

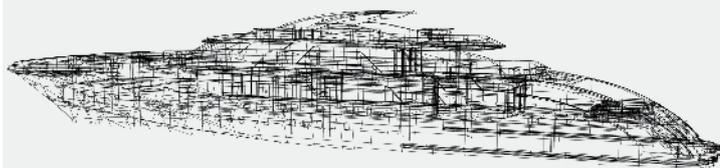
## VAN OOSSANEN'S FAST DISPLACEMENT HULL

# The revolution that fuels Heesen Yachts

In partnership with Van Oossanen Naval Architects, Heesen has created the fast displacement hull form. But how has this drastically new design been developed and how does it outperform conventional hulls? *SB* investigates

BY ROBERT WIELAARD

A wire-frame model allowing visualisation of the underlying design structure



There are patents on five specific features of the FDHF



**IN A VAST** Heesen Yachts construction hall, a fully-custom 70m (229ft) motoryacht project is taking shape. Due for launch in the spring of 2016, it will be Heesen's largest to date. It's not just its six staterooms, four guest cabins, infinity pool or helipad that raise eyebrows. What's so special about the yacht is its 'fast displacement hull form' (FDHF) — a patented shape that is 30% more efficient at cruising speeds and 15% more at top speed compared to a hard chine yacht. Heesen will introduce the yacht with a press conference at the Monaco Yacht Club, on the opening day of the 2014 Monaco Yacht Show. For now, camera-toting visitors are kept outside. By all accounts, the FDHF technology is a winner.

The yacht building industry is no stranger to hyperbole. But when Heesen Yachts speaks of a 'revolutionary' hull, that designation finds no dissenters

in the industry. While Dickon Buckland, senior engineer at the Wolfson Unit for Marine Technology and Industrial Aerodynamics at the University of Southampton, says: "We have tested hundreds of motoryachts over the years at our unit. We are an independent organisation without a vested interest in any company. We found this hull to be significantly different in terms of efficiency and hull speed."

### New kind of hull

By 'significantly different' he means significantly better. In fact, the FDHF is ranked as the most efficient in the Wolfson Unit database which dates back to 1967. The brainchild of Van Oossanen Naval Architects of the Netherlands, which is also naval architect for Heesen Yachts, it represents a drastic design departure. One that renders lower fuel consumption and a quieter,

more comfortable yacht at all speeds. Importantly, it gets rid of the traditional 'resistance hump,' so evident in hard chine yachts when they shift from displacement to semi-displacement speed.

"You will see more of our yachts with the FDHF," predicts Sjoerd van Herk, Heesen Yachts' manager of naval architecture. "That's because we know it works. In fact, it worked better than anticipated on *Galactica Star*." That 65m (213ft) FDHF yacht won a Neptune Trophy for 'best semi-displacement or planing three-deck motoryacht, over 45m (147ft)' at the 2014 World Superyachts Awards in Amsterdam.

Heesen has made the new technology a feature across all of its yachts. It confirms the yard's pursuit and love of fast hulls. Still, it says, clients are free to choose. They can opt for all, some or none of the FDHF technology's upsides.

Yacht speeds are sensitive and specified in contracts. If a yacht does not reach a 'contracted' top or cruising speed, for instance, its builder can be fined. The penalty is often spelled out for each tenth of a knot the yacht misses its promised speed. Conventional hulls deliver cruising or top speeds within narrow bands of speed ranges. What is striking about the FDHF hull is that it delivers fuel efficiency over a yacht's entire speed range, not just in a restricted speed interval around the top speed.

Heesen and Van Oossanen say the FDHF out-performs conventional displacement and semi-displacement type hull forms, at all speeds up to full 'planing'. At semi-displacement speeds, the FDHF's resistance values are up to 20% better than those of well-designed hard chine hulls. Additionally, the FDHF technology, especially when compared to

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hard chine yachts, delivers improved sea keeping and maneuverability.

### Across the range

The technology makes for a low resistance, high performance hull. That leads, in turn, to less installed engine power which cuts building costs. And, importantly for semi-custom FDHF series, there is no need to develop different hull forms for different speed ranges. The FDHF technology serves displacement and semi-displacement speed ranges well. In other words: a one-design hull, a single platform

Yachts in the Netherlands.” That accounts for the majority of the dozen or so Van Oossanen designs currently being built.

It takes a fairly trained eye to spot a FDHF boat, says Van Oossanen. That bulbous bow is easy to see. Beyond that, the FDHF is evident in a slender forebody and remarkable shallow transom area. Van Oossanen has not patented the FDHF design as such. “Let’s face it, every superyacht is unique in its design,” he says. “But we have patents on five specific features of a FDHF. And it is on the combination of those five features — a shallow transom,

more efficient on a lower speed than for larger yachts,” says van der Zanden.

An ‘efficient hull’ is one that moves through the water with the least resistance across a range of speeds. During sea trials, *Galactica Star* averaged 28.8kt, which was two knots above her contractual top speed. The yacht managed a range of 4,200nm at 14kt.

### Designed for speed

Yacht designing inevitably yields a riot of speed and other calculations that are meaningless to the uninitiated. In marketing it’s FDHF, Heesen

aluminium at 15kt with only half of the power installed (1300kW) is quite remarkable.”

In addition to the FDHF technology, Heesen also offers clients the option of a ‘hull vane’, another Van Oossanen efficiency feature. It is an underwater spoiler, mounted aft of the transom and spanning the width of a vessel’s stern. “The hull vane,” says Van Oossanen, “is an invention that predates the FDHF by a decade. But it is only now finding its way to the market.” The vane changes the pressure distribution causing a 20% reduction in pitch and

Heesen’s 65m FDHF has a slender forebody and bulbous bow



Galactica Star’s hull doing what it was built for



and a single engineering package. The advantages for the owner include lower running costs, more hull space because of less need for bunker capacity and less noise and vibrations because of reduced installed propulsion power.

In only a few years, the FDHF technology has become a successful business format and marketing boon for both parties. Van Oossanen signed a contract with Heesen Yachts in 2009 for the design of the yard’s new flagship, the then-future *Galactica Star*. It was to be the first yacht featuring the FDHF concept. It now appears on yachts ranging from 20m (66ft) to 75m (256ft) in length.

“Heesen has half a dozen FDHF superyachts under construction right now,” says Perry van Oossanen, director of the company that bears his name. “Two more are being built in Turkey and three at Storm

a round bilge hull, a sprayrail, an interceptor and a bulbous bow — that have a patent.”

Peter van der Zanden, Heesen’s general manager for design and development, says the FDHF offers great benefits for both owner and builder. “Until a few years ago you had a choice between a comfortable ride in a displacement yacht doing 16kt,” he says. “Or, alternatively, you could go for fast and get a hard chine yacht with a light aluminium hull. The FDHF technology generated a hybrid, if you will. It combines the efficiency of a full-displacement hull at low speed with the top speed performance of a semi-displacement yacht.”

As speed and fuel consumption benefits hinge on the Froude number — which relates a ship’s speed to its length, “It means that for smaller yachts, the semi-displacement hull becomes

offers easy-to-grasp speed comparisons. *Galactica Star*, with a top speed of 28.8kt, is compared to running star Usain Bolt (24.1kt) and a dolphin (21kt), coming out faster than both.

### Efficiency benchmark

Heesen makes its FDHF yachts in steel and aluminium, ranging from 50m (164ft) to 65m (213ft). In recent years it has already built three. In addition to the 70m (229ft) aluminium FDHF yacht, the yard is working on a 55m (180ft) FDHF motoryacht with a steel hull. Developed jointly by Van Oossanen and Heesen Yachts’ in-house naval architects, it will have a remarkable top speed of 16.5kt, with a range of 4500nm at a cruising speed of 13kt.

Van Oossanen comments: “We believe the 55m (180ft) will set a benchmark in terms of efficiency. Propelling around 600 tonnes of steel and

heave motions. Van Oossanen markets its technology for commercial shipping and the yachting sector.

At Southampton, Buckland’s Wolfson Unit has been testing hulls since 1967. By now it has a ‘hull efficiency index’ based on the test results of many boats. “It lets us compare ships at different speeds based on their installed power,” says Buckland. That index gives the most efficient hulls ever tested a rating. Zero per cent signifies the least and 100% the most efficient hull. Compared to conventional round bilge hulls doing between 15kt (cruising speed) and up to 44kt (near-planing speeds), the FDHF hull rates between 100% and 140%.

That makes it the most efficient in the Wolfson Unit’s database. When compared to hard chine forms, the FDHF hull rated as high as 200% on the Wolfson unit hull efficiency index. **SB**