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Objekat: Čamac – Hunter 575
Predmet: Hidrostatički proračun i proračun stabiliteta
Investitor: Nautikcentar, SRBIJA
Dostaviti: Nautikcentar, SRBIJA

ČAMAC HUNTER 575 -HIDROSTATIKA&PRORAČUN STABILITETA-

u Mačvanskoj Mitrovici
17.09.2013. god.

Sastavio:
Goran Budečević, dipl.ing.

1. *Opšte*

Za čamac Hunter 575, hidrostatički proračuni i proračun stabiliteta je urađen. Glavne karakteristike čamca date su u tekstu dole.

2. *Osnovne karakteristike*

Osnovne karakteristike date su u tekstu dole:

LH	5.75	m	length
BH	1.72	m	breadth
D_0	280	kg	mlcc light craft displacement
T_0	0.08	m	light craft displacement coresponding draft
CL	6		crew limit
m_{CL}	450	kg	mass of desired crew
$m_{provision}$	30	kg	provision
m_{fuel}	25	kg	fuel
$m_{fittings}$	180	kg	fittings and engine for 60 HP
m_{mtl}	685	kg	maximum total load
m_{lcc}	280	kg	light craft condition mass
m_{ldc}	965	kg	loaded displacement mass
T_1	0.195	m	loaded displacement mass coresponding draft

3. *Hidrostatički proračun*

Rezultati hidrostatičkih proračuna dati su u tekstu dole.

Displacement t	0	0.1282	0.3884	0.9979	1.675	2.401
Draft	0	0.05	0.1	0.2	0.3	0.4
WL Length m	1.622	4.422	4.757	5.11	5.318	5.49
Beam max extents on WL m	0	1.372	1.434	1.474	1.515	1.557
Wetted Area m^2	0	4.589	6.015	7.519	8.887	10.12
Waterpl. Area m^2	0	4.518	5.616	6.477	7.025	7.495
Block coeff. (Cb)	0	0.422	0.569	0.662	0.693	0.702
Max Sect. area coeff. (Cm)		0.83	0.884	0.869	0.893	0.899
Waterpl. area coeff. (Cwp)	0	0.745	0.823	0.86	0.872	0.877
LCB from zero pt. (+ve fwd) m	2.813	1.667	1.882	2.105	2.222	2.303
LCF from zero pt. (+ve fwd) m	2.768	1.823	2.111	2.333	2.445	2.527
KB m	0	0.032	0.061	0.116	0.171	0.225
BMt m	0.001	4.542	2.179	1.039	0.703	0.547
BML m	11973.9	38.389	20.106	11.264	8.191	6.66
KMt m	0.001	4.575	2.241	1.155	0.874	0.772
KML m	11973.9	38.422	20.167	11.38	8.362	6.885
Immersion (TPc) tonne/cm	0	0.045	0.056	0.065	0.07	0.075

4. *Proračun centracije*

Rezultati proračuna centracije dati su u tekstu dole.

Weight calculation

	mass	Zg	Mz
	(kg)	(m)	(kg.m)
mlcc	180	0.2	36
mprovision	30	0.1	3
mfuel	25	0.2	5
mfittings	140	0.2	28
mCL	300	0.4	120
mldc	675		192

ZG1 0.2844 m vertical center of gravity

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m_{ldc}	675		192

ZG1 0.2844 m vertical center of gravity

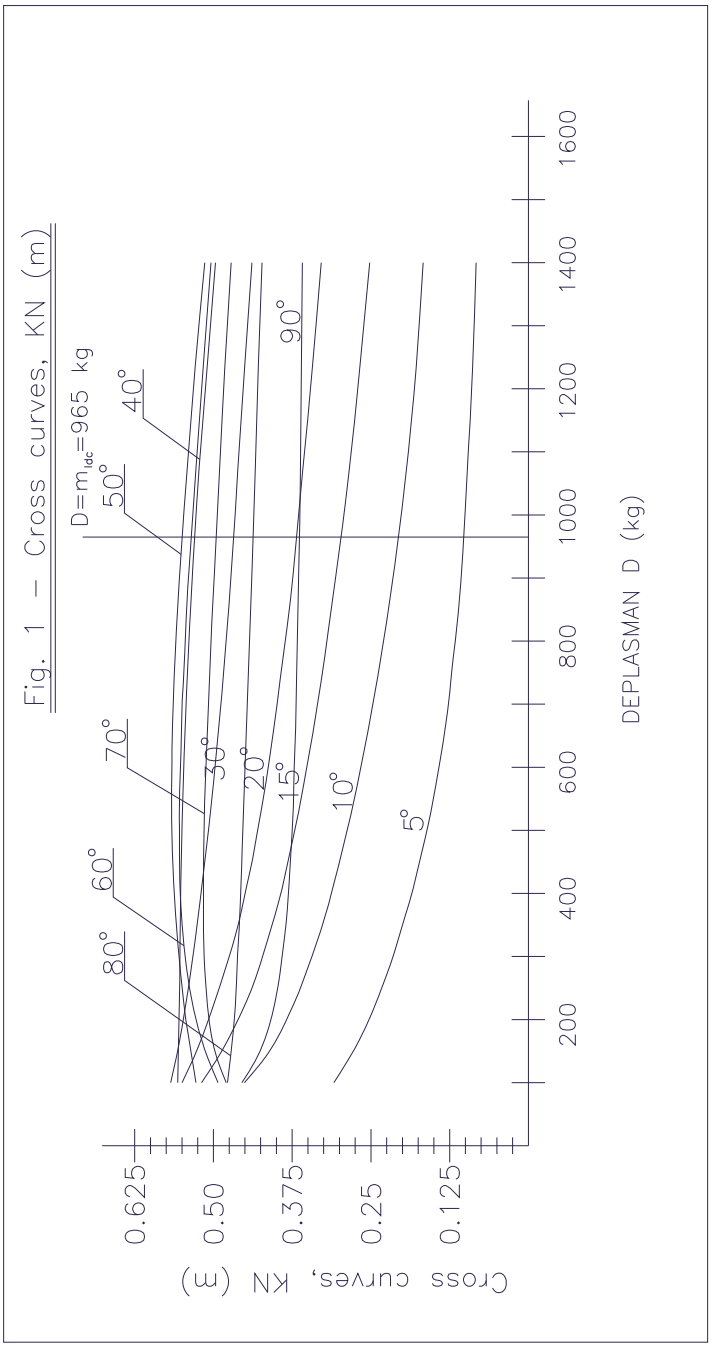
5. *Poprečne krive stabiliteta, KN*

Rezultati proračuna dati su u tekstu dole.

	cross curves, KN (m)					
	heeling angle φ (˚)					
	0	5	10	15	20	30
0.1	0	0.309	0.451	0.519	0.55	0.568
0.15	0	0.278	0.411	0.487	0.527	0.557
0.2	0	0.253	0.384	0.461	0.508	0.548
0.25	0	0.233	0.362	0.439	0.491	0.54
0.3	0	0.215	0.344	0.422	0.475	0.533
0.35	0	0.2	0.327	0.407	0.461	0.526
0.4	0	0.185	0.313	0.393	0.45	0.52
0.45	0	0.173	0.3	0.382	0.439	0.514
0.5	0	0.161	0.288	0.371	0.43	0.508
0.55	0	0.151	0.276	0.361	0.421	0.503
0.6	0	0.142	0.266	0.352	0.413	0.498
0.65	0	0.134	0.256	0.343	0.406	0.493
0.7	0	0.127	0.247	0.335	0.399	0.488
0.75	0	0.122	0.238	0.327	0.393	0.484
0.8	0	0.116	0.23	0.32	0.386	0.48
1	0	0.101	0.202	0.293	0.365	0.466
1.2	0	0.09	0.181	0.271	0.346	0.453
1.4	0	0.083	0.167	0.252	0.329	0.439

	cross curves, KN (m)					
	heeling angle φ (˚)					
	40	50	60	70	80	90
0.1	0.557	0.528	0.493	0.48	0.478	0.455
0.15	0.556	0.536	0.513	0.498	0.472	0.426
0.2	0.555	0.544	0.528	0.507	0.467	0.409
0.25	0.554	0.55	0.538	0.512	0.464	0.398
0.3	0.553	0.555	0.545	0.515	0.462	0.391
0.35	0.553	0.559	0.55	0.516	0.459	0.385
0.4	0.552	0.562	0.553	0.516	0.457	0.381
0.45	0.551	0.565	0.554	0.516	0.455	0.378
0.5	0.55	0.566	0.554	0.515	0.454	0.375
0.55	0.549	0.567	0.554	0.514	0.452	0.373
0.6	0.547	0.566	0.553	0.512	0.45	0.372
0.65	0.546	0.566	0.551	0.51	0.448	0.37
0.7	0.544	0.564	0.55	0.508	0.446	0.369
0.75	0.542	0.562	0.547	0.506	0.445	0.368
0.8	0.539	0.56	0.545	0.504	0.443	0.367
1	0.528	0.547	0.533	0.494	0.436	0.363
1.2	0.513	0.532	0.519	0.484	0.43	0.361
1.4	0.497	0.514	0.504	0.472	0.423	0.359

Rezultati su prikazani i u formi dijagrama:



6. *Proračun stabiliteta*

Rezultati proračuna dati su u tekstu dole:

φ	sinφ	φ (rad)	KN	KG	GZ	M1G1	D1	Mst
0	-	0	-	0.2902	-	-	965	0
5	0.087	0.087266	0.08	0.2902	0.103	0.8888	965	99.395
10	0.174	0.174533	0.161	0.2902	0.206	0.8888	965	198.790
15	0.259	0.261799	0.244	0.2902	0.298	0.8888	965	287.570
20	0.342	0.349066	0.309	0.2902	0.368	0.8888	965	355.120
30	0.5	0.523599	0.394	0.2902	0.468	0.8888	965	451.620
40	0.643	0.698132	0.425	0.2902	0.53	0.8888	965	511.450
50	0.766	0.872665	0.423	0.2902	0.55	0.8888	965	530.750
60	0.866	1.047198	0.399	0.2902	0.535	0.8888	965	516.275
70	0.939	1.22173	0.36	0.2902	0.496	0.8888	965	478.640
80	0.985	1.396263	0.308	0.2902	0.438	0.8888	965	422.670

Gde je:

KN -	Položaj tež. Istisnuća za odgovarajući ugao nakretanja, m
KG-	Položaj težišta po visini, Zg, m
GZ-	Krak stabiliteta, m
M1G1-	Metacentarska visina, m
D1-	Maksimalni deplasman, kg
Mst-	Moment stabiliteta, kg.m

Analiza je urađena u skladu sa pravilima Lloyd Registar; Special Service Craft Rules. za slučaj stabiliteta u neoštećenom stanju. Rezultati su prikazani u tekstu dole:

General intact stability criteria

1 The area under GZ curve is not to be less 0.055 m.rad. up to φ=30º
0.1570 YES

2 The area under GZ curve is not to be less 0.09 m.rad. up to φ=40º
0.189943 YES

3 The area under GZ curve between φ=30º-40º is not to be less 0.03 rad.m.
0.0329 YES

4 The righting lever GZ is to be at least 0.20 m at angle of heel to or greater than 30º
FOR φ=30º GZ=0.468 m YES

5 The max. GZ is to occur at an angle of heel preferebly exceeding φ=30º but not less than φ=25º.
GZ max.is for φ=50.5º YES

6 The initial metacentric height M1G1 is to be not less than 0.15 m
M1G1= 0.8888 m YES

7 The angle of heel on account of crowding of guests to one side is not to exceed 10º
Mnp = 483 kg.m>M(φ=10º)=200 kg.m, NO, FB = 207 mm

8 The angle of heel on account of turning is not to exceed 10º
when the heeling moment determined by the following formula is applied:

$M_H = (0.02*Vo^2*\Delta*(KG-0.5*Tm))/Lwl$

Vo – service speed(m/s),
Δ – displacement (t),
KG – height of centre of gravity above keel(m),
Tm – mean drought (m),
Lwl – waterline lenght (m).
M_H -heeling moment (t.m)

Vo	16	29.632	8.23	m/s
Δ	0.965	t		
KG	0.290155	m		
Tm	0.195	m		
Lwl	4.836	m		
M_H	52.09178	kg.m		

Mh =52.1 kg.m<M(φ=10º)=200 kg.m YES

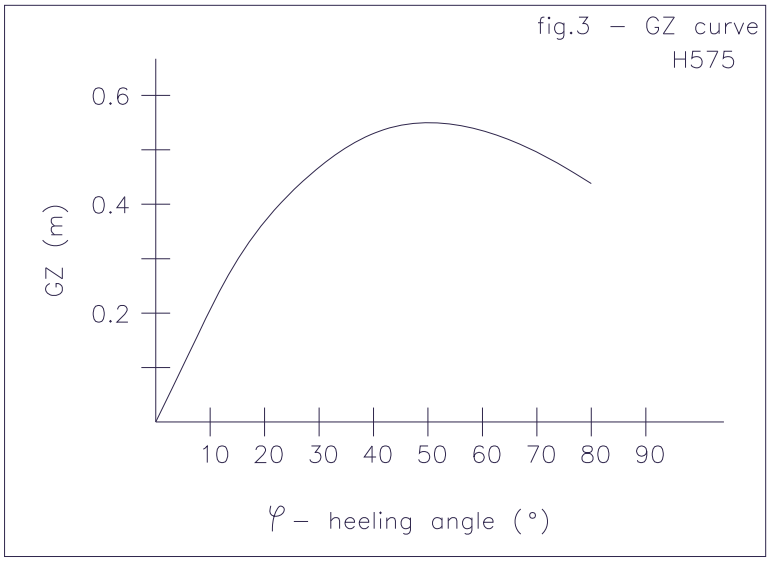


fig.3 – GZ curve
H575
0.6
0.4
0.2
GZ (m)
10 20 30 40 50 60 70 80 90
φ – heeling angle (°)

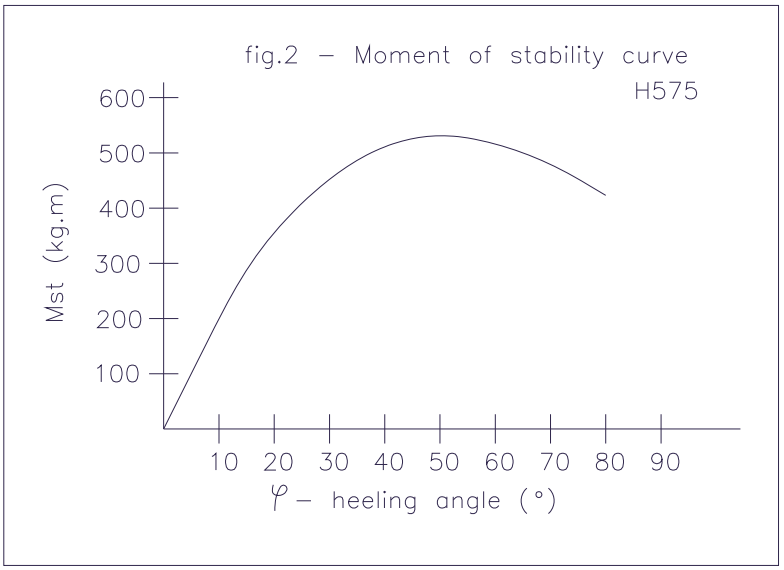


fig.2 – Moment of stability curve
H575
600
500
400
300
200
100
Mst (kg.m)
10 20 30 40 50 60 70 80 90
φ – heeling angle (°)

7. *Zaključak*

Prethodna analiza, kao i mnogo godina prakse, pokazala je dobre karakteristike stabiliteta prema LR SSC Rules kriterijumima, osim u slučaju prelaska svih putnika na jedan bok kada ugao prelazi 10º ali je visina slobodnog boka i dalje zadovoljavajuća (207 mm). Postojanje krivih stabiliteta, proračun stabiliteta po bilo kojim drugim kriterijumima čini relativno lakim. Ipak, finalni zaključak o stabilitetu čamca daće nadležna ustanova.