

Corbin 39 – mass spreadsheet estimation – as for 18 04 2020

I consider the following subsets :

Hull (skin, stiffeners, reinforcements)

Upper hull
Lower hull
Keel (GRP part)
Skeg-Rudder (GRP part)

Deck – roof – cockpit(skin and structure)

Rig, sails and deck fittings (for sails service)

Deck/other various equipment (safety, tender, ...)

Cabin accomodation, internal equipment, motor, ...

Ballast / Lead part

Rudder and helm / mechanical system

, for which subset one estimate at the best the mass, Xg and Zg in the objective that the total mass is 14000 kg and the trim is (assumed) zero which leads to an Xg of 4,505 m (this value giving zero Trim for such displacement according to the Proxi 39 loading-stability subroutine). Then, for the stability, the GM1° (initial stability upright), the GZ curve and the RM to introduce in the VPP, it is the Zg value which is crucial. I show you at first the final result obtained and then I detail each line with sources and arguments.

The final result (as for 18 04 2020) of this approach, leads to a **Zg of 0,038 m**

Mass and Xg, Zg position – early stage estimation	Input data		Results				
	L or S or V m or m2 or m3	mass unit or % Disp.	Mass (kg)	Xg (m)	M Xg	Zg (m)	M Zg
Hull (skin, stiffeners, reinforcements)							
(GRP equi. Th ~ 16 mm) Upper hull	35,85	24,72	886,2	4,86	4306,99	0,65	576,04
(GRP equi. Th ~ 23 mm) Lower hull	25,24	35,15	887,1	4,57	4053,86	-0,41	-363,69
(GRP equi. Th ~30 m) Keel (GRP part)	8,27	46,50	384,6	4,93	1895,86	-1,13	-434,55
(GRP equi. Th ~ 25 mm) Skeg-Rudder (GRP part)	2,44	38,75	94,4	0,46	43,44	-0,89	-83,98
		(kg/m2)					
Deck – roof – cockpit(skin and structure)(Th ~26 mm)	32,53	40,27	1310,0	4,87	6379,62	1,31	1716,08
		(kg/m2)					
Rig, sails and deck fittings (for sails service)			625,3	5,59	3496,42	5,51	3446,48
Deck/ other various equipment (safety, tender, ...)			200,0	4,87	974,00	1,61	322,00
Cabin accomodation, internal equipment and motor			5380,1	4,22	22725,54	0,16	854,60
Ballast (Lead part)	0,35968	11350 (kg/m3)	4082,3	4,69	19129,62	-1,35	-5495,89
Rudder mechanical system			150,0	0,46	69,05	0,00	0,00
			Results : Light weight boat >>> 14000,0	4,505	63074,40	0,038	537,08

1) Hull (skin, stiffeners, reinforcements)

Repartition and figures proposed by David :

« I went through the construction data that we have, and made some approximations. I think that we can break the hull weight allocations into four groups, each with a corresponding location.

Deck = 1310 kg

Upper hull = 866 kg (assume from deck down to waterline for simplicity)

Lower hull inc. keel & rudder = 1366 kg

Lead ballast = 4082 kg »

Upper Hull (above waterline of the linesplan)

Shull : 35,85 m² (by subtraction Shull (from Delfship) – Swet hull alone (from Multisurf))

Xg : 4,74 m ; Zg 0,65 m (idem, deduced from Shull and Swet figures)

>> M 886 kg (with using a mass unit of 24,72 kg / m², an equivalent GRP monolithic of ~ 16 mm)

The Lower Hull inc. Keel & Skeg-Rudder is splitted in 3 to take into account the various Xg, Zg of each one. And the mass units are arranged so that the total is 1366 kg.

Lower hull (below the waterline, without the keel)

Shull : 25,24 m² (Swet hull alone, from Multisurf)

Xg : 4,57 m ; Zg -0,41 m (idem, from Multisurf)

>> M 887 kg (with using a mass unit of 35,15 kg / m², an equivalent GRP monolithic of ~ 23 mm)

Keel (GRP part)

Shull : 8,27 m² (from Multisurf, by subtraction Sw total – Sw hull alone)

Xg : 4,93 m ; Zg -1,13 m (idem, from Multisurf)

>> M 385 kg (with using a mass unit of 46,5 kg / m², an equivalent GRP monolithic of ~ 30 mm)

Skeg-Rudder (GRP part)

Shull : 2,44 m² (from Proxi 39)

Xg : 0,46 m ; Zg -0,89 m (idem, from Proxi 39)

>> M 94 kg (with using a mass unit of 38,75 kg / m², an equivalent GRP monolithic of ~ 25 mm)

>>> **mass contribution : 2252 kg** (16% of the total)

2) Deck – roof – cockpit (skin and structure)

Sdeck = 32,53 m² (from Delfship)

Xg = 4,87 m ; Zg = 1,31 m (from Delfship)

>> M 1310 kg (with using a mass unit of 40,27 kg / m², an equivalent GRP monolithic of ~ 26 mm)

>>> **mass contribution : 1310 kg** (9,4% of the total)

3) Rig, sails and deck fittings (for sails service) - Here below done with the mk2 sailplan

Rig, sails and deck fittings (for sails service)	L ou S (m ou m2)	Masse unit	Masse (kg)	X (m)	M X	Z (m)	M Z
Main mast							
Mast alu type Selden C193 (193/102) 4,74 kg/m	15,35	4,74	72,76	6,50	472,55	9,01	655,35
Headbox and its equipment – estimation			2,00	6,50	12,99	16,68	33,36
Mast base – estimation			3,00	6,50	19,49	1,33	4,00
2 pairs of spreaders	6,80	1,20	8,16	6,50	53,00	9,50	77,52
Spinnaker mast attachment – estimation			3,00	6,50	19,49	3,50	10,50
Boom bracket / Mast attachment – estimation			3,00	6,40	19,19	2,96	8,87
various attachments and winches – 15%			13,79	6,50	89,55	9,01	124,19
<i>Sub-total</i>			105,70	6,49	686,25	8,64	913,79
Boom							
Boom alu type Selden B135 (135/71) 2,66 kg/ml	5,53	2,66	14,72	3,65	53,75	2,96	43,528
Boom bracket / Boom attachment – estimation			2,00	6,35	12,69	2,96	5,914
various attachments – 15%			2,51	6,40	16,04	2,96	7,42
<i>Sub-total</i>			19,23	4,29	82,48	2,96	56,86
Rig cables D 12mm 19 strand-wire 0,72 kg/ml Rr 12000kg							
Fore Stay	15,82	0,720	11,39	9,27	105,62	9,01	102,596
Inner stay	11,26	0,720	8,11	8,65	70,15	6,70	54,337
Shrouds	36,84	0,720	26,52	6,50	172,27	9,01	238,912
Low shrouds	24,57	0,720	17,69	6,50	114,91	6,03	106,767
Back stay	25,14	0,720	18,10	2,95	53,46	9,10	164,810
Chainplates, cable tips, shackles, ... : 15%	6,00	0,80	12,27	6,50	79,71	3,00	36,816
<i>Sub-total</i>			94,08	6,34	596,11	7,49	704,24
Sails							
Genoa Dacron or equivalent, ~360 g/m2	60,40	0,360	21,74	7,9	171,06	6,6	142,562
Genoa furling type Furlex 304S ~ 1,7 kg /m	15,82	1,70	26,89	7,9	211,56	6,6	176,310
Mainsail Dacron or equivalent , 360 g/m2	40,64	0,360	14,63	4,5	66,34	7,7	112,421
Inner staysail Dracon or equivalent, ~ 360 g/m2	22,03	0,360	7,93	8,0	63,14	5,0	39,671
Assimetical Spi, stored under the deck, ~ 150 g/m2	80,00	0,150	12,00	9,5	114,00	0,0	0,000
Gale jib, stored under the deck ~ 450 g/m2	12,00	0,450	5,40	9,5	51,30	0,0	0,000
Various battens, inner boom, reinforcements, ... 20%			17,72	6,5	115,09	7,7	136,145
<i>Sub-total</i>			106,32	7,45	792,49	5,71	607,11
Gréement courant							
Drisses, écoutes, balancines, poulies, manilles, mousquetons, etc			100,00	5,39	539,08	8,64	864,481
Deck fittings for the sails service							
Winches,....			200,00	4,00	800,00	1,50	300,000
Total Rig-Sails-Deck fittings for sails service			625,34	5,59	3496,42	5,51	3446,48

For the mast and the boom :

<http://www.seldenmast.com/en/products.html>

For the sails : just enter Corbin 39

Genoa : <https://www.sosails.com/fr/c/3-genois-et-focs>

Mainsail : <https://www.sosails.com/fr/configurer-ma-voile/grand-voile-semi-lattee-so-wide.html>

The deck fittings (winches, rails, ...) are just provisioned at 200 Kg and the various synthetic ropes at 100 kg (?)

>>> mass contribution : 625,3 kg (4,5% of the total)

4) Cabin accommodation, internal equipment and motor

The mass (5380 kg) and the Xg (4,22 m) are actually adopted, all other things being estimated, to reach the 14000 kg objective and the Xg 4,505 m which gives zero trim (according to the Proxi 39 computation at this displacement). Only the Zg can be a matter of discussion :
Zg 0,16 m : by default, taken equal to the geometrical center of the hull surface.

>>> mass contribution : **5380 kg** (38,4% of the total)

5) Ballast (Lead part)

Volume = 0,35968 m³ and Lead 11350 kg/m³ >>> 4082 kg (= 9000 lbs)

Xg 4,69 m & Zg -1,35 (Proxi 39 for Xg, and David Slater observation for Zg center of the ballast volume)

>>> mass contribution : **4082 kg** (29,2 % of the total)

7) Skeg-Rudder Helm system (mechanical part)

Mass 150 kg : just a preliminary estimation

Xg 0,46 m source : Proxi39 / center of volume of the Skeg-Rudder

Zg 0 m roughly : an average between the aft free board and the rudder draft

>>> mass contribution : **150 kg** (1,1 % of the total)