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THE SIMULATED EFFECT OF THE WIND ON A 13.300 TEU CONTAINER SHIP

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Abstract: *Knowing the wind's elements (magnitude and direction) on board is one of the basic tasks of the officer of the watch. Its action affects a vessel arising from its planned course with direct effects on the safety of the ship, its cargo and crew. Magnitude and direction of the wind force depend on the relative wind direction and the center of the wind pressure (W) depend on the area of the ship exposed. Starting with 2009, "Mircea cel Batran" Naval Academy has a complex of maritime simulators named "Integrated simulator for driving of watercrafts" for bridge and machinery. Using the simulator capabilities, this paper aims to present the influence of wind on a 13,300 TEU container. The 13,300 TEU container ship is the biggest ship simulated and is endowed to one of the largest shipping companies.*
Key words*: wind action, ship handling simulator, 13.300 TEU containe ship*

1. INTRODUCTION

Wind is one of the most powerful external factors influencing ship maneuvering, by its force, velocity and angle of incidence upon the sail area of the ship.The characteristic elements of the wind are direction and velocity.

Wind direction – represents the direction in which the air masses are moving relative to true north, materialized aboard by the vane, the smoke from the ship's basket, or by the flag and can be measured by putting the alidade orientation parallel to this direction.

Wind speed – can be measured with the help of the anemometer and is usuallty expressed in meters per second or by wind's force, from 0 to 12, on the Beaufort scale.

Wind action on a vessel is directly, through the effort that confronts the deadworks, and indirectly, through the waves that are generated in the navigation area.

Actiong upon a moving vessel is the apparent wind, that results fron the ship's wind and the real wind and shifts the apparent wind direction to the bow of the vessel and produces the following effects:

- deviation of the ship under wind, effect that is canceled by operating the ship's steering system;
- reducing or increasing the ship's speed, effect caused by the allure from which the wind is received;
- deviation of the vessel from it's true course on a deviated course, called course over groud, so the vessel will travel parallel to itself, in the direction of the true course, but on the path indicated by the course over ground.

As rules of principle, a vessel moving forward due to its propeller will be influenced by the winds effects as follows:

- *with the wind from the bow*: - the vessel has good stability, the wave effect is relatively small, it can steer well and turn to each board easily, but it will be hard to return to its old course;
- *with the wind from the stern*: - the vessel has good stability, the propeller and helm are sunk enough obtaining good steering and speed effects so the ship can easily turn to each board, but it is hard to bring her in the wind if she doesn't have eough speed;
- *with the wind from the bow sector*: - the vessel tends to turn into the wind and if the wind is strong enough the helm must be used to keep a steady course, but in this case the svessel will be derived;
- *with the wind before the beam or from the beam:* - the vessel steers easily but derives strongly having the tendency to come up with the bow into the wind, which means to keep the helm in the wind;
- *with the wind behind the beam and wide*: - the vessel steers easily but derived strongly having the tendency to come up with the bow into the wind, which means to keeo the helm as the wind.

Maximum drift occurs at slow speed vessels that are receiving the wind from the beam. If the drift angle is maintained constant at about 30° the vessel becomes ungovernable (ship sheltering is required).

The behavior of the ship to the wind represents its capacity to orient itself to the direction of the wind and is conditioned by:

- the dimensions and the form of the sail area;
- the dimensions and the form of the deadwork;
- ship's speed;
- the allure or the direction from which the wind is received;
- the sea state.

Windage area to be compared with:

a) the underwater profile
b) position of the pivot point

Windage area is not always at the center of gravity of the windage area: it depends of the angle between wind direction and ship's heading.

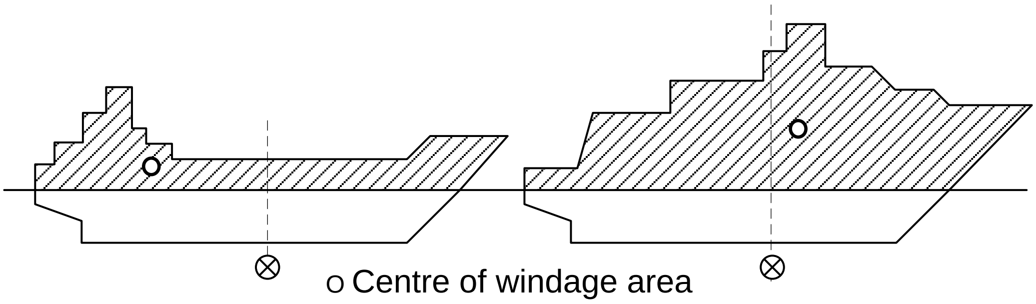

Fig. 1 Centre of windage area for different superstructures of the ships

Magnitude and direction of the wind force depends on the relative wind direction.

2. EFFECT OF WIND FORCE ON MANOEUVRING

Beam wind – ship stopped

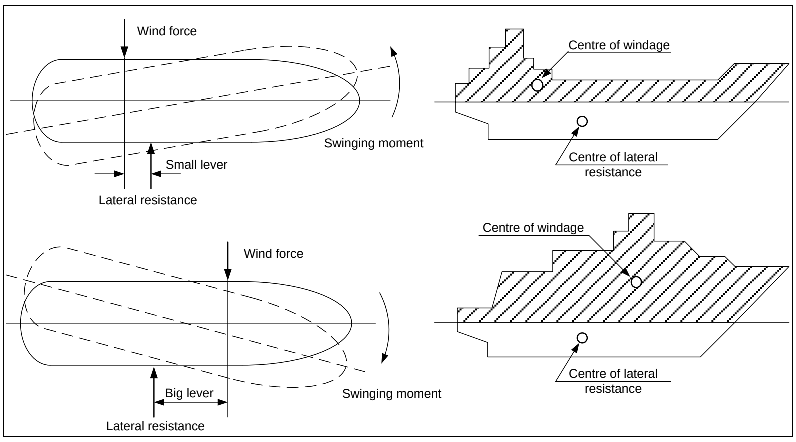

Fig. 2 The effect of the beam wind force for different superstructures

Mostly experienced when proceeding at slow speeds can create major problems when:

- During river passages
- When entering locks
- While berthing

Wind is usually not a problem under 4 Beaufort unless

a) On a ship in ballast
b) When coming from astern

Drifting moment

The drifting moment turns the vessel untill it reaches her drifting heading. A this moment there is an equilibrium between wind force on the windage area and water pressure on the underwater area.
Drifting moment = Wind force x distance in meter between Center of water pressure and wind force point.

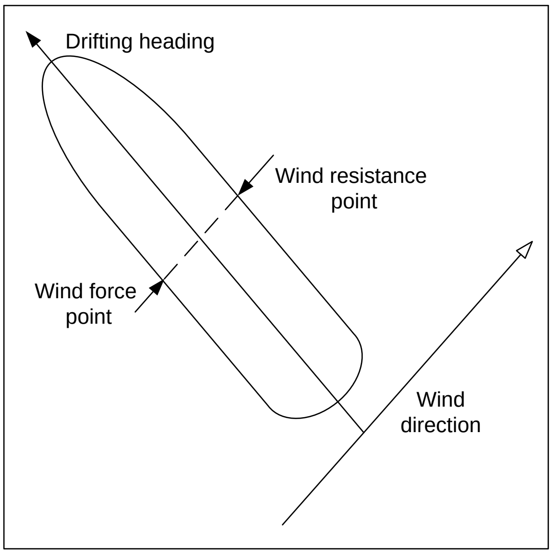

Fig. 3. The drifting moment of the ship

Headway / Beam wind

Pivot point moves forward: turning lever between P and W and the ship swings to port. When approaching the berth the vessel's speed decreases and the wind effect gets greater: it require considerable corrective action.

Sternway / Beam wind

With sternway is wind effect less predictable and more complex. Pivot point moves aft creating a different turning lever: the bow fall off the wind or with other words the stern seeks the wind.

3. THE SIMULATED 13.300 TEU CONTAINER SHIP CHARACTERISTICS

„Mircea cel Batran" Naval Academy (MBNA) purchased in 2009 a complex of operational maritime simulators named "Integrated simulator for driving of watercraft" type Navi-Trainer Professional 5000 manufactured by TRANSAS Limited Co and certified by DetNorskeVeritas (DNV) as A class (full mission) for bridge and machinery.

The simulator have the following training capabilities for 22 ship types (2 general cargo vessels, 5 container ships, 2 ore carriers, 3 tankers, 1 LPG carrier, 3 passenger vessels, 2 tugs and 5 military vessels):

- Harbor entering / departing maneuvers;
- Straights passing maneuvers;
- Search And Rescue operational training, according to the actual international regulations;
- Training with ships formations according to the NATO procedure;
- Replenishment At Sea Maneuvers;
- Familiarization and basic operational training for Engineering Teams (both for Merchant Fleet and for Romanian Navy);
- Advanced Bridge Team Management, Engine Team Management and Crisis Management Training;
- Complex training for crews in order to facilitate the knowledges regarding the onboard systems interaction;
- Damage Control basic and advanced training;
- Practicing joint maneuvering of ships in formations;
- Practicing refueling at sea operations;

The 13.300 TEU container ship is the bigger ship simulated and is endowed to one of the largest shipping companies.

Tab 1. The 13.300 TEU container ship characteristics

Deplasament	202650 tone
Deadweight	156800 tone
Max speeed	25.4 knts
Lenght overall	365.5 m
Lenght of Midbody	274.13 m
Breadth	51.2 m
Height	68.15 m
Bridge to stern	222.45 m
Bridge to bow	143.05 m
Type of engine Slow Speed Diesel	1*80080kW
Type of propeler	FPP
Minimum RPM	25
Thruster bow	yes
Thruster stern	none
Type of bow	bulbous
Type of stern	transom

Using the integrated simulator for driving watercraft capabilities, the vessel with a 12.6 speed and drafts of 11, 12 and 15 meters receiving the wind from beam with 10 knots the course over ground and speed over grounf was determined. Time of maneuver: 30 minutes.

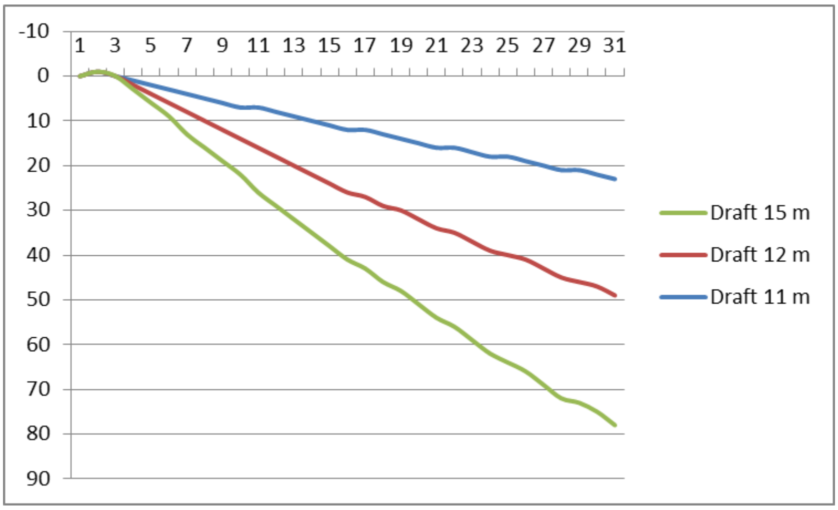

Fig. 4. The course over ground variation for different ship's draft when the ship stear to starboard

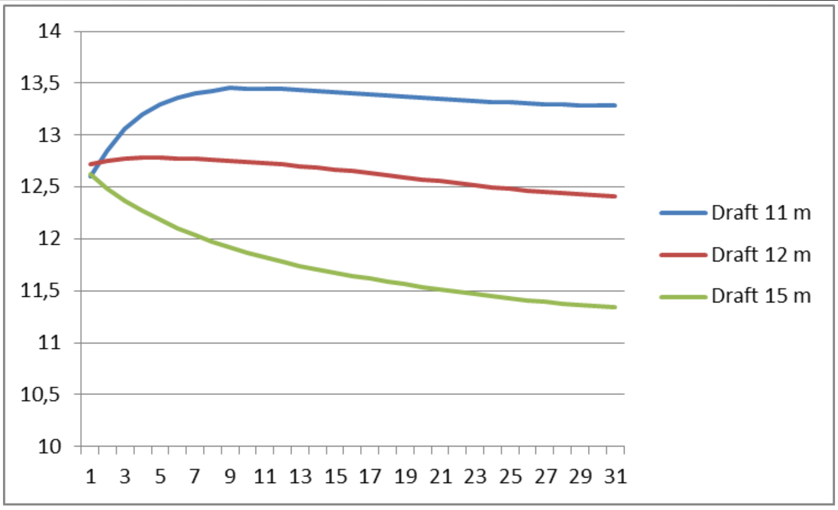

Fig. 5. The speed over ground variation for different ship's draft when the ship stear to starboard

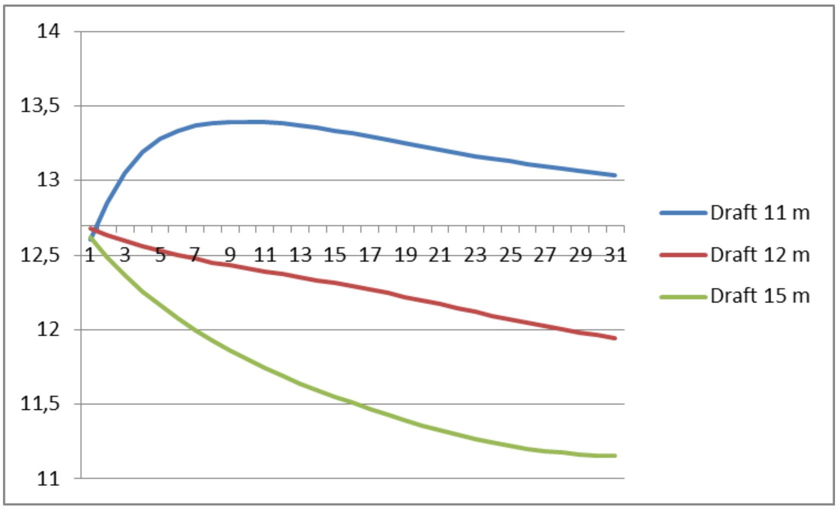

Fig. 6. The speed over ground variation for different ship's draft when the ship stear to port

4. CONCLUSIONS

When increasing the vessel's draft, the sail area got smaller and the wind effect drops. When increasing the ship's draft the drift is more pronounced reaching 80° after only 30 minutes, fact that can be explained as a result of the moving of the windage area to the stern of the vessel.

It can be observed that in both cases, when receiving the wind from port or starboard, after a time of maneuvering of 30 minutes, the ship's speed has an approximately linear downward trend. For the 11 meters draft, speed over ground initially increases, having a propelling role. When approaching the berth the vessel's speed decreases and the wind effect gets greater.

The effect is more pronounced when the wind is from the port due to the fact that right step propeller helps the ship in moving faster to port.

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[1] Transas Ltd, August 2009. NAVI-TRAINER 5000, Navigation Bridge, (version 5.00)
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