



With over 150 projects for large motor yachts in the last 20 years, MARIN is confident it can assist in improving their design.

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Model research helps yacht owners' dreams come true...

Design considerations for yacht operations

When talking about ship operations, generally operational conditions for commercial vessels are discussed. Large motor yachts however, also require a design strategy for their operational conditions. Besides maximum attainable speed and range speed, zero speed is also a very important operational condition.

Designing for maximum speed

When optimising the hull lines for a luxury motor yacht, a number of aspects have to be taken into account. A required maximum or trial speed has to be attained with the installed power, whilst bearing in mind the very high level of comfort for zero speed conditions. The latter requires a certain transom immersion which is not favourable from a propulsion point-of-view. Trim wedges are a common feature used to reduce the required power around the top speed, while still enabling an adequate transom immersion. Application of a trim wedge, optimised by means of several short propulsion tests with a number of various trim wedges, can reduce the required power by

up to 10% around the design speed. However, at low speeds the increased transom immersion due to the trim wedge has a clear negative effect on the required power.

When optimising for maximum speed, a bulbous bow is recommended. A well-designed bulb can reduce the required power by up to 15%. However, a bulbous bow is often not an option due to the aesthetics and anchor handling aspects. However, a compromise taking into account these aspects can improve the calm water performance characteristics. Hull form optimisation can be performed by means of CFD calculations and by using a systematic hull form variation approach, well considered decisions can be made.

Designing for transit

Under transit conditions, such as a crossover from the Mediterranean to the Caribbean, the range speed can be defined. In these conditions a significantly lower speed than the maximum speed is sailed and for a long period. The volume of the fuel tanks is determined based on the required power for this speed. The usual range speeds for

large motor yachts have no benefit from a trim wedge and are sometimes even negatively affected. This has to be considered when optimising the yacht for maximum speed.

By increasing their size and expending their use – exploring overseas more than floating at anchor in a quiet environment – the seaworthiness of yachts in severe conditions becomes an important consideration for captains and owners.

A good balance of parameters such as stability, type and location of stabilisers, rudders and skeg area, are a guarantee that the vessel will feature good course-keeping ability in stern-quartering waves, as well as good performance in calm water

manoeuvres. Freeboard height, forward deck arrangement and bow flare shape are parameters that will influence the seaworthiness of yachts and that must be carefully balanced with purely aesthetic considerations.

Such balance can be discussed at a preliminary concept level and then refined with simulations. Finally, only free sailing model tests in oblique seas can provide an accurate assessment of all these combined factors. Design choices made for seakeeping aspects must be made at a conceptual level, which makes it important to discuss them as early as possible in the project.

Designing for zero speed

Motion down certainly means pleasure levels up for enjoying a stay onboard a yacht at anchor. Over the years, any studies related to motor yachts

included an assessment of the comfort level at anchor. Smart and efficient inventions have accompanied the evolution of the booming yacht market. The wealth of this market, combined with the quest for fresh and different features, is creating an invaluable atmosphere of creativity in this segment in order to answer a quite simple operational target – reducing roll at anchor. Such a quest becomes so driven that the performance of the onboard system itself is sometimes prevailing on the final global performance of the yacht.



Roll reduction of 90% is often provided as an operational target, regardless of the actual roll angles experienced onboard! The low levels of roll recorded at MARIN over the years correspond to a 45 to 80% in roll reduction levels. In this respect, MARIN is constantly investing in order to provide the most accurate testing platform to assess this operational target that is so typical of the yacht market. Motor yachts are a very good example of a compromise; maybe they represent more of a compromise between several operational conditions than a commercial vessel does.

Comfort, safety, aesthetics and hydrodynamic performance, have to be integrated into one design meeting all the requirements of the owner. More model research into operational conditions is crucial to be sure that the yacht will make the owner's dream come true.

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