

## Dinghy for coastal expeditions – Hull preliminary approach

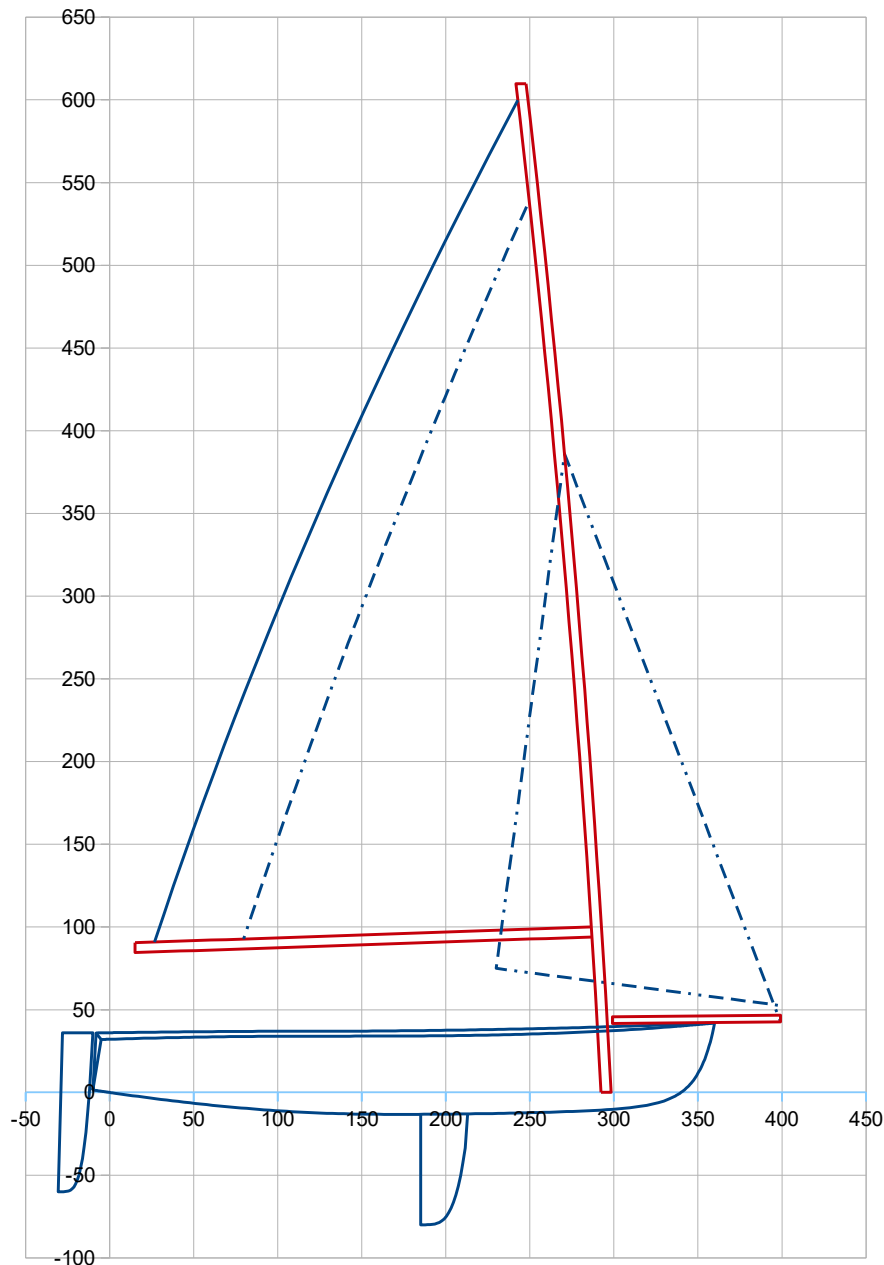
Loa : 3,70 m ; Lwl : 3 ,40 m ; B : 1,50 m ; Light weight (Hull - Rig - Sail) : ~ 77 kg (a priori conservative, inc. ~ 200 liters of floatation foams)

### Payload :

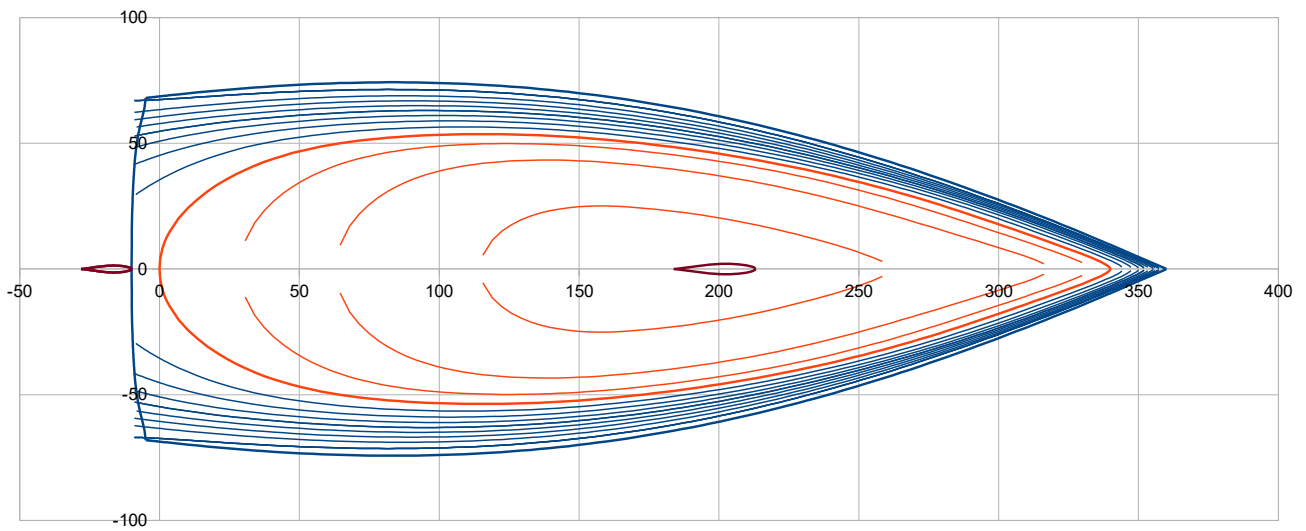
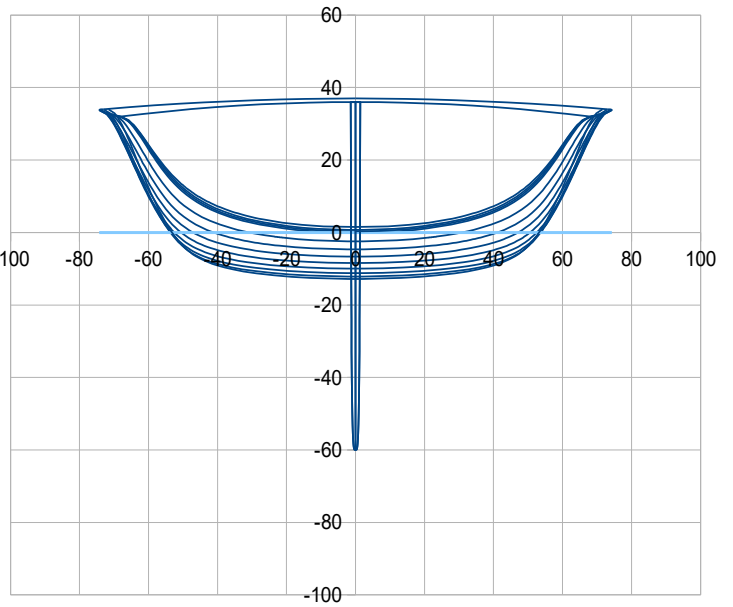
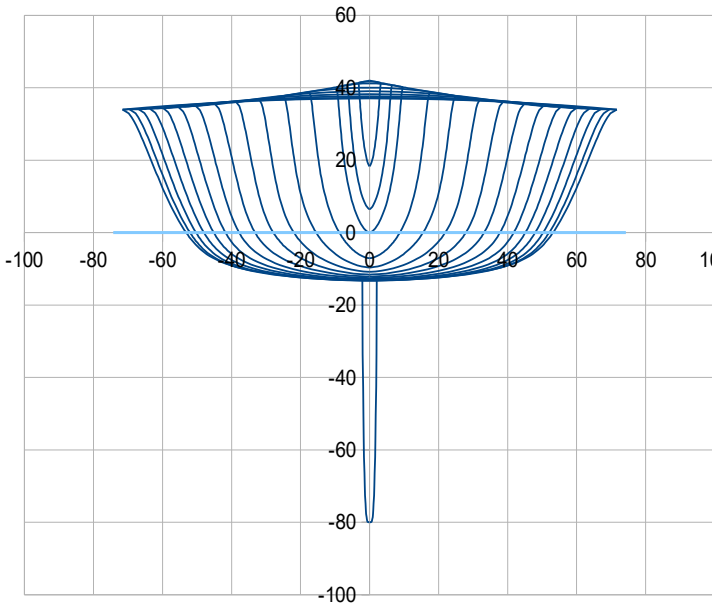
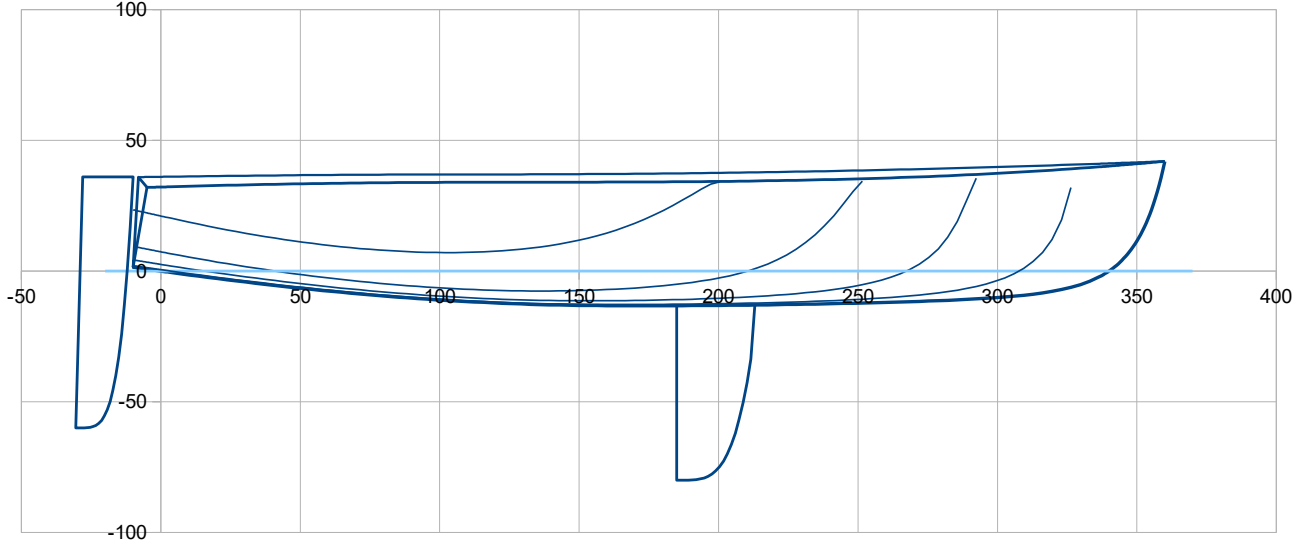
- **Normal: 150 kg** (~ 2 persons) >>> 2D drawings here below are done with waterline H0 for a displacement of  $77 + 150 = 227$  kg.
- **Heavy : 200 kg** (~2 persons + 50 kg of food and camping equipment for ~ 10 days ? )

### Rig and sails :

- Self-standing carbon mast
- Main : ~ 7,2 m<sup>2</sup> and 4,9 m<sup>2</sup> with a reefing
- Jib on a small bow-sprit, to use when light winds and/or downwind : ~ 2,7 m<sup>2</sup>



**Hull 2D linesplan** (with waterline H0 for 227 kg displacement) :



## Hydrostatics ( with waterline H0 for 227 kg displacement)

### 2.1 Hull

Loa (m)	3,70	Lwl (m)	3,40	> Lwl/D^(1/3)	5,66			
>> ft	12,14		11,15					
B (m)	1,49	at X (% Lwl)	25,0					
>> ft	4,87							
Bwl (m)	1,07	at X (% Lwl)	34,0	> Bwl / B	0,723			
>> ft	3,52							
Tc (m)	0,1326	at X (%Lwl)	50			<b>Freeboards (m) &gt;</b>	<b>Aft</b>	<b>Midship</b>
>> ft	0,44					>> ft	0,32	0,34
							1,05	1,12
Displacement at H0 (m3)	0,21648	at Xc (m)	1,622	Xc (%Lwl)	47,70	Zc (m)	-0,050	
>> lbs	489	w. seawater	1025	kg/m3		>> ft	-0,16	
Disp at H(cm)	-1,133286936	at Xc (m)	1,641	Xc (%Lwl)	48,25	Zc (m)	-0,03	
Disp at H(cm)	1,133286936	at Xc (m)	1,604	Xc (%Lwl)	47,17	Zc (m)	-0,07	
Cp (%)	58,07							
Sf (m2)	2,63	at Xf (m)	1,484	Xf (%Lwl)	43,64	>>> Xc – Xf (%Lwl)	4,06	
>> ft2	28,27	>> ft	4,87					
Angle immersed sheer li (°)	25,4	at section C4 (40% Lwl)						
Sw (m2)	2,78	>Sw/D^(2/3)	7,71					
>> ft2	29,93							
Shull (m2)	5,80	at X (m)	1,563	Z (m)	0,046			
>> ft2	62,45	>> ft	5,13	>> ft	0,15			
Sdeck (m2)	3,99	at X (m)	1,394					
>> ft2	42,93	>> ft	4,57					

### 2.2 Daggerboard

Vol. keel(m3)	0,00374	at X (m)	1,988	X (%Lwl)	58,46	Z (m)	-0,40
Mass keel(kg)	1,87	>> ft	6,52			>> ft	-1,30
>> lbs	4						
Draft oa (m)	0,80	Sw (m2)	0,34	Sxz (m2)	0,16		
>> ft	2,62	>> ft2	3,64	>> ft2	1,75		
CLR (m)	2,057	CLR (%Lwl)	60,50	method : keel profile extended to the waterline, 25% c at 45% draft oa			
>> ft	6,75						

### 2.3 Rudder(s)

Number	1						
Volume (m3)	0,00143	at X (m)	-0,197	X (%Lwl)	-5,79	Z (m)	-0,04
Sw (m2)	0,18	>> ft	-0,65			Sxz (m2)	0,09
>> ft2	1,91					>> ft2	0,92
							per rudder

### 2.4 Hull + Daggerboard + Rudder(s)

Displacement at H0 (m3)	0,22164	at Xc (m)	1,616	Xc (%Lwl)	47,54	Zc (m)	-0,06
Disp. (kg)	227,2	>> ft	5,30			>> ft	-0,18
>> lbs	501						
Sw (m2)	3,30	>Sw/D^(2/3)	9,00	Lwl/D^(1/3)	5,62		
>> ft2	35,48			DLR	161	M(lbs/2240)/(Lwl(ft)/100)^3	
<b>Mass (kg)</b>	<b>227,2</b>	<b>at Xg (m)</b>	<b>1,62</b>	<b>Xc (%Lwl)</b>	<b>47,53</b>	<b>Hull (kg)</b>	<b>77,2</b>

DLR in function of payload (assuming a same Lwl of 3,4 m) :

- Payload 100 kg >>> 126
- Payload 150 kg >>> 161
- Payload 200 kg >>> 197 >>> risk of speed limitation to ~ 4,5 knots

(DLR < 150 being approximaty the frontier to access to planning speeds)

**Initial stability upright at displacement 177 kg** (with assuming 1 crew 75 kg sit on center at Z +52 cm + 25 kg camping equipment at Z + 10 cm >>> global Zg ~ + 40 cm and Yg = 0 (centered)) >>> **GM0,1° ~ 40 cm**

Data to enter		Results		Disp :					
Heel (°)	0,1	Disp. Heel 0°	0,22164	<b>0,17287</b>					
Height (cm)	1,925	> Disp. (m3)	<b>0,17287</b>	Mom (m4)	0,000	Mom (kN.m)	0,002	M tot (kg)	177,2
Trim (°)	0,215	Xc heel (m)	1,615	/ Xg	<b>1,615</b>	>> Xc - Xg	<b>0,00</b>	Zg tot (m)	0,401
				/ Xc 0°	1,62			Yg tot (m)	0,000
		Yc heel (m)	0,00	/ Yc 0°	0,00	Ym heel (m)	0,00	<b>GM (cm)</b>	
		Zc heel (m)	-0,05	/ Zc 0°	-0,06	>> GZ (m)	0,0007	<b>40,1</b>	
		Sw heel (m2)	<b>3,08</b>	/ Sw 0°	3,30	RM (kN.m)	<b>0,001</b>		

**Initial stability upright at displacement 227 kg** (with assuming 2 crew 150 kg sit on each deck bench at Z +52 cm >>> global Zg ~ + 47 cm and Yg = 0 (centered)) >>> **GM0,1° ~ 25 cm**

Data to enter		Results		Disp :					
Heel (°)	0,1	Disp. Heel 0°	0,22164	<b>0,22165</b>					
Height (cm)	0	> Disp. (m3)	<b>0,22165</b>	Mom (m4)	0,000	Mom (kN.m)	0,003	M tot (kg)	227,2
Trim (°)	0,000	Xc heel (m)	1,616	/ Xg	<b>1,616</b>	>> Xc - Xg	<b>0,00</b>	Zg tot (m)	0,474
				/ Xc 0°	1,62			Yg tot (m)	0,000
		Yc heel (m)	0,00	/ Yc 0°	0,00	Ym heel (m)	0,00	<b>GM (cm)</b>	
		Zc heel (m)	-0,06	/ Zc 0°	-0,06	>> GZ (m)	0,0004	<b>24,8</b>	
		Sw heel (m2)	<b>3,30</b>	/ Sw 0°	3,30	RM (kN.m)	<b>0,001</b>		

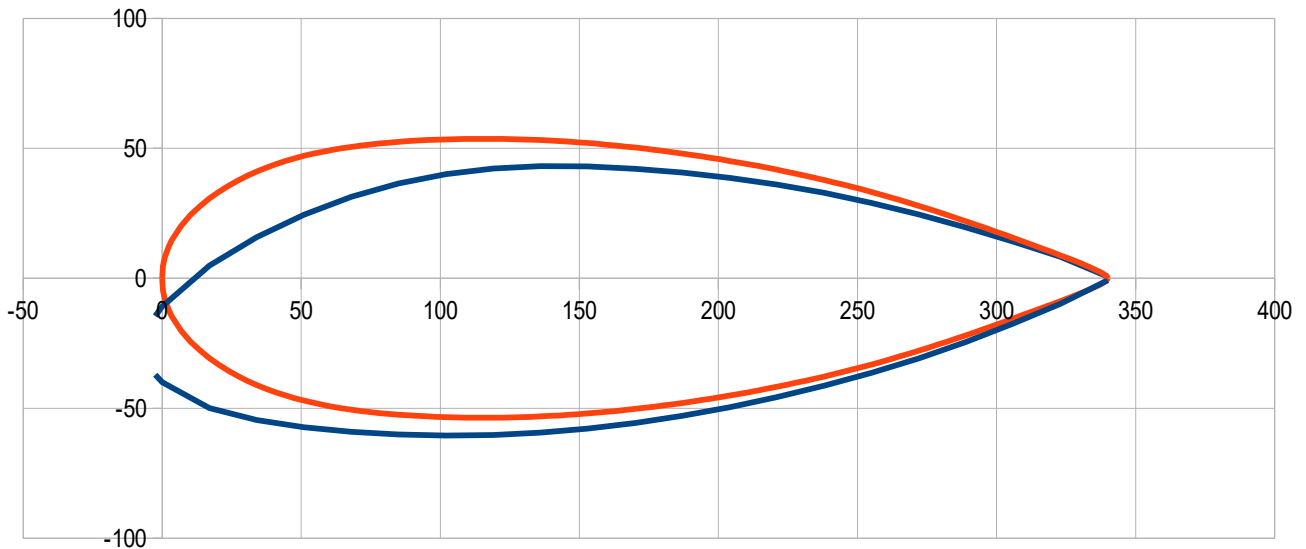
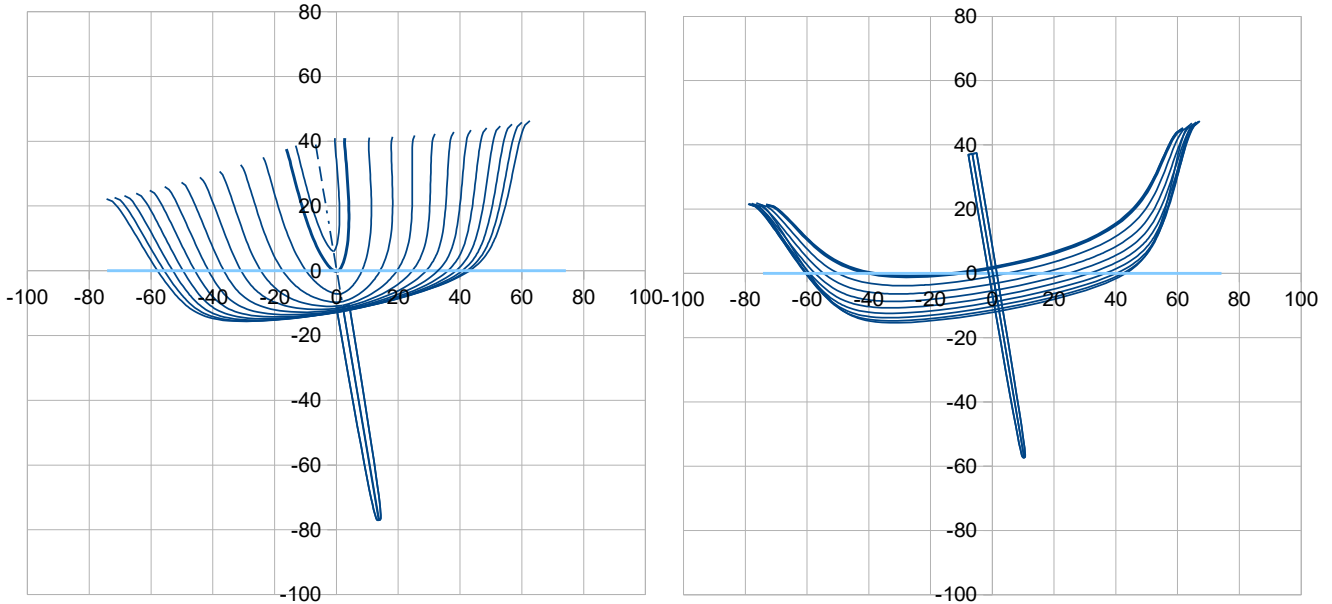
**Initial stability upright at displacement 277 kg** (with assuming 2 crew 150 kg sit on each deck bench at Z + 52 cm + 50 kg camping equipment at Z + 10 cm >>> global Zg ~ + 41 cm and Yg = 0 (centered)) >>> **GM0,1° ~ 26 cm**

Data to enter		Results		Disp :					
Heel (°)	0,1	Disp. Heel 0°	0,22164	<b>0,27043</b>					
Height (cm)	-1,8157	> Disp. (m3)	<b>0,27043</b>	Mom (m4)	0,000	Mom (kN.m)	0,003	M tot (kg)	277,2
Trim (°)	-0,265	Xc heel (m)	1,622	/ Xg	<b>1,622</b>	>> Xc - Xg	<b>0,00</b>	Zg tot (m)	0,406
				/ Xc 0°	1,62			Yg tot (m)	0,000
		Yc heel (m)	0,00	/ Yc 0°	0,00	Ym heel (m)	0,00	<b>GM (cm)</b>	
		Zc heel (m)	-0,06	/ Zc 0°	-0,06	>> GZ (m)	0,0005	<b>25,8</b>	
		Sw heel (m2)	<b>3,52</b>	/ Sw 0°	3,30	RM (kN.m)	<b>0,001</b>		

**Sailing at a 10° Heel angle, at 227 kg displacement** (with assuming the 2 crew 150 kg just sit windward at Y 66cm / boat axis >>> global Yg ~ 44 cm)

Data to enter		Results		Disp :					
Heel (°)	10,0	Disp. Heel 0°	0,22164	<b>0,22165</b>					
Height (cm)	0,7927	> Disp. (m3)	<b>0,22165</b>	Mom (m4)	0,027	Mom (kN.m)	0,269	M tot (kg)	227,2
Trim (°)	-0,326	Xc heel (m)	1,616	/ Xg	<b>1,616</b>	>> Xc - Xg	<b>0,00</b>	Zg tot (m)	0,474
		Yc heel (m)	-0,12	/ Yc 0°	1,62	Ym heel (m)	0,35	Yg tot (m)	0,436
		Zc heel (m)	-0,06	/ Zc 0°	-0,06	>> GZ (m)	0,4662	<b>GM (cm)</b>	<b>268,5</b>
		Sw heel (m2)	<b>3,23</b>	/ Sw 0°	3,30	<b>RM (kN.m)</b>	<b>1,039</b>		

>>> Righting Moment **RM10° = 1,04 kN.m** ; Wetted surface **Sw = 3,23 m2**



## Mass spreadsheet - preliminary

### Mass spreadsheet – Preliminary

Eléments	L m	S m2	V m3	Masse unit	Masse (kg)	X (cm)	M X	Z (cm)	M Z
<b>Hull :</b>									
GRP Hull assuming at ~ 4,5 kg/m2		5,80		4,50	<b>27,41</b>	156,3	4284,656	4,6	127,186
Hull-deck liaison assuming at ~ 0,5 kg/m		7,40		0,50	<b>3,89</b>	177,5	689,588	37,0	143,745
Transom assuming at ~ 4,5 kg/m2		0,33		4,50	<b>1,54</b>	-6,5	-10,009	21,9	33,776
<b>Deck</b>									
Deck assuming at ~ 4,5 kg/m2		3,99		4,50	<b>18,84</b>	139,4	2626,111	37,0	697,199
<b>Daggerboard :</b>									
Daggerboard in Plywood ~ 500 kg/m3		0,006382		500,00	<b>3,35</b>	198,8	665,948	-23,0	-77,064
Hull interface Th12 mm , CP 500 kg/m3 + 30% renforts		0,003630		500,00	<b>2,36</b>	198,8	468,906	10,4	24,465
<b>Rudder :</b>									
Rudder CP 500 kg/m3		0,002311		500,00	<b>1,21</b>	-19,7	-23,869	-3,72	-4,509
Rudder hinges , Alu 2700 kg/m3		0,000403		2700,00	<b>1,14</b>	-12,5	-14,288	18,0	20,575
helm and stick					<b>0,50</b>	32,0	16,000	41,0	20,500
<b>Rig and sails :</b>									
Mast carbon Dia 64 Ep 2 >> 0,7 kg/m3		6,097		0,70	<b>4,48</b>	270,1	1210,293	304,9	1366,277
Boom carbon Dia 54 Ep 2 >> 0,6 kg/m3		2,715		0,60	<b>1,71</b>	150,8	258,013	92,3	157,828
Mainsail 300g/m2		7,19		0,30	<b>2,26</b>	219,9	497,820	135,8	307,473
<b>Deck &amp; cockpit equipment :</b>									
Polystyrene foam 30 kg/m3 for 200 l		0,199		30,00	<b>5,98</b>	170,0	1017,331	17,0	101,733
Various deck equipment ~ 2,5 kg provision				2,50	<b>2,50</b>	170,0	425,000	17,0	42,500
<b>Light weight &gt;&gt;&gt;</b>					<b>77,19</b>	<b>156,9</b>	12111,500	<b>38,4</b>	2961,683
					<b>%Lf &gt;&gt;&gt;</b>	46,2			
2 persons					<b>150,00</b>	164,0	24600,000	52,0	7800,000
Camping					<b>0,00</b>	175,0	0,000	10,0	0,000
<b>With 150 kg payload &gt;&gt;&gt;</b>					<b>227,19</b>	<b>161,6</b>	36711,500	<b>47,4</b>	10761,683
					<b>%Lf &gt;&gt;&gt;</b>	47,53			
1 person					<b>75,00</b>	150,0	11250,000	52,0	3900,000
Camping					<b>25,00</b>	210,0	5250,000	10,0	250,000
<b>With 100 kg payload &gt;&gt;&gt;</b>					<b>177,19</b>	<b>161,5</b>	28611,500	<b>40,1</b>	7111,683
					<b>%Lf &gt;&gt;&gt;</b>	47,49			
2 persons					<b>150,00</b>	164,0	24600,000	52,0	7800,000
Camping					<b>50,00</b>	165,0	8250,000	10,0	500,000
<b>With 200 kg payload &gt;&gt;&gt;</b>					<b>277,19</b>	<b>162,2</b>	44961,500	<b>40,6</b>	11261,683
					<b>%Lf &gt;&gt;&gt;</b>	47,71			