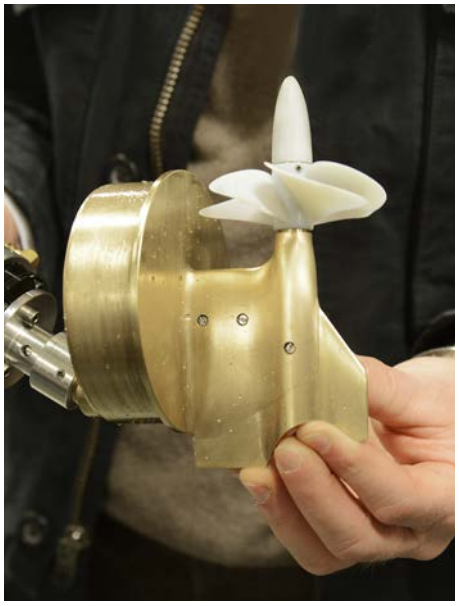
SSPA ramps up yacht testing

Lately, SSPA has tested models for a number of major yacht projects. Yacht testing requires attention to details not only in terms of the methods and model accuracy, but also, and possibly most importantly, in terms of how to handle the demands and criteria set by the client. Our test methods have therefore been developed and become more specialised for testing yachts. The latest feature to be introduced is running radio-controlled models for a more realistic impression. In cooperation with Mani Frers (Frers Naval Architecture & Engineering), a 24 m motor yacht was successfully tested in this way.

Photo from the project in cooperation with Mani Frers (Frers Naval Architecture & Engineering): a light and slender 24 m motor yacht designed for 25 kn. Photo: Magnus Wikander.



One of the two driving units / thrusters of pulling propeller type. Photo: Anders Mikaelsson.

In general, yacht testing is no different from testing other vessels. Resistance tests, self-propulsion, wake-, streamline-, seakeeping tests, etc. are all the same tests as performed for commercial ships. The procedure is the same but what is different is often the criterion that the client wants to achieve.

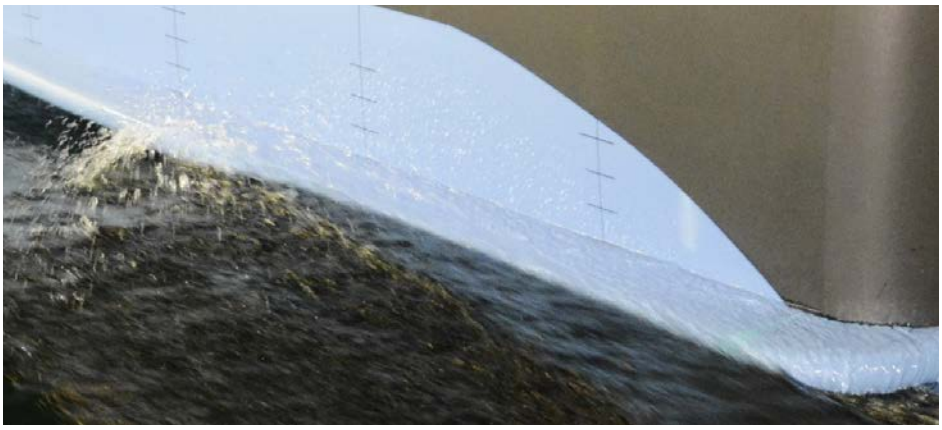
When the most important feature for a commercial ship might be reaching the required contract speed with the smallest engine possible, the criteria for yachts are often more intricate. Having said this does not mean that low resistance is not an important issue. It is, but not only for economic reasons. It might be an important factor that the owner of the new motor yacht is mindful of the environment and requests a smaller carbon footprint than the average yacht of the same size and speed range.

However, many other aspects are often highly ranked, factors such as the demand for moderate dynamic trimming during the acceleration phase, minimal heel in turns, reducing the problem with sloshing in the swimming pool during run, strong seakeeping capability (limited roll and pitch to avoid sea sickness both in transit and at anchor), a submerged transom to avoid any loud slamming noises while at anchor, low noise emissions from the propellers, etc.

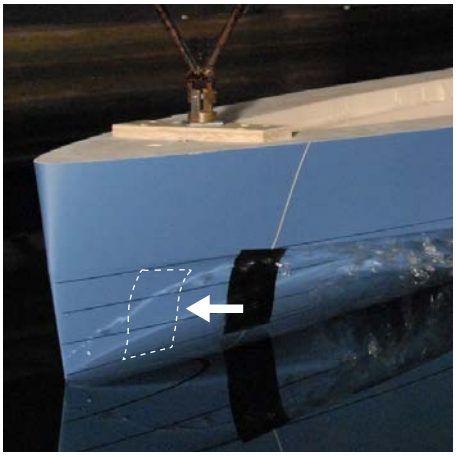
There are also several issues connected with the design and general appearance; a forward trim at speed is not aesthetically pleasing, to be avoided - no bulb above the waterline - popular place for seagull followed by that type of pollution. Plumb stems are also popular today, but they cause more spray on deck and require a different anchor arrangement etc.

Towing tank test observations

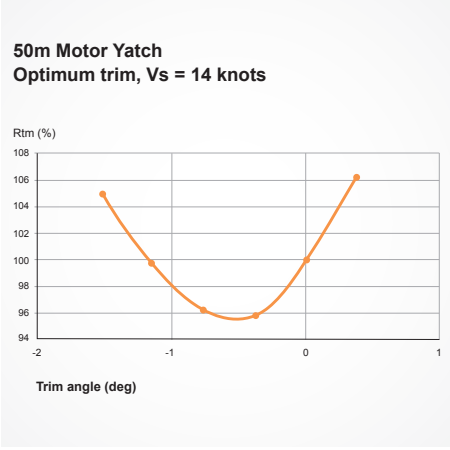
Several of the issues mentioned above can be investigated in the towing tank. At SSPA we take photos from three angles as standard procedure and could from these pictures in detail study occurring hydrodynamic phenomena. To start with the bow spray, this is depending on the



This observation during towing tests might lead to another design of the platform. Photo: SSPA.



The black field is representing the suggested area of the anchor pocket. A better position might be more forward and higher up.



The Y-axis is showing total resistance for each load case (trim at rest) in % of the resistance for the vessel loaded to even keel.

profile of the stem. With the new popular plumb stem, the deck area and volume below will be limited and the windlass and chain as well as the anchor pocket has to be mowed. This can lead to that the bow wave hit straight into the pocket if no care is taken.

One way to avoid this is to move the anchor pocket as far forward and upwards as possible. Another solution is to install an anchor system that is fully retractable into the hull below the waterline.

A swimming platform is often integrated with the hull aft. Sometimes the design does not work well with the wake wash. That's a reason to always include these features in the model. The influence on the resistance is minimal but it does not look good.

The running trim is measured during the towing tests and is plotted for the whole speed range. A trim variation for the design speed can be worth doing. It can reveal large gains to do and an experienced naval architect can with these results judge if the transom is too much submerged or the bulb (if present) is too deep or just that the LCB can be more optimized.

In this example, the best trim is found for a bow down trim of 0.5 deg. This can be interpreted as that the transom is a bit too deep. Lifting the stern and by that reducing the trim half a degree will reduce the resistance by 4 %. The question of whether this is worth doing is a trade-off decision between a silent aft body and a lower oil consumption.

On-board comfort

On-board comfort is becoming an even more important issue for yachts. For us, this issue involves movement and acceleration both at anchor and in transit. Modern-day yachts are almost always equipped with some sort of roll-reduction feature, and the most common today are zero-speed anti-roll fins. They are large because at zero-speed there are no flow from speed that can generate lift so the forces has to be generated by large surfaces that moves in the water. However, they will of course also be very effective at speed with the correct steering algorithm.

SSPA have recently tested a number of yachts with active fins, both at rest and at speed with the steering algorithm provided by the supplier. The tests have been performed in our large seakeeping and manoeuvring basin MDL (Maritime Dynamics Laboratory) where the vessel is free in all six degree of freedom and self-propelled and steered by an auto helm. It is amazing how effective they are!

In a previous stage, during the design phase, we have performed simulation with different types of anti-roll devices like fins, gyros, anti-roll tanks etc. This is a very cost-effective way to compare different methods for roll damping already at the drawing table.

Radio-controlled models – for a more realistic impression

At the end of the day there are still many questions from a yacht customer. Even with collected figures from resistance-, self-propulsion- and sea keeping tests presented in tables and diagrams using N, kW, degrees and m/s^2, they often still wonder: how does it look in reality, what is the impression when sailing in high seas, how does it feel when standing at the bridge running at 25 kn and turning hard to SB (or P)?

Of course, it's impossible to give a perfect answer to these questions, but we think we have gone a bit in the right direction by introducing the possibility to run the actual yacht model radio-controlled at the correct speed, the correct loading condition (loaded to correct displacement, pitch- and roll radius of gyration and GM).

The tests are performed in MDL where we can keep control on all environmental factors. An important factor is that we can generate sea states with representative significant wave height and correct period. It is worth mentioning

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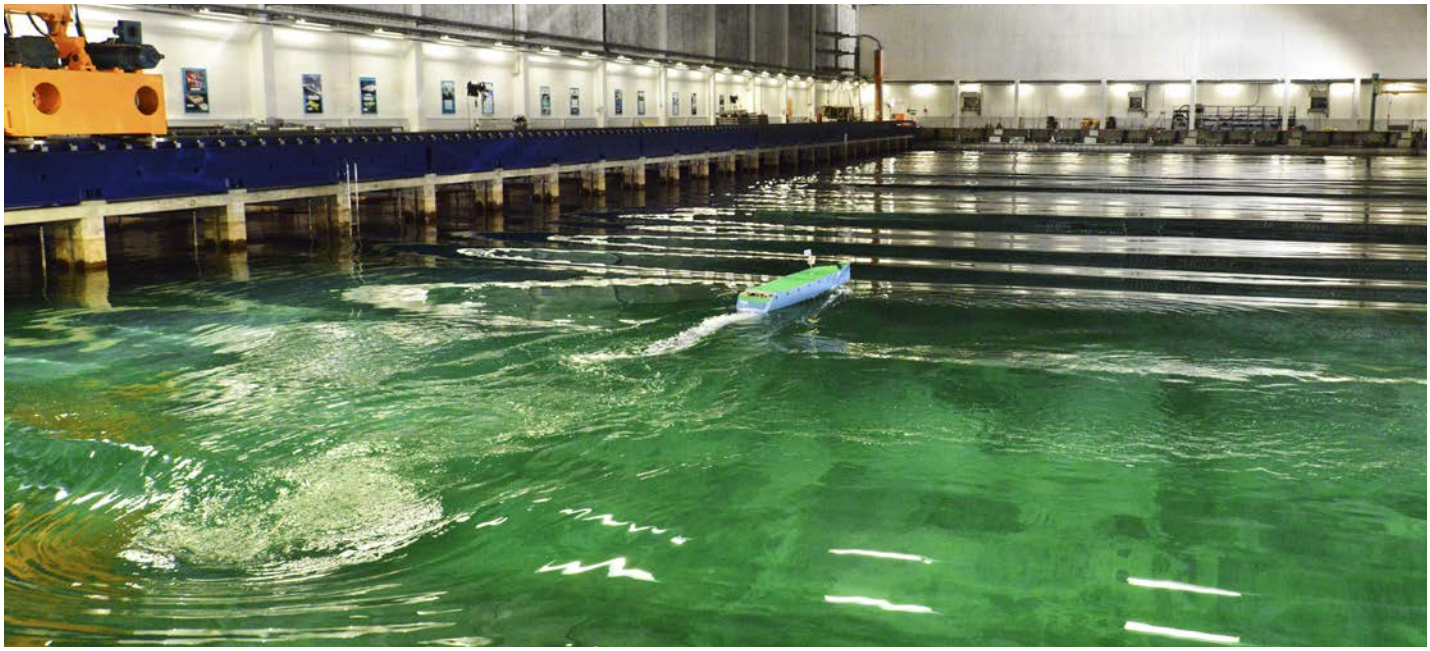

Photo of the 24 m motor yacht tested in SSPA's large seakeeping and manoeuvring basin MDL (Maritime Dynamics Laboratory). Photo: Anders Mikaelsson.

that outdoor tests will seldom be conducted under representative sea states. The natural waves don't scale correctly.

The model is video-recorded by two land-based cameras that automatically follow the model and one small video camera on board at the steering position. The recorded sequences can then be time-scaled to full-scale, creating a very realistic impression. The photos are from a recently completed project in cooperation with Mani Frers (Frers Naval Architecture & Engineering): a light and slender 24 m motor yacht designed for 25 kn with two driving units.

The procedure is still under development and improved track system, speed control, measurement system including measurement of heel- and pitch angle, and acceleration are on their way.

All kinds of propulsive system can be modeled, for example; propellers on straight shafts, thrusters of pulling type such as IPS, water jet, outboard drives etc.

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MARITIME DYNAMICS LABORATORY

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