Availability of a yacht at anchor

A quasi static design analysis to control the horizontal motions *(Abstract Only)*

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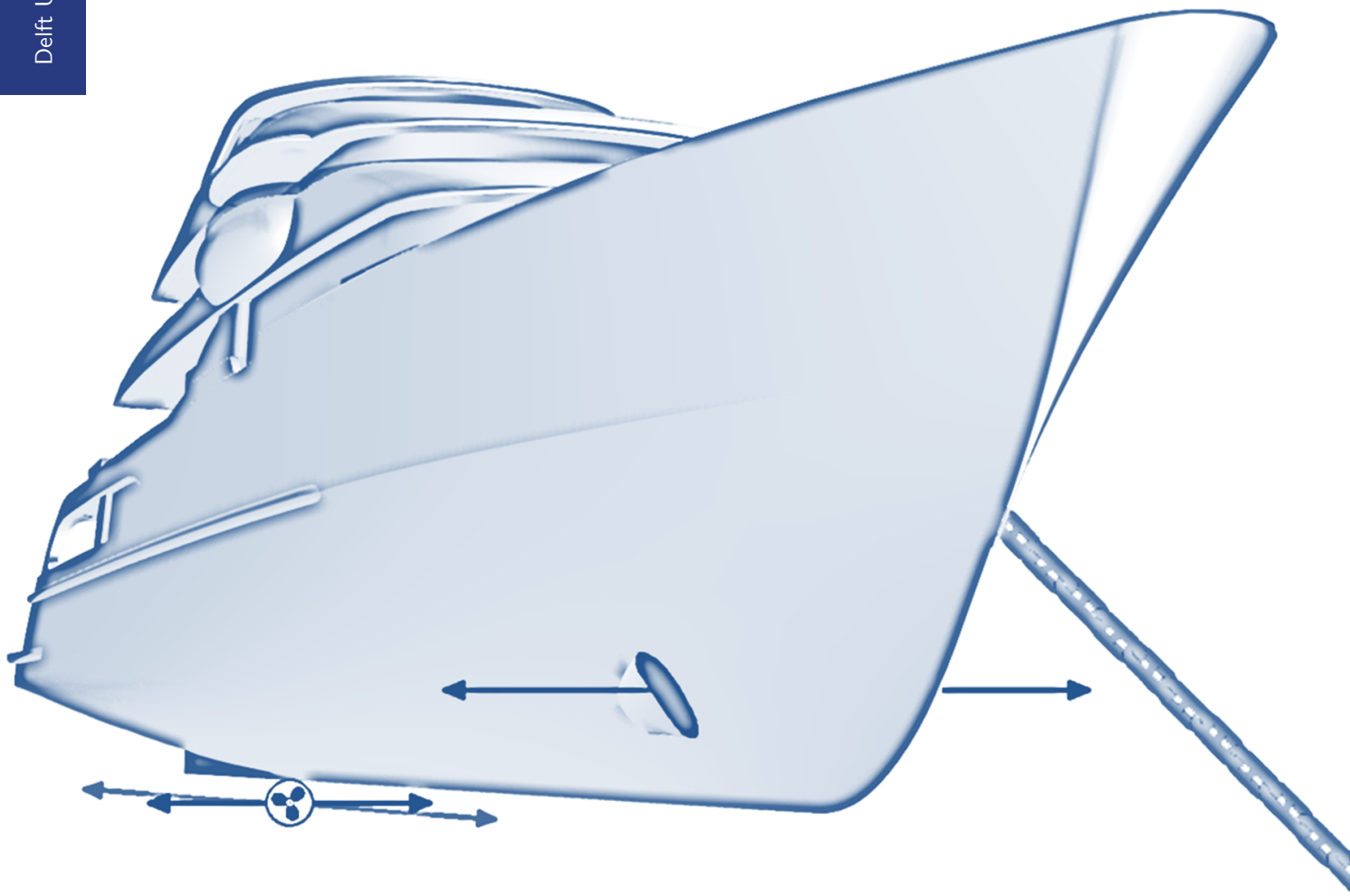

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De Voogt Naval Architects Haarlem,
part of Feadship Royal Dutch Shipyards

AVAILABILITY OF A YACHT AT ANCHOR

A QUASI STATIC DESIGN ANALYSIS TO CONTROL THE HORIZONTAL MOTIONS *(Abstract Only)*

MASTER OF SCIENCE THESIS

by

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This thesis is confidential and cannot be made public.

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ABSTRACT

Yachts are built to provide guests with a unique experience. In order to provide this experience, yachts are often anchored at special locations. Captains prefer to use a single bow anchor when they moor the vessel. Problems are reported with respect to the availability while yachts are at anchor. These are caused by environmental forces. Availability is the yachting term for the operability of a yacht. The comfort on board and the availability of activities are the main aspects playing a role in the overall availability.

Horizontal motions and accelerations of the vessel, respectively caused by wind and waves, are the main issues at anchor. These undesired accelerations can be reduced by controlling the yacht's heading, ensuring optimal wave interaction. The objective of this research is to improve the availability while at anchor by suppressing the horizontal motions and controlling the heading of the vessel. Previous research suggests that using thrusters is a feasible solution for this. The research performed in this thesis provides a design proposition based on a quasi static analysis. For that reason, mathematical models are developed which are embedded in engineering tools.

When these tools are defined, the first step is a parameter study. This has been performed to examine what, theoretically, is the preferred anchor support system. In this study, the required power and mooring force is calculated for a predefined capability. The capability is the environmental condition at which the system is able to be stationary. Based on the results can be concluded that the mooring line has to be located close to the pivot point of the vessel and that the thrusters have to be located with a large distance to the pivot point opposite to the mooring line location. Using multiple thrusters is often preferable because the same thrust can be delivered with less power. However, the thruster located the closest to the mooring line and pivot point delivers little thrust compared to the other thruster located further away. The usage of a tunnel thruster or an azimuth thruster is preferred. The difference between these two is limited because the azimuth thruster operates at an angle θ of 90 degrees.

The theoretical solutions found neglect practical aspects which have to be taken into account for implementation; e.g. the layout of the vessel and the range of the required headings. To consider these aspects, multiple assessment criteria have been defined. The design study has been performed with various design cases. The capability of these cases has been calculated with the developed model in terms of wind speed. When the used power is reduced, the comfort with respect to noise is increased. However, this reduces the capability as well because less thrust can be delivered. The reduction of the capability is related to the power margin to the power $\frac{1}{3}$, when the thrusters are operating at maximum allowable power. For each design case, the dynamic positioning capability has been calculated to investigate whether including a mooring line influences the capability. As a result of this research can be concluded that the capability of the anchor support systems is higher than the capability of the *DP* systems and that the anchor support system requires less power to do so. The *DP* system uses twice as much power for the required range of headings.

The design proposition is determined based on the results of the quasi static calculations supported by a multi-criteria analysis. The preferred anchor support system for a yacht has an azimuth stern thruster in front of the platforms at the stern. Placing a thruster below these platforms causes safety issues and reduces the comfort. The yacht is equipped with an azimuth thruster in the bow because such a thruster can provide the same amount of thrust with less power and provides better controllability. The mooring line location is situated in the bow and is located on the centreline, thus an underwater anchor is required.

The used approach and developed tools are provided to Feadship which allow them to consider the capability of anchor support system in the early design phase of the new yachts. This gives Feadship the opportunity to build yachts with a higher availability at anchor. As a result, the guests will be able to enjoy an even more unique experience due to the control of horizontal motions.

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