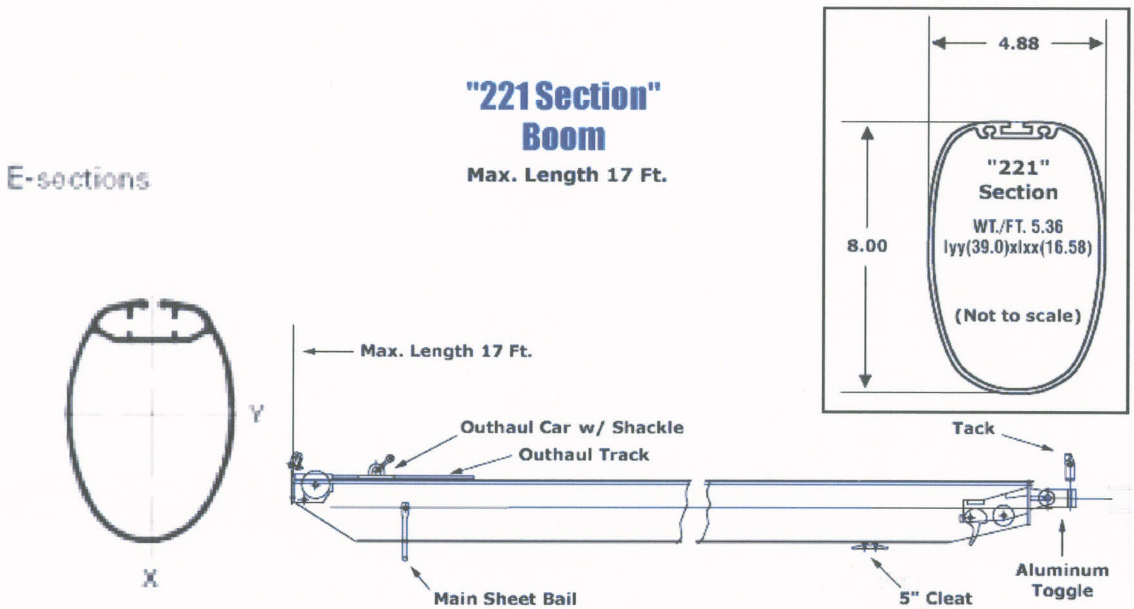


- Figure 5: Mast (left) and Boom (right) sections -

	Mast		Boom	
Source	Selden Mast AB		Sailnet	
Section Type	E-section		221	
Dimensions (mm)	274/185	Required	203/124	Required
Iy (cm4)	**3689**	**3463**	**1623**	**1600**
Ix (cm4)	**1653**	**1373**	690	
Weight (kg/m)	10.18		7.98	

- Table 7: Mast and Boom section main characteristics

Shroud	Angle with vertical (deg)	Panel Length(m)	Safety factor	Required breaking strength (kg)	Rod Diameter (mm)	Shroud length (m)	Weight (kg/m)	Total weight	VCG
V1	0.83	7.620	3	13448	11.1	7.62	0.764	5.8	5.1
D1	13.64	7.718	3	11321	11.1	7.94	0.764	6.1	5.1
V2	6.17	5.582	2.5	6148	8.4	5.61	0.435	2.4	11.7
D2	17.63	5.646	2.5	5344	7.1	5.92	0.316	1.9	11.6
D3	13.42	4.784	2.5	6284	8.4	4.92	0.435	2.1	16.8

- Table 8: Shrouds characteristics -

Spreaders	Height above deck (m)	Up angle (deg)	Half-width (m)
S1	7.50	4.0	1.70
S2	13.00	8.0	1.20

- Table 9: Spreaders characteristics -

The headstay, the backstay, and the boom are sized according to Larsson and Eliasson. The required breaking strength, the chosen rod characterisitcs and stay weight/LCG/VCG position are shown in table 10. The required moment of inertia of the boom (Iy) is shown in table 7.

	Headstay	Backstay
Length (m)	18.5	23.6
Breaking strength (kg)	8209	3465
Type	9.5mm rod	6.4mm rod
Weight (kg/m)	0.562	0.25
VCG (m above DWL)	10.109	10.85
LCG (m fwd Amid)	4.4	-3.1

- Table 10: Headstay and Backstay characteristics -

All the shrouds and stays are made of Navtec rod. Their specifications are given in appendix 15 and are chosen to meet the required breaking strength.

Despite the very large chainplate width, and thanks to the spreaders backsweep and the relatively low overlap of the jib, the rigging does not interfere with the jib: the ideal position of the jib leach is computed by taking into account the wind triangles, the jib downwash, the main upwash, the leeway angle, and the ideal angle of attack at different heights. The results are shown in table 11. From the Jib leading edge position, the chord angle (Beta LT) and the Jib chord length a given height, we can draw the position of the jib leach at different heights and check that it does not intersects the rig. This drawing is shown in appendix 7, on the 3 view graph showing the complete rig, the sails and the deck. Finally, this shows that we can sheet the jib inside all the shrouds without any problem.

U10	12	kts								
TWA	41.500	deg								
Boat speed (from VPP)	7.3	kts								
Height above DWL (m)	AWS (m/s)	AWA (deg)	Leeway angle	Jib self downwash	Main upwash	Beta effective	ideal AOA	Beta LT	Jib chord	Jib leading edge
1.6 (deck)	7.5	23.3	2	5.00	1	17.3	2	15.3	6.38	7.30
8.8 (S1)	8.6	25.9	2	2.53	1	22.4	2	20.4	3.75	4.91
12	8.7	26.3	2	1.45	1	23.8	2	21.8	2.60	3.86
14.3 (S2)	8.9	26.5	2	0.65	1	24.9	2	22.9	1.75	3.09
16	8.9	26.6	2	0.08	1	25.6	2	23.6	1.15	2.54
18	9.0	26.8	2	-0.61	1	26.4	2	24.4	0.42	1.88
19.2 (jib top)	9.0	26.9	2	-1.00	1	26.9	2	24.9	0.00	1.50

- Table 11: position of the jib leach at different heights-

Balance

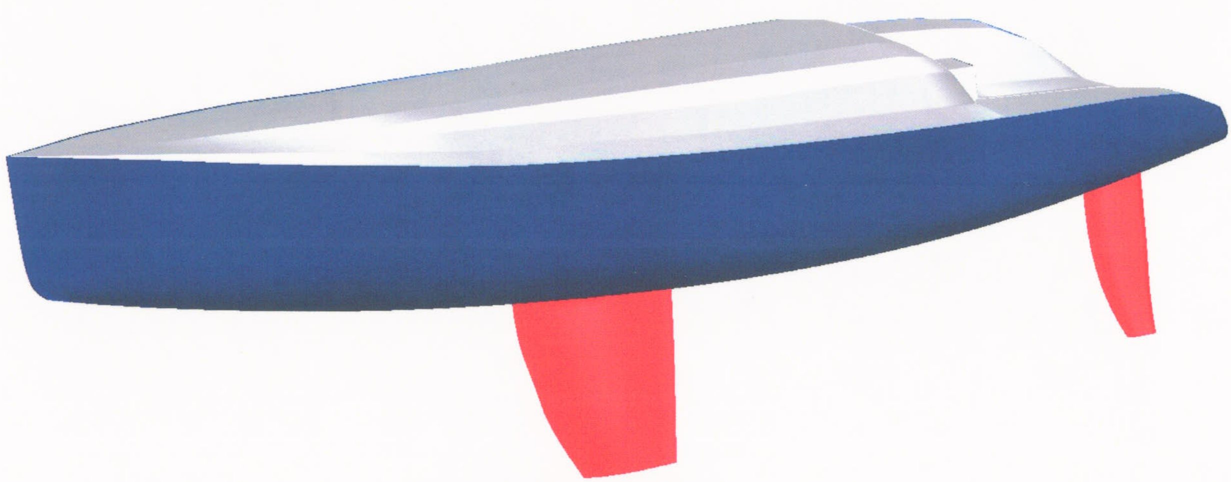
For a given sailplan, the position of the center of effort (CP) is computed. The longitudinal position of the keel is then adjusted such that the CLR (assumed at 25% of the keel chord, at 45% of the total draft) is 67.5cm aft of the CP, corresponding to a lead of 5% of the waterline length, which sould ensure a good balance. The positions of the CLR and CP for the final rig design are shown in table 12.

Balance	X (m fwd amidships)	Z (m above DWL)
CLR	0.52	-1.26
CP	1.16	9.56
Lead (%Lwl)	5%	
HA (m)		10.82

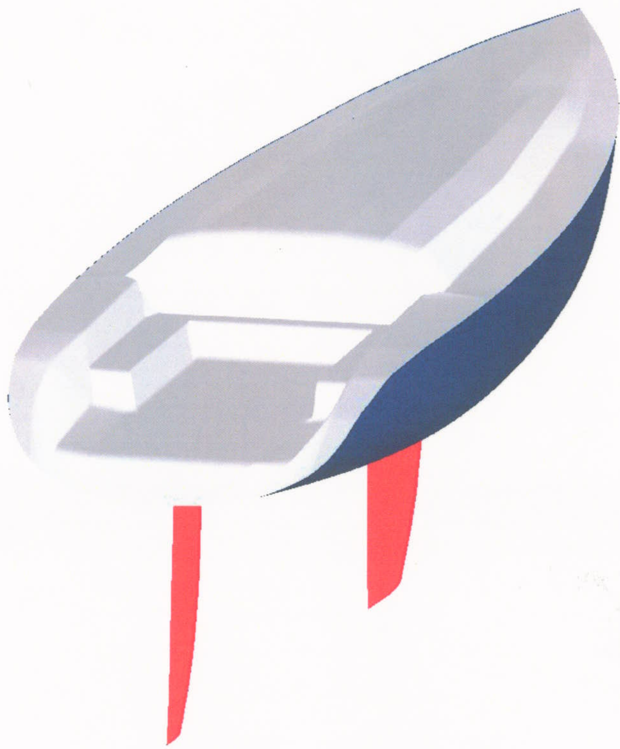
- Table 12 -

Deck

The height of the roof is determined by imposing a clearance above the floor decreasing from 2m at the end of the cockpit (x=-3.6m aft amidships) to 1.9m at x=2.7m forward amidships (corresponding to the forward end of the main cabins or of the saloon depending on the interior layout), with a minimum of 1.8m at x=5.4m forward amidships (forward end of the forward cabins). This roof height is imposed on the centerline of the boat (y=0). The floor is assumed at 30cm below the design water line (DWL). This value seems reasonable considering the canoe body draft of 60cm, but the floor might end higher depending on the structure thickness that will be determined later.
The cockpit is about 3m long, and ends on an open forward raked transom (possible place for the life raft), closed by a lifeline (for safety during night passages). The benches are 40cm high, about 40cm deep, with a back of about 40cm, and 1.9m wide (longitudinally).
These features are illustrated on the views given in appendix 4, 5 and 6, and the perspective views on figures 5a and 5b.
The complete layout of the deck (winches, steering wheel, main and jib tracks) is shown in appendix 7.



- Figure 5a: perspective view 1 -



- Figure 5b: perspective view 2 -

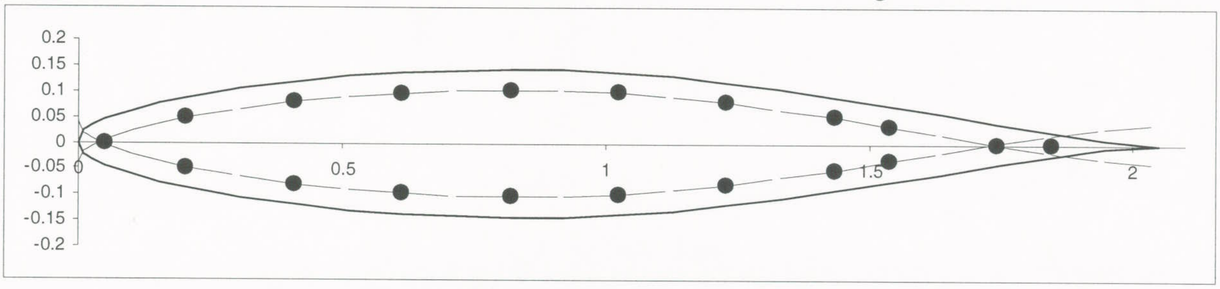
Construction

In order to be able to achieve the high length-to-displacement ratio of 5.8, we decide to build the hull shell, the deck, the cockpit, and the bulkheads in sandwich construction. The inner and outer skins of the sandwich are made of E-Glass Reinforcement with Vinyl Ester resin, and the core is made of linear polyvinyl chloride. The stiffeners and the reinforced shell in the way of the keel are made of single skin laminate.
The construction is made according to the ABS rules. The details of the calculations are shown in appendix 12. We observe that an important weight reduction is allowed by the sandwich construction compared with the single skin laminate (from 1500kg to about 900kg for the shell only). However, considering different sandwich thicknesses for the different panels only leads to a weight saving of about 40kg. Taking into account the cost and the added complexity (female mold is required) of changing the sandwich thickness, we decide to build the entire hull with the same sandwich composition, without variation above 19cm above DWL:

- inner skin thickness: 0.2cm
- core thickness: 2.35cm
- outer skin thickness: 0.35cm

The computations shown in appendix 12 are for panels of different thicknesses. The selected sandwich composition is the larger of the 6 different sandwiches considered in these computations.
Six bulkheads are distributed longitudinally, essentially imposed by the interior layout. The third bulkhead is placed right aft of the mast, in order to stiffen this sensitive area. The chainplates are structurally linked to this bulkhead, which thus carries a part of the load down to the mast step. The reinforced shell at the keel is extended about 5cm forward of the mast.
Six longitudinal stiffeners (3 port, 3 starboard) are distributed transversally. By changing the stiffener section at Bulkhead 2 and 6, we easily save 6*7=42kg. The arrangement of the

stiffeners and bulkheads is shown on the 3 view graph in appendix 9. The dimensions of the stiffeners sections are given in the structural calculation in appendix 12.
We observe that the sandwich for the deck and the cockpit can be the same without important weight penalty. The bulkheads are also made in sandwich (all of the same composition). The compositions of these different sandwiches are given in appendix 12.
The position of the 19 keel bolts (see in appendix 12) is shown on figure 6.



- Figure 6: Position of the keel bolts -

Interior Layout

The interior layout is detailed on the 2 views graph in appendix 8. The main features of this layout are:

- The two aft berth, each with its own bathroom and lockers,
- The large forward berth, with its own bathroom and lockers,
- The saloon, where a crew of 6 can easily seat, and where one or two person can sleep at sea (close to the nav station, good spot for the Helmsman)
- The nav station, with a large chart table and usual electronics
- The engine room, with a 75+HP traditional diesel engine
- The windsurf storage area

Weight Balance

The weight balance is detailed in appendix 11. This allows computing the longitudinal and vertical positions of the center of gravity of the entire yacht, and thus computing the large angle stability analysis and running the Velocity Prediction Program.