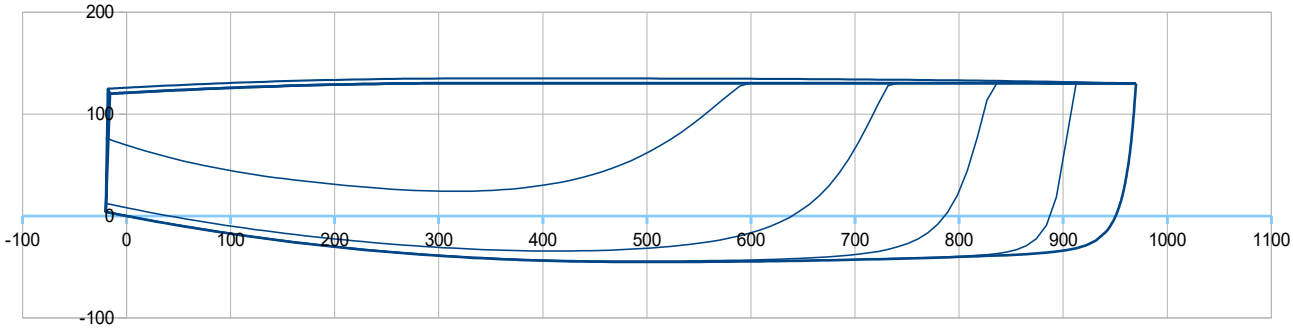
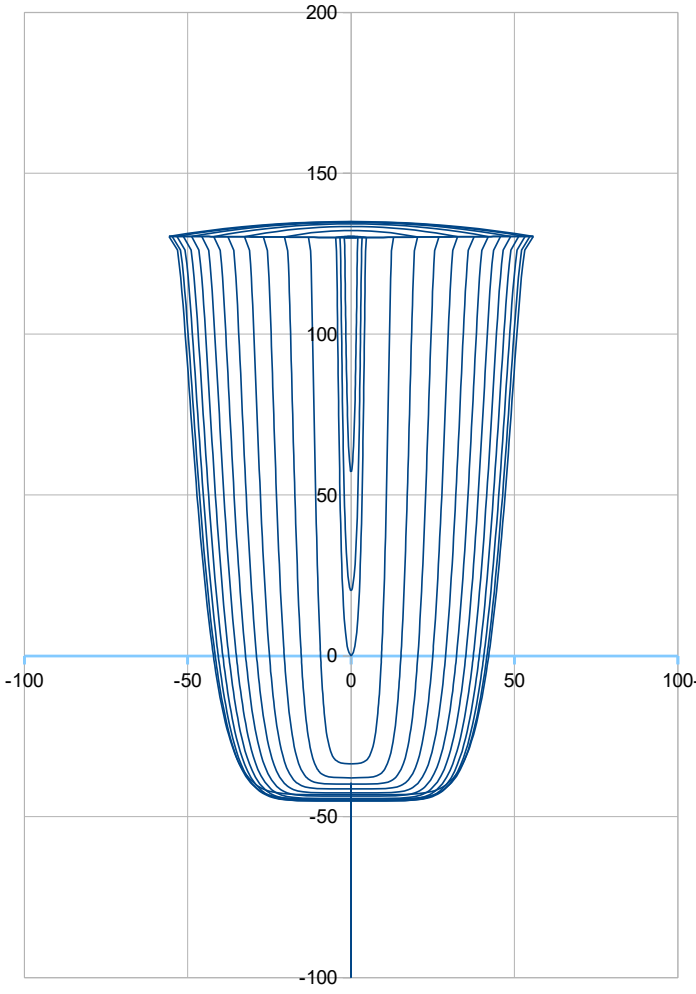
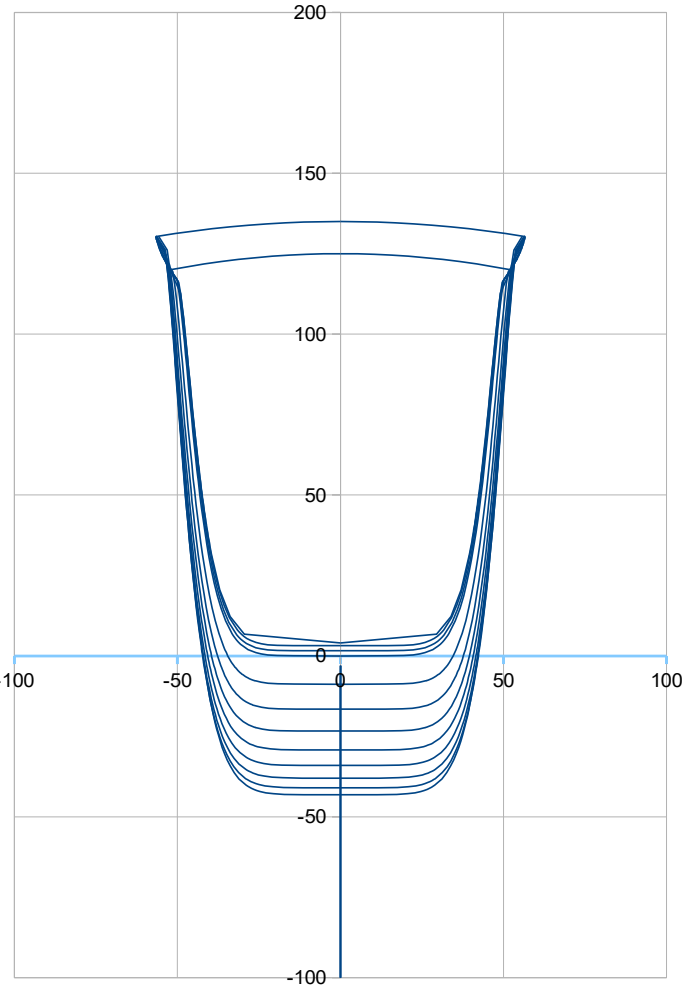
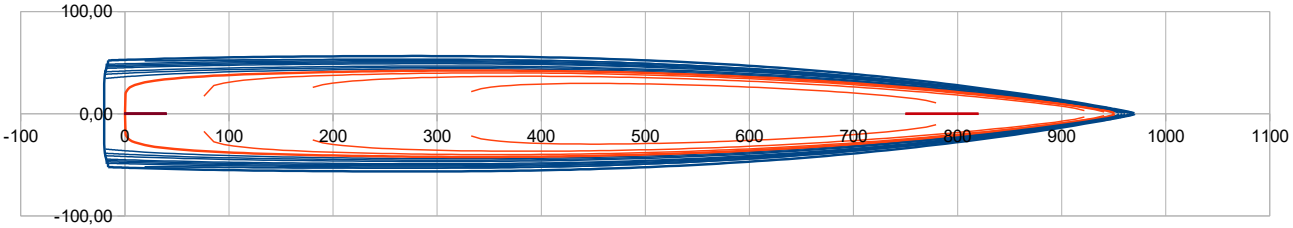
# Catamaran of length 9,5 m - Stability investigation

## 1. The numerical hull to address the stability issue of the project catamaran



**Hydrostatics** with in red the figures to compare with the project hull ones :

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **2.1 Hull** | | | | | | | | | |
| **Loa (m)** | **9,900** | **Lwl (m)** | **9,504** | | | | | | |
| *>> ft* | *32,48* | | *31,18* | | | | | | |
| **Bhull (m)** | **1,131** | **at X (% Lwl)** | **29,0** | **Boa (m)** | **4,94** | | | **Space (m)** | **3,807** |
| *>> ft* | *3,71* | | | *>> ft* | *16,20* | | | > S/Lw | 0,40 |
| **Bwl (m)** | **0,846** | **at X (% Lwl)** | **35,0** | > Lwl / Bwl | 11,24 | | | | |
| *>> ft* | *2,77* | | | | **Freeboards (m) >** | | **Aft** | **Midship** | **Fore** |
| **Tc (m)** | **0,451** | **at X (%Lwl)** | **52,5** | > Bwl/Tc | 1,87 | | **1,2** | **1,304** | **1,30** |
| *>> ft* | *1,48* | | | | *>> ft* | | *3,94* | *4,28* | *4,27* |
| **Displacement at H0 (m3)** | | **1,97696** | **at Xc (m)** | **4,661** | **Xc (%Lwl)** | | **49,05** | **Zc (m)** | **-0,185** |
| *>> lbs* | | *4467* | *w. seawater* | *1025* | *kg/m3* | | | *>> ft* | *-0,61* |
| Disp at H(cm) | -3,00 | 1,79415 | at Xc (m) | 4,709 | Xc (%Lwl) | | 49,55 | Zc (m) | -0,173 |
| Disp at H(cm) | 3,00 | 2,16675 | at Xc (m) | 4,611 | Xc (%Lwl) | | 48,52 | Zc (m) | -0,198 |
| **Cp** | **0,641** | | | > Lw/D^(1/3) | 7,57 | | | | |
| **Sf (m2)** | **6,28** | **at Xf (m)** | **4,113** | **Xf (%Lwl)** | **43,28** | | >>> Xc – Xf (%Lwl) | | 5,77 |
| *>> ft2* | *67,60* | *>> ft* | *13,50* | | | | | | |
| **Angle immersed sheer li (°)** | | **66,8** | at section C4 (40% Lwl) | | | | | | |
| **Sw (m2)** | **10,966** | >Sm/D^(2/3) | 6,96 | | | | | | |
| *>> ft2* | *118,04* | | | | | | | | |
| **Shull (m2)** | **36,68** | **at X (m)** | **4,709** | **Z (m)** | **0,370** | | | | |
| *>> ft2* | *394,86* | *>> ft* | *15,45* | *>> ft* | *1,21* | | | | |

>>>>> Comparison :

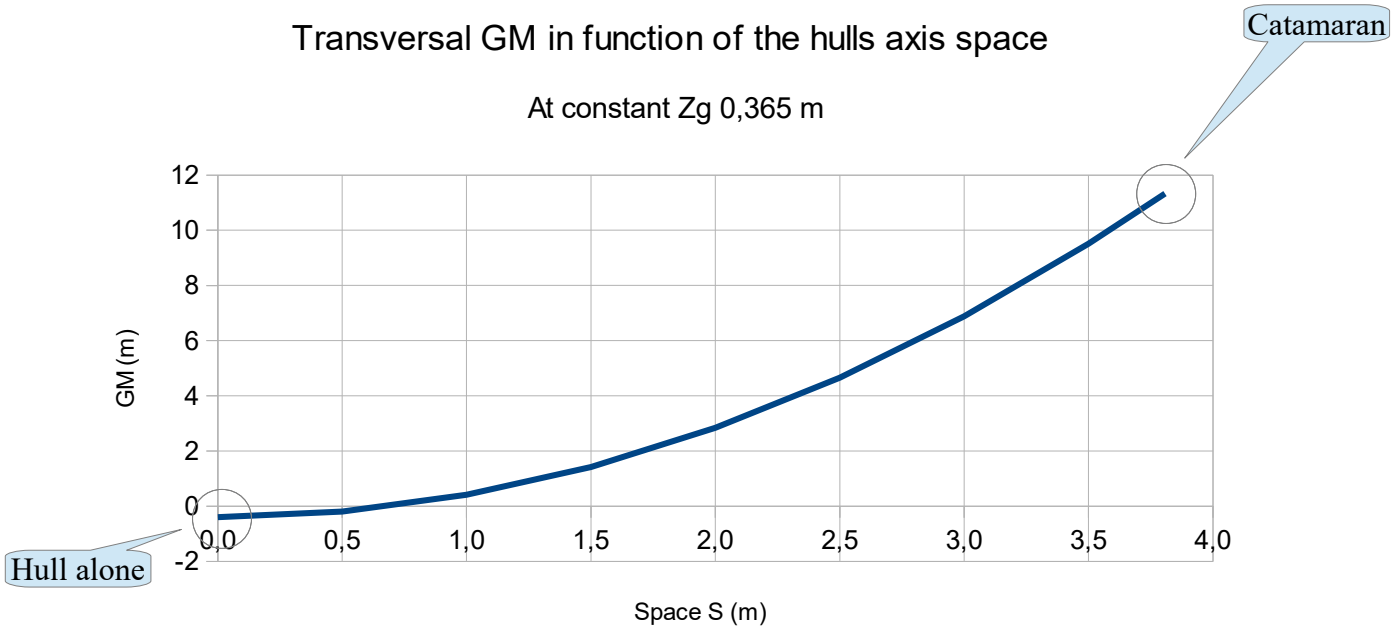
| | **Project Hull** | **Numerical hull** |
|---|---|---|
| Lw (m) | 9,504 | 9,504 |
| Bw (m) | 0,841 | 0,846 |
| Tc (m) | 0,451 | 0,451 |
| Space (m) | 3,807 | 3,807 |
| Displacement (m3) | 1,977 | 1,977 |
| VCB (m) | -0,184 | -0,185 |
| VCG (m) | 0,365 | 0,370 |
| Cp | 0,665 | 0,641 |
| Free-board (m) | 1,304 | 1,304 |
| Sw (m2) | 10,674 | 10,966 |
| **>>> Ratios :** | | |
| Lw/Bw | 11,31 | 11,24 |
| Bw/Tc | 1,86 | 1,87 |
| Lw/D^(1/3) | 7,57 | 7,57 |
| S/Lw | 0,40 | 0,40 |

## 2. Influence of the hulls space on the transversal GM

Computation with Zg (= VCG) = 0,365 m , weight is 4054 kg (2 hulls)

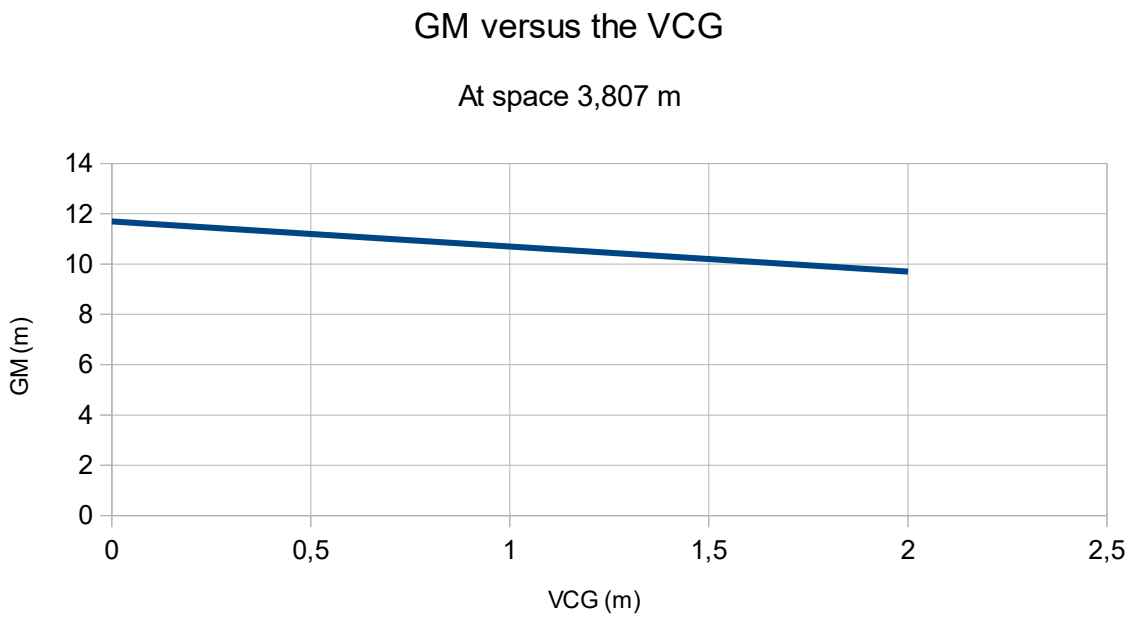
Space S is varying from 0 (stability of 2 hulls without space which is equivalent to each hull stand alone) up to 3,807 m (the project cata space for S/Lw = 0,4)

| Zg (m) | Space (m) | GM (m) | |
|---|---|---|---|
| 0,365 | **0,000** | **-0,40** | Hull alone |
| | 0,500 | -0,20 | |
| | 1,000 | 0,41 | |
| | 1,500 | 1,42 | |
| | 2,000 | 2,84 | |
| | 2,500 | 4,66 | |
| | 3,000 | 6,89 | |
| | 3,500 | 9,52 | |
| | **3,807** | **11,33** | Catamaran |



### 3. Influence of the height of the center of gravity (VCG) on the transversal GM

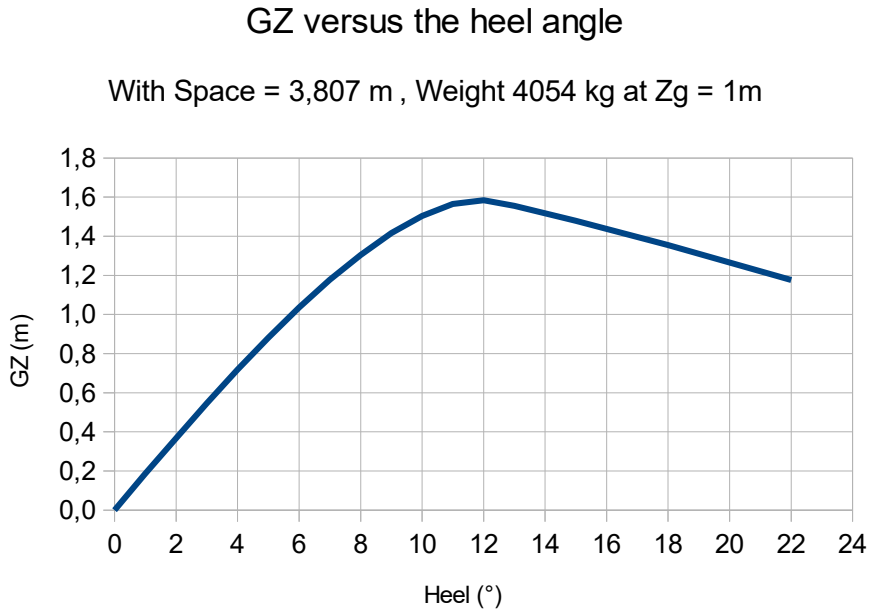
The space is fixed at 3,807 m,  weight is 4054 kg.




### 4. Righting arm GZ and moment RM with heel angle

At constant Space 3,807 m, weight 4054 kg and VCG is assumed at 1 m after completion of the project with the cabin.

| Space (m) | Zg (m) | GM (m) |
|---|---|---|
| 3,807 | 1 | 10,7 |
| Heel (°) | GZ (m) | RM (kN.m) |
| 0 | 0,00 | 0,00 |
| 1 | 0,19 | 7,39 |
| 2 | 0,37 | 14,62 |
| 3 | 0,55 | 21,73 |
| 4 | 0,72 | 28,56 |
| 5 | 0,88 | 35,08 |
| 6 | 1,04 | 41,19 |
| 7 | 1,18 | 46,83 |
| 8 | 1,30 | 51,88 |
| 9 | 1,42 | 56,21 |
| 10 | 1,50 | 59,79 |
| 11 | 1,57 | 62,26 |
| **12** | **1,58** | **63,00** |
| 13 | 1,56 | 61,84 |
| 15 | 1,48 | 58,82 |
| 18 | 1,36 | 53,91 |
| 22 | 1,18 | 46,80 |




>>> The maximum moment (RM = 63 kN.m)  is reached for an heel angle of 12°, which corresponds with the off watering of one hull

## At 12° heel angle

| Data to enter | | Results for leeward hull | | Results for windward hull | | Results for the 2 hulls | | Data to compare with : | | RM | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Mass (kg) | 4053,96 | | |
| Heel (°) | 12,0 | | | | | | | | | | |
| Height (cm) | 8,6932 | Disp. (m3) | 3,94686 | Disp. (m3) | 0,00822 | Disp. (m3) | 3,95508 | / Disp. (m3) | 3,95508 | Hull Mom(m4) | 7,087 |
| Trim (°) | -0,725 | Xc heel (m) | 4,464 | Xc heel (m) | 5,757 | Xc heel (m) | 4,466 | / Xg (m) | 4,466 | Mom(kN.m) | 71,26 |
| | | Other results | | Other results | | Other results | | Xc Heel 0° | 4,662 | Yg heel (m) | -0,208 |
| | | Yc heel (m) | -1,799 | Yc heel (m) | 1,698 | Yc heel (m) | -1,792 | Yc Heel 0° | 0,000 | >> GZ (m) | 1,584 |
| | | Zc heel (m) | -0,311 | Zc heel (m) | -0,077 | Zc heel (m) | -0,310 | Zc Heel 0° | -0,186 | RM (kN.m) | 63,00 |
| | | Sw heel (m2) | 21,08 | Sw heel (m2) | 4,50 | Sw heel (m2) | 25,58 | Sw Heel 0° | 29,83 | >> GM (m) | 7,62 |