 47,32 %Lwl ; Cp hull : 0,543 ; Sw : 24,17 m2 ; DLR : 293 ; Ballast ratio : 47,3 %







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Boat T37 hydrostatics data :

2. Data sum-up and results of hydrostatic and surfaces calculations

2.1 Hull

Loa (m)	11,25			Lwl (m)	8,13					> Hull speed (Knots)	6,9	at Froude 0,4			
>> ft	36,91				26,67										
Boa (m)	3,30			at X (% Lwl)	40,0			Bsheer (m)	3,30			at X (% Lwl)	40,0		
>> ft	10,83														
Bwl (m)	2,79			at X (% Lwl)	41,0			> Bwl / Boa	0,846						
>> ft	9,16									Freeboards (m) >	Aft		Midship		Fore
Tc (m)	0,630			at X (%Lwl)	50						0,80		0,79		0,96
>> ft	2,07									>> ft	2,62		2,59		3,15
		Displacement at H0 (m3)	5,08827			at LCB (m)	3,847			LCB (%Lwl)	47,32			ZCB (m)	-0,212
		>> lbs	11498			w. seawater	1025		kg/m3					>> ft	-0,69
Cp	0,543														
Sf (m2)	15,65			at LCF (m)	3,691			LCF (%Lwl)	45,40					>>> LCB – LCF (%Lwl)	1,92
>> ft2	168,50			>> ft	12,11										
Angle Freeboard/Half beam			25,7		(°), at section C4 (40% Lwl)										
Sw (m2)	17,45			>Sw/D^(2/3)	5,90										
>> ft2	187,81														
Shull (m2)	37,92			at X (m)	3,645			Z (m)	0,045						
>> ft2	408,20			>> ft	11,96			>> ft	0,15						
Sdeck (m2)	25,15			at X (m)	3,455			Z (m)	0,86						
>> ft2	270,71			>> ft	11,33			>> ft	2,83						

2.2 Keel

Vol. keel(m3)	0,36490			at X (m)	4,033			X (%Lwl)	49,61			Z (m)	-1,199		
				>> ft	13,23							>> ft	-3,93		
Ballast (kg)	2669,1			at X (m)	4,066			X (%Lwl)	50,01			Z (m)	-1,143		
>> lbs	5884			>> ft	13,34							>> ft	-3,75		
Draft oa (m)	1,83					Sw (m2)	4,99					Sxz (m2)	2,45		
>> ft	6,00					>> ft2	53,71					>> ft2	26,35		
CLR (m)	4,51			CLR (%Lwl)	55,43	*CLR = Center of Lateral Resistance*									
>> ft	14,78	method: keel profile extended to the waterline, CLR at Z 45% draft and											30,00		% chord

2.3 Rudder(s)

Number	1														
Volume (m3)	0,05642			at X (m)	0,07			X (%Lwl)	0,82			Z (m)	-0,67		
Sw (m2)	1,73			>> ft	0,22							Sxz (m2)	0,83		per rudder
>> ft2	18,61											>> ft2	8,95		

2.4 Hull + Keel + Rudder(s)

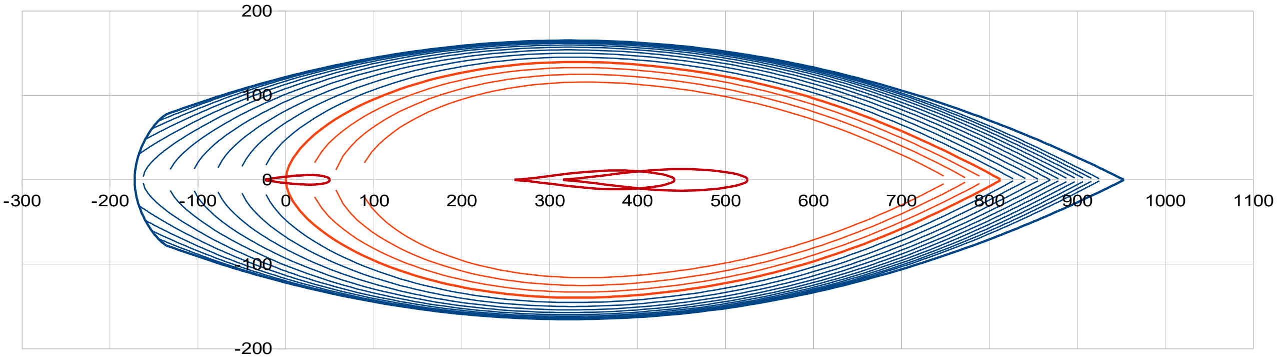
		Displacement at H0 (m3)	5,50959			at LCB (m)	3,821			LCB (%Lwl)	47,00			at ZCB (m)	-0,282
		(kg)	5647			>> ft	12,54							>> ft	-0,92
		>> lbs	12450												
		, of wich Ballast (kg)	2669			at Xg (m)	4,066			Xg (%Lwl)	50,01			at Zg (m)	-1,143
		>> lbs	5884			>> ft	13,34							>> ft	-3,75
		>> % Ballast	47,3												
		Sw (m2)	24,17			>Sw/D^(2/3)	7,75			Lwl/D^(1/3)	4,60				
		>> ft2	260,13							**DLR**	**293**	M(lbs/2240)/(Lwl(ft)/100)^3			

2.5 Data from the mass spreadsheet

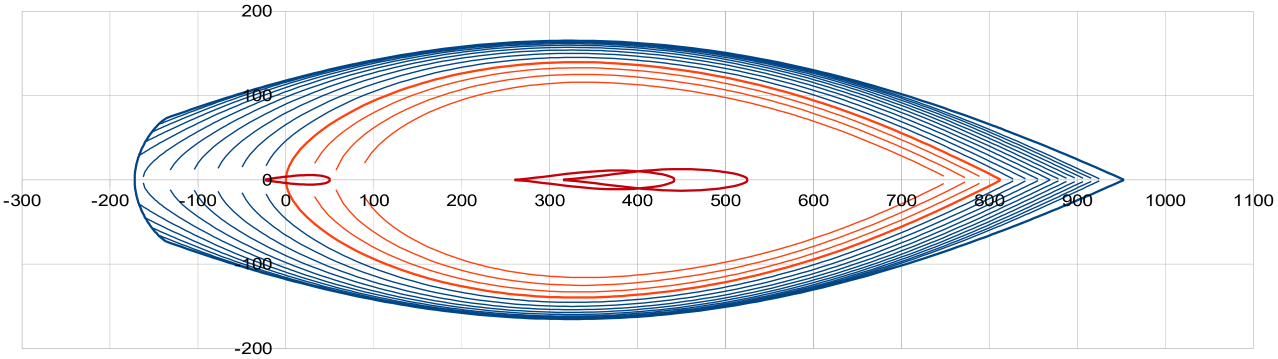
Light boat:		M (kg)	5647			at Xg (m)	3,912			Xg (%Lwl)	48,11			at Zg (m)	0,028

Within T37, demonstration by images of the **« Cor Pui liv » influence**, giving more or less strectched waterlines at fore and rear ends .

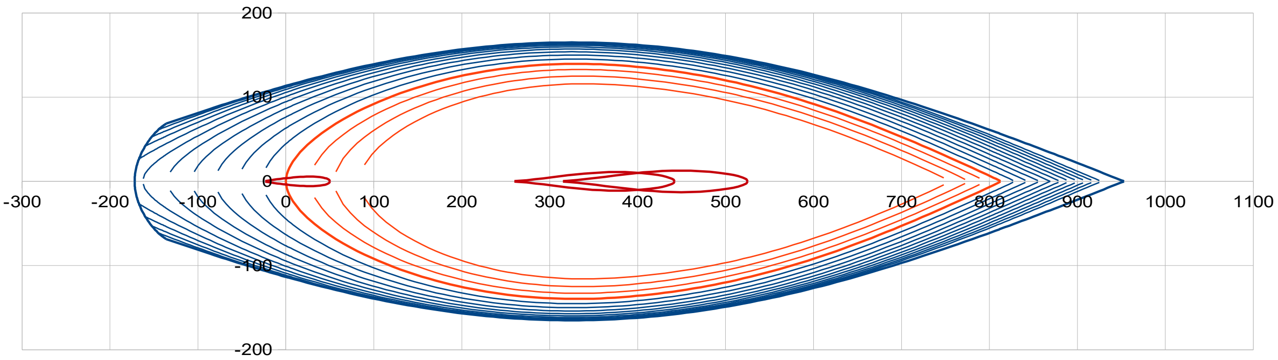
Cor Pui liv = 0 >>>



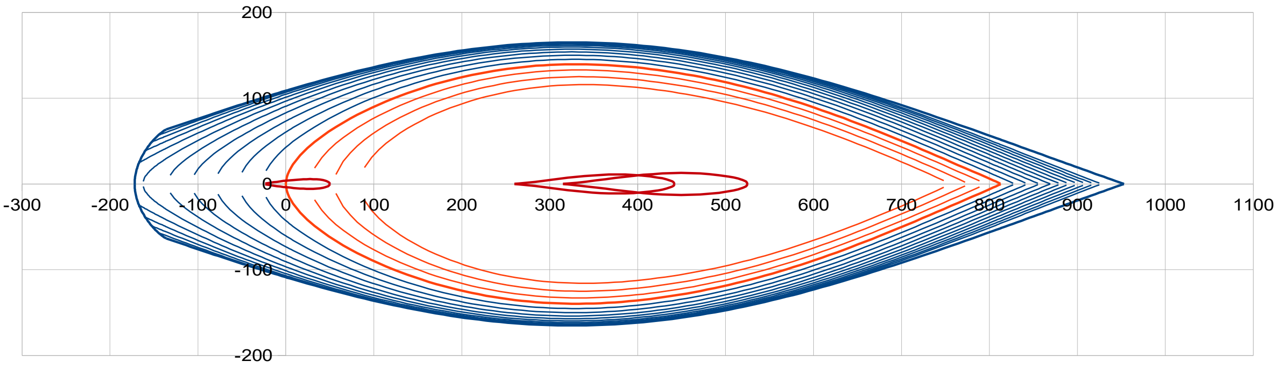
Cor Pui liv = 0,02 >>>



Cor Pui liv = 0,04 (T37 choice) >>>

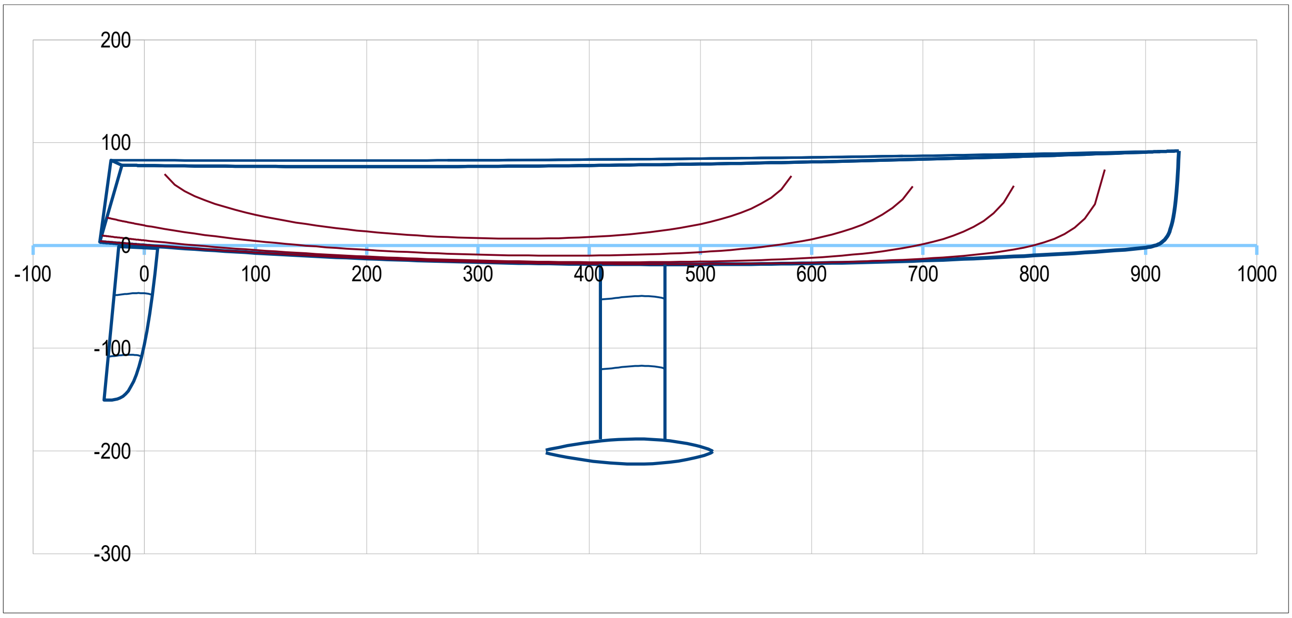


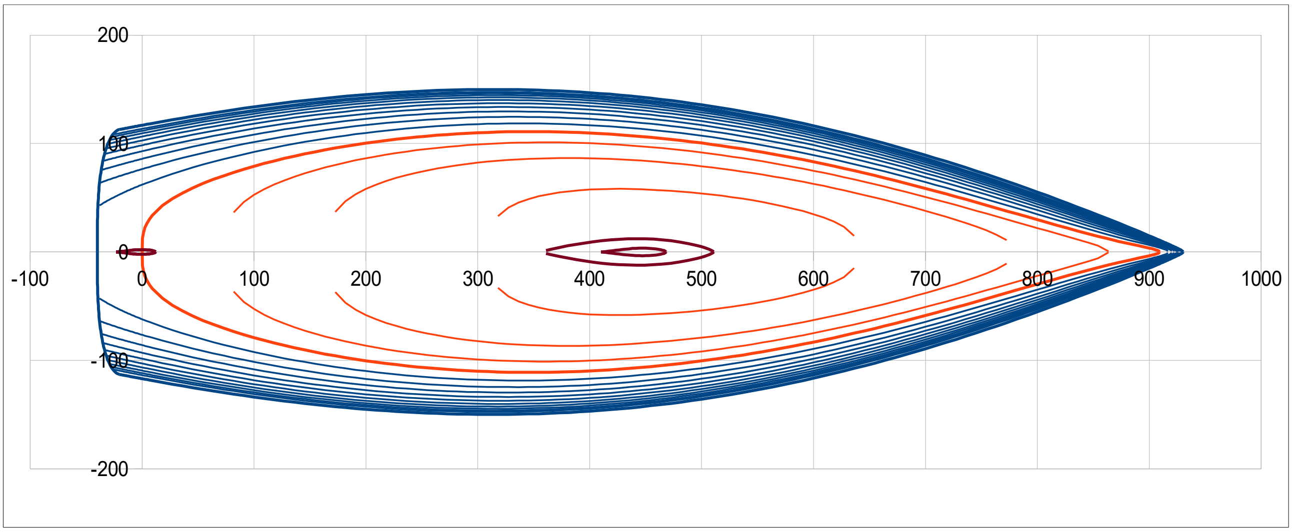
Cor Pui liv = 0,06 >>>

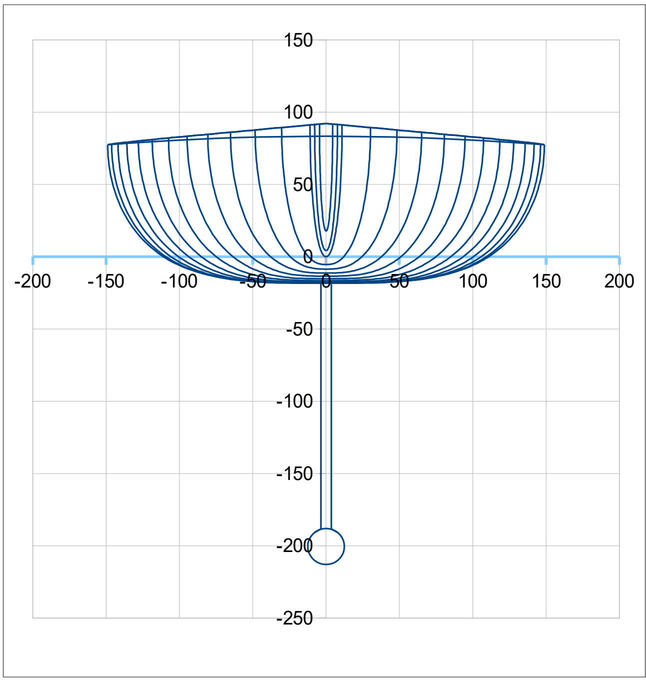


M32, inspired by Melges 32 / Reichel Pugh

Loa 9,70 m ; Lwl 9,09 m ; B 3,00 m ; Draft 2,13 m ; Displacement : 1722 kg ; Ballast : 775 kg
>> LCB hull 46,41 %Lwl ; Cp hull : 0,553 ; Sw : 17,92 m2 ; DLR : 64 ; Ballast ratio : 45,0 %



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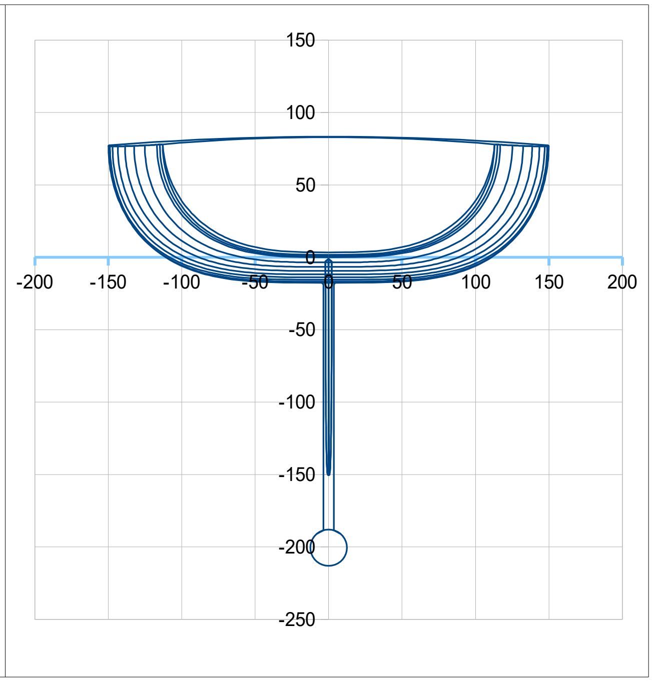
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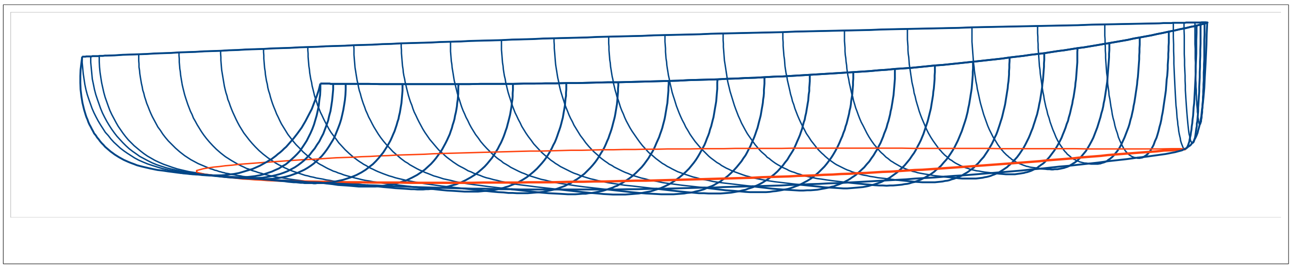

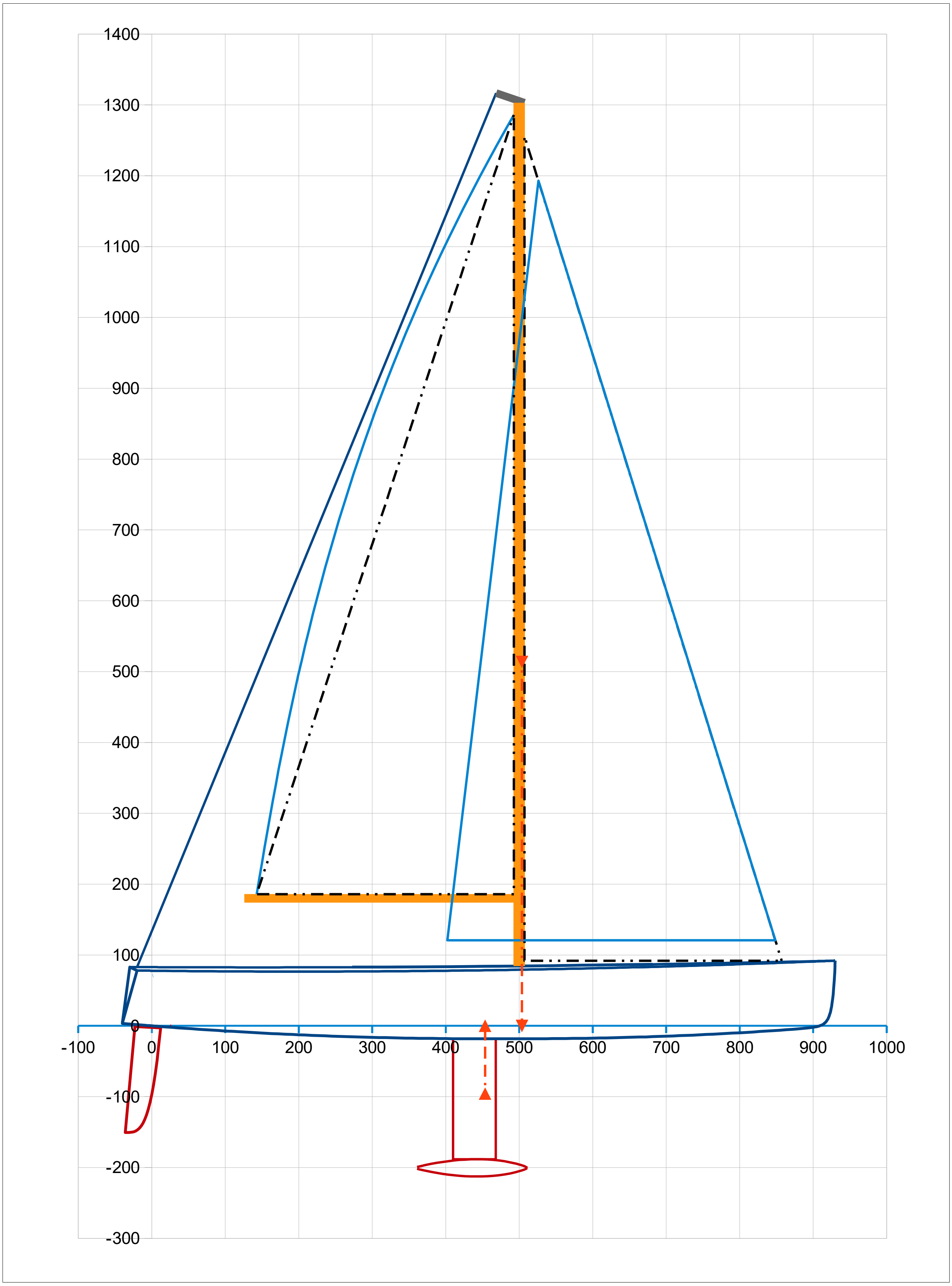
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Boat M32 hydrostatics data :

2. Data sum-up and results of hydrostatic and surfaces calculations

2.1 Hull

Loa (m)	9,70	Lwl (m)	9,09	> Hull speed (Knots)	7,3	at Froude 0,4		
>> ft	31,82		29,82					
Boa (m)	3,00	at X (% Lwl)	34,0	Bsheer (m)	3,00	at X (% Lwl)	34,0	
>> ft	9,83							
Bwl (m)	2,22	at X (% Lwl)	38,0	> Bwl / Boa	0,741			
>> ft	7,29			Freeboards (m) >	Aft		Midship	Fore
Tc (m)	0,184	at X (%Lwl)	52		0,78		0,77	0,92
>> ft	0,60			>> ft	2,56		2,53	3,02
Displacement at H0 (m3)	1,58424	at LCB (m)	4,219	LCB (%Lwl)	46,41	ZCB (m)		-0,070
>> lbs	3580	w. seawater	1025	kg/m3		>> ft		-0,23
Cp	0,553							
Sf (m2)	13,91	at LCF (m)	3,932	LCF (%Lwl)	43,25	>>> LCB – LCF (%Lwl)		3,16
>> ft2	149,75	>> ft	12,90					
Angle Freeboard/Half beam	27,5	(°), at section C4 (40% Lwl)						
Sw (m2)	14,18	>Sw/D^(2/3)	10,44					
>> ft2	152,66							
Shull (m2)	32,64	at X (m)	4,130	Z (m)	0,148			
>> ft2	351,32	>> ft	13,55	>> ft	0,48			
Sdeck (m2)	21,37	at X (m)	3,773	Z (m)	0,83			
>> ft2	230,05	>> ft	12,38	>> ft	2,73			

2.2 Keel

Vol. keel(m3)	0,08429	at X (m)	4,417	X (%Lwl)	48,59	Z (m)	-1,489	
		>> ft	14,49			>> ft	-4,89	
Ballast (kg)	775,4	at X (m)	4,412	X (%Lwl)	48,54	Z (m)	-1,596	
>> lbs	1709	>> ft	14,47			>> ft	-5,24	
Draft oa (m)	2,13			Sw (m2)	2,78	Sxz (m2)	1,24	
>> ft	6,99			>> ft2	29,92	>> ft2	13,38	
CLR (m)	4,54	CLR (%Lwl)	49,89	CLR = Center of Lateral Resistance				
>> ft	14,88	method: keel profile extended to the waterline, CLR at Z 45% draft and					25,00	% chord

2.3 Rudder(s)

Number	1							
Volume (m3)	0,01133	at X (m)	-0,10	X (%Lwl)	-1,07	Z (m)	-0,64	
Sw (m2)	0,96	>> ft	-0,32			Sxz (m2)	0,46	per rudder
>> ft2	10,28					>> ft2	4,94	

2.4 Hull + Keel + Rudder(s)

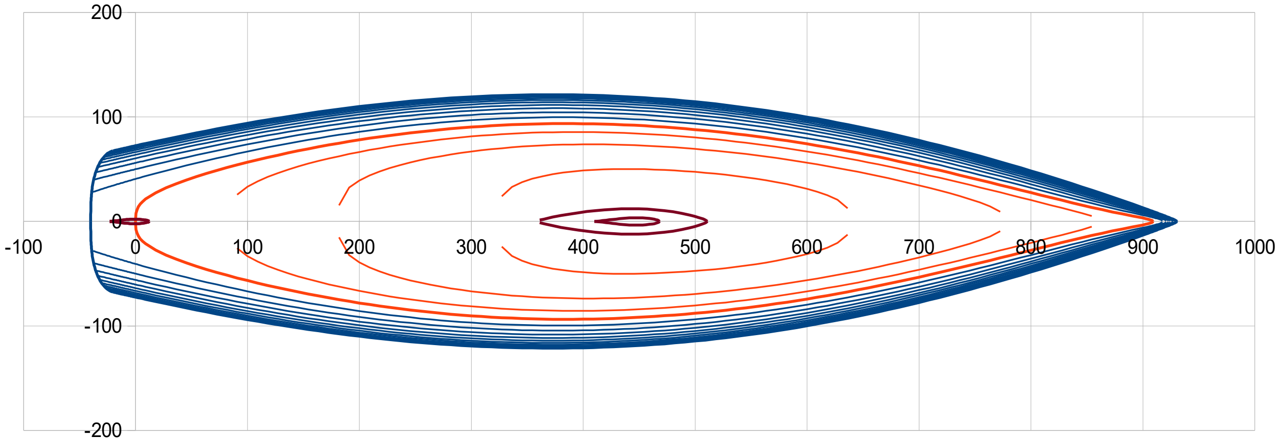
Displacement at H0 (m3)	1,67986	at LCB (m)	4,200	LCB (%Lwl)	46,20	at ZCB (m)	-0,145
(kg)	1722	>> ft	13,78			>> ft	-0,47
>> lbs	3796						
, of wich Ballast (kg)	775	at Xg (m)	4,412	Xg (%Lwl)	48,54	at Zg (m)	-1,596
>> lbs	1709	>> ft	14,47			>> ft	-5,24
>> % Ballast	45,0						
Sw (m2)	17,92	>Sw/D^(2/3)	12,68	Lwl/D^(1/3)	7,65		
>> ft2	192,85			**DLR**	**64**	M(lbs/2240)/(Lwl(ft)/100)^3	

2.5 Data from the mass spreadsheet

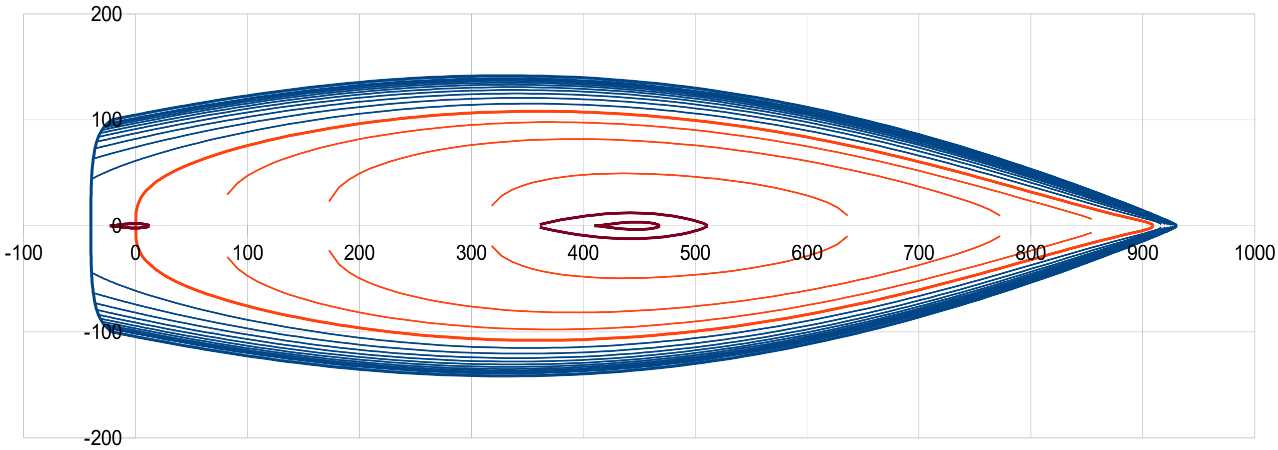
Light boat:	M (kg)	1722	at Xg (m)	4,218	Xg (%Lwl)	46,41	at Zg (m)	-0,209

Within M32, demonstration by images of the **« Alpha » influence**, acting on the hull body opening with the bow end as center of rotation + adjustement of hull draft Tc to keep constant the displacement in this serie.

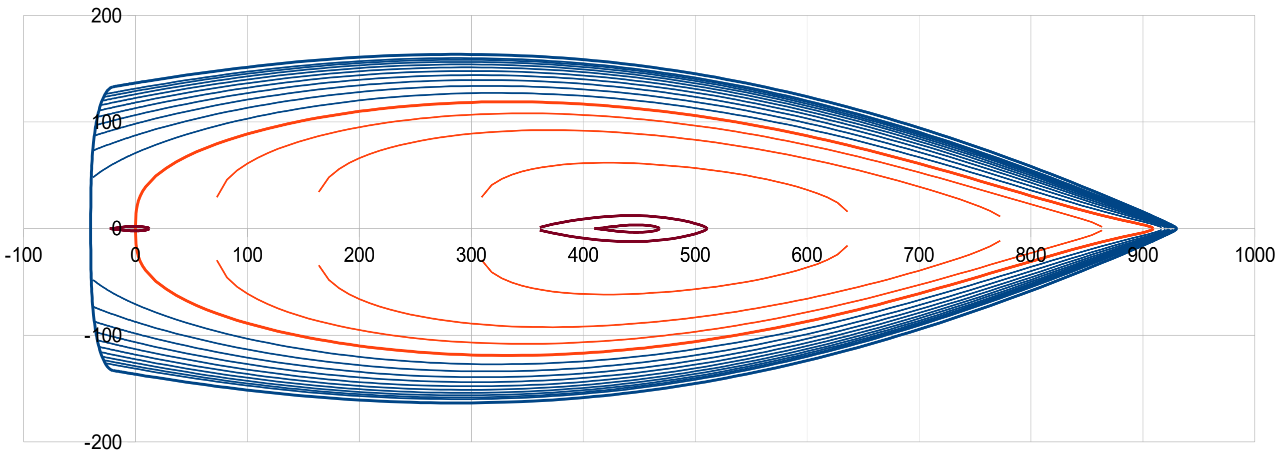
Alpha (°) = 4 and Tc = 0,221 m >>> Boa = 2,42 m ; LCB = 47,98 % Lwl ; Cp = 0,539



Alpha (°) = 6 and Tc = 0,192 m >>> Boa = 2,83 m ; LCB = 46,8 % Lwl ; Cp = 0,549



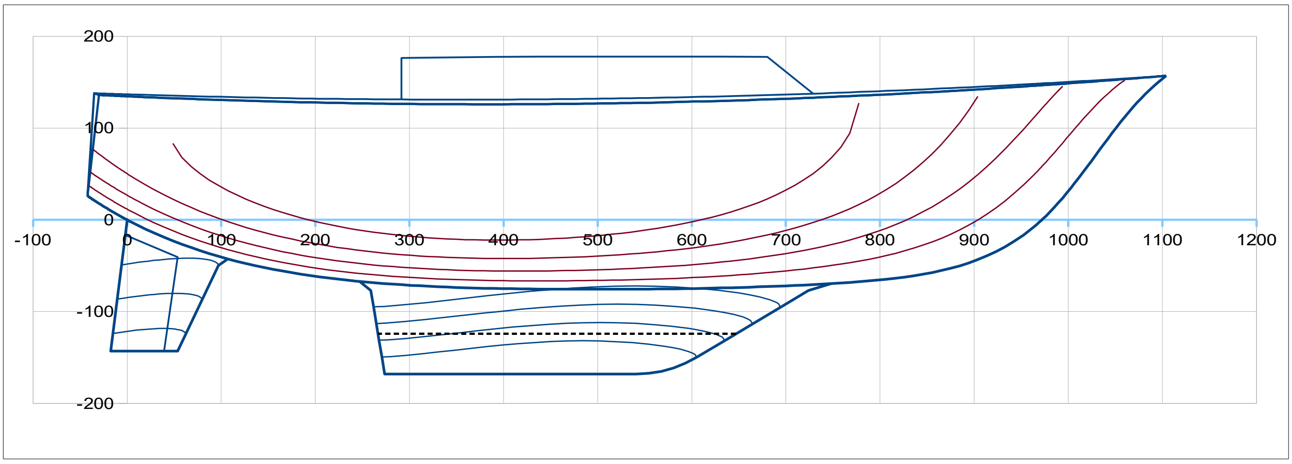
Alpha (°) = 8 and Tc = 0,171 m >>> Boa = 3,27 m ; LCB = 45,89 % Lwl ; Cp = 0,559

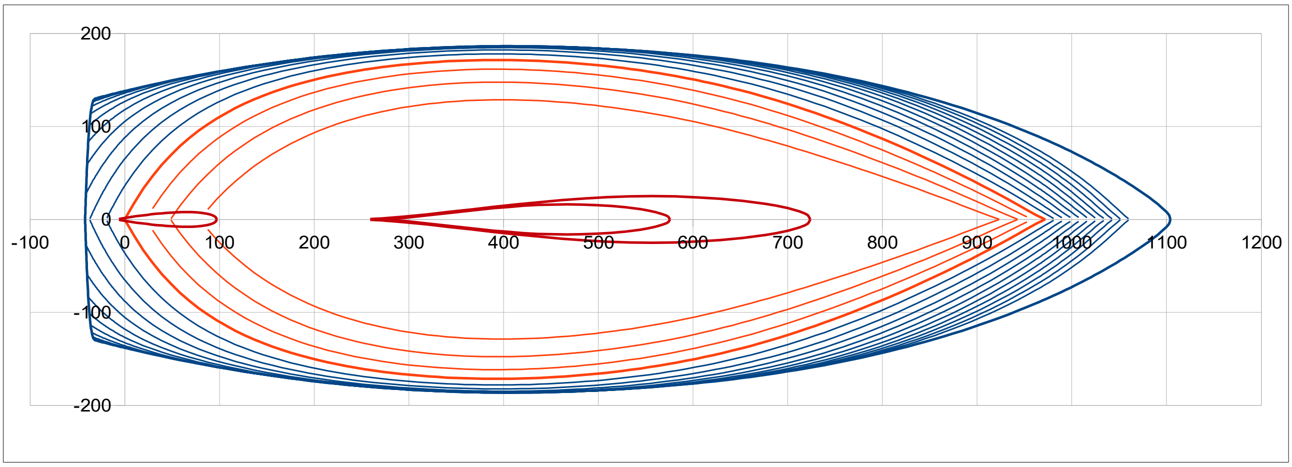


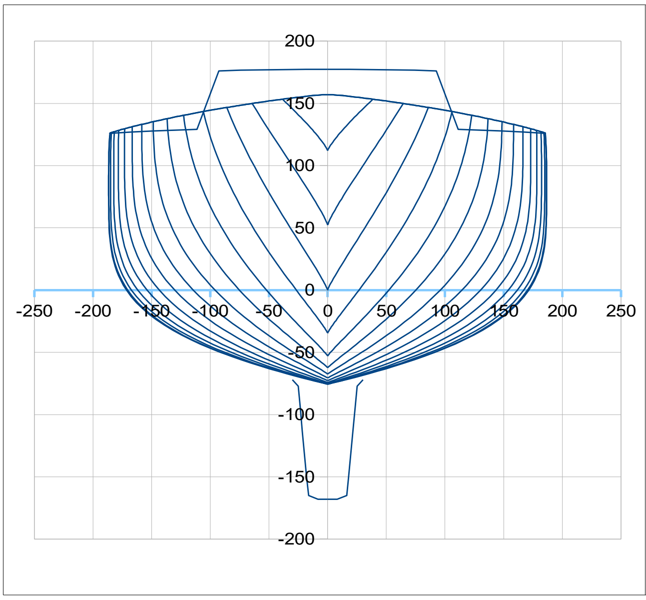
M32 choice is Alpha (°) = 6,77 and Tc = 0,1836 m

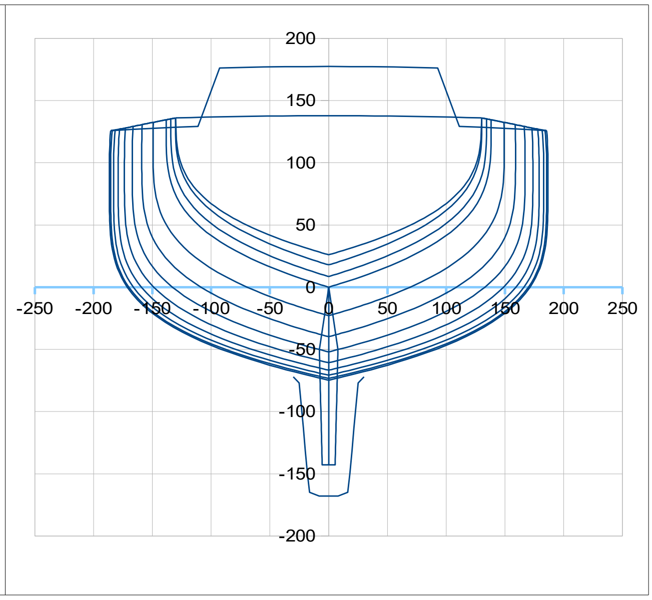
Blue Water 39, inspired by Corbin 39 / Robert Dufour – Marius Corbin

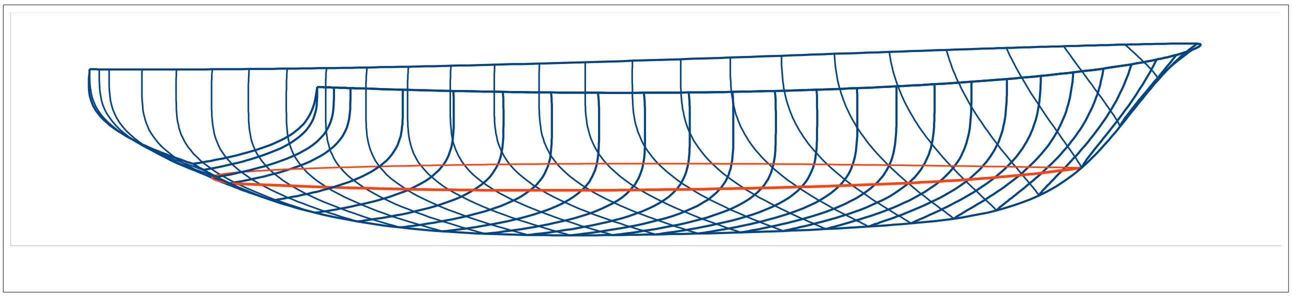
Loa 11,46 m ; Lwl 9,72 m ; B 3,73 m ; Draft 1,68 m ; Displacement : 10891 kg ; Ballast : 4073 kg
>> LCB hull 46,8 %Lwl ; Cp hull (%): 0,598 ; Sw : 36,60 m2 ;   DLR : 331 ;   Ballast ratio : 37,4 %

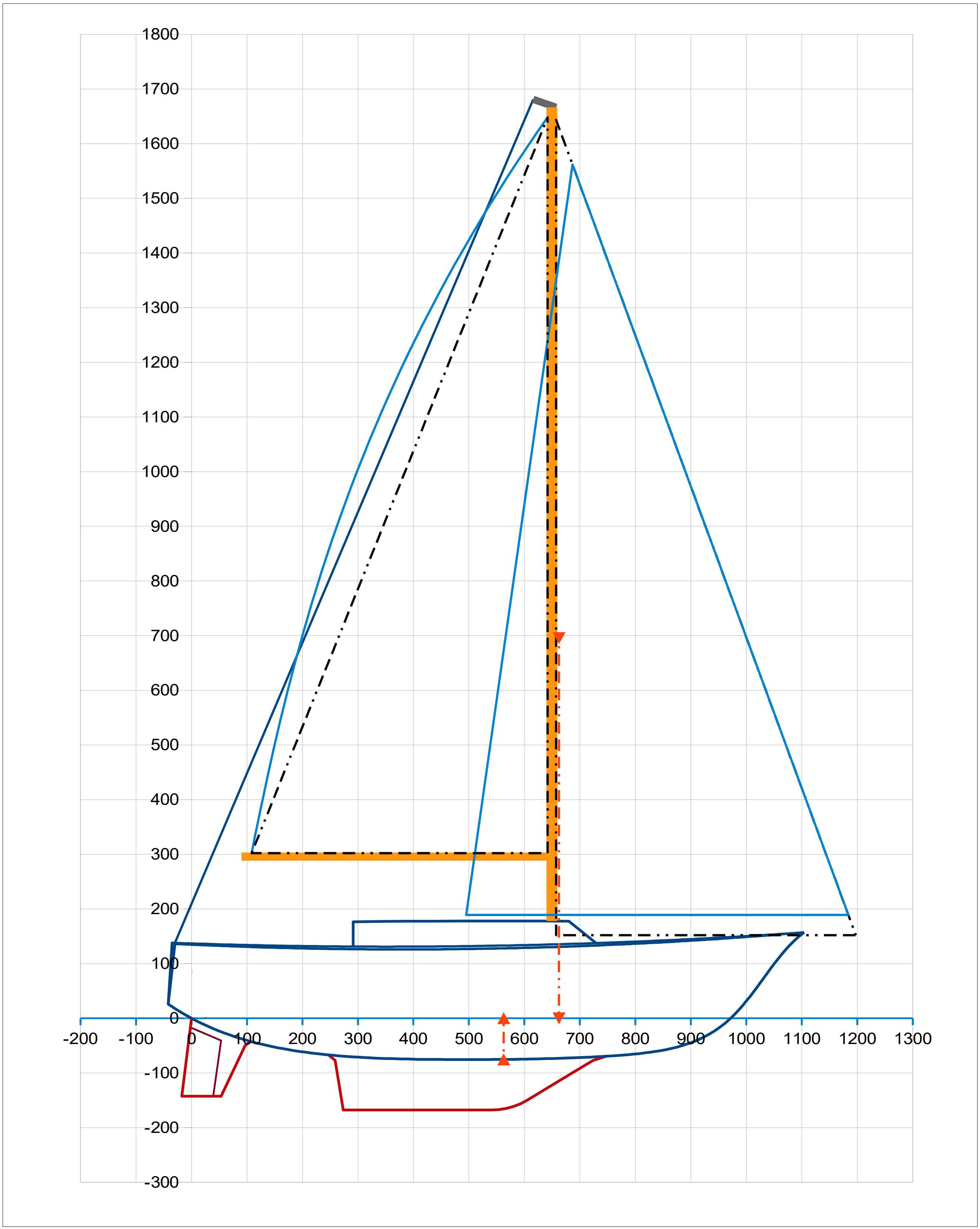








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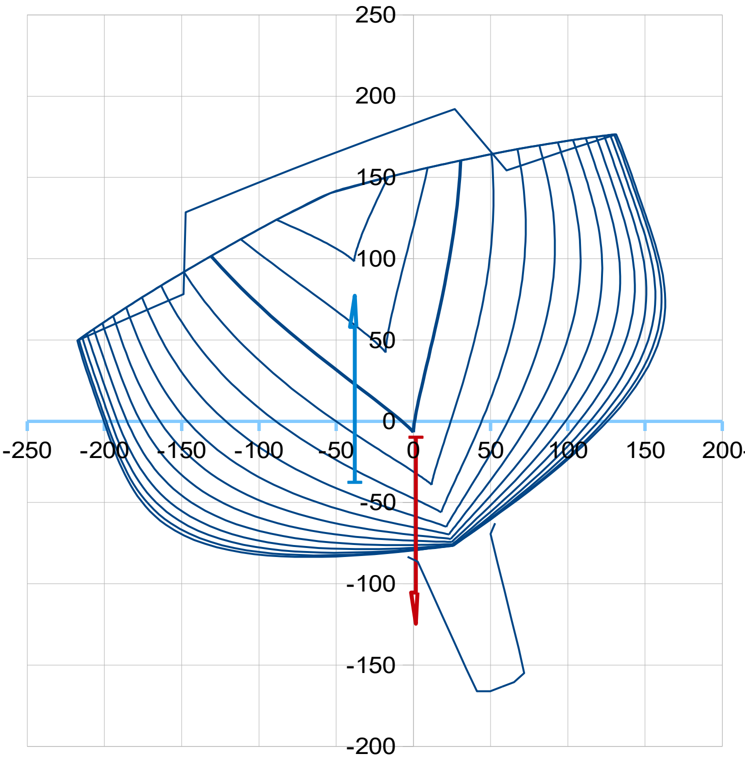
Blue Water 39 hydrostatics data :

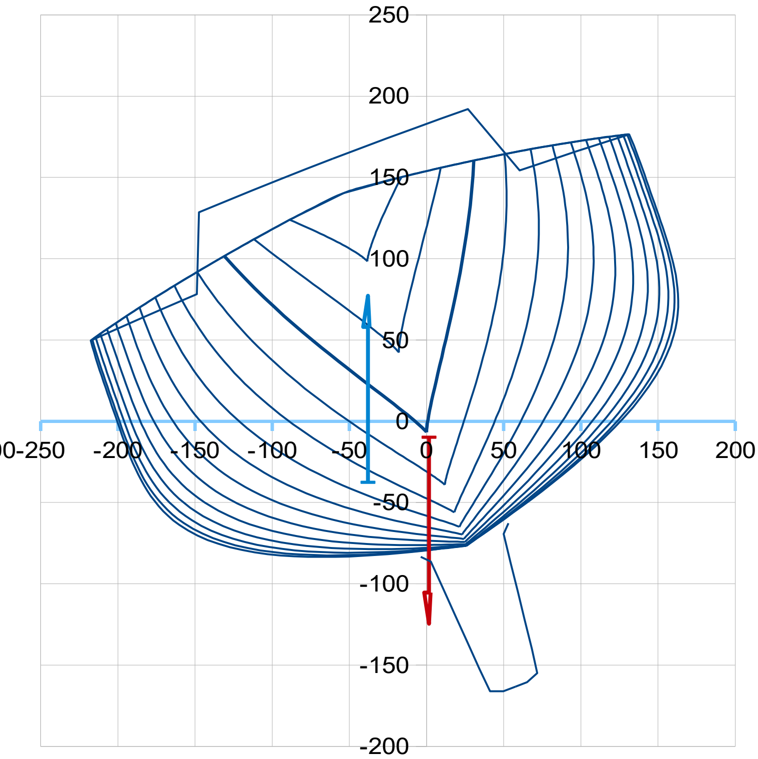
2. Data sum-up and results of hydrostatic and surfaces calculations								
2.1 Hull								
Loa (m)	**11,46**	**Lwl (m)**	**9,72**	> Hull speed (Knots)		7,6	at Froude 0,4	
>> ft	*37,60*		*31,89*					
Boa (m)	**3,73**	**at X (% Lwl)**	**43,0**	Bsheer (m)	3,71	at X (% Lwl)	43,0	
>> ft	*12,25*							
Bwl (m)	**3,43**	**at X (% Lwl)**	**40,0**	> Bwl / Boa	0,918			
>> ft	*11,25*				**Freeboards (m) >**	**Aft**	**Midship**	**Fore**
Tc (m)	**0,756**	**at X (%Lwl)**	**50**			**1,36**	**1,26**	**1,57**
>> ft	*2,48*				*>> ft*	*4,46*	*4,13*	*5,15*
	Displacement at H0 (m3)	**9,55084**	**at LCB (m)**	**4,549**	**LCB (%Lwl)**	**46,80**	**ZCB (m)**	**-0,255**
	>> lbs	*21582*	*w. seawater*	*1025*	*kg/m3*		*>> ft*	*-0,84*
Cp	**0,598**							
Sf (m2)	**23,60**	**at LCF (m)**	**4,438**	**LCF (%Lwl)**	**45,66**		>>> LCB – LCF (%Lwl)	1,13
>> ft2	*254,01*	*>> ft*	*14,56*					
Angle Freeboard/Half beam		34,2	(°), at section C4 (40% Lwl)					
Sw (m2)	**26,69**	>Sw/D^(2/3)	5,93					
>> ft2	*287,26*							
Shull (m2)	**58,23**	**at X (m)**	**4,795**	**Z (m)**	**0,159**			
>> ft2	*626,81*	*>> ft*	*15,73*	*>> ft*	*0,52*			
Sdeck (m2)	**33,33**	**at X (m)**	**4,704**	**Z (m)**	**1,38**			
>> ft2	*358,81*	*>> ft*	*15,43*	*>> ft*	*4,52*			
2.2 Keel								
Vol. keel(m3)	**0,96865**	**at X (m)**	**4,955**	**X (%Lwl)**	**50,97**	**Z (m)**	**-1,148**	
		>> ft	*16,26*			*>> ft*	*-3,77*	
Ballast (kg)	**4073,0**	**at X (m)**	**4,722**	**X (%Lwl)**	**48,58**	**Z (m)**	**-1,411**	
>> lbs	*8979*	*>> ft*	*15,49*			*>> ft*	*-4,63*	
Draft oa (m)	**1,68**		**Sw (m2)**	**7,69**		**Sxz (m2)**	**3,85**	
>> ft	*5,51*		*>> ft2*	*82,81*		*>> ft2*	*41,49*	
CLR (m)	**5,63**	**CLR (%Lwl)**	**57,90**	*CLR = Center of Lateral Resistance*				
>> ft	*18,46*	method: keel profile extended to the waterline, CLR at Z 45% draft and					35,00	% chord
2.3 Rudder(s)								
Number	**1**							
Volume (m3)	**0,10547**	**at X (m)**	**0,38**	**X (%Lwl)**	**3,96**	**Z (m)**	**-0,75**	
Sw (m2)	**2,22**	*>> ft*	*1,26*			**Sxz (m2)**	**1,07**	per rudder
>> ft2	*23,91*					*>> ft2*	*11,50*	
2.4 Hull + Keel + Rudder(s)								
	Displacement at H0 (m3)	**10,62495**	**at LCB (m)**	**4,544**	**LCB (%Lwl)**	**46,75**	**at ZCB (m)**	**-0,341**
	(kg)	**10891**	*>> ft*	*14,91*			*>> ft*	*-1,12*
	>> lbs	*24009*						
	, of wich Ballast (kg)	**4073**	**at Xg (m)**	**4,722**	**Xg (%Lwl)**	**48,58**	**at Zg (m)**	**-1,411**
	>> lbs	*8979*	*>> ft*	*15,49*			*>> ft*	*-4,63*
	>> % Ballast	37,4						
	Sw (m2)	**36,60**	>Sw/D^(2/3)	7,57	Lwl/D^(1/3)	4,42		
	>> ft2	*393,99*			***DLR***	***331***	*M(lbs/2240)/(Lwl(ft)/100)^3*	
2.5 Data from the mass spreadsheet								
Light boat:	**M (kg)**	**10891**	**at Xg (m)**	**4,673**	**Xg (%Lwl)**	**48,08**	**at Zg (m)**	**-0,089**

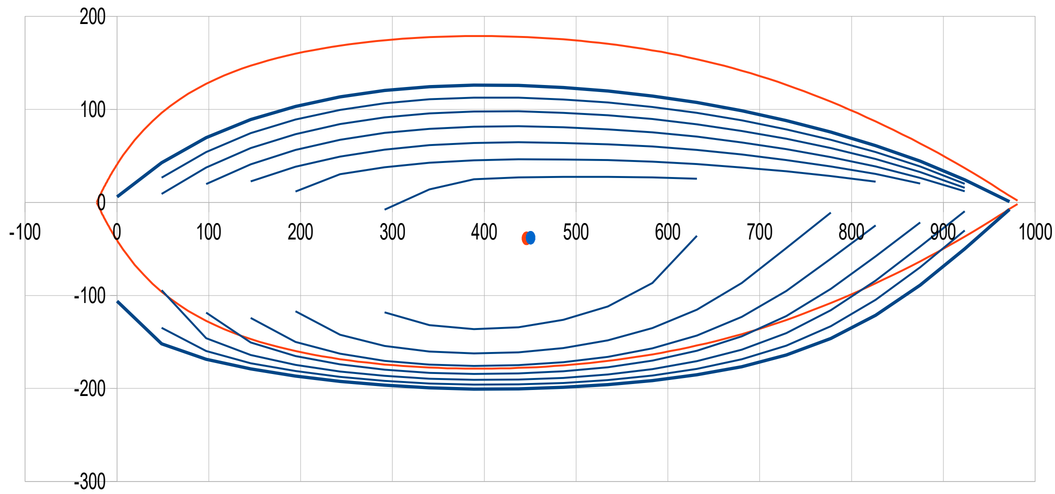
At 20° heel angle with a loading of 3109 kg >>> Displacement 14 000 kg

5.1 Mass spreadsheet with input of a load					
	Mass	Xg	Zg	Yg	(in the coordinates of the 2D
Data to enter : yellow cells	(kg)	(m)	(m)	(m)	
Boat light weight (kg)	*10891,02*	*4,673*	*-0,089*	*0*	*from the mass spreadsheet*
Load (kg)	**3109,00**	**3,92**	**0,10**	**0,00**	Crew at center
			0,10	**0,00**	Crew sit windward
Total >>> Mass (kg)	**14000,02**	**4,506**	**-0,047**	**0,000**	**Crew at center**
Disp. (m3)	**13,65855**		**-0,047**	**0,000**	**Crew sit windward**

Data to enter : yellow cells		Results			
Heel (°)	**20**	**Disp. (m3)**	**13,65854**	**/ Disp. (m3)**	**13,65855**
Height (cm)	**-5,4583**	**Xc heel (m)**	**4,506**	**/ Xg (m)**	**4,506**
Trim (°)	**-0,145**	Yc heel (m)	-0,380	Yg heel (m)	0,016
		Zc heel (m)	-0,376	**> GZ (m)**	**0,396**
		Sw heel(m2)	**39,33**	**RM (kN.m)**	**54,375**
		Bwl heel (m)	**3,27**	**FB mini (cm)**	**49,6**
		LCB – LCF (%Lwl)	**0,46**	**Obliquity (°)**	**2,0**

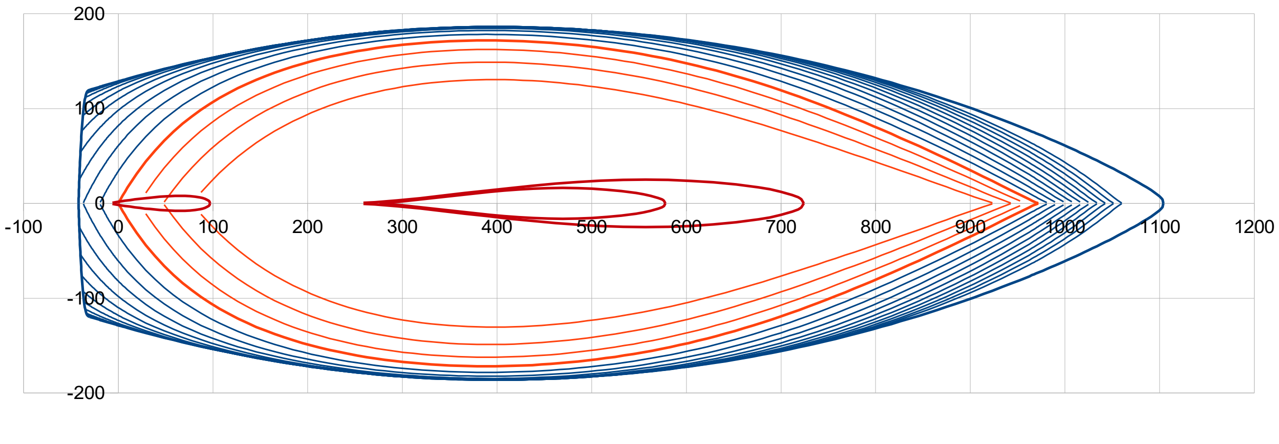




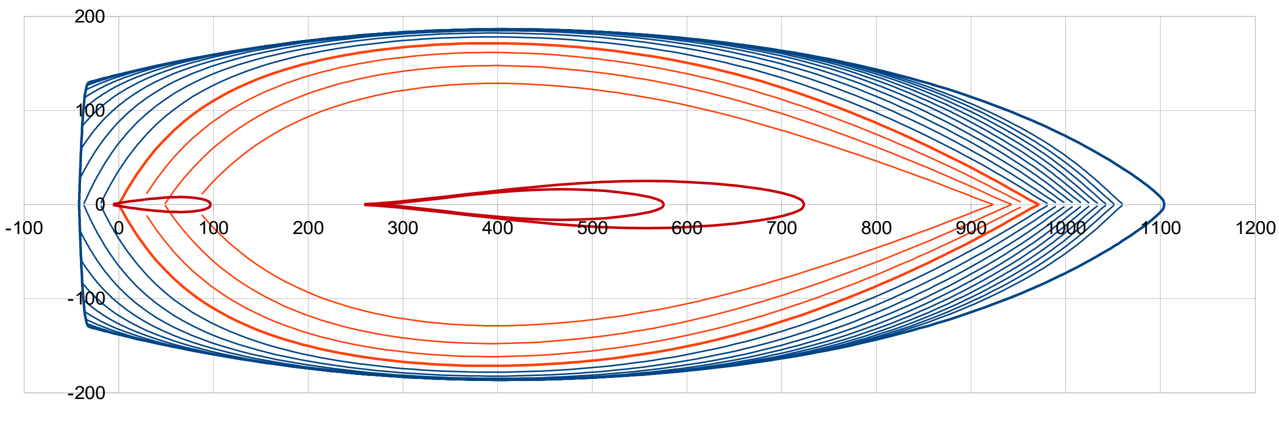


Within Blue Water 39, demonstration by images **the influence of the use of negative values for « Cor Pui liv »** acting on the sheer line roundness towards the ends + slight adjustment of the hull draft **Tc** to keep constant the displacement :

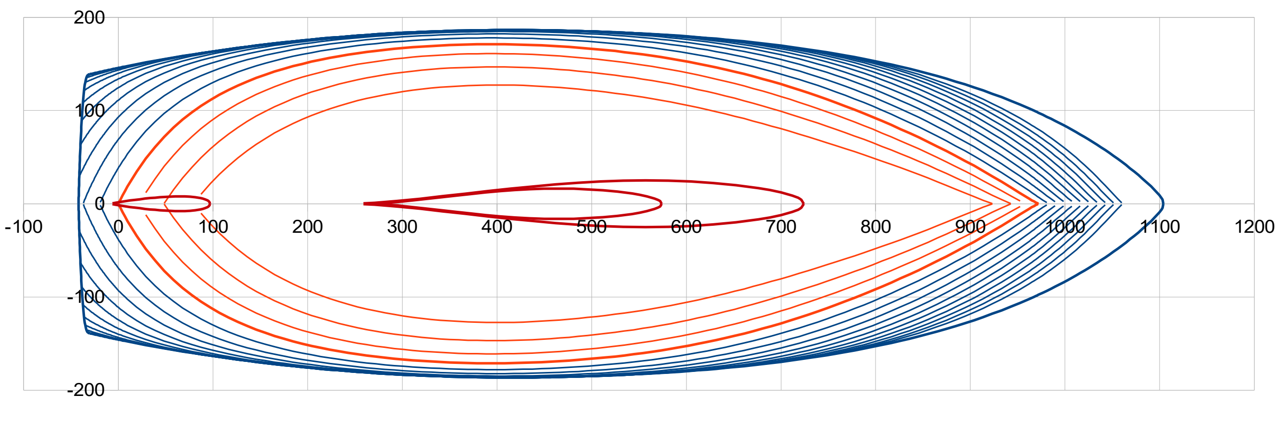
Cor pui liv = 0 and Tc = 0,770 m >>> … LCB = 46,52 % Lwl ; Cp = 0,586



Cor pui liv = - 0,04 and Tc = 0,756 m >>> … LCB = 46,8 % Lwl ; Cp = 0,596
(Blue water 39 choice)

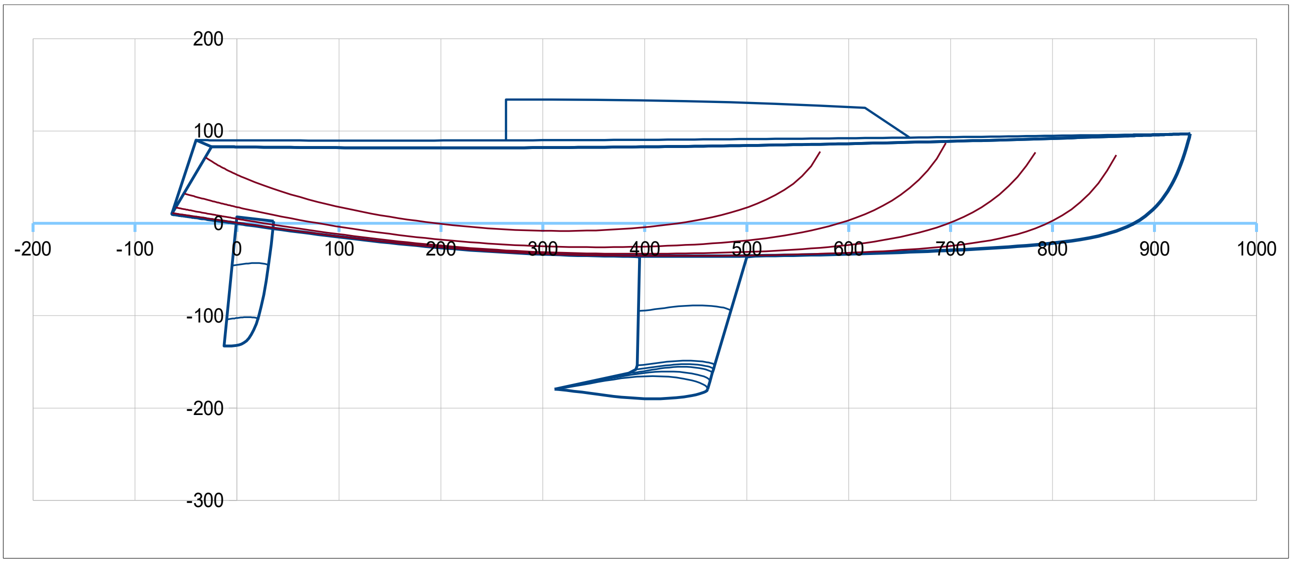


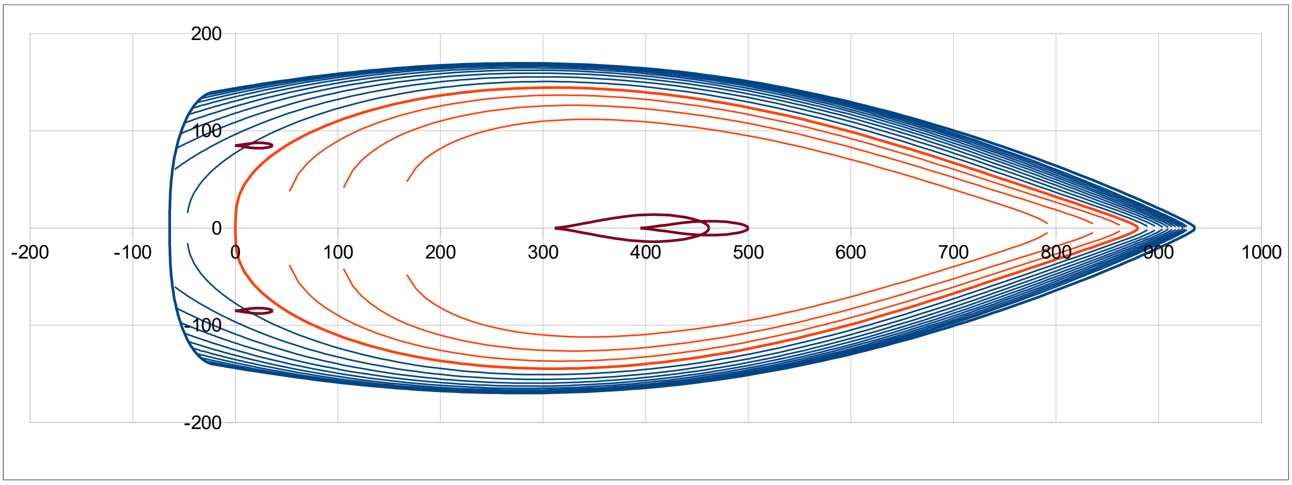
Cor pui liv = - 0,08 and Tc = 0,746 m >>> … LCB = 47,02,72 % Lwl ; Cp = 0,607

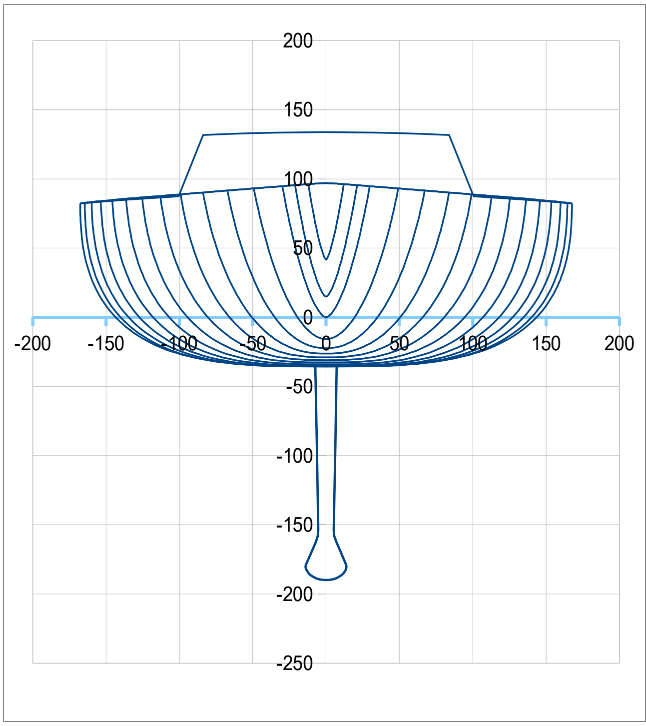


T10, inspired by Tofinou 10 / Joubert – Nivelt

Loa 9,99 m ; Lwl 8,80 m ; B 3,39 m ; Draft 1,90 m ; Displacement : 4213 kg ; Ballast : 1210 kg
>> LCB hull 46,15 %Lwl ; Cp hull (%): 0,560 ; Sw : 24,24 m2 ; DLR : 172 ; Ballast ratio : 28,7 %



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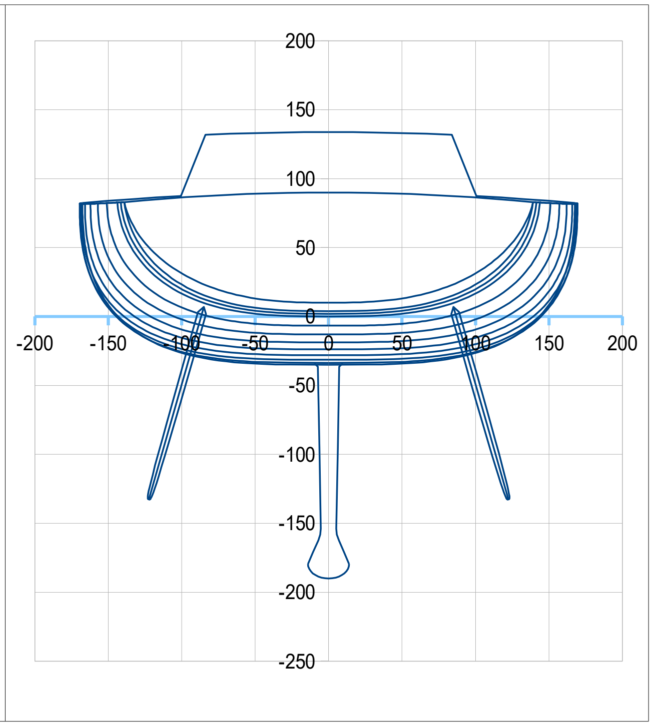
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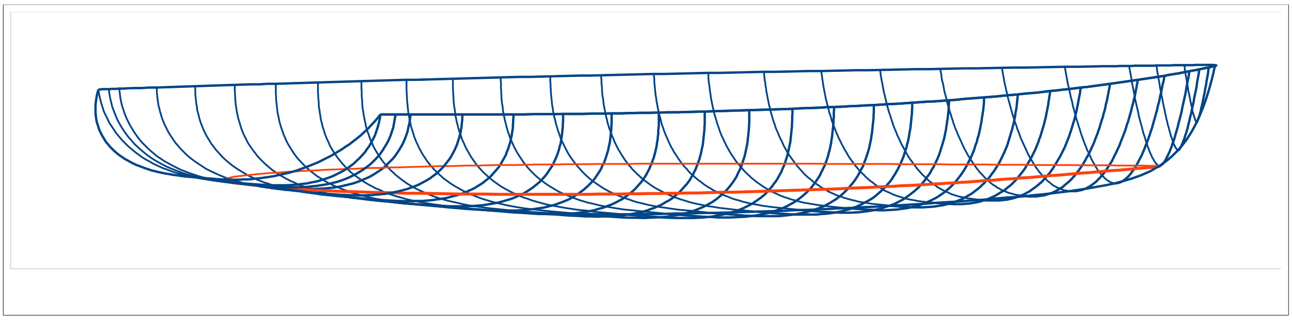

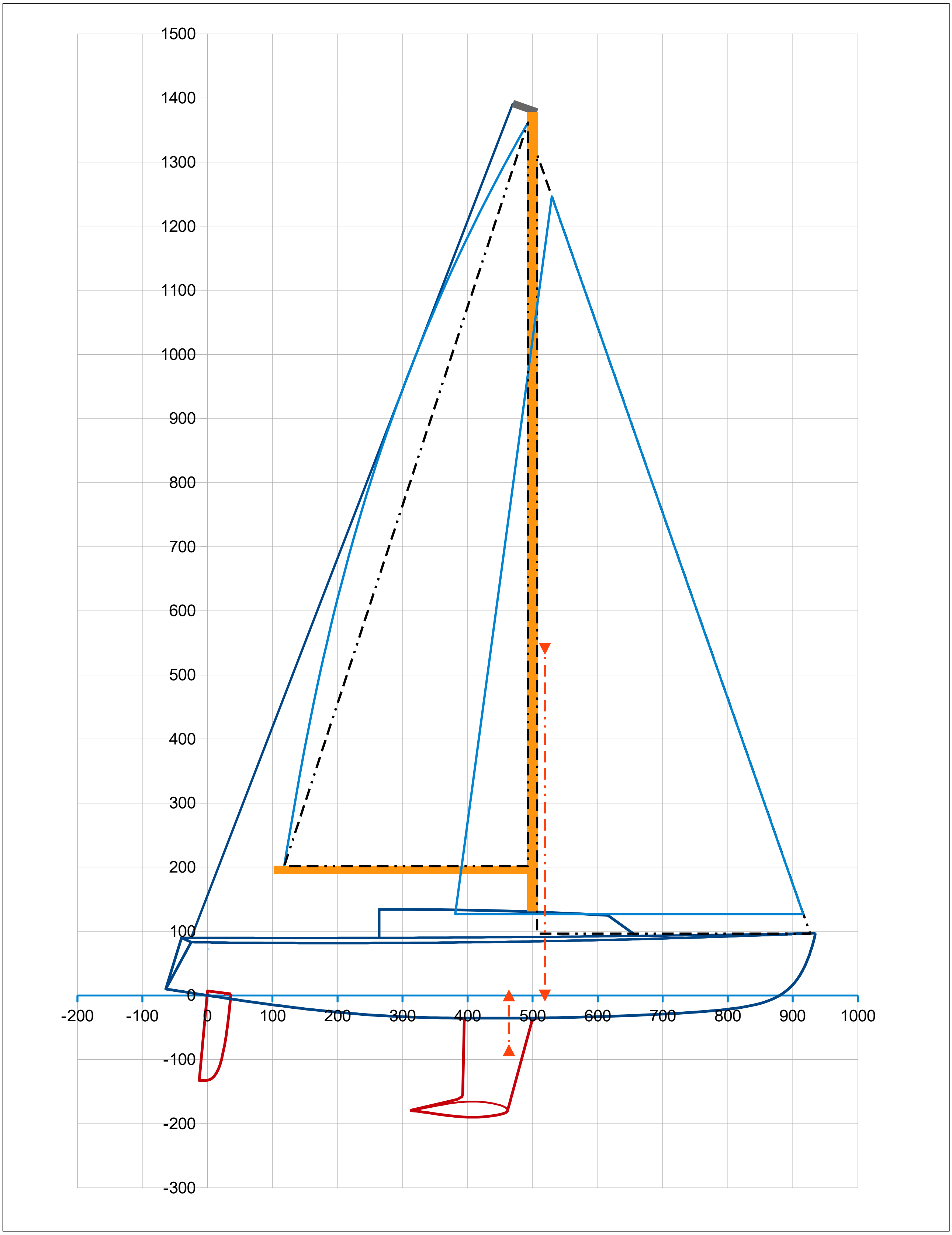

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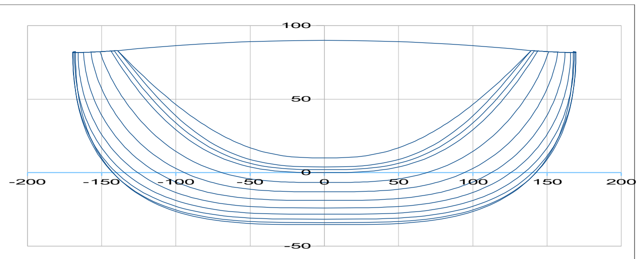
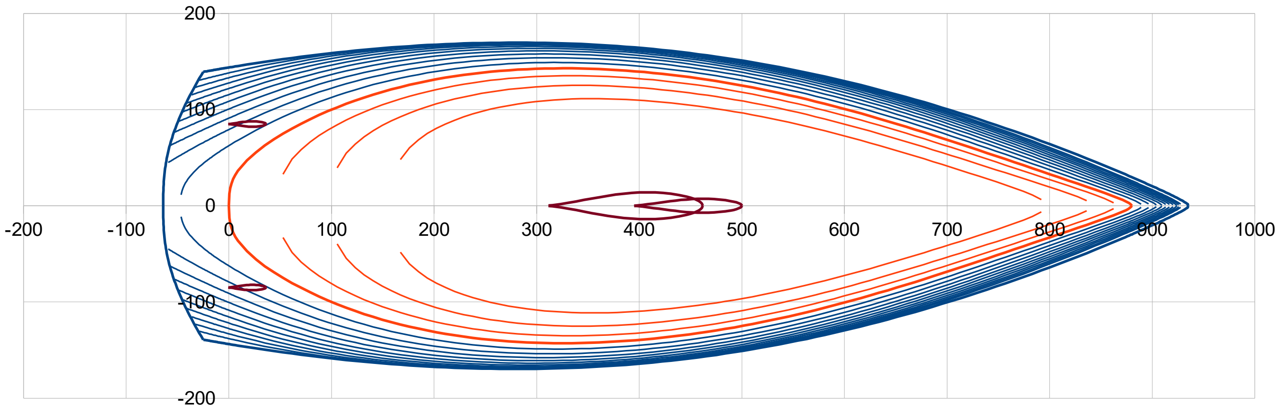
T10 hydrostatics data :

2. Data sum-up and results of hydrostatic and surfaces calculations								
2.1 Hull								
Loa (m)	**9,99**	**Lwl (m)**	**8,80**	> Hull speed (Knots)		7,2	at Froude 0,4	
>> ft	32,78		28,87					
Boa (m)	**3,39**	**at X (% Lwl)**	**32,0**	Bsheer (m)	3,39	at X (% Lwl)	32,0	
>> ft	11,12							
Bwl (m)	**2,89**	**at X (% Lwl)**	**35,0**	> Bwl / Boa	0,853			
>> ft	9,49				**Freeboards (m) >**	**Aft**	**Midship**	**Fore**
Tc (m)	**0,356**	**at X (%Lwl)**	**50**			**0,83**	**0,82**	**0,97**
					>> ft	2,72	2,69	3,18
Displacement at H0 (m3)		**3,94251**	**at LCB (m)**	**4,061**	**LCB (%Lwl)**	**46,15**	**ZCB (m)**	**-0,136**
	>> lbs	8909	w. seawater	1025	kg/m3		>> ft	-0,45
Cp	**0,560**							
Sf (m2)	**17,66**	**at LCF (m)**	**3,773**	**LCF (%Lwl)**	**42,88**	>>> LCB – LCF (%Lwl)		3,27
>> ft2	190,08	>> ft	12,38					
Angle Freeboard/Half beam		26,2	(°), at section C4 (40% Lwl)					
Sw (m2)	**18,66**	>Sw/D^(2/3)	7,48					
>> ft2	200,87							
Shull (m2)	**37,88**	**at X (m)**	**3,972**	**Z (m)**	**0,080**			
>> ft2	407,70	>> ft	13,03	>> ft	0,26			
Sdeck (m2)	**24,62**	**at X (m)**	**3,710**	**Z (m)**	**0,89**			
>> ft2	265,03	>> ft	12,17	>> ft	2,92			
2.2 Keel								
Vol. keel(m3)	**0,13768**	**at X (m)**	**4,303**	**X (%Lwl)**	**48,89**	**Z (m)**	**-1,284**	
		>> ft	14,12			>> ft	-4,21	
Ballast (kg)	**1210,3**	**at X (m)**	**4,303**	**X (%Lwl)**	**48,89**	**Z (m)**	**-1,284**	
>> lbs	2668	>> ft	14,12			>> ft	-4,21	
Draft oa (m)	**1,90**		**Sw (m2)**	**3,64**			**Sxz (m2)**	**1,36**
>> ft	6,23		>> ft2	39,17			>> ft2	14,61
CLR (m)	**4,64**	**CLR (%Lwl)**	**52,68**	*CLR = Center of Lateral Resistance*				
>> ft	15,21	method: keel profile extended to the waterline, CLR at Z 45% draft and					25,00	% chord
2.3 Rudder(s)								
Number	**2**							
Volume (m3)	**0,03007**	**at X (m)**	**0,14**	**X (%Lwl)**	**1,60**	**Z (m)**	**-0,58**	
Sw (m2)	**1,94**	>> ft	0,46			**Sxz (m2)**	**0,47**	per rudder
>> ft2	20,89					>> ft2	5,02	
2.4 Hull + Keel + Rudder(s)								
Displacement at H0 (m3)		**4,11026**	**at LCB (m)**	**4,040**	**LCB (%Lwl)**	**45,91**	**at ZCB (m)**	**-0,178**
	(kg)	**4213**	>> ft	13,26			>> ft	-0,58
	>> lbs	9288						
, of wich Ballast (kg)		**1210**	**at Xg (m)**	**4,303**	**Xg (%Lwl)**	**48,89**	**at Zg (m)**	**-1,284**
	>> lbs	2668	>> ft	14,12			>> ft	-4,21
	>> % Ballast	28,7						
	Sw (m2)	**24,24**	>Sw/D^(2/3)	9,45	Lwl/D^(1/3)	5,49		
	>> ft2	260,93			**DLR**	**172**	M(lbs/2240)/(Lwl(ft)/100)^3	
2.5 Data from the mass spreadsheet								
Light boat:	**M (kg)**	**4213**	**at Xg (m)**	**4,017**	**Xg (%Lwl)**	**45,65**	**at Zg (m)**	**0,150**

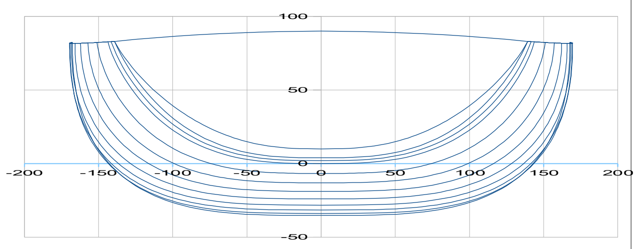
Within T10, one can demonstrate by images **the influence of aft value of PE1 on the rear transom and waterlines.** Done with hull draft Tc adjustement to keep constant the displacement.

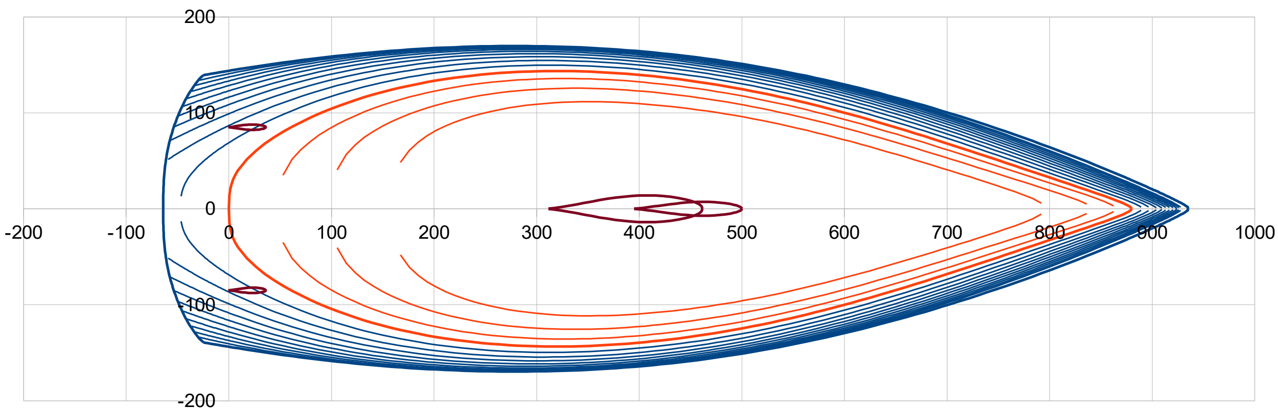
Aft PE1 = 0,5 and Tc = 0,361 m
>>>
LCB = 46,77 % Lwl
Cp = 0,559
....



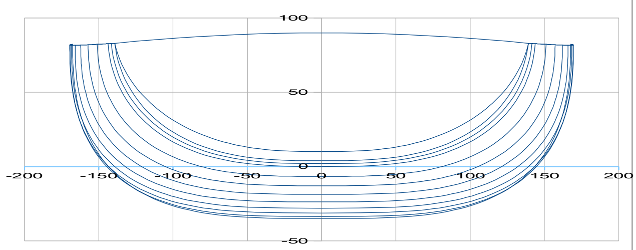


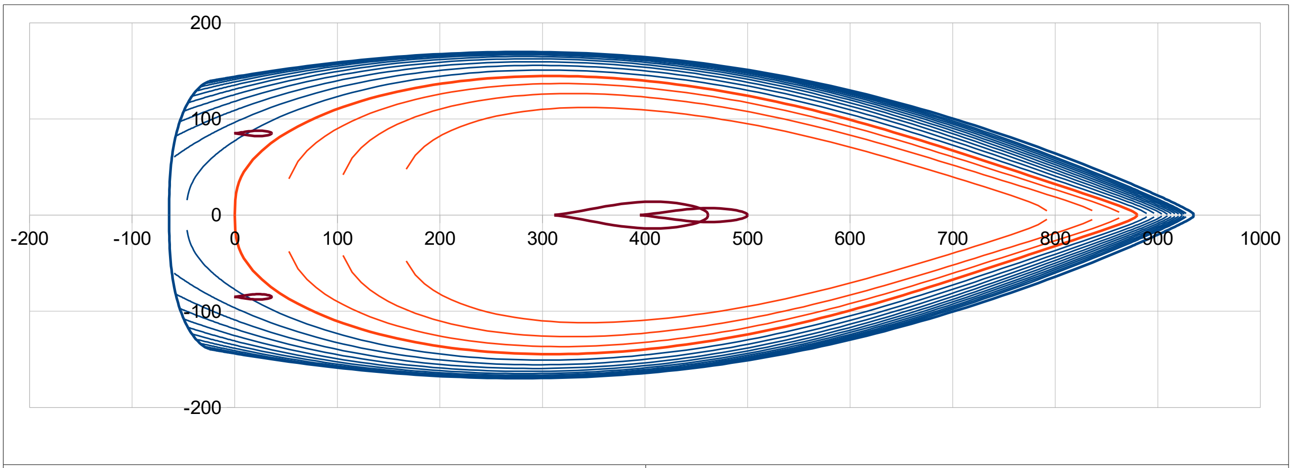
Aft PE1 = 1,0 and Tc = 0,359 m
>>>
LCB = 46,51 % Lwl
Cp = 0,56
....





Aft PE1 = 1,8 and Tc = 0,356 m
>>>
LCB = 46,15 % Lwl
Cp = 0,56
....
(T10 Choice)





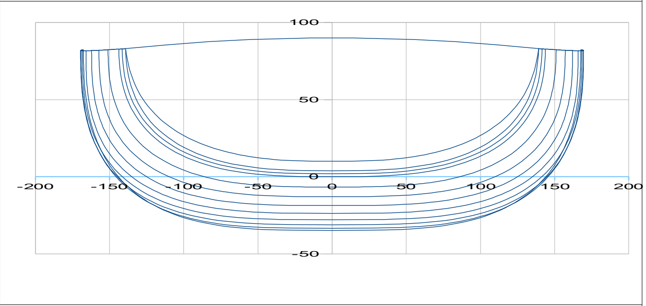
Aft PE1 = 2,5 and Tc = 0,354 m

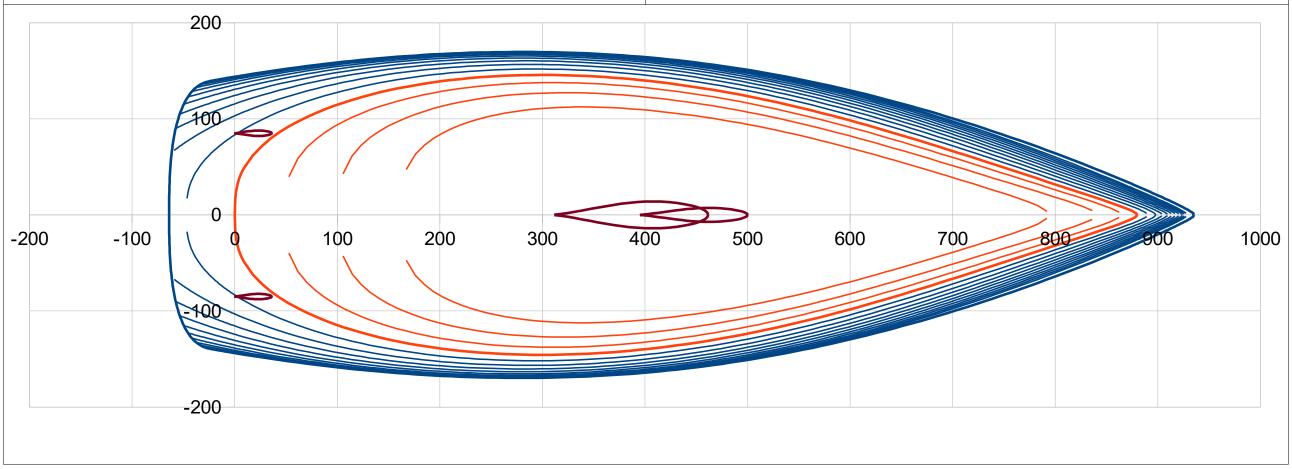
>>>

LCB = 45,86 % Lwl

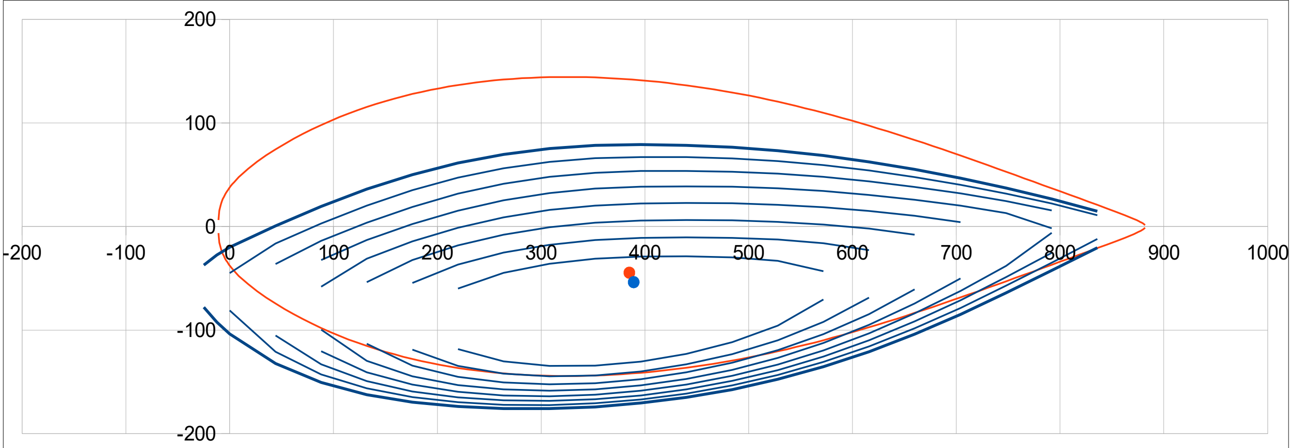
Cp = 0,56

....

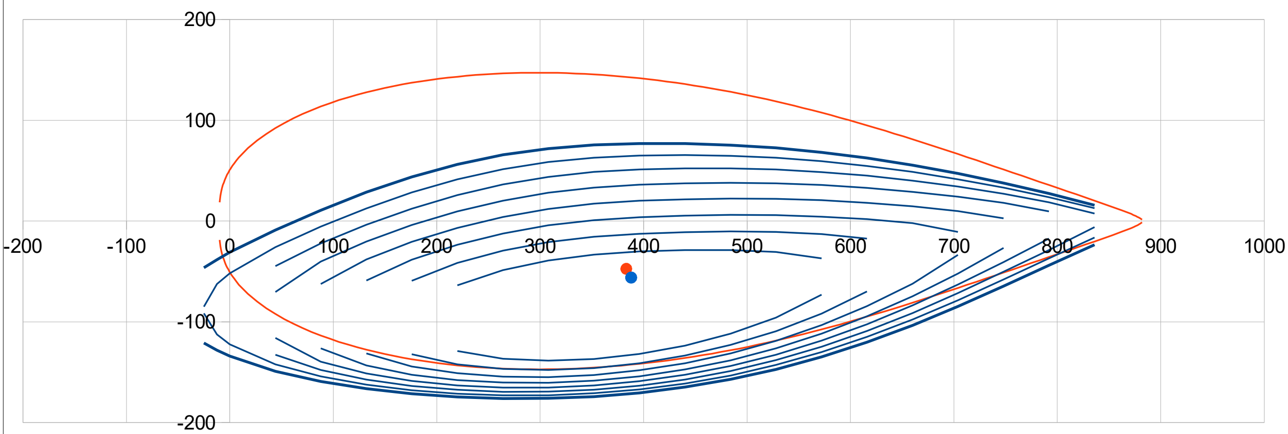




Comparison of the 20° heeled hull with the 2 extremes rear transom shape



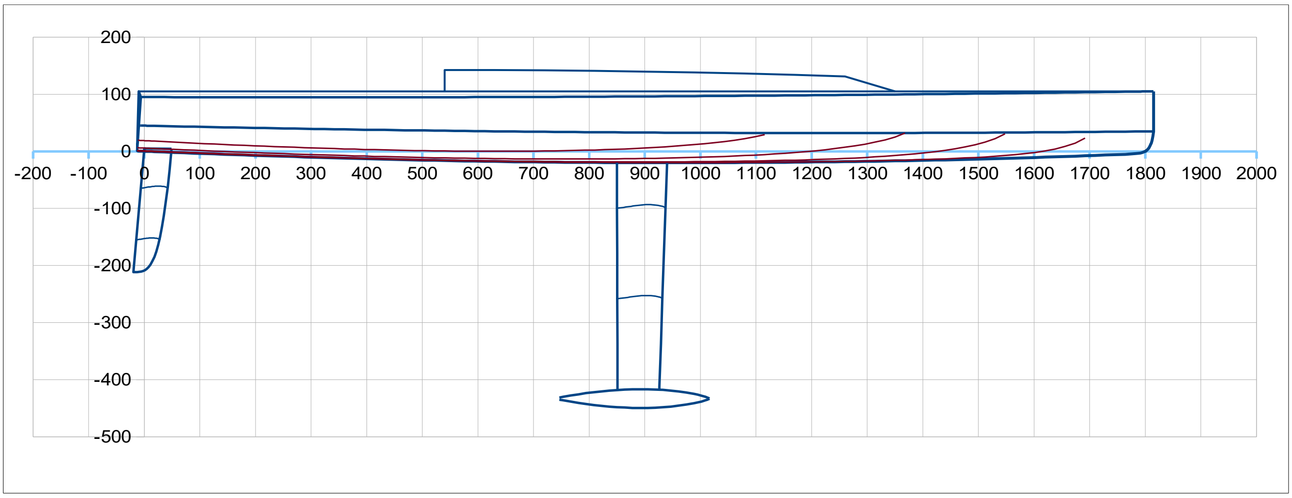
With Aft PE1 = 0,5

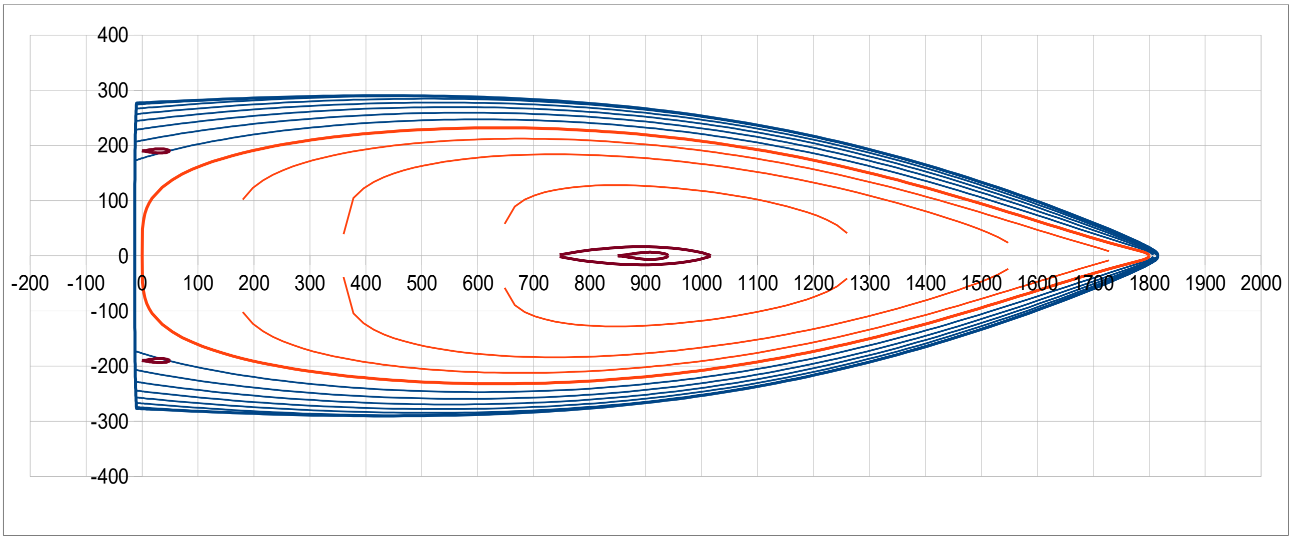


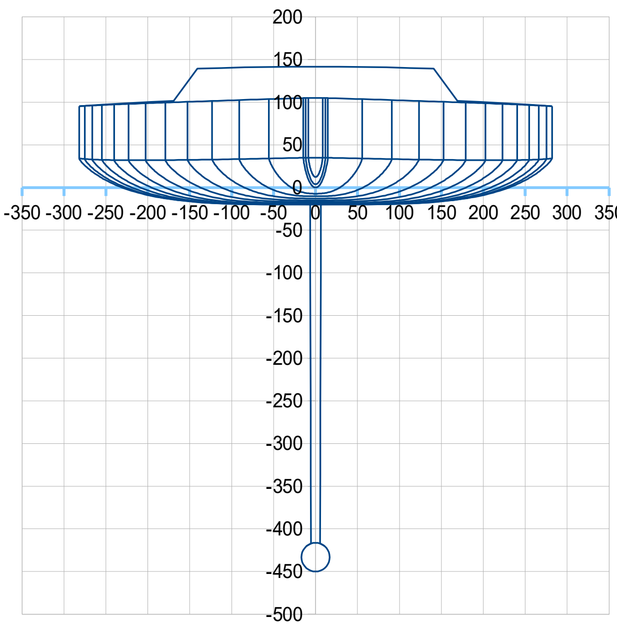
With Aft PE1 = 2,5

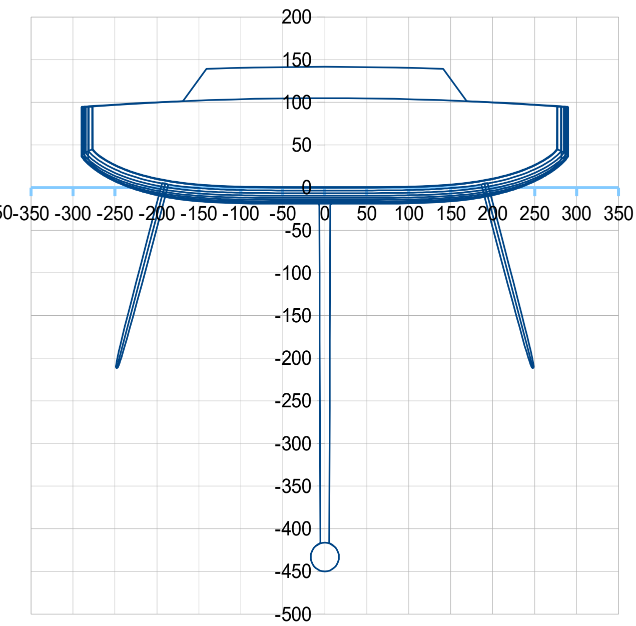
I60, inspired by Imoca designs

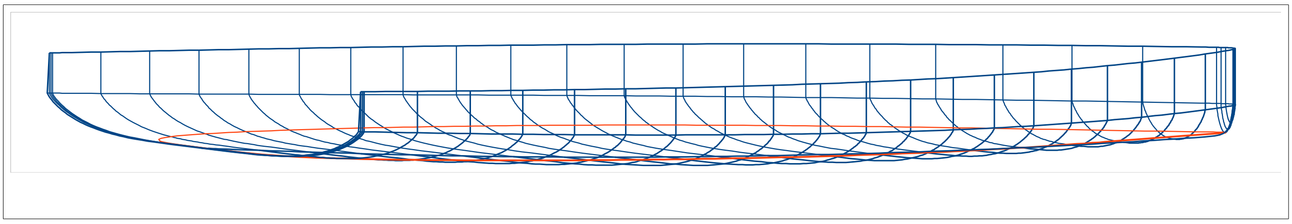
Loa 18,28 m ; Lwl 18,00 m ; B 5,80 m ; Draft 4,50 m ; Displacement : 7996 kg ; Ballast : 3303 kg
>> LCB hull 46,61 %Lwl ; Cp hull : 0,564 ; Sw : 72,42 m2 ;   DLR : 38 ;   Ballast ratio : 41,3 %

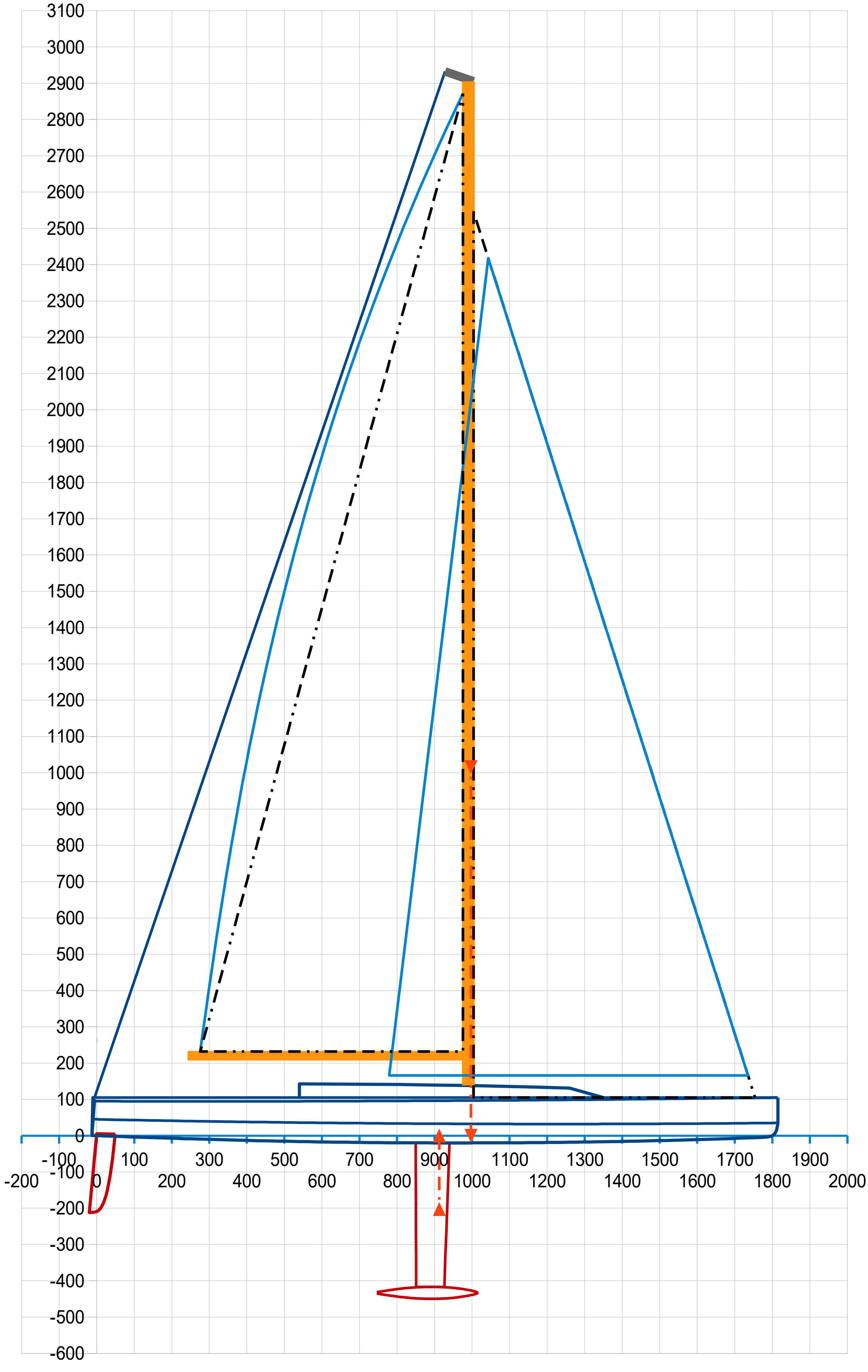












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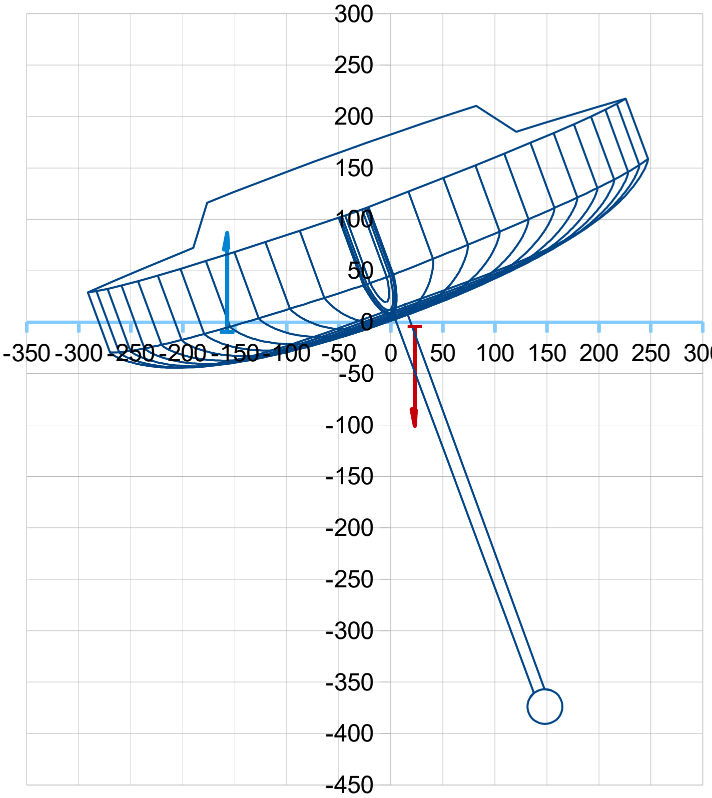
-200 0 200 400 600 800 1000 1200 1400 1600 1800 2000

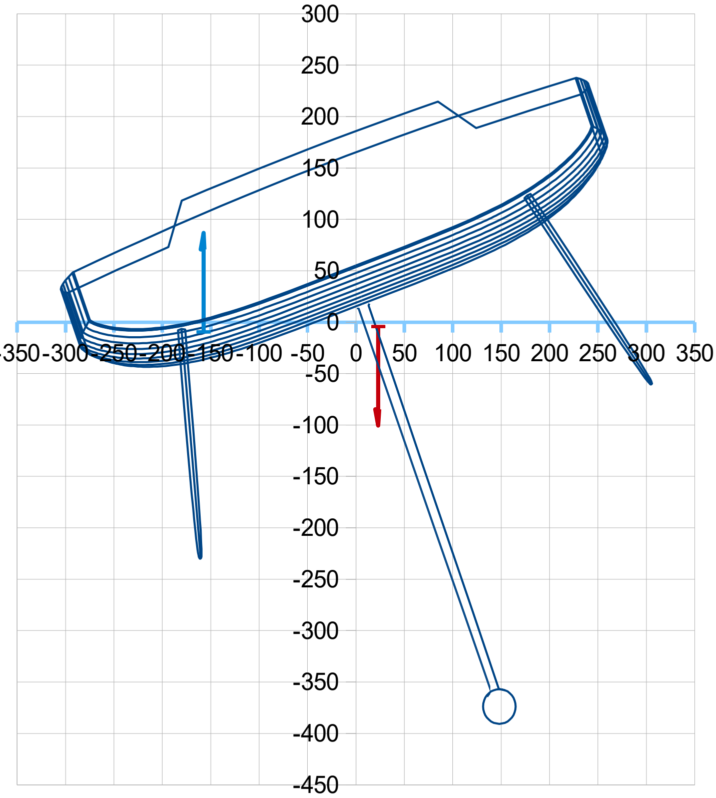
I60 hydrostatics data :

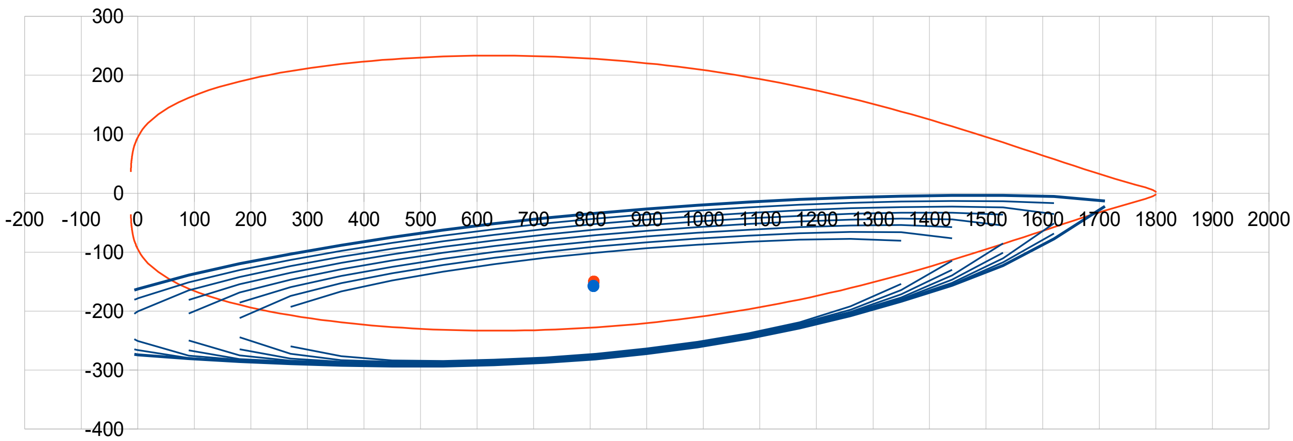
2. Data sum-up and results of hydrostatic and surfaces calculations								
2.1 Hull								
Loa (m)	**18,28**	**Lwl (m)**	**18,00**	> Hull speed (Knots)		10,3	at Froude 0,4	
>> ft	*59,97*		*59,06*					
Boa (m)	**5,80**	**at X (% Lwl)**	**24,0**	Bsheer (m)	5,80	at X (% Lwl)	24,0	
>> ft	*19,03*							
Bwl (m)	**4,64**	**at X (% Lwl)**	**35,0**	> Bwl / Boa	0,800			
>> ft	*15,22*				**Freeboards (m) >**	**Aft**	**Midship**	**Fore**
Tc (m)	**0,200**	**at X (%Lwl)**	**52,5**			**0,95**	**0,95**	**1,05**
>> ft	*0,66*				*>> ft*	*3,12*	*3,12*	*3,44*
	Displacement at H0 (m3)	**7,33485**	**at LCB (m)**	**8,390**	**LCB (%Lwl)**	**46,61**	**ZCB (m)**	**-0,075**
	>> lbs	*16575*	*w. seawater*	*1025*	*kg/m3*		*>> ft*	*-0,25*
Cp	**0,564**							
Sf (m2)	**60,22**	**at LCF (m)**	**7,636**	**LCF (%Lwl)**	**42,42**	>>> LCB – LCF (%Lwl)		4,19
>> ft2	*648,17*	*>> ft*	*25,05*					
Angle Freeboard/Half beam		18,7	(°), at section C4 (40% Lwl)					
Sw (m2)	**59,79**	>Sw/D^(2/3)	15,84					
>> ft2	*643,54*							
Shull (m2)	**109,11**	**at X (m)**	**7,911**	**Z (m)**	**0,104**			
>> ft2	*1 174,44*	*>> ft*	*25,95*	*>> ft*	*0,34*			
Sdeck (m2)	**81,43**	**at X (m)**	**7,373**	**Z (m)**	**1,01**			
>> ft2	*876,49*	*>> ft*	*24,19*	*>> ft*	*3,32*			
2.2 Keel								
Vol. keel(m3)	**0,38080**	**at X (m)**	**8,948**	**X (%Lwl)**	**49,71**	**Z (m)**	**-2,828**	
		>> ft	*29,36*			*>> ft*	*-9,28*	
Ballast (kg)	**3303,5**	**at X (m)**	**8,936**	**X (%Lwl)**	**49,65**	**Z (m)**	**-3,066**	
>> lbs	*7283*	*>> ft*	*29,32*			*>> ft*	*-10,06*	
Draft oa (m)	**4,50**		**Sw (m2)**	**8,58**		**Sxz (m2)**	**3,90**	
>> ft	*14,76*		*>> ft2*	*92,40*		*>> ft2*	*41,95*	
CLR (m)	**9,13**	**CLR (%Lwl)**	**50,71**	*CLR = Center of Lateral Resistance*				
>> ft	*29,95*	method: keel profile extended to the waterline, CLR at Z 45% draft and					25,00	% chord
2.3 Rudder(s)								
Number	**2**							
Volume (m3)	**0,08497**	**at X (m)**	**0,18**	**X (%Lwl)**	**1,01**	**Z (m)**	**-0,90**	
Sw (m2)	**4,05**	*>> ft*	*0,60*			**Sxz (m2)**	**0,97**	per rudder
>> ft2	*43,63*					*>> ft2*	*10,49*	
2.4 Hull + Keel + Rudder(s)								
	Displacement at H0 (m3)	**7,80062**	**at LCB (m)**	**8,328**	**LCB (%Lwl)**	**46,27**	**at ZCB (m)**	**-0,219**
	(kg)	**7996**	*>> ft*	*27,32*			*>> ft*	*-0,72*
	>> lbs	*17627*						
	, of wich Ballast (kg)	**3303**	**at Xg (m)**	**8,936**	**Xg (%Lwl)**	**49,65**	**at Zg (m)**	**-3,066**
	>> lbs	*7283*	*>> ft*	*29,32*			*>> ft*	*-10,06*
	>> % Ballast	41,3						
	Sw (m2)	**72,42**	>Sw/D^(2/3)	18,41	Lwl/D^(1/3)	9,08		
	>> ft2	*779,57*			***DLR***	***38***	*M(lbs/2240)/(Lwl(ft)/100)^3*	
2.5 Data from the mass spreadsheet								
Light boat:	**M (kg)**	**7996**	**at Xg (m)**	**8,172**	**Xg (%Lwl)**	**45,40**	**at Zg (m)**	**-0,487**

At Heel 20° with a loading of 300 kg

Data to enter : yellow cells		Results			
Heel (°)	20	Disp. (m3)	8,09342	/ Disp. (m3)	8,09342
Height (cm)	32,6322	Xc heel (m)	8,057	/ Xg (m)	8,057
Trim (°)	-1,438	Yc heel (m)	-1,574	Yg heel (m)	0,233
		Zc heel (m)	-0,095	> GZ (m)	1,807
		Sw heel(m2)	45,59	RM (kN.m)	147,066
		Bwl heel (m)	2,47	FB mini (cm)	28,6
		LCB – LCF (%Lwl)	-0,04	Obliquity (°)	6,4

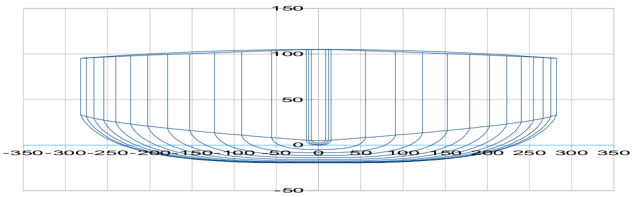


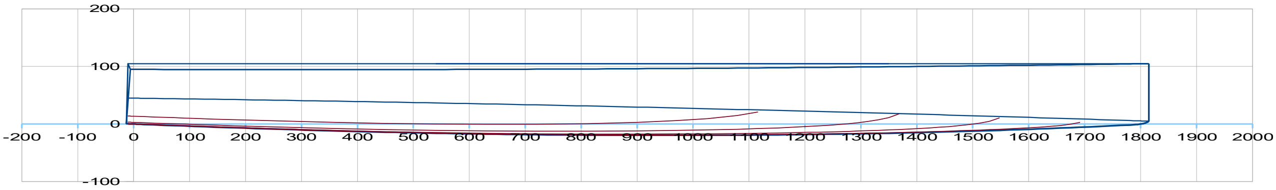


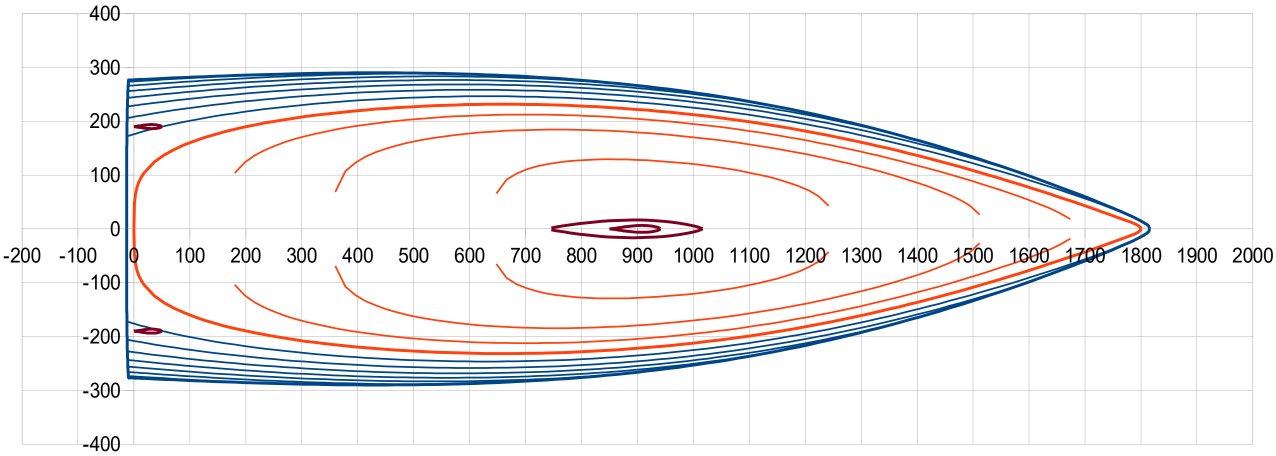


Within I60, one can demonstrate by images **the influence of « Z hc av » on the hard chine line, the fore sections and waterlines.** Done with hull draft Tc adjustement to keep constant the displacement.

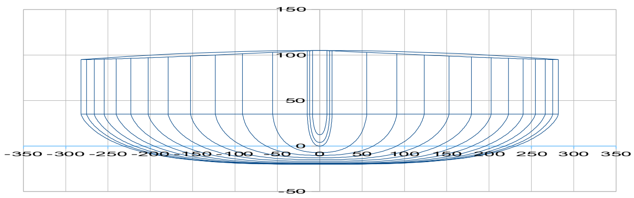
Z hc av = 0,05 m and Tc = 0,197 m
>>>>>
LCB = 46,96 % Lwl
Cp = 0,569

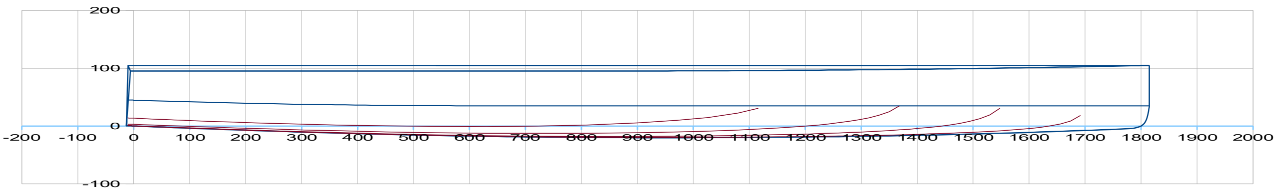


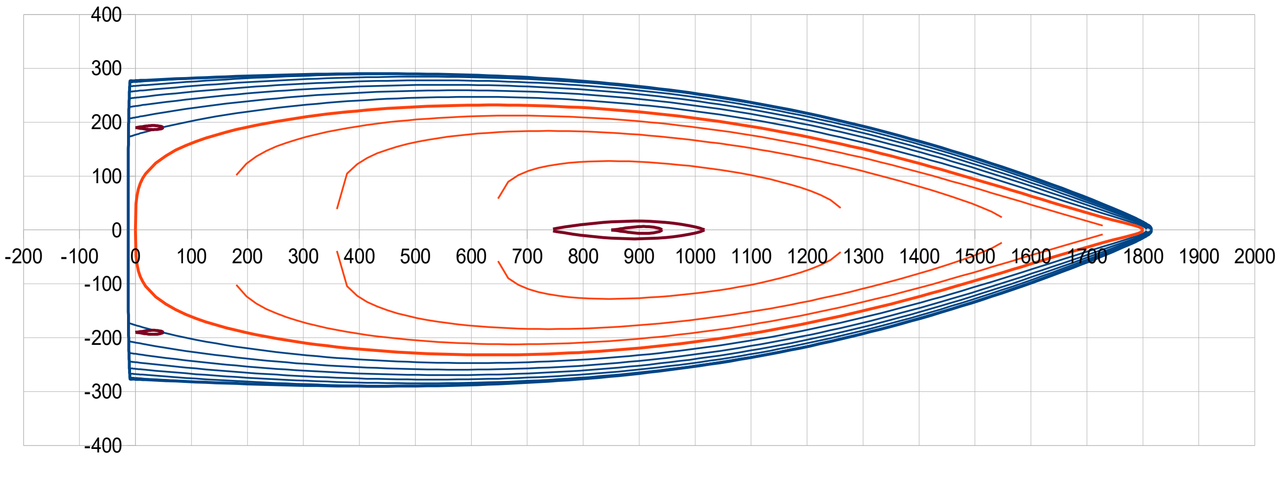




Z hc av = 0,35 m and Tc = 0,200 m
(I60 Choice) >>>>>
LCB = 46,61 % Lwl
Cp = 0,564
....







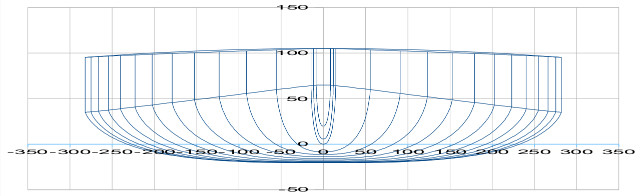
Z hc av = 0,65 m and Tc = 0,203 m

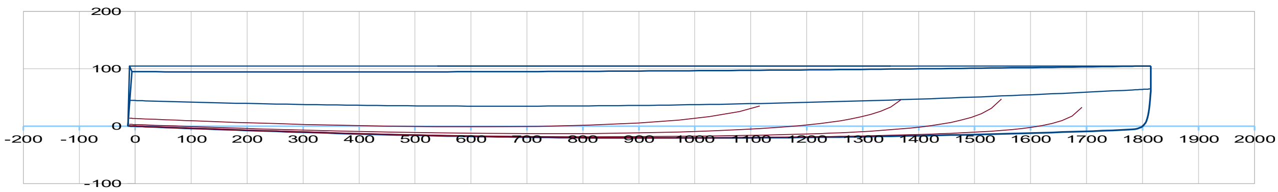
>>>>>

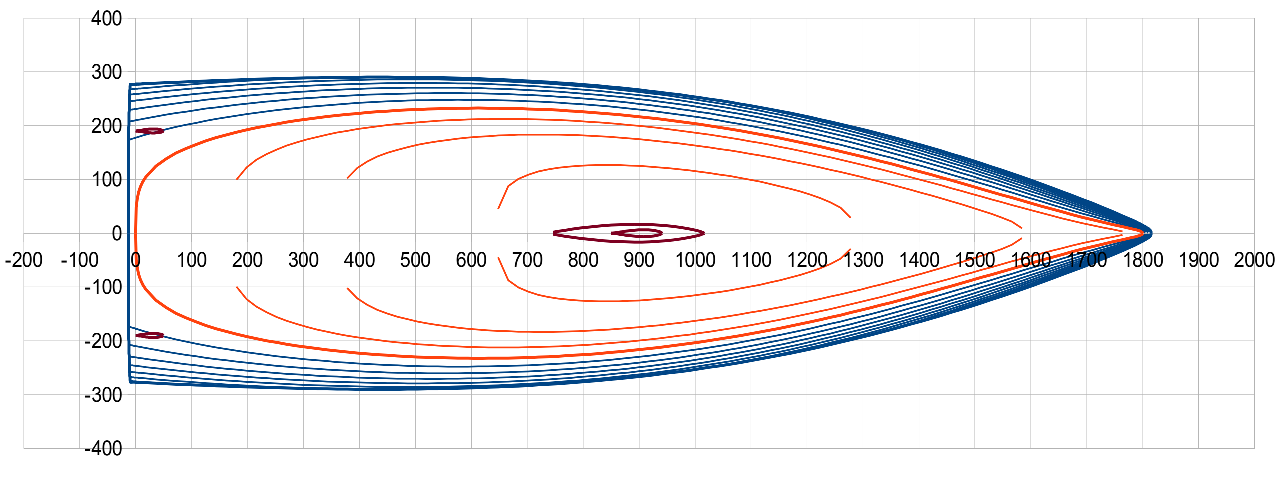
LCB = 46,28 % Lwl

Cp = 0,559

……..







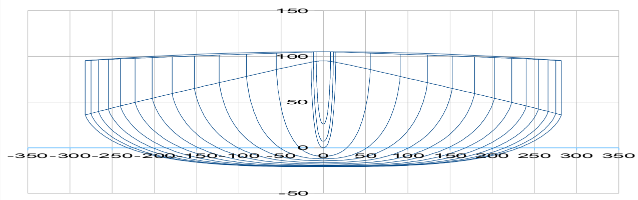
Z hc av = 0,95 m and Tc = 0,206 m

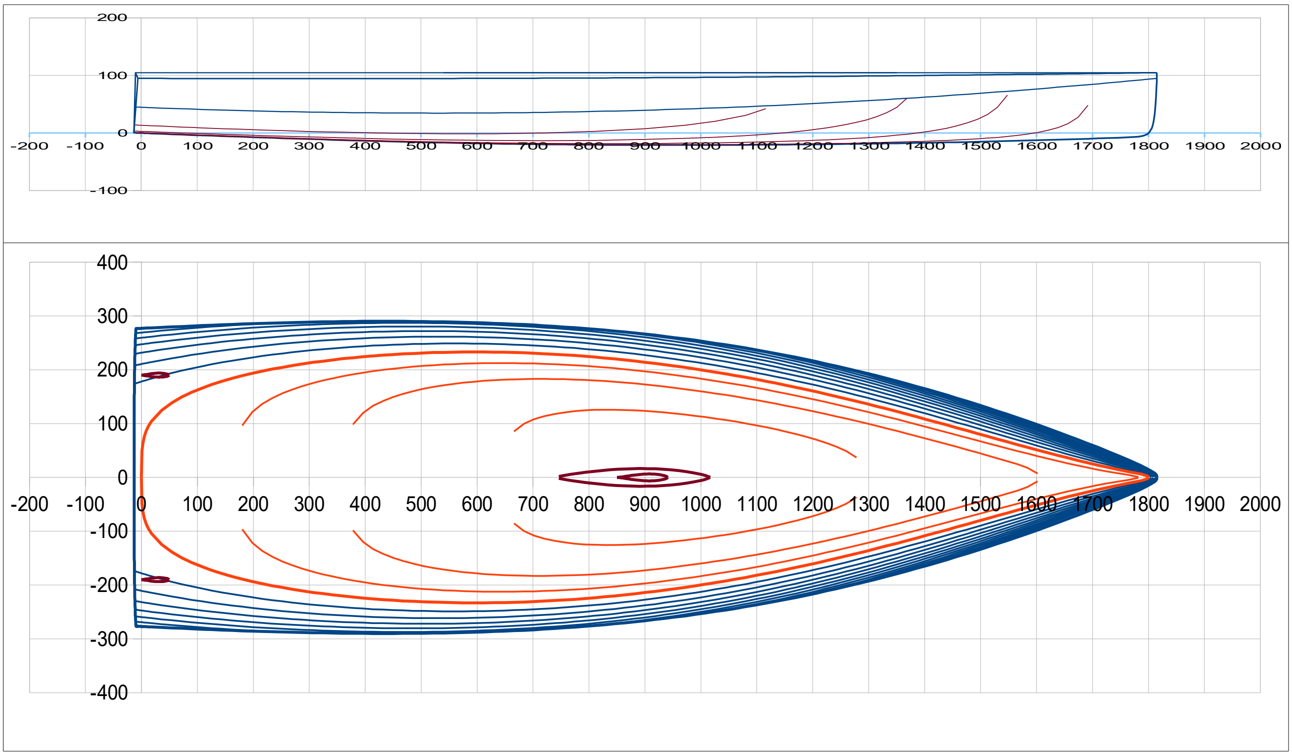
>>>>>

LCB = 46,00 % Lwl

Cp = 0,555

……..





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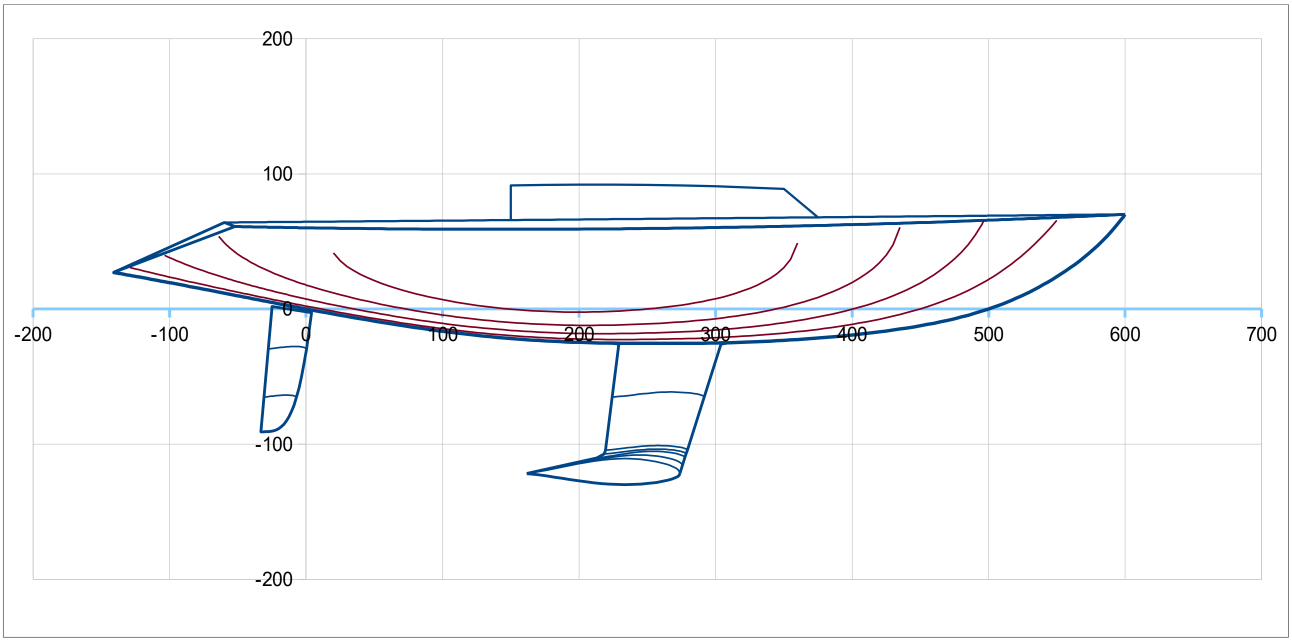
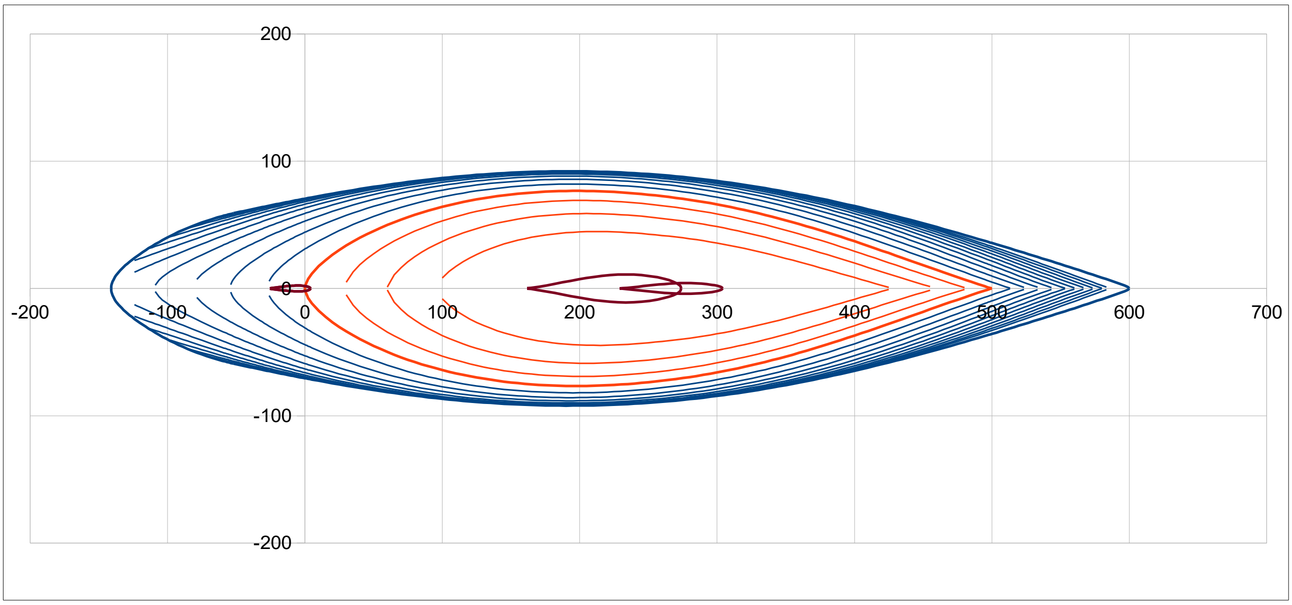
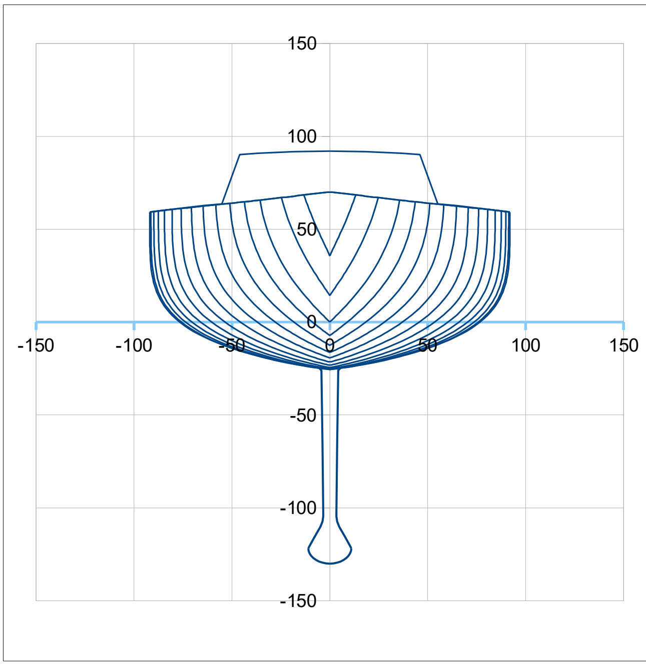
Keel Boat KB15, inspired by 15m2 SNS designs

Loa 7,41 m ; Lwl 5,00 m ; B 1,84 m ; Draft 1,30 m ; Displacement : 744 kg ; Ballast : 343 kg
>> LCB hull 46,57 %Lwl ; Cp hull : 0,542 ; Sw : 7,86 m2 ; DLR : 166 ; Ballast ratio : 46,1 %



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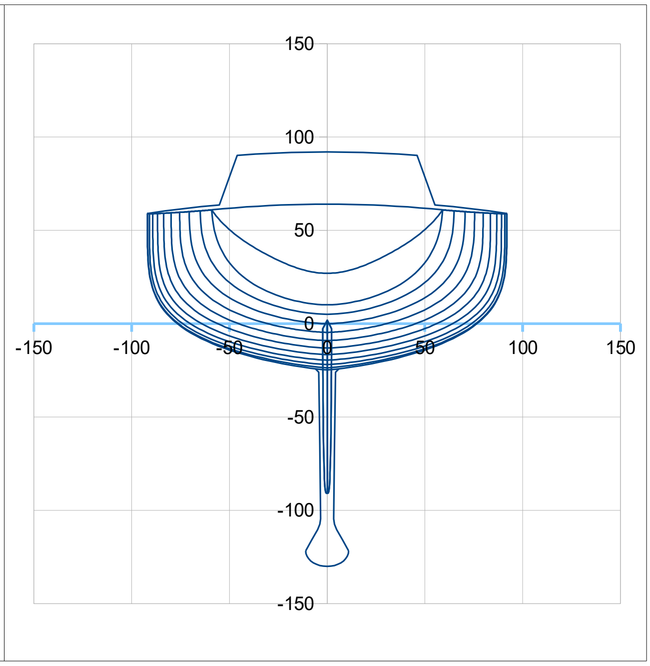
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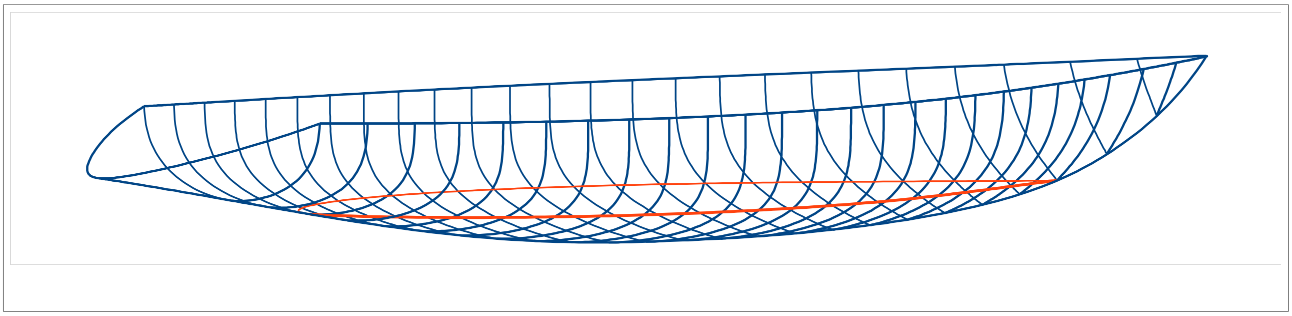

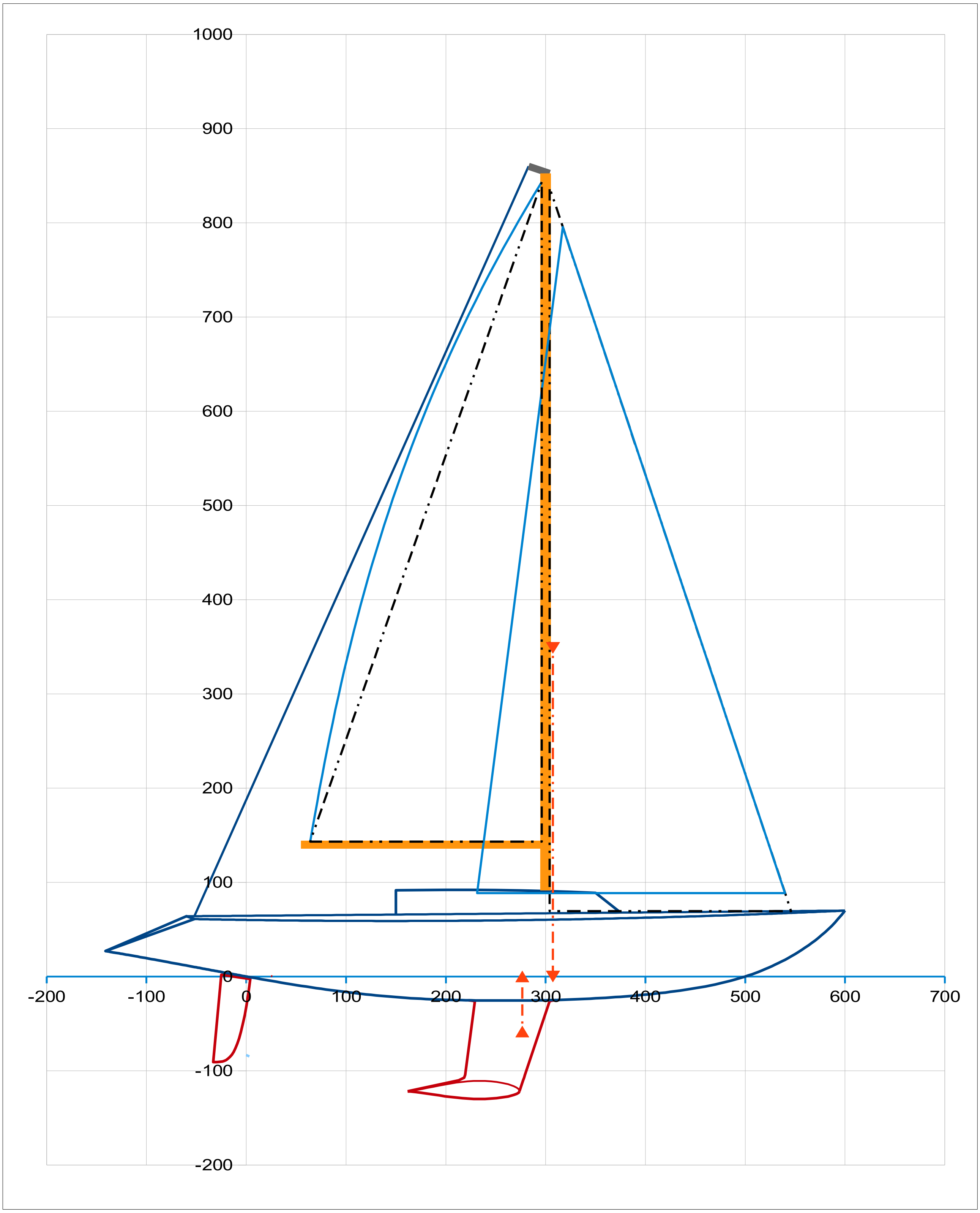

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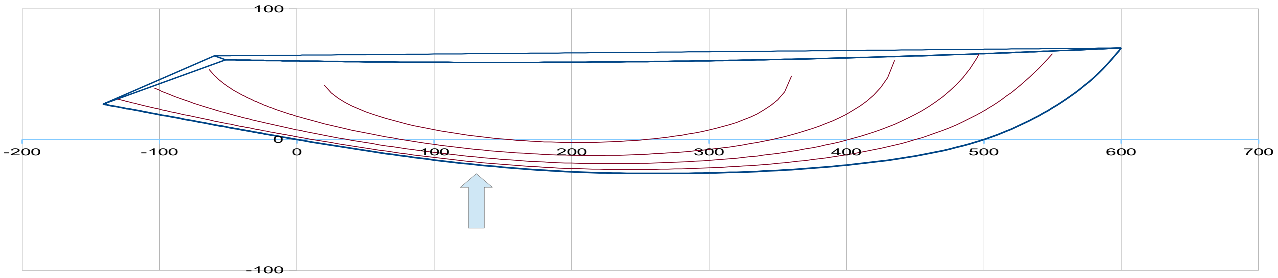
KB15 hydrostatics data :

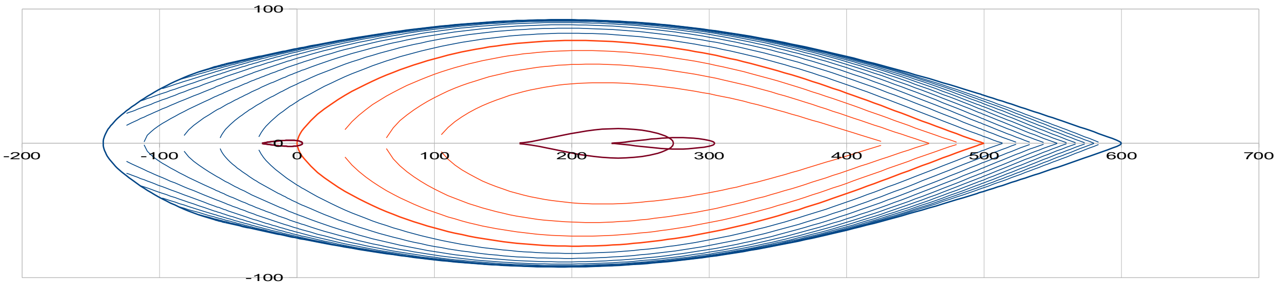
2. Data sum-up and results of hydrostatic and surfaces calculations

2.1 Hull								
Loa (m)	**7,41**	**Lwl (m)**	**5,00**		> Hull speed (Knots)	5,4	at Froude 0,4	
>> ft	24,31		16,40					
Boa (m)	**1,84**	**at X (% Lwl)**	**38,0**	Bsheer (m)	1,84	at X (% Lwl)	38,0	
>> ft	6,04							
Bwl (m)	**1,53**	**at X (% Lwl)**	**40,0**	> Bwl / Boa	0,833			
>> ft	5,03				**Freeboards (m) >**	**Aft**	**Midship**	**Fore**
Tc (m)	**0,255**	**at X (%Lwl)**	**52,5**			**0,61**	**0,59**	**0,7**
>> ft	0,84				>> ft	2,00	1,94	2,30
Displacement at H0 (m3)		**0,67277**	**at LCB (m)**	**2,329**	**LCB (%Lwl)**	**46,57**	**ZCB (m)**	**-0,084**
	>> lbs	1520	w. seawater	1025	kg/m3		>> ft	-0,28
Cp	**0,542**							
Sf (m2)	**5,18**	**at LCF (m)**	**2,237**	**LCF (%Lwl)**	**44,74**		>>> LCB – LCF (%Lwl)	1,83
>> ft2	55,72	>> ft	7,34					
Angle Freeboard/Half beam		32,7	(°), at section C4 (40% Lwl)					
Sw (m2)	**5,52**	>Sw/D^(2/3)	7,19					
>> ft2	59,44							
Shull (m2)	**15,11**	**at X (m)**	**2,201**	**Z (m)**	**0,108**			
>> ft2	162,64	>> ft	7,22	>> ft	0,35			
Sdeck (m2)	**8,74**	**at X (m)**	**2,221**	**Z (m)**	**0,64**			
>> ft2	94,06	>> ft	7,29	>> ft	2,11			
2.2 Keel								
Vol. keel(m3)	**0,04703**	**at X (m)**	**2,514**	**X (%Lwl)**	**50,28**	**Z (m)**	**-0,869**	
		>> ft	8,25			>> ft	-2,85	
Ballast (kg)	**343,3**	**at X (m)**	**2,514**	**X (%Lwl)**	**50,28**	**Z (m)**	**-0,869**	
>> lbs	757	>> ft	8,25			>> ft	-2,85	
Draft oa (m)	**1,30**		**Sw (m2)**	**1,87**		**Sxz (m2)**	**0,69**	
>> ft	4,27		>> ft2	20,10		>> ft2	7,40	
CLR (m)	**2,77**	**CLR (%Lwl)**	**55,31**	*CLR = Center of Lateral Resistance*				
>> ft	9,07	method: keel profile extended to the waterline, CLR at Z 45% draft and					25,00	% chord
2.3 Rudder(s)								
Number	**1**							
Volume (m3)	**0,00602**	**at X (m)**	**-0,13**	**X (%Lwl)**	**-2,69**	**Z (m)**	**-0,38**	
Sw (m2)	**0,47**	>> ft	-0,44			**Sxz (m2)**	**0,23**	per rudder
>> ft2	5,07					>> ft2	2,44	
2.4 Hull + Keel + Rudder(s)								
Displacement at H0 (m3)		**0,72581**	**at LCB (m)**	**2,320**	**LCB (%Lwl)**	**46,40**	**at ZCB (m)**	**-0,138**
(kg)		**744**	>> ft	7,61			>> ft	-0,45
>> lbs		1640						
, of wich Ballast (kg)		**343**	**at Xg (m)**	**2,514**	**Xg (%Lwl)**	**50,28**	**at Zg (m)**	**-0,869**
>> lbs		757	>> ft	8,25			>> ft	-2,85
>> % Ballast		46,1						
Sw (m2)		**7,86**	>Sw/D^(2/3)	9,73	Lwl/D^(1/3)	5,56		
>> ft2		84,61			**DLR**	**166**	M(lbs/2240)/(Lwl(ft)/100)^3	
2.5 Data from the mass spreadsheet								
Light boat:	**M (kg)**	**744**	**at Xg (m)**	**2,364**	**Xg (%Lwl)**	**47,28**	**at Zg (m)**	**-0,129**

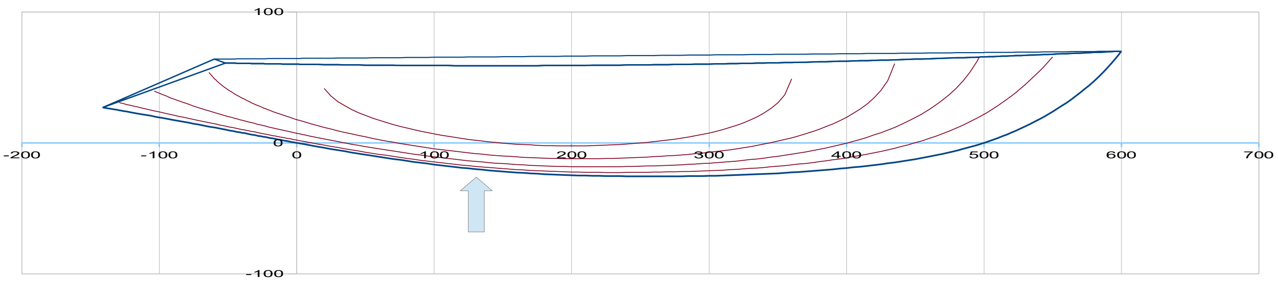
Within KB15, one can demonstrate by images **the influence of «Pui q ar » on LCB and Cp.** Pui q ar acts on the curvature of the half part of the keel line. Done with hull draft Tc adjustement to keep constant the displacement.

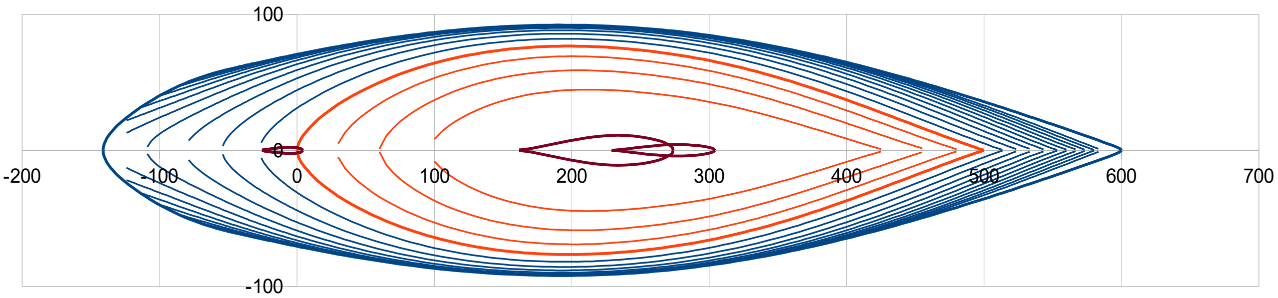
Pui q ar = 2,25 and Tc = 0,260 m >>> LCB = 47,23 % Lwl Cp = 0,533 ....



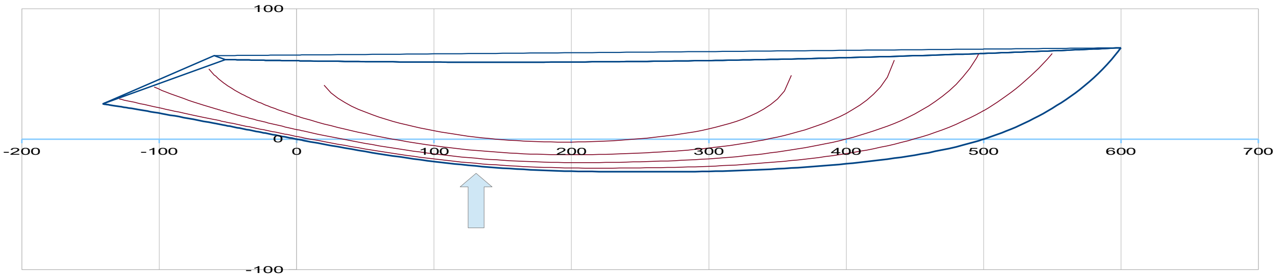


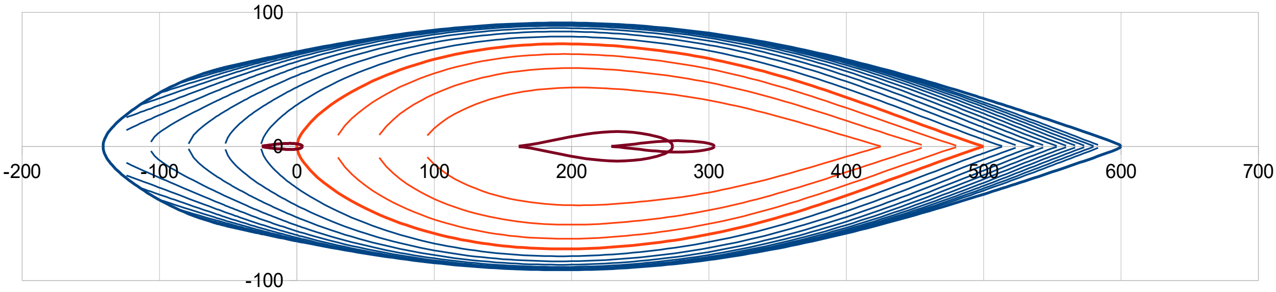
Pui q ar = 2,75 and Tc = 0,255 m >>> LCB = 46,57 % Lwl Cp = 0,542 ....
(KB15 Choice)



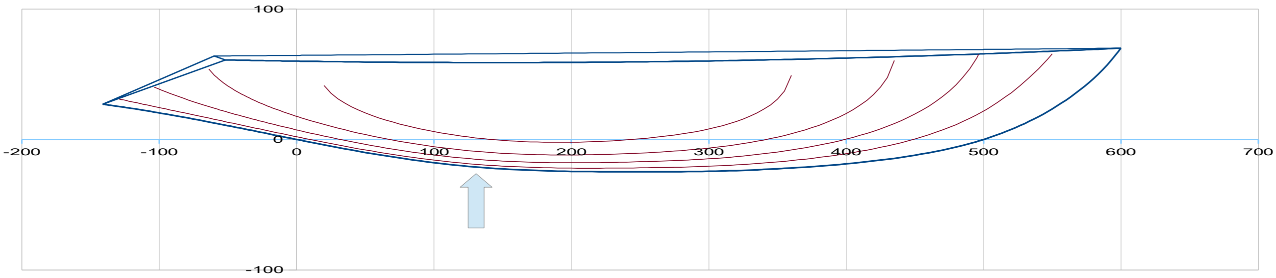


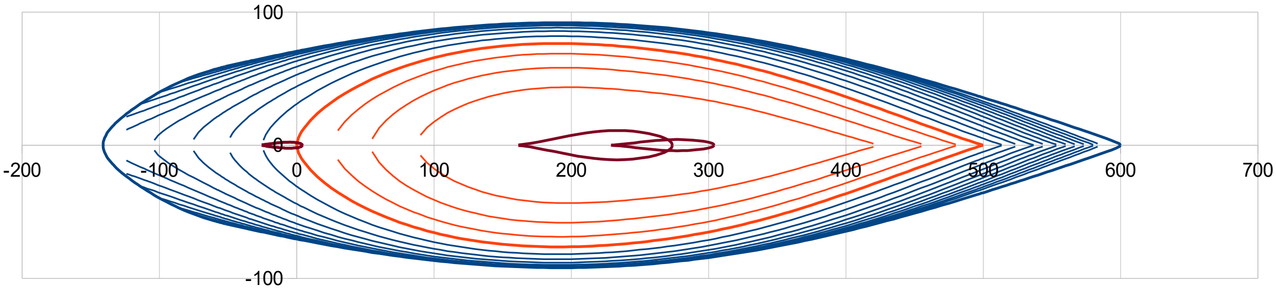
Pui q ar = 3,25 and Tc = 0,250 m >>> LCB = 46,02 % Lwl Cp = 0,547 ....





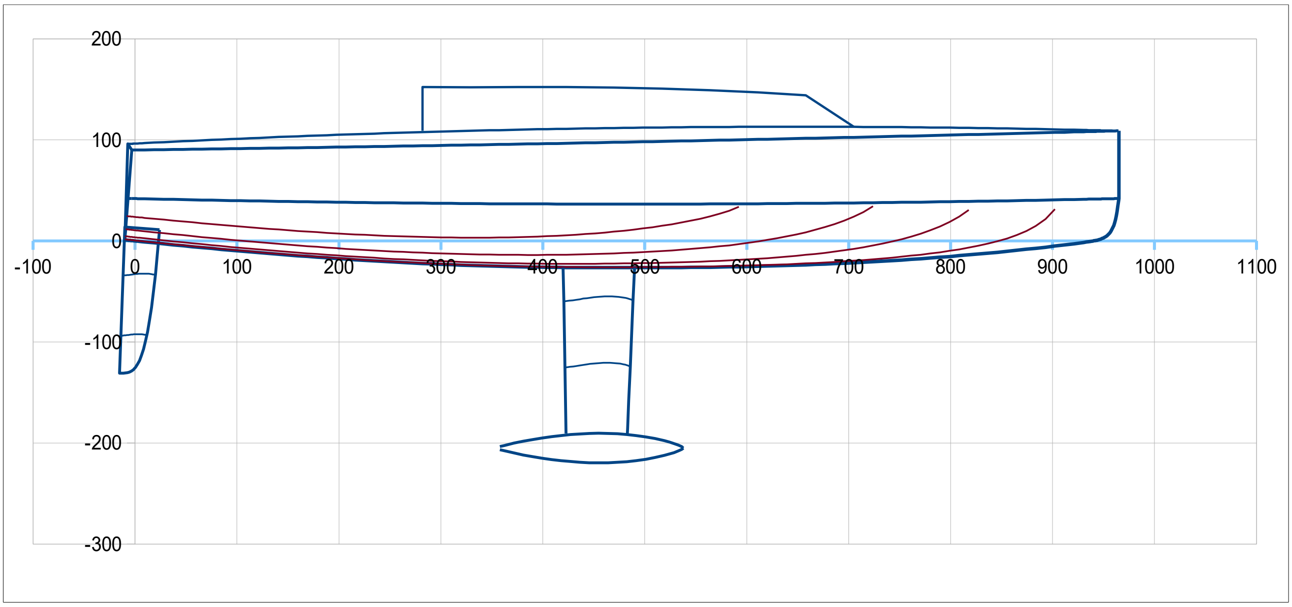
Pui q ar = 3,75 and Tc = 0,247 m >>> LCB = 45,56 % Lwl Cp = 0,552 ....

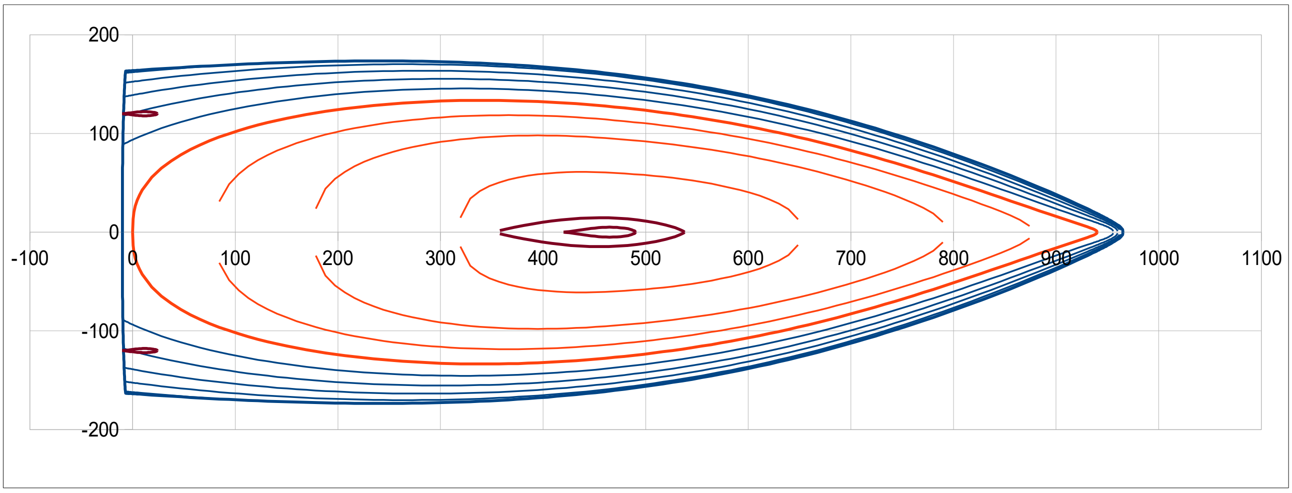


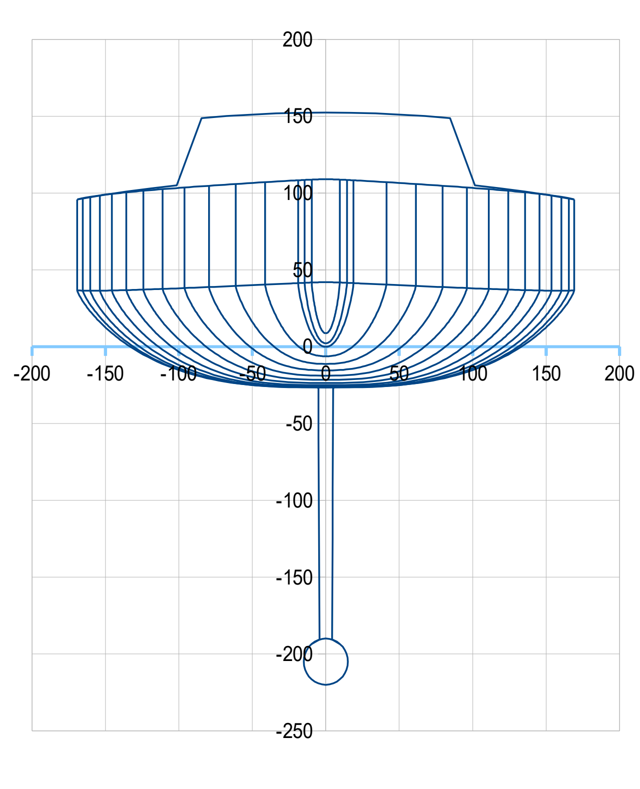


Dolfi 32S, inspired by Beneteau Figaro III / VPLP

Loa 9,75 m ; Lwl 9,40 m ; B 3,47 m ; Draft 2,20 m ; Displacement : 2977 kg ; Ballast : 1248 kg
>> LCB hull 46,56 %Lwl ; Cp hull : O,562 ; Sw : 23,36 m2 ; DLR : 100 ; Ballast ratio : 41,9 %



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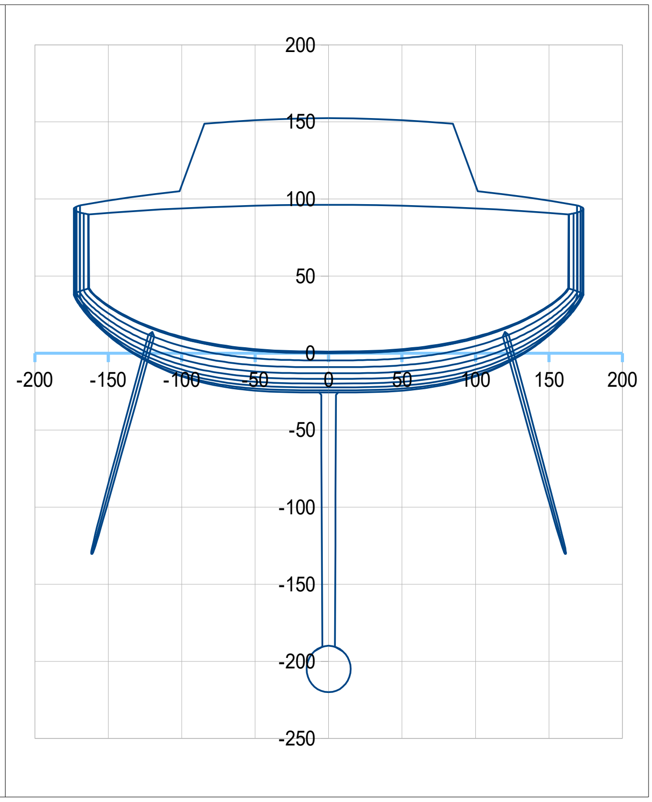
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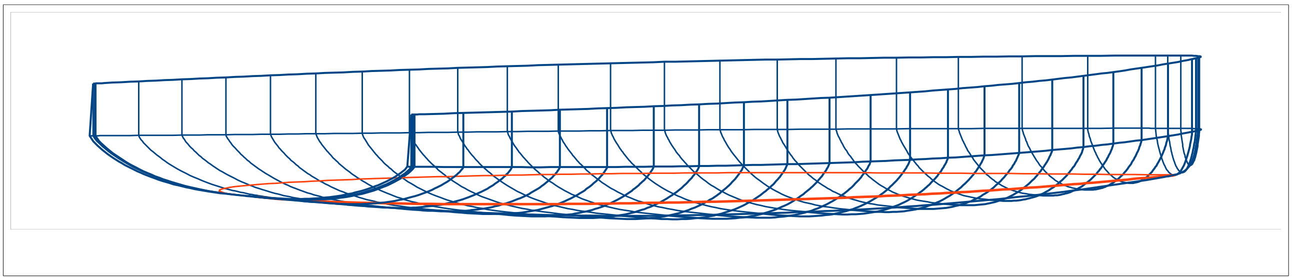

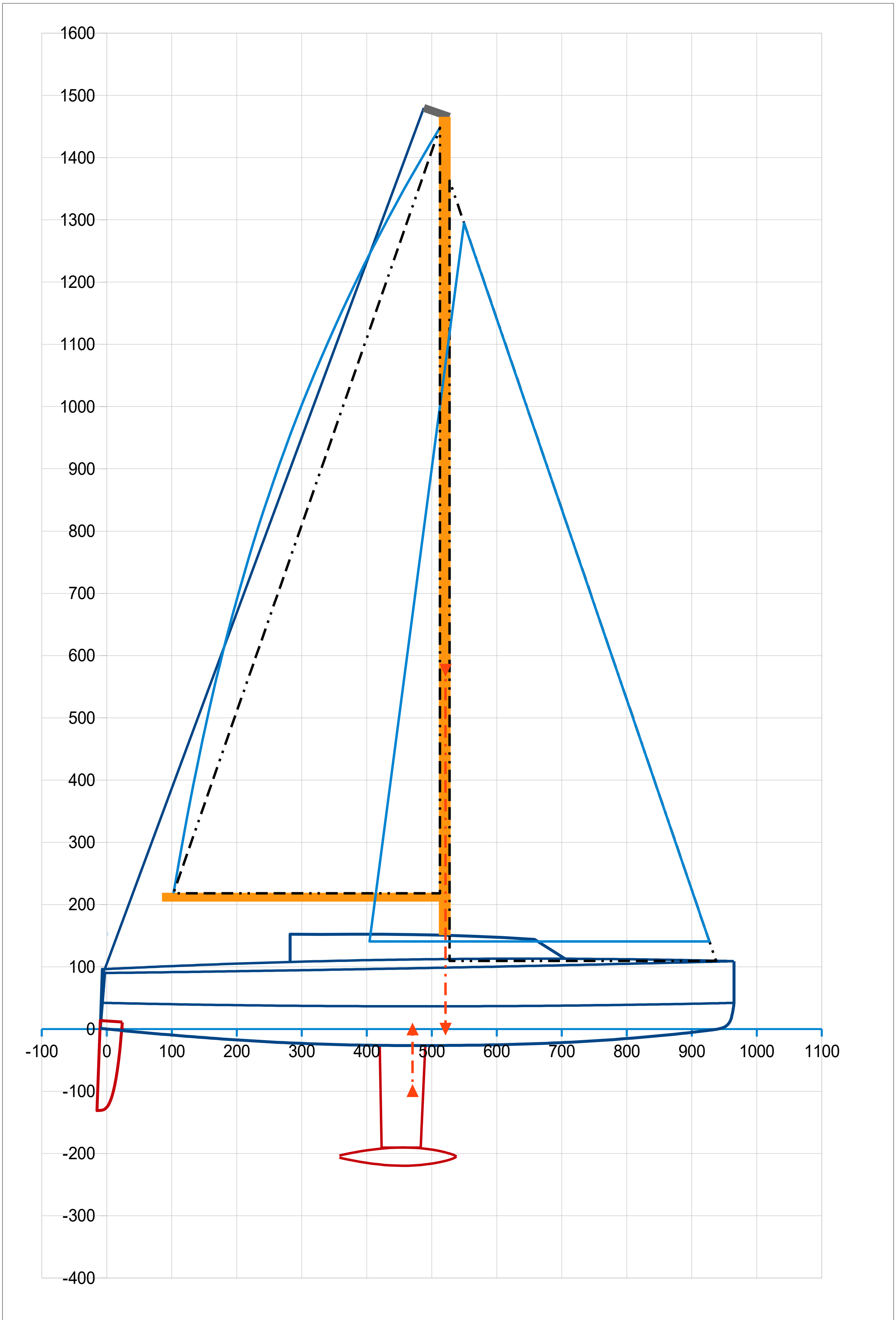

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Dolfi 32S hydrostatics data :

2. Data sum-up and results of hydrostatic and surfaces calculations

2.1 Hull

Loa (m)	9,75	Lwl (m)	9,40		> Hull speed (Knots)	7,5	at Froude 0,4	
>> ft	31,99		30,84					
Boa (m)	3,47	at X (% Lwl)	26,0	Bsheer (m)	3,47	at X (% Lwl)	26,0	
>> ft	11,38							
Bwl (m)	2,67	at X (% Lwl)	36,0	> Bwl / Boa	0,770			
>> ft	8,76				Freeboards (m) >	Aft	Midship	Fore
Tc (m)	0,265	at X (%Lwl)	50			0,90	0,95	1,09
>> ft	0,87				>> ft	2,95	3,12	3,58
	Displacement at H0 (m3)	2,75290	at LCB (m)	4,376	LCB (%Lwl)	46,56	ZCB (m)	-0,097
	>> lbs	6221	w. seawater	1025	kg/m3		>> ft	-0,32
Cp	0,562							
Sf (m2)	17,94	at LCF (m)	4,081	LCF (%Lwl)	43,42		>>> LCB – LCF (%Lwl)	3,14
>> ft2	193,07	>> ft	13,39					
Angle Freeboard/Half beam		29,5	(°), at section C4 (40% Lwl)					
Sw (m2)	18,33	>Sw/D^(2/3)	9,33					
>> ft2	197,31							
Shull (m2)	41,42	at X (m)	4,353	Z (m)	0,168			
>> ft2	445,89	>> ft	14,28	>> ft	0,55			
Sdeck (m2)	25,95	at X (m)	3,931	Z (m)	1,02			
>> ft2	279,37	>> ft	12,90	>> ft	3,33			

2.2 Keel

Vol. keel(m3)	0,13298	at X (m)	4,555	X (%Lwl)	48,46	Z (m)	-1,560	
		>> ft	14,94			>> ft	-5,12	
Ballast (kg)	1248,1	at X (m)	4,547	X (%Lwl)	48,37	Z (m)	-1,669	
>> lbs	2752	>> ft	14,92			>> ft	-5,47	
Draft oa (m)	2,20		Sw (m2)	3,30		Sxz (m2)	1,44	
>> ft	7,22		>> ft2	35,51		>> ft2	15,46	
CLR (m)	4,70	CLR (%Lwl)	50,05	CLR = Center of Lateral Resistance				
>> ft	15,43	method: keel profile extended to the waterline, CLR at Z 45% draft and					25,00	% chord

2.3 Rudder(s)

Number	2							
Volume (m3)	0,01876	at X (m)	0,05	X (%Lwl)	0,56	Z (m)	-0,47	
Sw (m2)	1,73	>> ft	0,17			Sxz (m2)	0,42	per rudder
>> ft2	18,61					>> ft2	4,47	

2.4 Hull + Keel + Rudder(s)

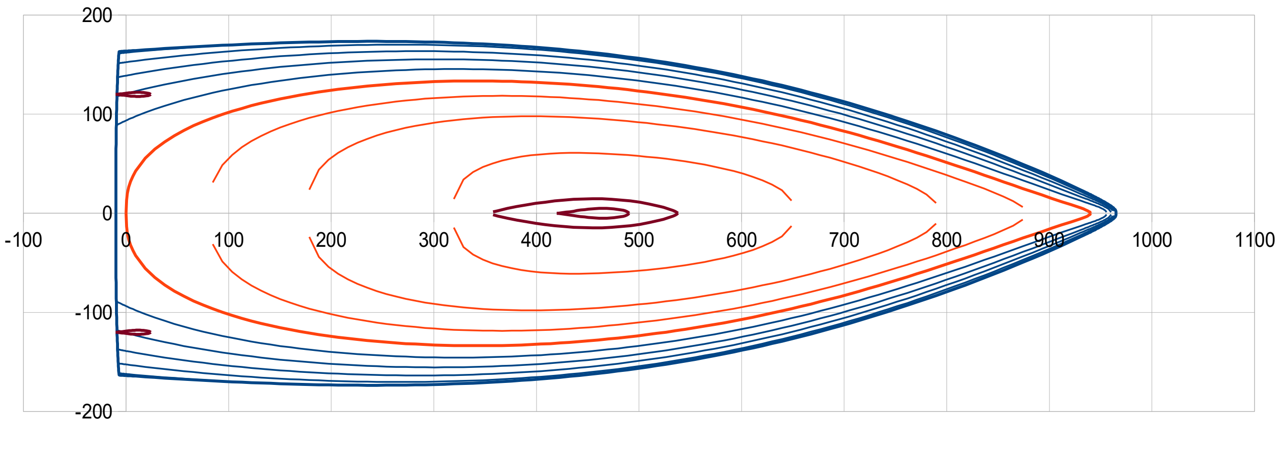
	Displacement at H0 (m3)	2,90464	at LCB (m)	4,357	LCB (%Lwl)	46,35	at ZCB (m)	-0,166
	(kg)	2977	>> ft	14,29			>> ft	-0,55
	>> lbs	6564						
	, of wich Ballast (kg)	1248	at Xg (m)	4,547	Xg (%Lwl)	48,37	at Zg (m)	-1,669
	>> lbs	2752	>> ft	14,92			>> ft	-5,47
	>> % Ballast	41,9						
	Sw (m2)	23,36	>Sw/D^(2/3)	11,47	Lwl/D^(1/3)	6,59		
	>> ft2	251,43			DLR	100	M(lbs/2240)/(Lwl(ft)/100)^3	

2.5 Data from the mass spreadsheet

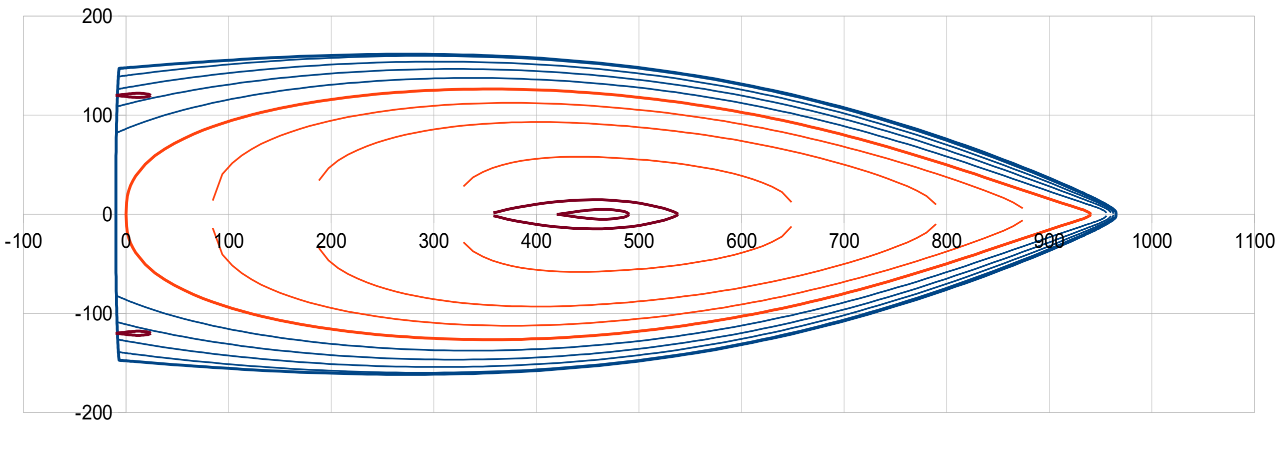
Light boat:	M (kg)	2977	at Xg (m)	4,288	Xg (%Lwl)	45,62	at Zg (m)	-0,193

Within Dolfi 32S, one can demonstrate by images **the influence of «Alfa » transformation on the beam and the waterlines.** Done with hull draft Tc adjustement to keep constant the displacement.

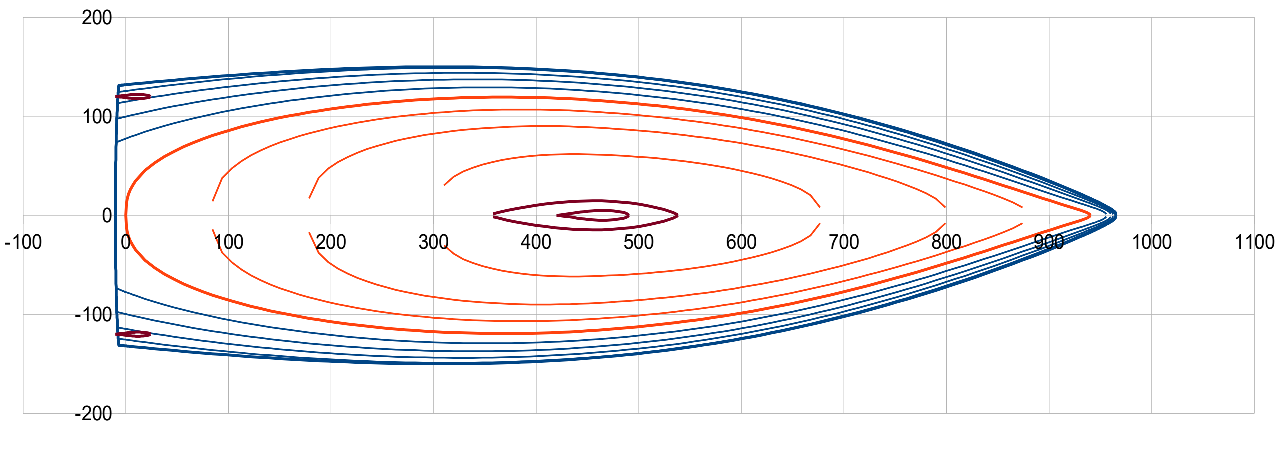
Alfa = 14,18° and Tc = 0,265 m >>> Boa 3,47 m LCB = 46,56 % Lwl Cp = 0,562 ....
(Dolfi 32S choice)



Alfa = 13,18° and Tc = 0,280 m >>> Boa 3,23 m LCB = 46,96 % Lwl Cp = 0,558 ....

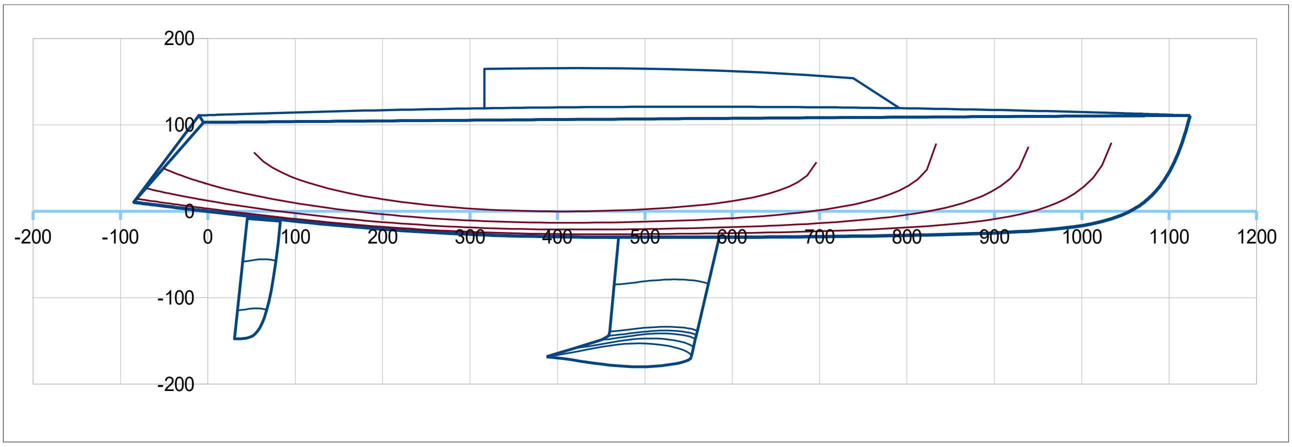


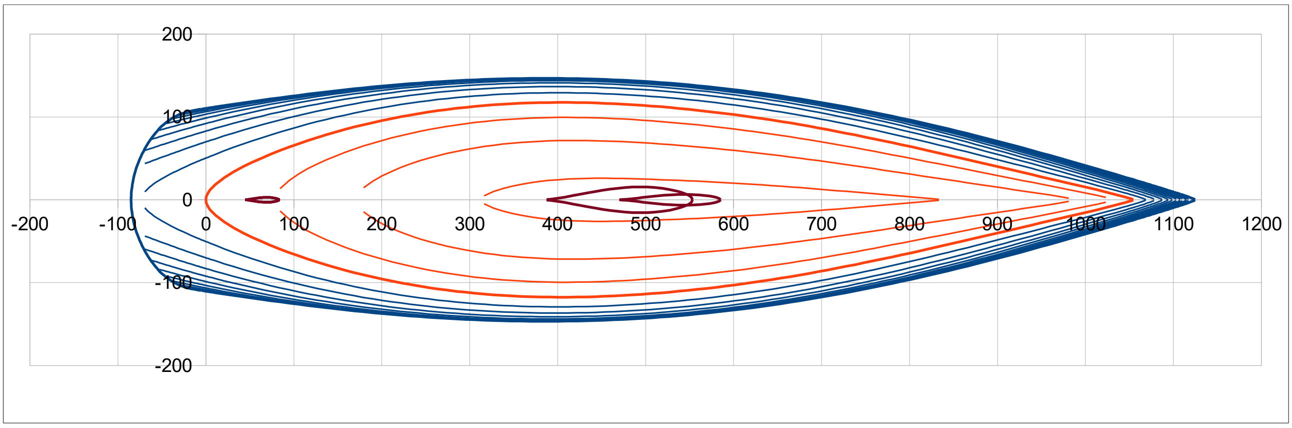
Alfa = 12,18° and Tc = 0,298 m >>> Boa 3,00 m LCB = 47,41 % Lwl Cp = 0,554 ....

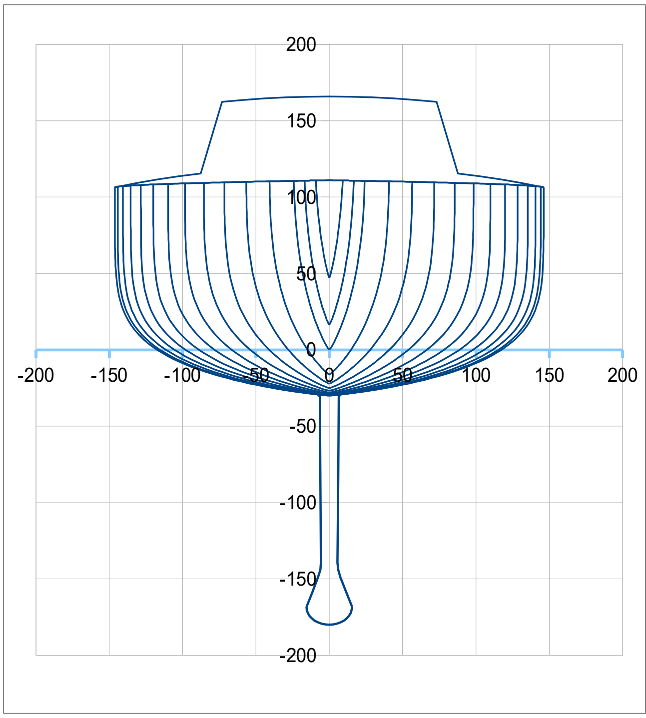


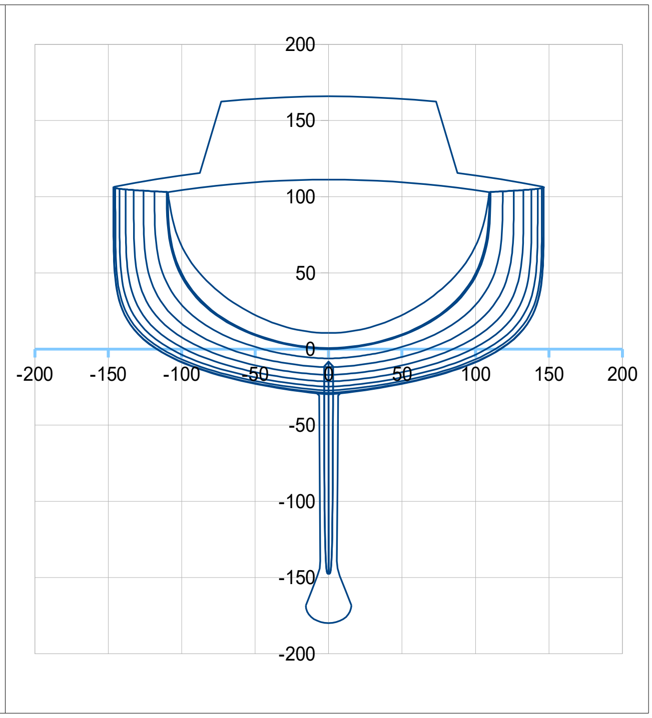
ULDB 40, inspired by ULDB designs

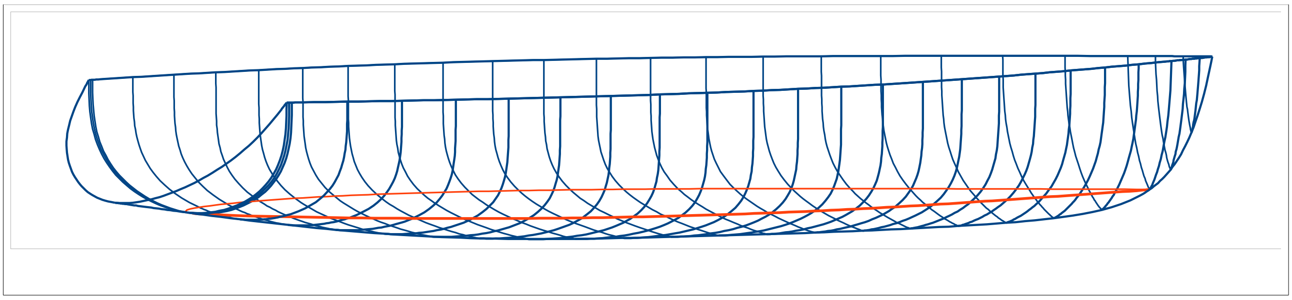
Loa 12,09 m ; Lwl 10,55 m ; B 2,93 m ; Draft 1,80 m ; Displacement : 2923 kg ; Ballast : 1200 kg
>> LCB hull 46,79 %Lwl ; Cp hull : 0,562 ; Sw : 22,52 m2 ; DLR : 69 ; Ballast ratio : 41,1 %

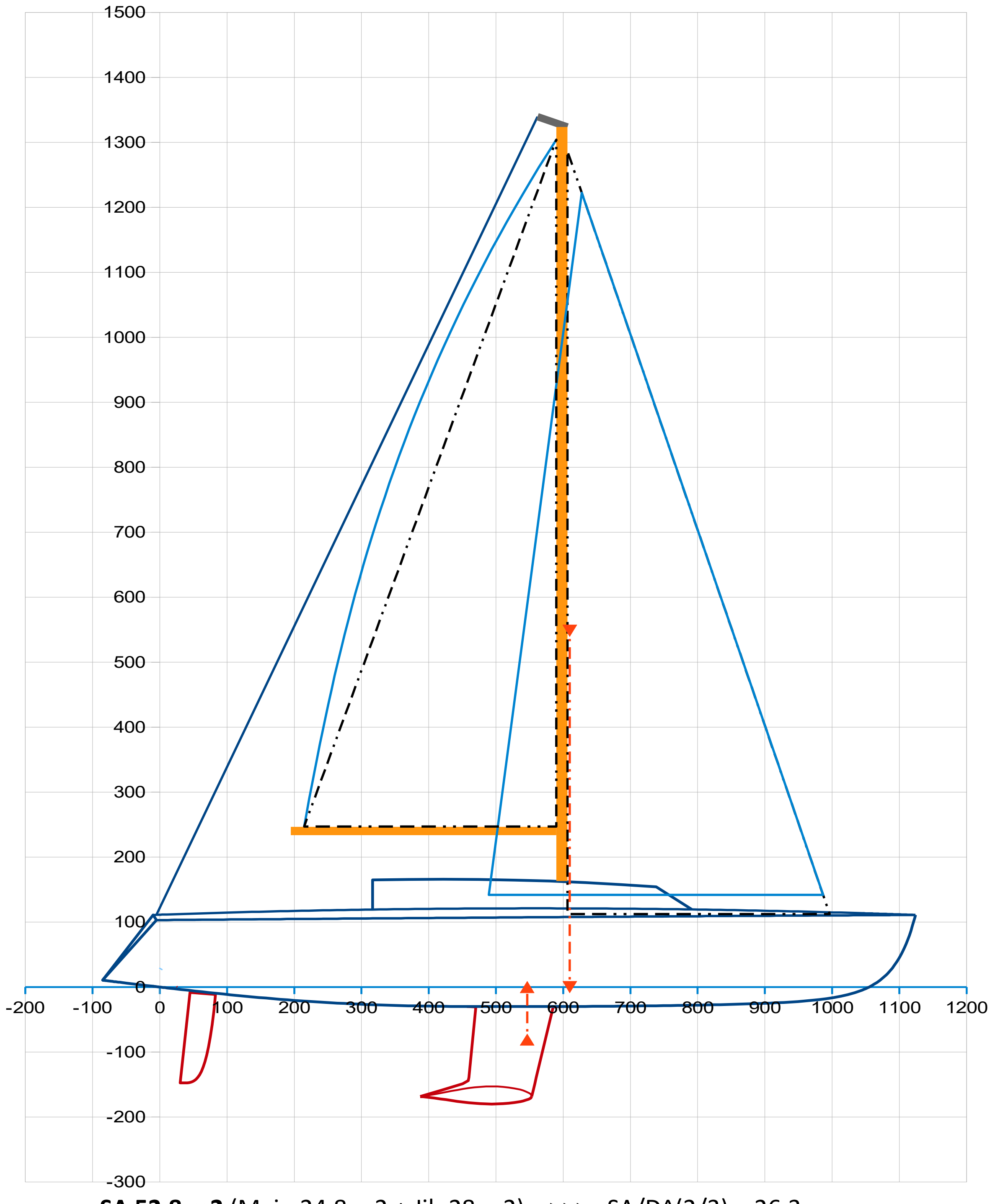












SA 52,8 m2 (Main 24,8 m2 + Jib 28 m2) >>> SA/D^(2/3) = 26,3

ULDB 40 hydrostatics data :

2. Data sum-up and results of hydrostatic and surfaces calculations

2.1 Hull

Loa (m)	**12,09**			**Lwl (m)**	**10,55**					> Hull speed (Knots)	7,9	at Froude 0,4			
>> ft	*39,67*				*34,61*										
Boa (m)	**2,93**			**at X (% Lwl)**	**37,0**			Bsheer (m)	2,93			at X (% Lwl)	37,0		
>> ft	*9,61*														
Bwl (m)	**2,35**			**at X (% Lwl)**	**38,0**			> Bwl / Boa	0,802						
>> ft	*7,71*									**Freeboards (m) >**	**Aft**		**Midship**		**Fore**
Tc (m)	**0,300**			**at X (%Lwl)**	**50**						**1,03**		**1,06**		**1,11**
>> ft	*0,98*									*>> ft*	*3,38*		*3,48*		*3,64*
		Displacement at H0 (m3)	**2,67038**			**at LCB (m)**	**4,936**			**LCB (%Lwl)**	**46,79**			**ZCB (m)**	**-0,103**
		>> lbs	*6034*			*w. seawater*	*1025*		*kg/m3*					*>> ft*	*-0,34*
Cp	**0,561**														
Sf (m2)	**16,48**			**at LCF (m)**	**4,697**			**LCF (%Lwl)**	**44,52**					>>> LCB – LCF (%Lwl)	2,27
>> ft2	*177,38*			*>> ft*	*15,41*										
Angle Freeboard/Half beam			36,0	(°), at section C4 (40% Lwl)											
Sw (m2)	**17,32**			>Sw/D^(2/3)	9,00										
>> ft2	*186,47*														
Shull (m2)	**45,33**			**at X (m)**	**4,931**			**Z (m)**	**0,226**						
>> ft2	*487,91*			*>> ft*	*16,18*			*>> ft*	*0,74*						
Sdeck (m2)	**24,62**			**at X (m)**	**4,630**			**Z (m)**	**1,11**						
>> ft2	*265,02*			*>> ft*	*15,19*			*>> ft*	*3,64*						

2.2 Keel

Vol. keel(m3)	**0,16445**			**at X (m)**	**5,136**			**X (%Lwl)**	**48,69**			**Z (m)**	**-1,174**		
				>> ft	*16,85*							*>> ft*	*-3,85*		
Ballast (kg)	**1200,5**			**at X (m)**	**5,136**			**X (%Lwl)**	**48,69**			**Z (m)**	**-1,174**		
>> lbs	*2647*			*>> ft*	*16,85*							*>> ft*	*-3,85*		
Draft oa (m)	**1,80**					**Sw (m2)**	**4,20**					**Sxz (m2)**	**1,56**		
>> ft	*5,91*					*>> ft2*	*45,21*					*>> ft2*	*16,76*		
CLR (m)	**5,46**			**CLR (%Lwl)**	**51,79**	*CLR = Center of Lateral Resistance*									
>> ft	*17,92*	method: keel profile extended to the waterline, CLR at Z 45% draft and											25,00	% chord	

2.3 Rudder(s)

Number	**1**														
Volume (m3)	**0,01658**			**at X (m)**	**0,59**			**X (%Lwl)**	**5,63**			**Z (m)**	**-0,70**		
Sw (m2)	**1,00**			*>> ft*	*1,95*							**Sxz (m2)**	**0,48**		per rudder
>> ft2	*10,77*											*>> ft2*	*5,18*		

2.4 Hull + Keel + Rudder(s)

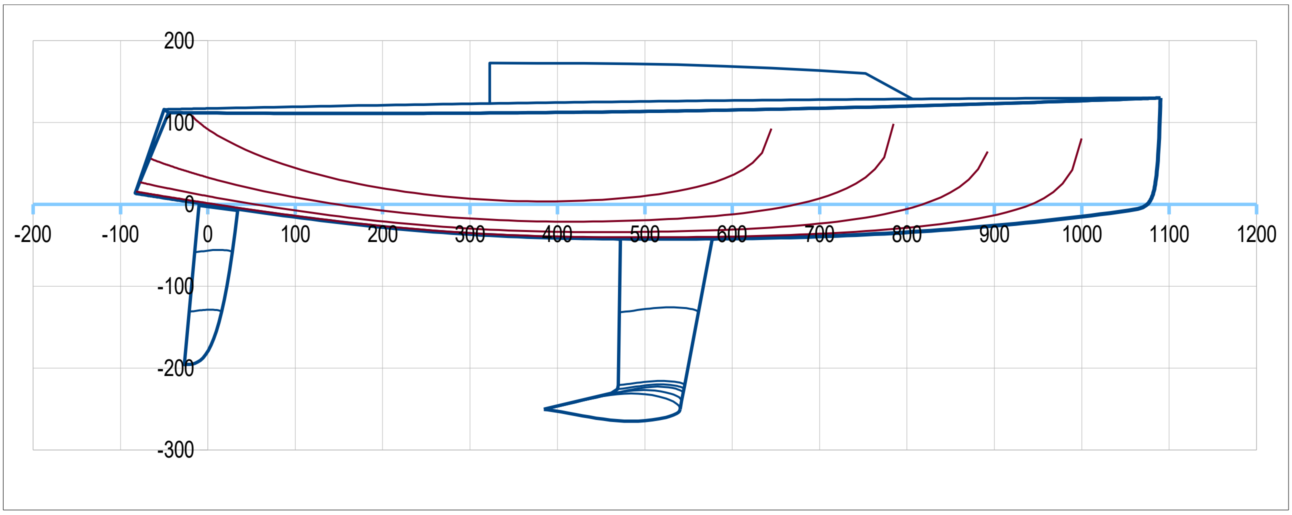
		Displacement at H0 (m3)	**2,85141**			**at LCB (m)**	**4,922**			**LCB (%Lwl)**	**46,66**			**at ZCB (m)**	**-0,168**
		(kg)	**2923**			*>> ft*	*16,15*							*>> ft*	*-0,55*
		>> lbs	*6443*												
		, of wich Ballast (kg)	**1200**			**at Xg (m)**	**5,136**			**Xg (%Lwl)**	**48,69**			**at Zg (m)**	**-1,174**
		>> lbs	*2647*			*>> ft*	*16,85*							*>> ft*	*-3,85*
		>> % Ballast	41,1												
		Sw (m2)	**22,52**			>Sw/D^(2/3)	11,20			Lwl/D^(1/3)	7,44				
		>> ft2	*242,46*							***DLR***	***69***	*M(lbs/2240)/(Lwl(ft)/100)^3*			

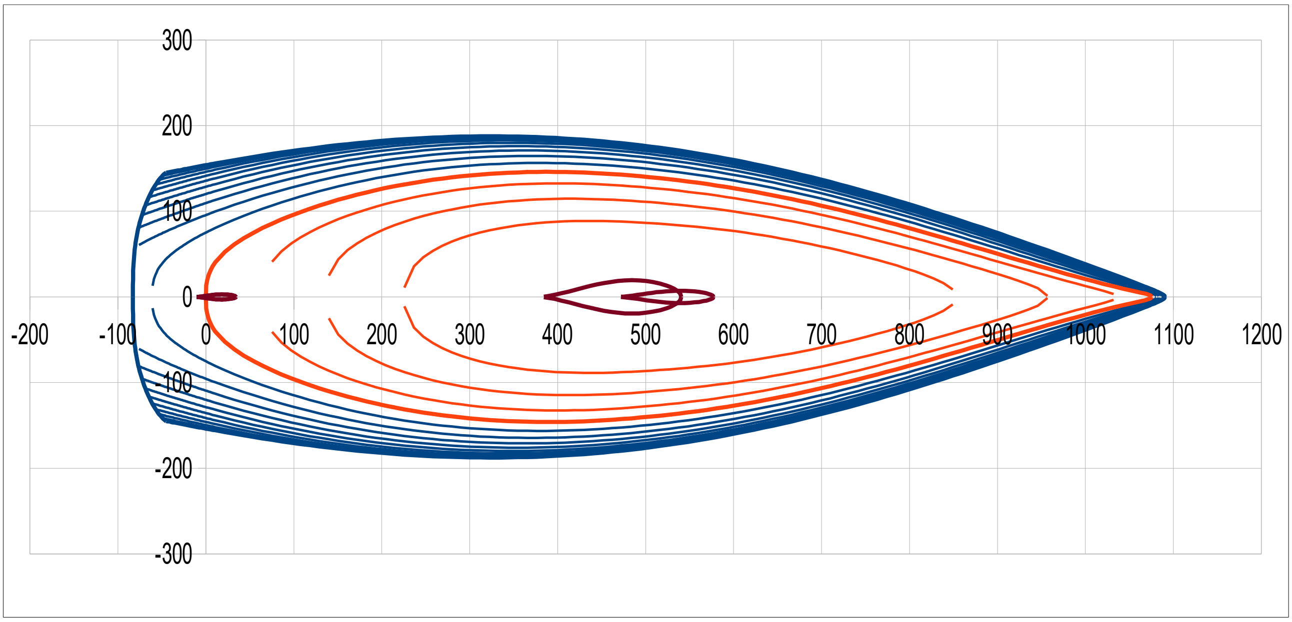
2.5 Data from the mass spreadsheet

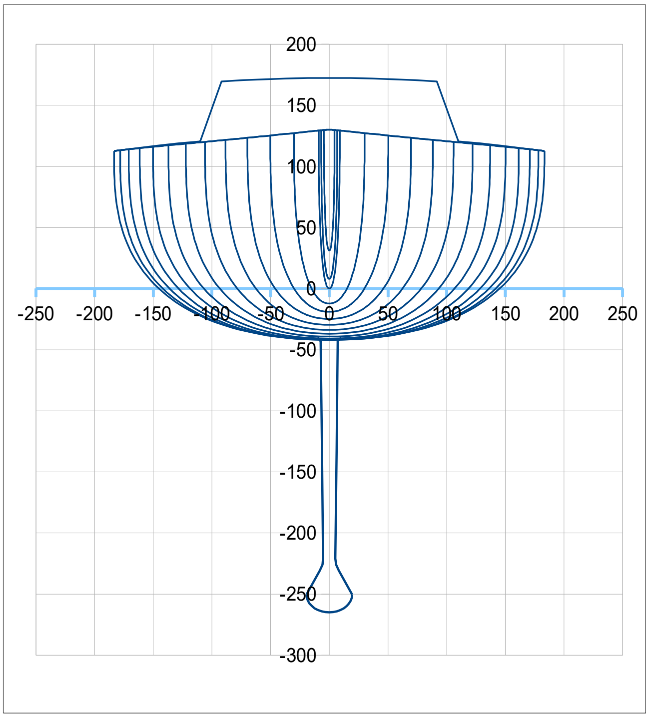
Light boat:		**M (kg)**	**2923**			**at Xg (m)**	**4,940**			**Xg (%Lwl)**	**46,82**			**at Zg (m)**	**-0,007**

Syd 38, inspired by Sydney 38 / Murray Burns Dovell

Loa 11,73 m ; Lwl 10,75 m ; B 3,75 m ; Draft 2,65 m ; Displacement : 5560 kg ; Ballast : 1930 kg
>> LCB hull 45,24 %Lwl ; Cp hull : 0,551 ; Sw : 29,19 m2 ; DLR : 125 ; Ballast ratio : 34,7 %



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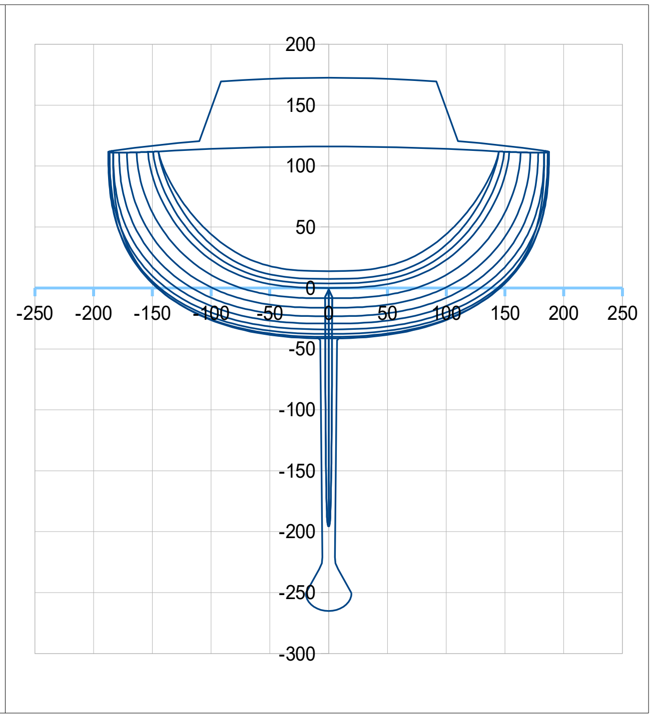
-250 -200 -150 -100 -50 0 50 100 150 200 250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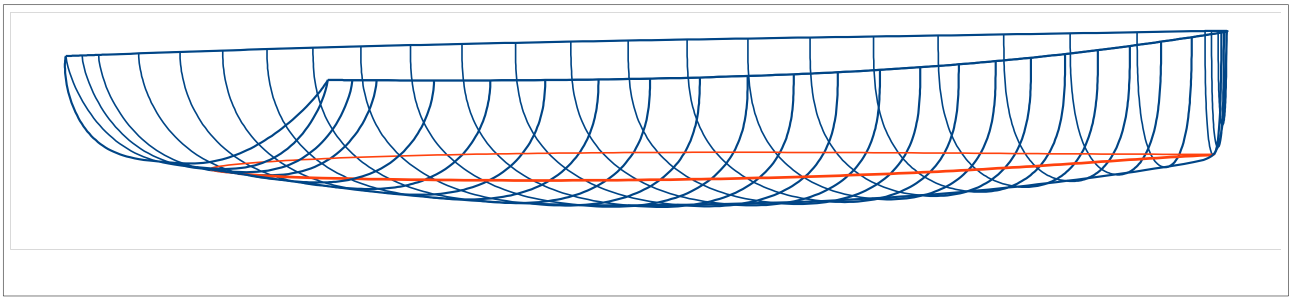

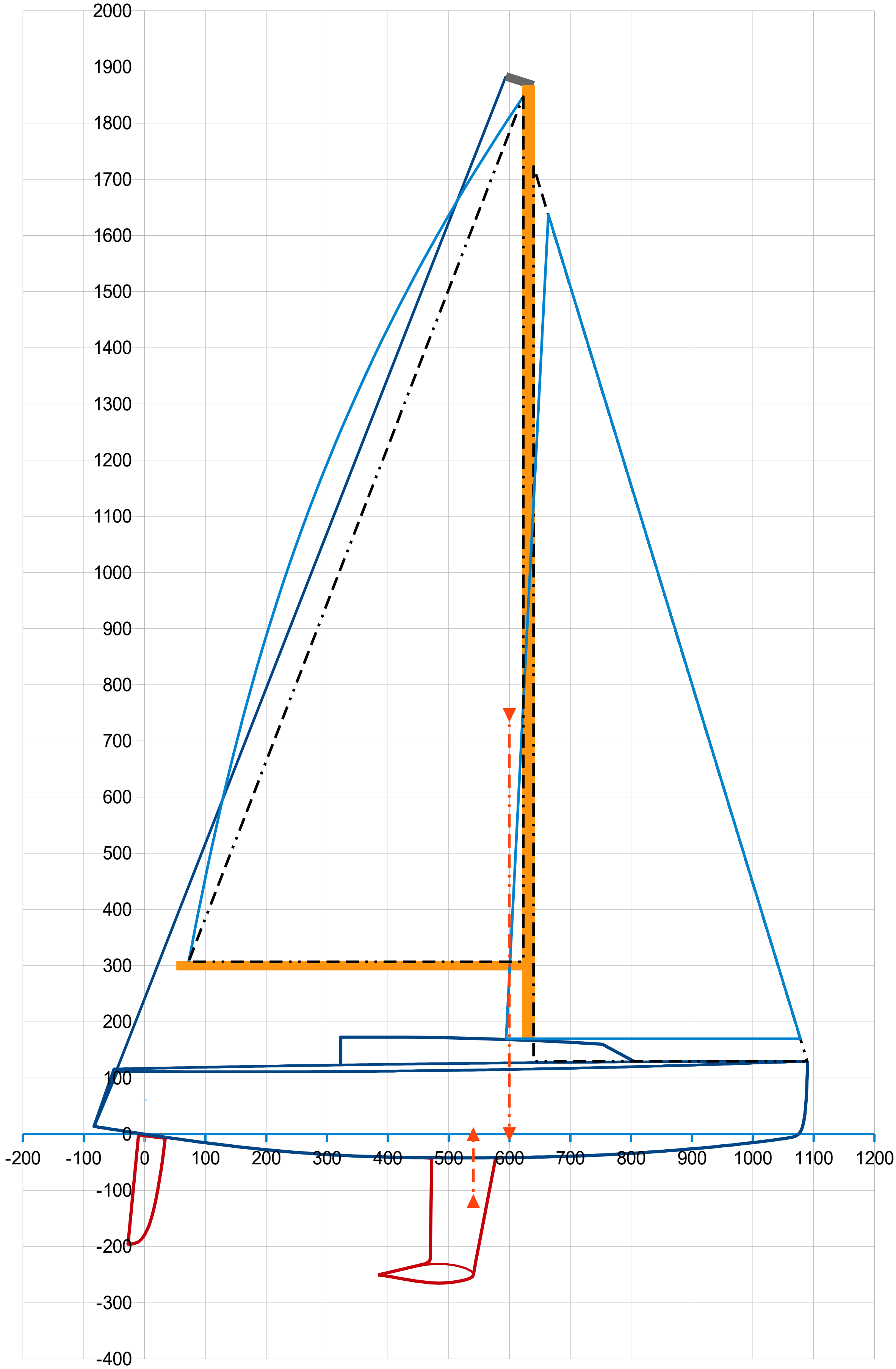

SA 90 m2 (Main 53 m2 + Jib 37 m2) >>> SA/D^(2/3) = 29,16

Syd 38 hydrostatics data :

2. Data sum-up and results of hydrostatic and surfaces calculations

2.1 Hull

Loa (m)	11,73	Lwl (m)	10,75		> Hull speed (Knots)	8,0	at Froude 0,4	
>> ft	38,48		35,27					
Boa (m)	3,75	at X (% Lwl)	30,0	Bsheer (m)	3,75	at X (% Lwl)	30,0	
>> ft	12,30							
Bwl (m)	2,92	at X (% Lwl)	36,0	> Bwl / Boa	0,779			
>> ft	9,58				Freeboards (m) >	Aft	Midship	Fore
Tc (m)	0,420	at X (%Lwl)	50			1,12	1,12	1,3
>> ft	1,38				>> ft	3,67	3,67	4,27
	Displacement at H0 (m3)	5,18433	at LCB (m)	4,864	LCB (%Lwl)	45,24	ZCB (m)	-0,153
	>> lbs	11715	w. seawater	1025	kg/m3		>> ft	-0,50
Cp	0,551							
Sf (m2)	21,18	at LCF (m)	4,603	LCF (%Lwl)	42,82	>>> LCB – LCF (%Lwl)		2,43
>> ft2	228,02	>> ft	15,10					
Angle Freeboard/Half beam		31,5	(°), at section C4 (40% Lwl)					
Sw (m2)	22,51	>Sw/D^(2/3)	7,51					
>> ft2	242,30							
Shull (m2)	53,35	at X (m)	4,773	Z (m)	0,192			
>> ft2	574,28	>> ft	15,66	>> ft	0,63			
Sdeck (m2)	31,40	at X (m)	4,202	Z (m)	1,20			
>> ft2	338,03	>> ft	13,79	>> ft	3,94			

2.2 Keel

Vol. keel(m3)	0,21707	at X (m)	5,055	X (%Lwl)	47,02	Z (m)	-1,830	
		>> ft	16,58			>> ft	-6,00	
Ballast (kg)	1930,4	at X (m)	5,055	X (%Lwl)	47,02	Z (m)	-1,830	
>> lbs	4256	>> ft	16,58			>> ft	-6,00	
Draft oa (m)	2,65		Sw (m2)	5,19		Sxz (m2)	1,96	
>> ft	8,69		>> ft2	55,86		>> ft2	21,05	
CLR (m)	5,40	CLR (%Lwl)	50,27	*CLR = Center of Lateral Resistance*				
>> ft	17,73	method: keel profile extended to the waterline, CLR at Z 45% draft and					25,00	% chord

2.3 Rudder(s)

Number	1							
Volume (m3)	0,02319	at X (m)	0,06	X (%Lwl)	0,58	Z (m)	-0,82	
Sw (m2)	1,49	>> ft	0,20			Sxz (m2)	0,72	per rudder
>> ft2	16,09					>> ft2	7,74	

2.4 Hull + Keel + Rudder(s)

	Displacement at H0 (m3)	5,42459	at LCB (m)	4,851	LCB (%Lwl)	45,12	at ZCB (m)	-0,223
	(kg)	5560	>> ft	15,92			>> ft	-0,73
	>> lbs	12258						
	, of wich Ballast (kg)	1930	at Xg (m)	5,055	Xg (%Lwl)	47,02	at Zg (m)	-1,830
	>> lbs	4256	>> ft	16,58			>> ft	-6,00
	>> % Ballast	34,7						
	Sw (m2)	29,19	>Sw/D^(2/3)	9,46	Lwl/D^(1/3)	6,12		
	>> ft2	314,25			**DLR**	**125**	M(lbs/2240)/(Lwl(ft)/100)^3	

2.5 Data from the mass spreadsheet

Light boat:	M (kg)	5560	at Xg (m)	4,851	Xg (%Lwl)	45,13	at Zg (m)	-0,030

At Heel 20° with 450 kg of load sit windward :

Data to enter : yellow cells	
Heel (°)	20
Height (cm)	6,4709
Trim (°)	-0,398

Results			
Disp. (m3)	**5,86335**	**/ Disp. (m3)**	**5,86336**
Xc heel (m)	**4,712**	**/ Xg (m)**	**4,712**
Yc heel (m)	-0,520	Yg heel (m)	0,080
Zc heel (m)	-0,236	**> GZ (m)**	**0,601**
Sw heel(m2)	**28,77**	**RM (kN.m)**	**35,411**
Bwl heel (m)	**2,70**	**FB mini (cm)**	**48,3**
LCB – LCF (%Lwl)	**1,00**	**Obliquity (°)**	**4,1**