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STUDY OF INERTIA AND SWING PARAMETERS OF AN ANZAC TYPE FRIGATE USING THE SHIP HANDLING SIMULATOR

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Abstract: *The Ship handling Simulator is intended to ensure the training of the Naval Academy students, as well as of teams and ship units for ship steering, gradually, at different levels of knowledge and hierarchical levels of command. Among the types of ships that can be simulated with this device, one can notice the ANZAC type frigates, which are owned by the Romanian Naval Forces. The study aims to highlight the behavior of ANZAC type frigate within the running hours of the steering and propulsion installations, for different speed regimes and simulated hydro meteorological conditions.*
Key words: *ship handling simulator, frigate ANZAC, simulated hydro meteorological conditions.*

1. INTRODUCTION

This paper presents the variations of speed, curve radius of gyration and time depending on the steering angle and simulated hydro meteorological conditions.

2. EXPOSITION

The "Ship handling Simulator" is Navy-Trainer Professional 5000, accredited by Class A and meets the requirements Det Norske Veritas, STCW'78 Convention as amended in 1995 and also covers the skills included in Tables A-II / 1 and A -II / 2 of Part A of the STCW Code for shipping bridge simulators.

The following coordinate system are used for the description of the own ship's motion (all reference frames are Cartesian):

- $x_0y_0z_0$ earth-fixed reference frame with O_0 origin in a certain fixed point:

- x_0 axis is directed towards the north and lies in the plane parallel to the undisturbed water surface;

- y_0 axis is directed towards the east and lies in the plane parallel to the the undisturbed water surface;

- z_0 axis is directed downward at a right angle to the undisturbed water surface.

- XYZ body-fixed frame with *O* origin in the vessel's center of gravity (CG):

- X axis is directed from aft to fore, lies in the central lateral plane and is parallel to the water plane (longitudinal axis);

- Y axis is directed to starboard, is perpendicular to the central lateral plane and parallel to the water plane (transverse axis);

- Z axis is directed from top to bottom at a right angle to the waterplane (normal axis).

- $x_1y_1z_1$ local frame with *O* origin in the vessel's center of gravity (CG) (axis obtained by translating) $x_0y_0z_0$ earth-fixed coordinate system parallel to itself until its origin coincides with the origin of the body-fixed coordinate system:

- x_1 axis is directed towards the north and lies in the plane parallel to the undisturbed water surface;

- y_1 axis is directed towards the east and lies in the plane parallel to the undisturbed water surface;

- z_1 axis is directed downward at a right angle to the undisturbed water surface.

The coordinate systems in use are shown in Fig. 1 and Fig. 2.

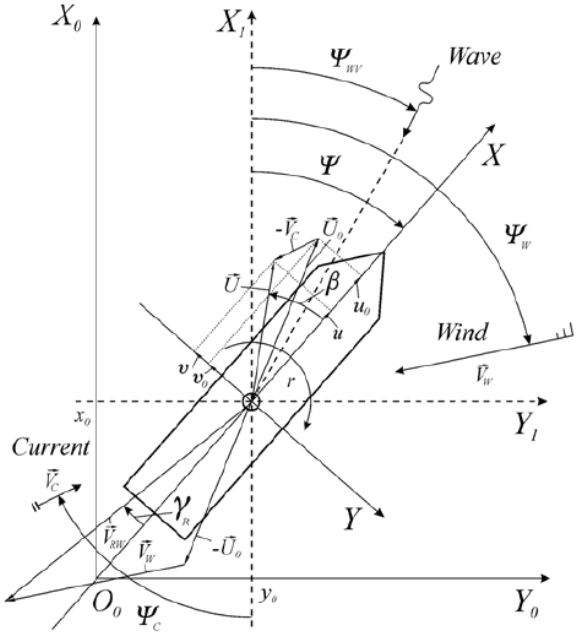


Fig. 1 Coordinate systems (horizontal plane)

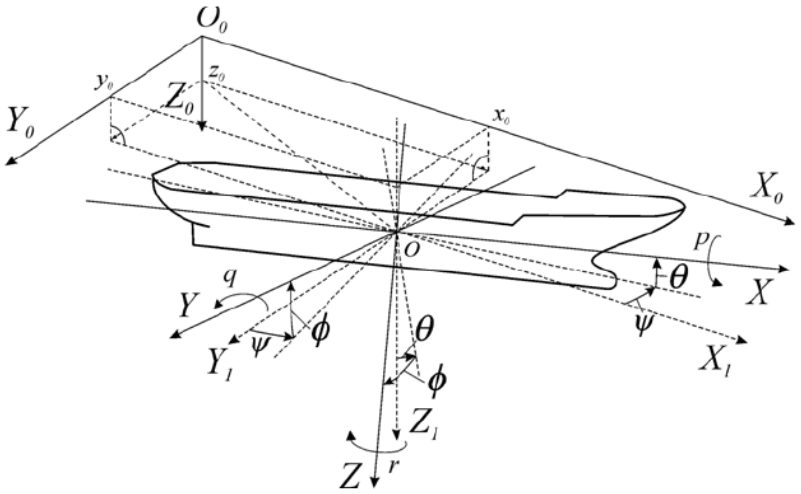


Fig. 2 Coordinate systems

Simulated ANZAC frigate has the following characteristics:

General informations

Displacement	3663,83 tones
Deadweight	3350 tones
Max Speed	32,4 knt
Lenght overall	130,5 m
Breadth	14,57 m
Bow draft	3,9 m
Stern draft	4,6
Height of eye	14 m
Type of engine	Gas Turbine (2 x 20902 KW)
Type of propeler	CPP
Thruster bow	None
Thruster stern	None

Main engine

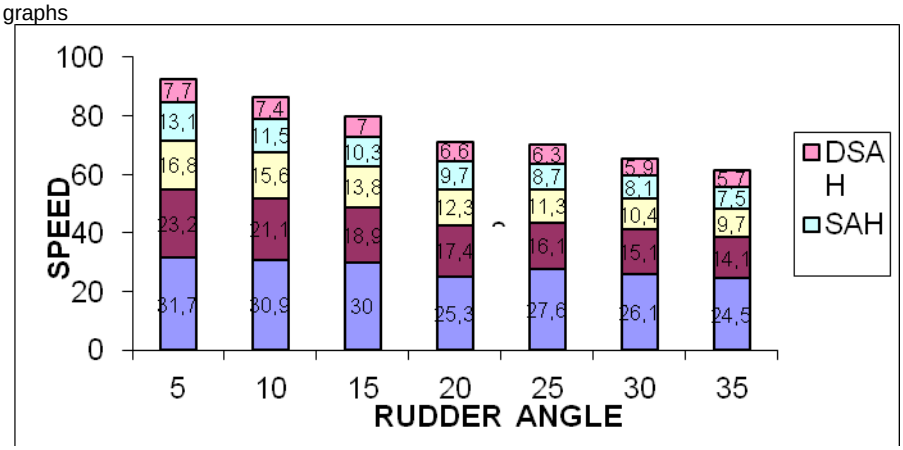
Conditions speed	RPM	Speed [Knt]
Full sea ahead (FSAH)	236	32
Full ahead (FAH)	156	24
Half ahead (HAH)	117	18
Slow ahead (SAH)	91	14
Dead slow ahead (DSAH)	86	8

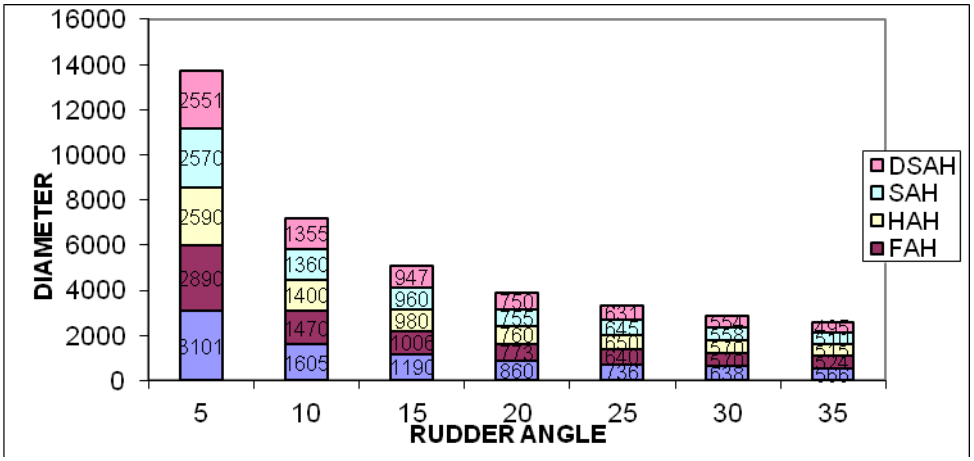
We determined the following characteristics:
- the bottom speed (SOG) [KNT];
- diameter of gyration (Diam.) [m];
- Time to maneuver[minutes and seconds].

For sea level 0 Beaufort

Rudder angle	FSAH			FAH			HAH			SAH			DSAH		
	SOG	Diam	Time	SOG	Diam.	Time	SOG	Diam.	Time	SOG	Diam.	Time	SOG	Diam.	Time
5	31,7	3101	10:02	23,2	2890	13:00	16,8	2590	15:45	13,1	2570	20:05	7,7	2551	33:45
10	30,9	1605	05:23	21,1	1470	07:05	15,6	1400	09:08	11,5	1360	11:50	7,4	1355	18:53
15	30,1	1190	04:00	18,9	1006	05:22	13,8	980	07:07	10,3	960	09:12	7,0	947	13:52
20	28,8	860	03:01	17,4	773	04:26	12,3	760	06:13	9,7	755	07:42	6,6	750	11:28
25	27,6	736	02:43	16,1	640	04:00	11,3	650	05:16	8,7	645	07:16	6,3	631	10:17
30	26,1	638	02:18	15,1	570	03:42	10,4	570	05:14	8,1	558	06:46	5,9	554	09:31
35	24,5	566	02:15	14,1	524	03:37	9,7	515	05:07	7,5	510	06:33	5,7	495	09:15

I have the following graphs





For sea level 3 Beaufort, Wind speed 8 knt, wind direction 90º

Rudder angle	FSAH			FAH			HAH			SAH			DSAH		
	SOG	Diam	Time	SOG	Diam.	Time	SOG	Diam.	Time	SOG	Diam.	Time	SOG	Diam.	Time
15	30	1120	03:50	18,0	936	05:12	13,6	962	07:03	10	895	08:47	6,8	948	14:08
35	24,6	560	02:19	14,2	516	03:26	9,7	501	05:08	7,8	498	06:32	5,8	507	09:08

For sea level 3 Beaufort, Wind speed 8 knt, wind direction 180º

Rudder angle	FSAH			FAH			HAH			SAH			DSAH		
	SOG	Diam	Time	SOG	Diam.	Time	SOG	Diam.	Time	SOG	Diam.	Time	SOG	Diam.	Time
15	30	1114	03:49	19,4	1013	05:18	13,8	979	07:07	10,7	968	09:06	7,0	986	11:12
35	25,3	561	02:15	14,5	505	03:30	9,7	495	05:07	7,8	490	06:35	5,0	486	08:07

For these conditions of wind and sea level it was recorded the average speed from the bottom.

3. CONCLUSIONS AND PROPOSALS

From the graph of variation of speed for 0 sea level, we can note that it is directly proportional to the steering angle and time to maneuver. From the graph of variation of diameter for 0 sea level,we see that it greatly reduces for the steering angle of 10 degrees, after having a linear variation.

For sea level 3 and wind speed of 8knots, it is observed that the speed and diameter do not undergo significant changes.

Thus, it can be concluded that trade is optimal for turning circle maneuver since steering angle of 10 degrees. Over this angle, the variation of speed, diameter of turning circle and time is slowly decreasing.

REFERENCES

[1] Description of Transas Mathematical Model
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