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The "Fast Stability" computer program used for training in maritime schools

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Abstract

This paper presents computer software "FastStability". The software has been developed for all kind of vessels and calculates stability with many additional options. The "Fast Stability" program is used in Post-Secondary Maritime School in Szczecin in education purpose.

Introduction

Society for the Promotion of Knowledge of Marine, as the body leading secondary school in the Maritime, is a non-governmental social organization. The activities started in 1995, and in 2005 was entered into the National Court Register under the number 0000061904. The purpose of the Society is to support educational initiatives in favor of the maritime economy [1].

This objective Society accomplishes by [1]:

organizing the Post-Secondary Maritime School in Szczecin,

- organizing courses, lectures, seminars and other forms of education for children and adults;
- cooperation with local governments, public administration, schools, academic institutions in particular, the Maritime Academy in Szczecin;
- cooperation with domestic and foreign organizations engaged in similar activities.

Post-Secondary Maritime School in Szczecin, enables young people to achieve in a short period of about three years, diplomas and professional officer, capable of working on ships around the world. The school is for young people who graduated from high school or technical school final exams or not. The school prepares students to work in the deck department on vessels and marine engineering, preparing for the exam for diploma officer of the watch, it opens the way for further advancement [1, 2].

A graduate of the College for Maritime has full authority to apply for a certificate merchant navy officer on watch after passing the examination before the Examination Committee of the Maritime Office, which allows for employment in this position on maritime vessels domestic and foreign shipowners [1, 2].

Education in Post-Secondary Maritime School in Szczecin is currently implemented for the following [1, 2]:

- techniques navigator marine;
- technician engineer.

The curriculum specialties Navigator Marine Technician training meets the requirements in accordance with [3, 4] of support and operational. After completing the first year of study and completion of two months of practice students can apply for a certificate Mariner watch. However, after completing his studies in Post-Secondary School of Marine and serving 12 months of practice graduates can apply for a Diploma officer of the watch [1, 4, 5].

The curriculum specialty engineer technician training meets the requirements in accordance with the requirements of the STCW Convention and the operating subsidiary level. After completing the first year of study and completion of two months of practice students can apply for a certificate of engine assistant. However, after completing his studies in Post-Secondary School of Marine and serving six months of practice graduates can apply for a diploma engineer officer on watch [1, 2].

The Post-Secondary Maritime School as well as other units of teaching trainees sailors, there are problems related to the implementation and monitoring of the learning process [1, 2]:

- the need to maintain a high level of education;
- the need to develop the knowledge and practical skills;
- prepare students for examination before the Central Examination (according to [5]);
- the need to archive test results for the checks carried out by the maritime administration offices.

In order to solve these problems in Post-Secondary Maritime School in Szczecin is used and implemented computer software for control stability called "Fast Stability".

The computer software "FastStability"

The FastStability software has been developed for all kind of vessels and calculates stability with many additional options:

- Change of ship characteristics;
- Planning of loading, discharge, reserve and balance;
- Stability calculation;

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Hydrostatic Data			
Hydrostatics:		_	
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Cross curves of stability:			
C:\Temp\Fast Stability\Cross curves of st	ability.xls	6	
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Moulded breadth B [m]:	12	•	
Draught Extreme T [m]:	5	-	
Keel thickness [m]:	0,013		
Links Chie Date			
Light Ship Data			
Weight [t]	1125	<u> </u>	
LCG (m):	35,69	•	
VCG [m]:	4 ,79	-	
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Fig. 1. The module for change of ship characteristics

- Draught survey;
- Seakeeping.

The "Change of ship characteristics" module is allowed to (Fig. 1):

- change of main particulars (length, breadth, draught, etc.);
- loading hydrostatics and cross curves from MS Excel format files.

🕆 Microsoft Excel - Hydrostatic curves.xls									_ & ×	
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1	T [m]	D [t]	LCF [m]	LCB [m]	KM[m]	M [t-m/m]	TPC [t/cm]	Aft Mark	Fore Mark	
2	1,35	1086	42,55	42,51	10,03	3671	8,46	-1	0,8	
3	1,37	1103			9,92	3678	8,47			
4	1,39	1120	42,56		9,82	3686				
5	1,41	1137			9,72	3693	8,48			
6	1,43	1154			9,61	3700	8,49			
7	1,45	1171		42,52	9,51	3708	8,49			
8	1,47	1188			9,42	3715	8,5			
9	1,49	1205	42,57		9,32	3722	8,5			
10	1,51	1222			9,22	3729	8,51	-0,8		
11	1,53	1239			9,13	3736	8,52			
12	1,55	1256		42,53	9,04	3743	8,52			
13	1,57	1273			8,94	3750	8,53		0,5	
14	1,59	1291	42,56		8,85	3757	8,53			
15	1,61	1308			8,77	3764	8,54			
16	1,63	1325			8,68	3771	8,55			
17	1,65	1342			8,59	3777	8,55			
18	1,67	1359		42,54	8,51	3784	8,56			
19	1,69	1376	42,55		8,43	3791	8,56			
20	1.71	1393	42.55		8.35	3797	8.57			- -
Gotov	FIL Krzywe	e nyorostatyczne /					4		NUM	

Fig. 2. The hydrostatics

The FastStability Program loads hydrostatics from Excel format file *.xls. The hydrostatics data must be given in following order (Fig. 2):

- theoretical draught above base line T [m];
- displacement D [t];

- long. center of flotation LCF from AP [m];
- long. center of buoyancy LCB from AP [m];
- KM transverse above base line [m];
- moment change trim 1 cm [tm/cm];
- ton/cm immersion TPC [t/cm]

× Microsoft Excel - Cross curves of stability.xls											
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1	Depl [t]	10	20	30	40	50	60	70			
2	1100	1,742	3,087	3,831	4,296	4,582	4,739	4,63			
3	1151	1,684	3,034	3,798	4,283	4,591	4,755	4,638			
4	1200	1,629	2,982	3,767	4,27	4,601	4,768	4,648			
5	1250	1,578	2,933	3,736	4,258	4,611	4,779	4,66			
6	1300	1,53	2,885	3,707	4,246	4,621	4,786	4,673			
7	1350	1,486	2,838	3,679	4,235	4,631	4,789	4,689			
8	1400	1,446	2,794	3,652	4,224	4,639	4,788	4,707			
9	1450	1,408	2,75	3,625	4,214	4,644	4,786	4,727			
10	1500	1,374	2,708	3,599	4,205	4,647	4,784	4,748			
11	1550	1,343	2,667	3,573	4,196	4,649	4,781	4,769			
12	1600	1,315	2,627	3,549	4,187	4,648	4,779	4,791			
13	1650	1,289	2,588	3,525	4,179	4,645	4,777	4,813			
14	1700	1,264	2,55	3,503	4,172	4,641	4,776	4,835			
15	1750	1,24	2,513	3,481	4,165	4,634	4,776	4,857			
16	1800	1,218	2,478	3,459	4,158	4,626	4,777	4,88			
17	1850	1,197	2,443	3,439	4,152	4,617	4,779	4,902			
18	1900	1,178	2,41	3,419	4,147	4,606	4,782	4,924			
19	1950	1,161	2,378	3,4	4,141	4,595	4,787	4,941			
20	2000	1.145	2.348	3.381	4.134	4.585	4.791	4.956			
Gotov	Vý				[NU			

Fig. 3. The cross curves of stability



Fig. 4. The module for control stability when docking

and data for Draught Survey ("+" fore, "-" aft):

- distance from AP to aft mark [m];
- distance from FP to fore mark [m].

The cross curves must be given in following format (Fig. 3):

- cells in first column: displacement [t];
- cells in first row: angles of heel;
- other cells: values of cross curves [m].

There are following options in "Planning of loading, discharge, reserve and balance" module:

- all types of vessels (container ship, OBO, Tanker, Bulk carrier, ...) with retrieval of any loading conditions as a combination of single items, tanks, containers, bulk cargo, etc.;
- automatic access to ship data available in the system, such as: hydrostatics, cross curves or limits of stability;
- stability when docking (Fig. 4);
- run aground (Fig. 5);
- reserve of deadweight calculation;
- automatic balance correction for two points due to the extreme draught and trim;
- voyage information.

The "Stability calculation" module consist of (Fig. 6):

- several GM-limits;
- leverarm balance, single values, area below leverarm curve;
- trim and heel;
- IMO weather criterion;
- grain stability calculations.

The "Draught survey" module consist of (Fig. 7):

- fast calculation of tank weights;
- saving and loading data;
- print, print preview and printer set-up options;
- extra export to Excel file which enables preparing reports in standard format (e.g. NBC).

The "Seakeeping" module is allowed to (Fig. 8):

- motion transfer functions;
- prediction of: roll, pitch, heave, slamming, acceleration, screw surfacing, green water;
- calculation of Seakeeping Performance Index;
- prediction of ship operability in heavy seas;
- optimum service parameters on the red-green circular chart.

🗮 Run aground								
Before ground Draught Fore [m]:	Port	Starboard	Ме. 11,0000	an	Force [T]: GM [m]:	38,18		
Draught Mid (m): Draught Aft (m): VCG (m):	11,0000 ÷ 11,0000 ÷	11,0000 - 11,0000 - 11,0000 - 11,0000 - 10,000 - 10,000010,000010,000010,00000	11,0000		Points coord	inates m]: 93,52		
After ground	Port	Starboard	, .	ean	Y from CL [r	n): -1,62		
Draught Fore [m]: Draught Mid [m]: Draught Aft [m]:	10,9300 ÷ 10,0000 ÷	10,9000 × 11,0000 ×	10,9148		Before grou	nd [m]: 11,000		
	11,000	Draught MMM from B.L. [m]	10,5904	× ×		Int		
Description		We	ight [t]	LCG [m]	TCG [m]	VCG [m]		
ballast		-30	D	120	0	8		
fuel		-10	D	50	-10	3		
fuel 100 50 10 3								
<u>QK</u> <u>Cancel</u> <u>Print</u> <u>Load</u>								

Fig. 5. The module of run aground

The "Fast Stability" computer program used for training in maritime schools

💳 Faststabi	ility Ver. 2.1 [Kusocinki na wyjscie SF 1.21.fsp]		-	-	-	-	-	
File Edit	Data Results Options Seakeeping Language Win	ndow Help						
D 🖻	🖬 🎒 🍇 🖾 🖬 with tanks calibration	-	<i></i>					
	Stability Results							
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	List [de	ea.l: 0		10	1.732	0.22		1
	Free surface correction GG	'[m]: 0,04		20	3,47	0,491		40 0,80 50 0,841
	Corr. transv. metacentric height G'M	[m]: 1,19	0,15	30	5,065	0,71	[30 0,71
	H Maximum GZ		0,2	40	6,406	0,807		E 200491
	Angle of maximum GZ [d	leg.]: 51	30	50	7,513	0,841		70 0,396
	Area up to 30 Degrees [m	rad]: 0,188	0,055	60	8,302	0,759		nbda 0 = [teta = 10.35]
	Area up to 40 Degrees (m	rad]: 0,321	0,09	70	8,58	0,396		
	Area between 30 and 40 Degrees [m	rad]: 0,133	0,03	80	8,618	0,04		
	Critical VCG	'[m]: 8,71	9,63					
	Weather Criter	ion:						Angle of heel [deg]
	Angle of roll [d	leg.]: 18,4						
	Period of rolling [s	ec.]: 15,4						12-
	Area "b/a" R	atio: 6,2	1					10-
	Wind heeling lever lw1	[m]: 0,03						
	Wind heeling lever lw2	2 [m]: 0,04						
	Longitudinal Stabi	ility:						
	Trim by sterr	n [m]: -1,01						
	Draught at L.C.F. (incl. keel th.) T	[m]: 10,91						2-
	Draught at midship (incl. keel th.) TM	l (m): 10,9						20.000 30.000 40.000 50.00
	Draught at aft perp. (incl. keel th.) TA	(m): 11,4					-	D [t]
	Drafts and trim							
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DWT Reserve	e (TMmax=11,01 m): 395,4 t Ba	lance at 41,6 m	c -56,3 t		Balar	nce at 164,1 m	: 451,7 t	List: 0 deg. Transv. mom.: 0 tm
Stability OK	🔵 d: 1,025 t/m3	1	G'M: 1,19 m		Trim: -1	1,01 m	TA: 1	1,4 m [11,4] TM: 10,9 m TF: 10,39 m [10,39] Pokaż pulpit
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Fig. 6. The "Stability calculation" module

➡ FastStability DEMO VERSION - [Conta ➡ File Edit Data Results Options Seak	() Draught Survey	,			×
					Perpendiculars
		Port		Starboard	Mean
	Draught Aft [m]:	5,4900	•	5,4900 📑	5,4900
	Draught Mid [m]:	5,4900	•	5,4900 📑	5,4900
FRISCHWASSER NO.7 B+S	Draught Fore [m]:	5,4900	· 1	5,4900	5,4900
	Density of seawate	er [t/m3]: 1,0250	Drau	ught MMM [m]:	5,4900
FAKALIEN NO.13 B	Trim [m]:	0,0000	Trim	Moment at 4,99 m [tm/m]:	5764,000
Container Raum	TPC [t/cm]:	10,170	Trim	Moment at 5,99 m [tm/m]:	6175,000
	LCF [m]:	-2,3300	Diffe	erence [tm]:	411,000
	Deductions:				
	Fuel oil [t]:	0,000 🔤 🔣	T Disp	placement at 5,49 m [t]:	4907,000
	<u>Diesel oil [t]:</u>	0,000	Corre	ection due to Trim [t]:	0,000
	Lubric oil [t]:	0,000	Seco	ond correction due to Trim [t]:	0,000
	Fresh water [t]:	0,000	Disp	placement at 1,025 t/m3 [t]:	4907,000 🚆
	Feet water [t]:	63,500	Corr.	, due to Density of s.w. [t]:	0,000
	Ballast water [t]:	0,000 📾 村	Actu	ual Displacement [t]:	4907,000
	Other tanks [t]:	0,000	Tota	al Deductions [t]:	1194,600
<u> </u>	Stores/Misc. [t]:	6,100	Carg	go [t]:	3712,400
	Light Ship [t]:	1125,000			
				<u> </u>	cel <u>E</u> xport
Weight Specification Stability Results GZ Cu	Click on the blue la calculate sum of m	abel to ass of tanks		Copy <u>A</u> ll <u>P</u> rin	t Print Preview
Stability OK	 Density of S.W.: 1.0:	25 t/m3	Draught Extre	eme:5 m Keelt	hickness: 0 m

Fig. 7. The "Draught durvey" module

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Fig. 8. The "Seakeeping" module

Conclusions

Innovative software "FastStability" presented in the article has been developed for all kind of vessels and calculates stability with many additional options:

- Change of ship characteristics;
- Planning of loading, discharge, reserve and balance;
- Stability calculation;
- Draught survey;
- Seakeeping.

The special effect of education in the maritime schools is the ability to using ships' stability software. The "Fast Stability" program is used in Post-Secondary Maritime School in Szczecin to training and learning. Presented stability software is allowed to examination before the Central Examination according to [5].

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