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Vessels highlighted
Atlantic Dawn BVB44M

The vision of
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Special
Marine Electronics

Photo by Flying Focus, Bussum, the Netherlands

Van Oossanen's Hull Vane

Nose jobs are out, butt lifts are the latest fashion

Van Oossanen's invention of the Hull Vane could be considered as one of the most interesting innovations in underwater appendages for reducing a ship's resistance since the invention of the bulbous bow in the late 19th century. The Hull Vane consists of a (hydro)foil positioned below the aft hull bottom of a vessel, way below the water surface. With the bulb forming an integrated part of the forward hull of a vessel, the Hull Vane is an add-on below the stern of the vessel by means of struts. Both however have similar purposes: reducing the vessel's resistance.

The wing shaped Hull Vane is very similar to those used on hydrofoil vessels, which develop a lift force to raise the hull of the vessel above the water surface at high speed. In this instance however, the Hull Vane is positioned in such a way that besides developing lift, it also develops thrust, thereby recovering energy expended moving the water aside and under the hull. In addition, the foil actually manipulates the way the water flows around the aft hull and transom, reducing the height of the transverse wave system thus increasing speed, range and fuel efficiency. Although it is typically touted for reducing drag and creating thrust, it also reduces pitch and heave motions in head seas.

Van Oossanen Naval Architects

Dr. Ir. Pieter van Oossanen worked over 20 years for MARIN (Maritime Research Institute Netherlands) before founding his own maritime design office. Starting out as Van Oossanen & Associates BV in 1992, the name was recently changed into Van Oossanen Naval Architects BV. The Van Oossanen team presently consists of about eleven experts, all naval architects and hydrodynamicists, specialists in the design of sail and motor yachts, commercial ships and advanced marine vehicles.

Pieter's son, Perry, joined the company in 2002, and Niels Moerke joined the team in 2006. Niels is a specialist in the design of small craft and in the application of computational fluid dynamics (CFD), Perry has made hydrodynamics and performance optimisation in the design of (larger) motor and sailing yachts in particular his chosen field. Between the two they recently assumed running of the company, allowing Pieter to spend more time in what he likes to do: "Hydrodynamics and research into new developments."

Spreading their wings - A little bit of history

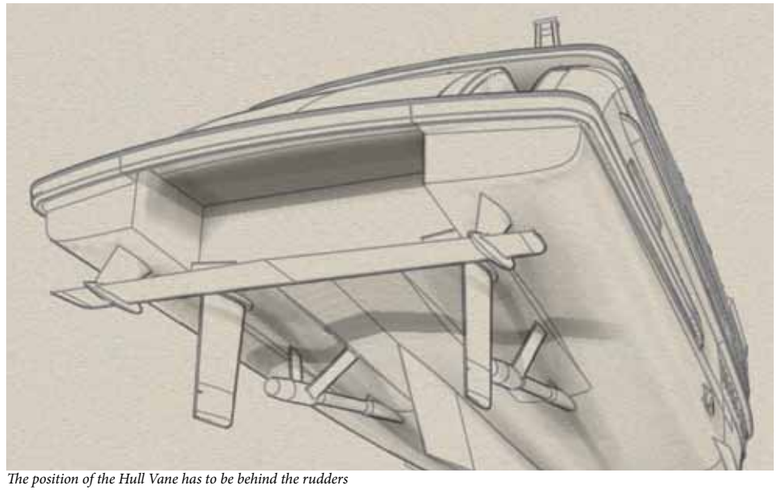
Pieter van Oossanen has, over the years, invested considerable time in the development of the Hull Vane. His first encounter with wings and (hydro)foils was at MARIN, where he (co)designed the wing keel for the *Australia II*, the sailing yacht that won the America's Cup in 1983. In 1992, after starting his own design office, he was awarded a project to develop

another wing, this time for a 60 foot sailing yacht. Out of curiosity, Pieter conceived the idea for designing a rudder with 'wings'. Like its earlier brothers it performed better than anticipated, providing both lift and thrust. It was from this design that the concept for the Hull Vane arose.

The Wagenborg saga

In 2002 Van Oossanen began to investigate the application of the Hull Vane for commercial vessels. Two years later he got together with Wagenborg and IHC and together they started a feasibility study. With the purchase of the latest CFD software and the arrival of Niels more sophisticated and deeper research could be undertaken. Further collaboration with Wagenborg in 2006 provided an opportunity to commercially develop the Hull Vane. "For the *Rijnborg*, a container feeder of 176 times 23.70 metres from the Wagenborg fleet, we achieved a theoretical 15.5% reduction in fuel consumption", Pieter proclaims. "This meant that the investment of the Hull Vane for this specific vessel could be recovered within 18 months." The Hull Vane was due to be built at Royal Niestern Sander and fitted to the feeder. Unfortunately Wagenborg abandoned the project at the last moment, because the conditions had changed, since the vessel had entered into a charter contract, with the chartering company obtaining all the benefit of the lower fuel consumption, presenting no commercial benefit to Wagenborg.

However, Wagenborg did want to fit the Hull Vane under the A-Borg vessels that were under construction in China at that time. "For these ships the theoretical savings would come to 7.5% average," Pieter continues, "and according to us, that would not be enough for a first practical test. Whilst fuel consumption is also influenced by sailing conditions and cargo loads, at such small percentages it would be difficult to actually demonstrate the savings. As this would clearly affect the introduction of the Hull Vane in a negative way, waiting for another opportunity and a vessel with an optimally shaped stern seemed a better option."



The position of the Hull Vane has to be behind the rudders

Bob Derks, who was at the time director projects and newbuilding at Royal Wagenborg, is still very passionate when talking about the ground-breaking project: "This concept is so simple and effective, it could have led to considerable savings in the operational costs of the Wagenborg fleet. Saving on fuel, which is a considerable part of the budget, and also reducing exhaust emissions are popular issues for today's fleet owners. Once the Hull Vane is fitted to a 'suitable' hull form, it hardly needs any maintenance or 'looking after'. If in practice the performance would be only half of what is theoretically predicted, it would still be a dream come true. I am eagerly looking forward to hearing the results of the first sea trails of the Heesen yacht."

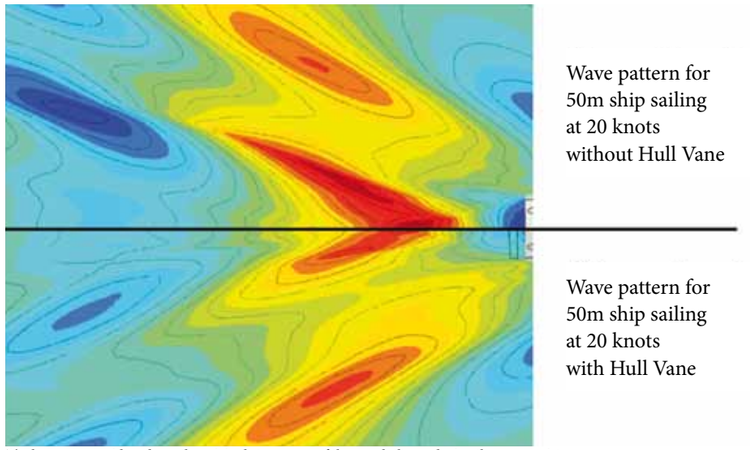
Each hull requires its own specific shape, size, aspect ratio and position for the Hull Vane

The Heesen saga

The breakthrough for the Hull Vane started with the remark from Pieter's son Perry: "Why not prototype the Hull Vane on a motor yacht?" From that moment on, around 2010, Van Oossanen focussed on the development of the Hull Vane for large motor yachts. The first motor yacht for which they conducted CFD calculations showed enormous potential, leading to a collaboration with Heesen Yachts.

"For Heesen Yachts the Hull Vane is very interesting, especially at a time when fuel saving and sustainability are hot social topics", says Heesen's general manager design & development, Peter van der Zanden. He continues: "With the use of the Hull Vane additional propulsion effect is obtained without the need for more energy, besides the energy required for manufacturing the appendage. Once built, the Hull Vane delivers savings with every mile you sail. Heesen has included the Hull Vane in the design of their newly developed 42 and 55 metres series, both of which are steel ships. Particularly at cruising speeds there is a large benefit, because the resistance of the Hull Vane itself is significantly smaller than the gain in the thrusting component."

Van der Zanden adds: "The collaboration of Heesen Yachts with Van Oossanen Naval Architects is good. This is a continuation of the past, when Van Oossanen supplemented Heesen's in-house design & development team. This successful collaboration over the years has extended to the joint development of new concepts. The Hull Vane and the fast displacement hull form are good examples of this association. Van Oossanen's theoretical knowledge and experience, when coupled with feedback data from the shipyard, provide a synergy that is reflected in the quality of the final product." Using the Hull Vane, when compared to cargo vessels, more fuel efficiency can be achieved on higher-speed vessels like motor yachts. Some have seen better than 20% improvement. For Heesen's 42 metres series, the shipyard believe average drag can be reduced with about 18% throughout the entire speed range.



The low pressure side reduces the original stern wave of the vessel, thus reducing the wave resistance

Theoretical justification

As stated above, the Hull Vane consists of a foil positioned below the hull at a specific location, fitted by means of struts or sponsons. The position of the Hull Vane has to be behind the rudder(s), where the water flow is inclined upwards due to the curvature of the buttocks. Although the principle of the design is standardised by Van Oossanen, each hull requires its own specific shape, size, aspect ratio and position. Each individual project is calculated on the basis of a range of ship parameters, like length, width, draught, block coefficient and entrance angles of water flow.

The Hull Vane is positioned horizontal in a water flow that is moving in an upward direction under the hull towards the transom, thus mitigating the drag forces on the Hull Vane, due to development of the thrust component. The forward thrust generated is significant enough to compensate for its own drag value. Furthermore, the low pressure side of the Hull Vane reduces the original stern wave of the vessel, thus reducing the wave resistance. This is the same effect that a bulb has at the bow: by changing the pressure distribution on the hull the overall resistance is reduced.

The performance of the Hull Vane however, increases with the speed of the vessel and with increased wave heights at the stern of the vessel. Without going too deep into the theory, favourable Froude Number (the ratio of a characteristic velocity to a gravitational wave velocity) values are between 0.15 and 0.6. The passive stabilising effect in head seas is due to the inhibitory influence of the Hull Vane to the vertical motion: thus reducing heave and pitch. Additional pleasing characteristics of the Hull Vane are that it has no moving (no wearing or malfunctioning) parts, it does not affect the hull stiffness or strength and it does not protrude outside the hull shape (not to the sides and there is no draught increase).

Nominations

The Hull Vane was nominated for two awards in 2013: the HME Maritime Innovation Award and the Showboat Innovation Award (category 'Design and Technology'), which confirms the increasing interest and recognises the new technology. In today's economy, efficiency in energy and fuel consumption in combination with green and sustainable designs are hot topics for ship owners. The Van Oossanen 'spoiler' not only creates a reduction in fuel costs, but also provides better ship handling in waves. The Hull Vane is not only suitable for (mega)yachts, but can also be applied to dry cargo vessels, tankers or container ships. The use is not restricted to new build projects only, but it is suitable for fitting on existing ships during a retrofit/conversion as well.

Tom Oomkens

For Wagenborg's Rijnborg a theoretical 15.5% reduction in fuel consumption was achieved

Photo by Henk Zuur, Delfzijl, the Netherlands