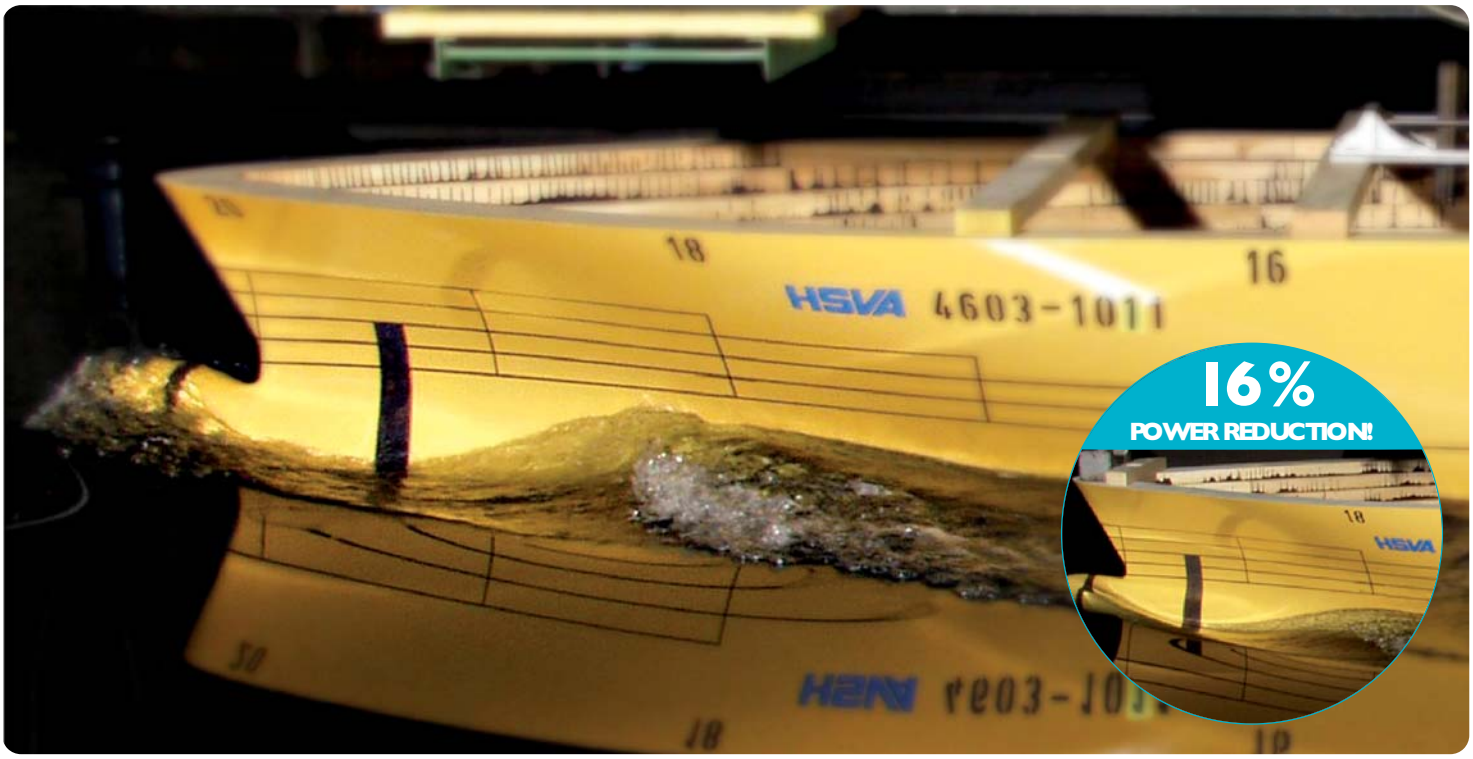
HSVA Newswave 2009/2

THE HAMBURG SHIP MODEL BASIN NEWSLETTER



IN THIS ISSUE:

Dear Reader,

welcome to the second Newswave 2009. Looking back, 2009 again was still a busy but also a very uncertain year. The financial crisis, the economical problems and finally the over capacities in ships and in ship yards are still challenges ahead. The remaining industry must build the most efficient ships, and if possible at low cost. Of course this is nothing really new but conditions have changed. New regulations force the ship yards and the owners to focus their interest in research and development projects for building high-efficiency ships with lower emissions despite the recent economic downturn. There are basically two ways of going about this, either through long-term investment and research, resulting in new types of ships, highly efficient and with low emissions, or a more short term solution which means modifying existing ships for example, by applying renewable energy concepts, using energy saving devices or by operating the ships more efficiently.

It is our strategy to meet these needs by developing measuring equipment, CFD tools and services that help ship owners to convert fuels into power more efficiently and with the lowest possible environmental impact. It is obvious that ship owners and operators need to improve their operations significantly. We assist them in minimizing the running costs and reducing the fuel consumption of each individual vessel in their fleet. For example recommendations are given for optimizing hull forms for real-life operation profiles. Optimizing the hydrodynamic performance of a ship offers a large potential for fuel savings and consequently reduced emissions. And today this needs no longer to be done only experimentally, Computational Fluid Dynamics tools offer a broad range of opportunities to assess the hydrodynamic performance of a ship in an early design stage. Being one of the forerunners of CFD development for maritime applications, HSVA today uses a variety of mainly in-house developed flow codes to analyze fluid flow behavior and ship responses.

Still, much effort and work are necessary to come to solutions. The combined effort of all involved parties -shipyards, ship owners and operators, suppliers, classification societies and model basins – will lead to solutions which are both, efficient and environmentally friendly. Our technical competence, the high quality of our work and our flexible service makes us the ideal partner for all your questions related to ship and offshore hydrodynamics.

I hope you enjoy reading this issue of Newswave!

Juergen Friesch
Managing Director

Optimising Container Ship Hull Forms for Real-Life Operation Profiles

by John Richards & Hans-Uwe Schnoor

In early 2009 HSVA was requested by A.P. Møller Maersk (APMM) to provide design assistance for their series of 16 container vessels with 7,450 TEU capacity under contract to Daewoo Shipbuilding and Marine Engineering Co. Ltd. in Korea. The existing hull form had already been thoroughly optimised by the shipyard for design draught and speed. The goal of the further investigation was to implement APMM's targeted operation profiles at lower draughts and speeds into the bulbous bow design while at the same time continuing to fulfil the performance requirement for the contract condition. Through close cooperation between the partners it was possible to achieve the goals set, which will result in considerable savings in operation costs for theses vessels under the actual expected service conditions.

The contract which is signed between the ship owner and the shipyard for a container ship newbuilding usually specifies only a single operating point which is the required speed at 85 % or 90 % MCR power at design draught. If nothing else is said then it is this design point that is concentrated on by the shipyard's specialists when preparing and optimising their hull form design. However, a seemingly optimal vessel designed under this criteria alone may operate uneconomically with respect to overall fuel consumption if in reality the vessel is operating at lower speeds and/or deviating draughts, so called "off design" conditions. This is usually the case for container and multi-purpose vessels today.

Now the most logical way to minimise the fuel eating penalty for off design operating conditions is to declare these conditions as further design points. The hull form designer can then produce a best compromise solution for all expected conditions.

Ever in search of potential fuel savings, and more recently with an eye on environmental and sustainability issues, Maersk Maritime Technology has intensified its analysis of operations data for its fleet of container vessels. This only seems reasonable when considering the size of the fleet and the prevailing fuel costs. Their Vessel Performance System provides Maersk with a complete history of routing, loading conditions and performance data for each vessel in operation. Based on this data the actual "real-life" operating conditions of the vessels with respect to speeds and loading conditions are found.

Using this knowledge, Maersk Maritime Technology is able to define realistic operation profiles for newbuildings which can be taken into account in the hull form design phase. For the 7,450 TEU container vessel series considered here, four cornerstones of the design refinement work were defined to be:

A) Full design speed at design draught (contract point)

B) Full design speed at about 70 % of design draught

C) About 80 % of design speed at design draught

D) About 80 % of design speed at about 70 % of design draught

For a given hull form and a single design condition of draught and speed it is not too difficult for the designer to make directed suggestions for improving the resistance, depending of course on the starting point. On the other hand it is quite a challenge to do the same for 4 different conditions simultaneously because the individual modifications can conflict with each other.

The shipyard was prepared to accept modifications forward of station 16 (20 % of the ship's length), and so with the above parameters and restriction the design of the alternative fore body forms began.

Due to both cost and time restraints it was decided to model test only the two most promising new bulbous bow variants. To support the decision which variants were to be tested it was necessary to provide APMM with quantified performance predictions in order to allow them to weigh the relative performance of the different bulbous bow designs within their overall performance evaluation system.

When doing hull form design work HSVA typically employs its own potential flow code v-SHALLO as a primary tool to support the designers' efforts. This is a good tool for calculating the wave pattern as well as the pressure distributions on the hull, and is also useful for qualitative comparison of competing designs. However, although the code does provide calculated results for the wave making and total resistance, these data are usually not reliable enough to be used directly. That is why in general the design work is CFD supported, but the performance confirmation comes from scale model tests. Nonetheless as mentioned above, for this project the numerical predictions were required.

In Figs. 1 and 2 below the CFD calculated pressure distributions and wave patterns for the initial hull form are compared at design draft and design speed as well as for the reduced draught and speed conditions. These plots demonstrate how the excellent wave pattern at design speed and draught deteriorates and becomes much less smooth when going to lower speed and lower draught. This general effect is in line with experience from observations in the towing tank. The challenge here is to use the CFD results for actually predicting the performance for these relatively extreme conditions.

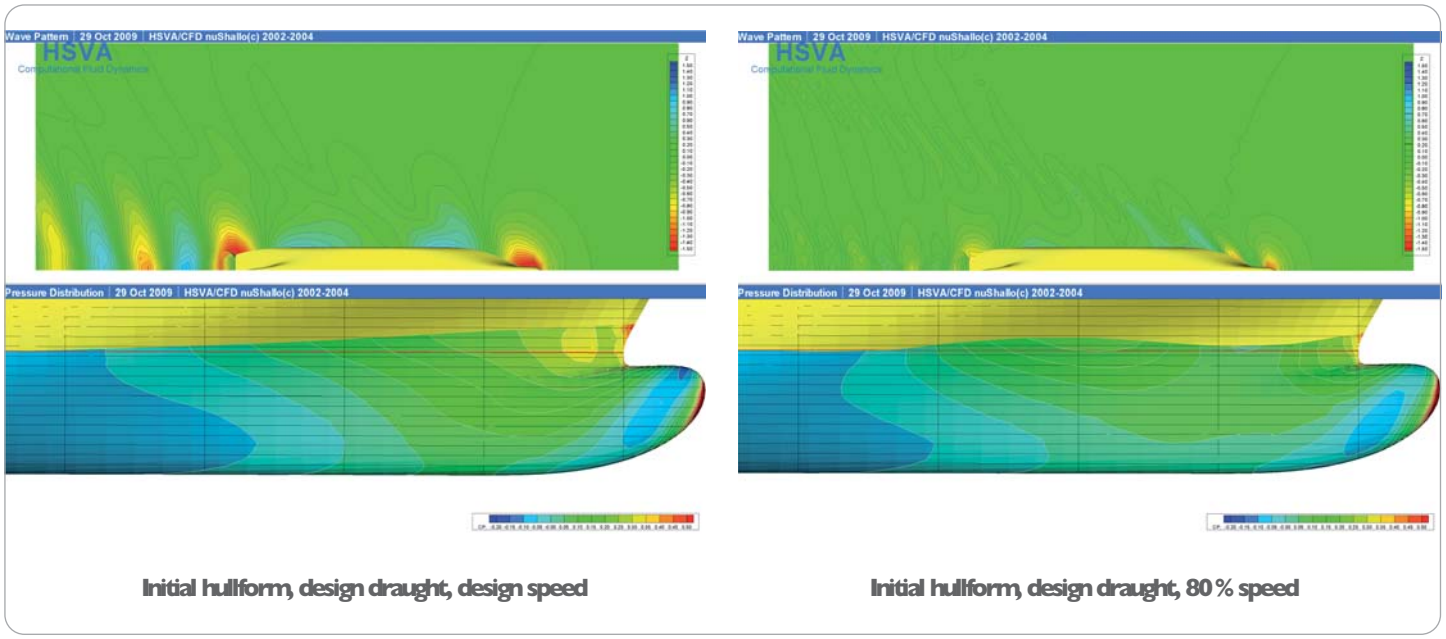


Fig. 1: CFD results for the initial hull form at design draught

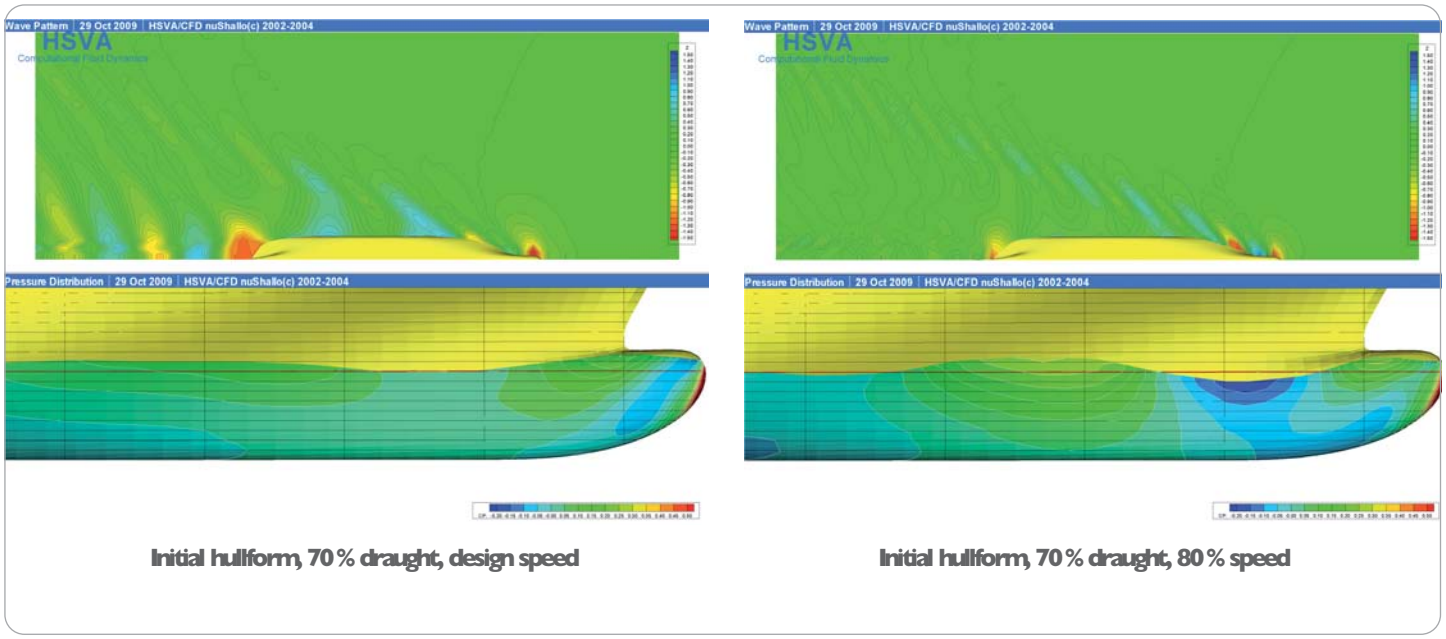
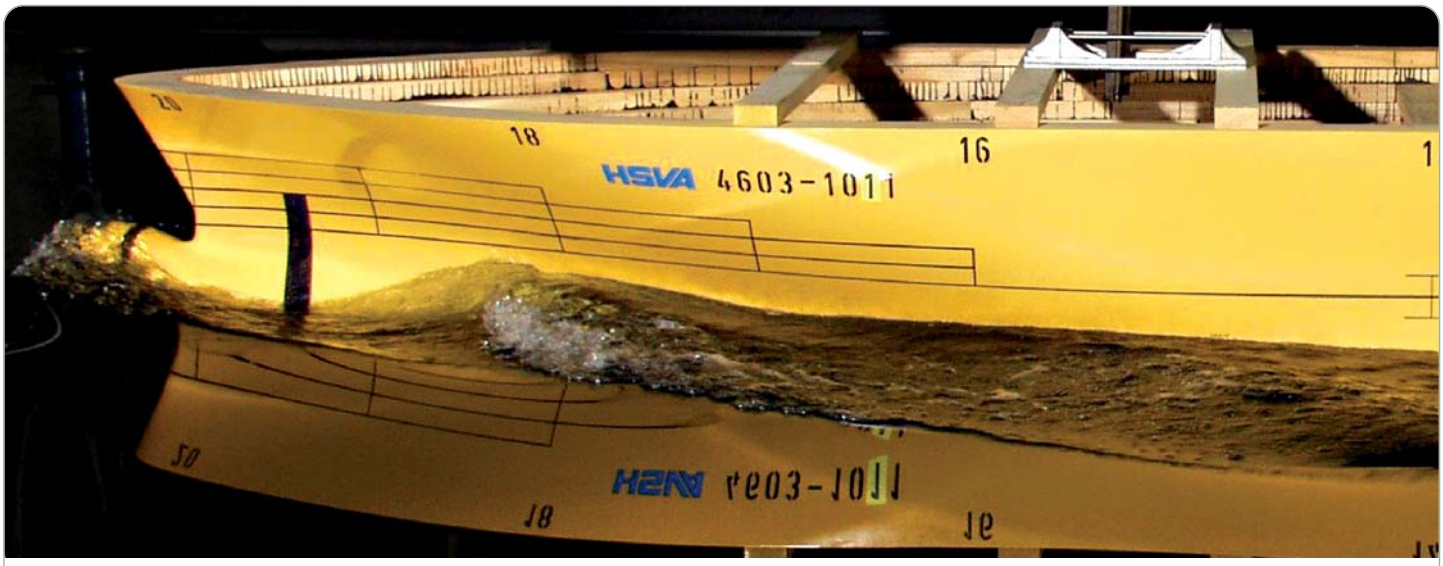


Fig. 2: CFD results for the initial hull form at reduced draught



Initial hullform

Best alternative bulbous bow

Fig. 3: Wave pattern at reduced draught and reduced speed

In the above photographs of the wave patterns taken during the model tests the differences between the initial hull form and the best alternative bulbous bow variant can be seen for the Reduced draught / Reduced speed case.

Here it can be seen that the breaking wave at the tip of the bulbous bow has been completely eliminated and the breaking wave at the forward shoulder has been greatly reduced.

The reduction in required power between these two conditions is about 16%!

We have to note that the breaking wave effects and spray development cannot be predicted using the potential flow method. This leaves some room for interpretation of the results for the designer, especially for the "off design" conditions where less experience is available.

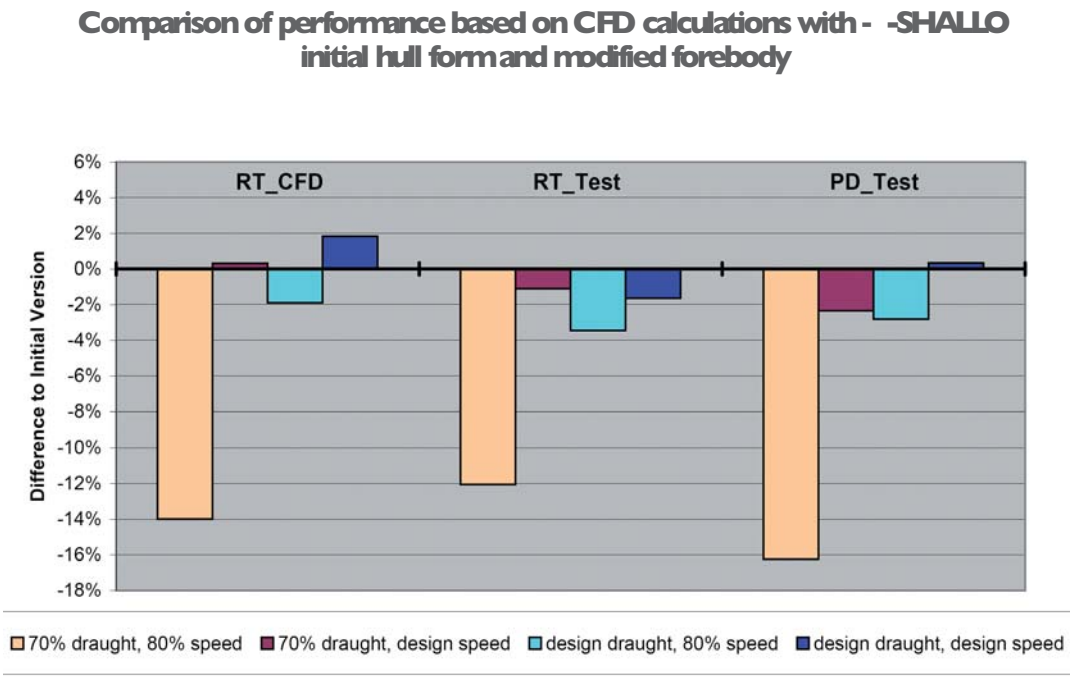


Fig. 4: Comparison of performance predictions based on CFD and Model tests

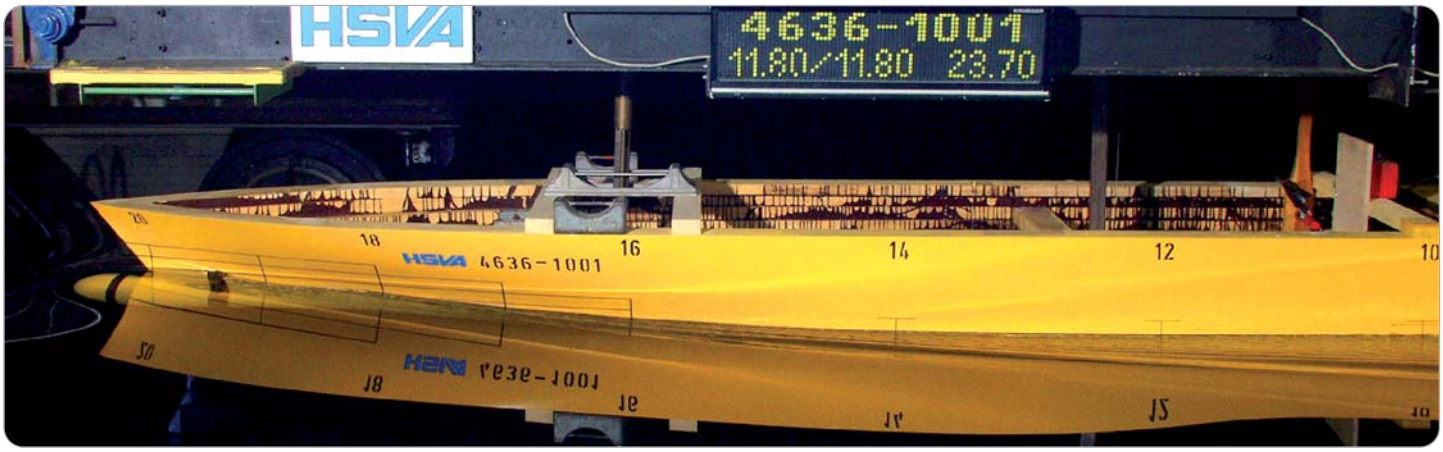
Being able to use a comparison of the wave photographs with the results of the CFD calculations for the existing hull form as a starting point is a great help in calibrating the methodology for the actual case at hand.

In Fig. 4 we show a comparison of the CFD based resistance predictions with those based on the model tests. Additionally the delivered power as determined from the model test is shown because, at the end of the day, it is really only the required power and not the resistance that is of interest to the ship operator.

In the graph the relative power requirements for the initial hull form and the best bulbous bow variant are compared using the initial hull form as a base line with 0 %. These examples show an unexpectedly accurate correlation between the CFD predicted differences and those based on model tests, even though the calculations were performed before the model tests. With the exception of the "70 % draught, 80 % speed condition" the actual performance was better than predicted.

As can be seen in the graph, the change in delivered power PD does not correspond very exactly to the change in measured resistance. This is an effect that we often see, and even if only local changes are made to the forebody and bulbous bow the resistance alone does not tell the whole story. It is our experience that the experimental confirmation of an optimisation should be done via a self propulsion test. We should note that these excellent quantitative CFD based predictions are more an exception than the rule. In a similar, more recent, investigation for a further APMM container ship newbuilding project, the quantitative CFD results were not so reliable as for the 7,450 TEU project, and were also a little bit less consistent from case to case. It still remains an important task for the hull form designer using CFD tools to consider the results very carefully so as not to be led astray. His or her experience and intuition are necessary to balance out the limitations inherent to CFD. Finally only the model test results can provide a sound conclusion to the optimisations.

The Successful Validation of CSBC's ES-10 Project

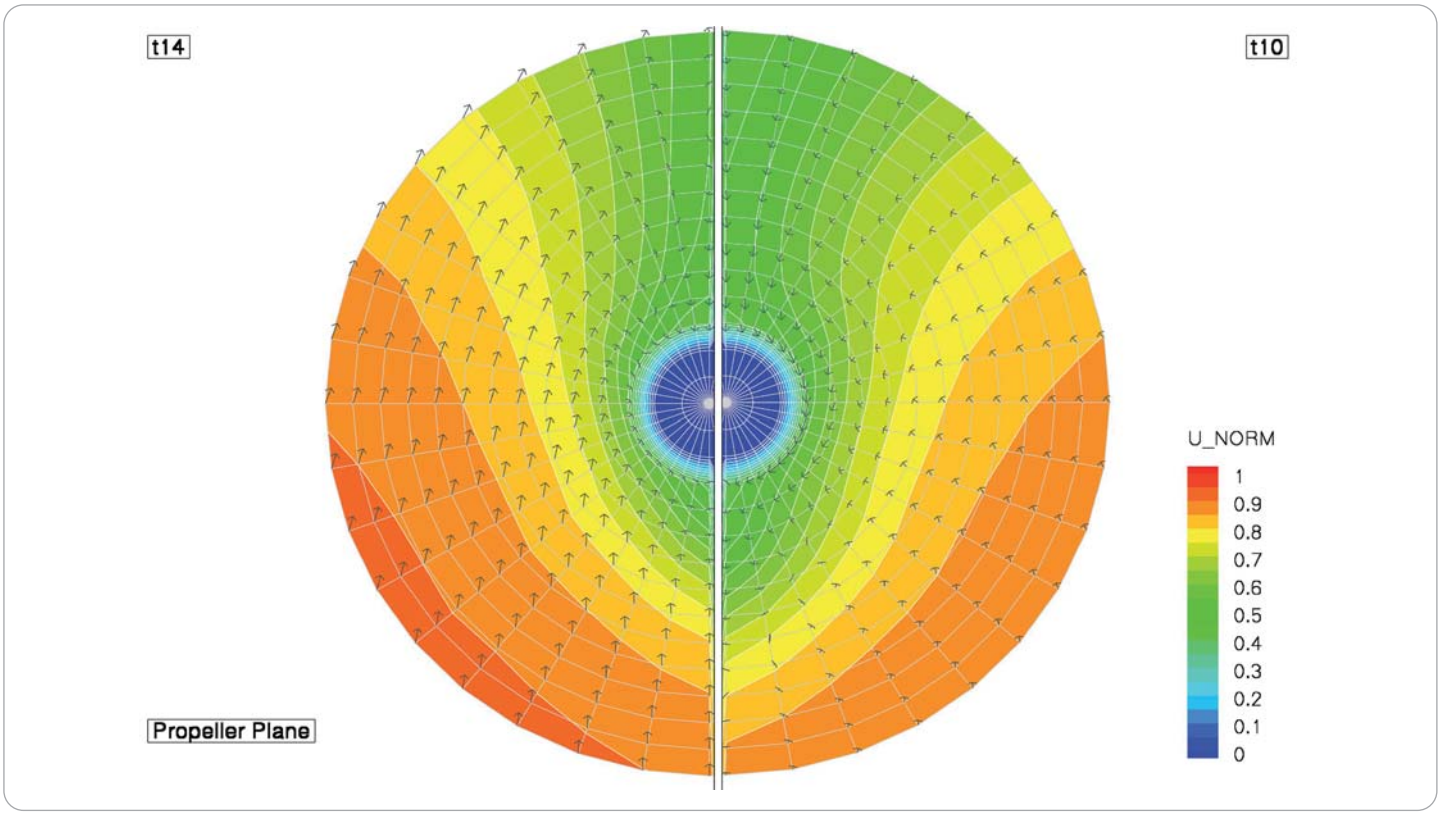


CV 4500: Calm water test

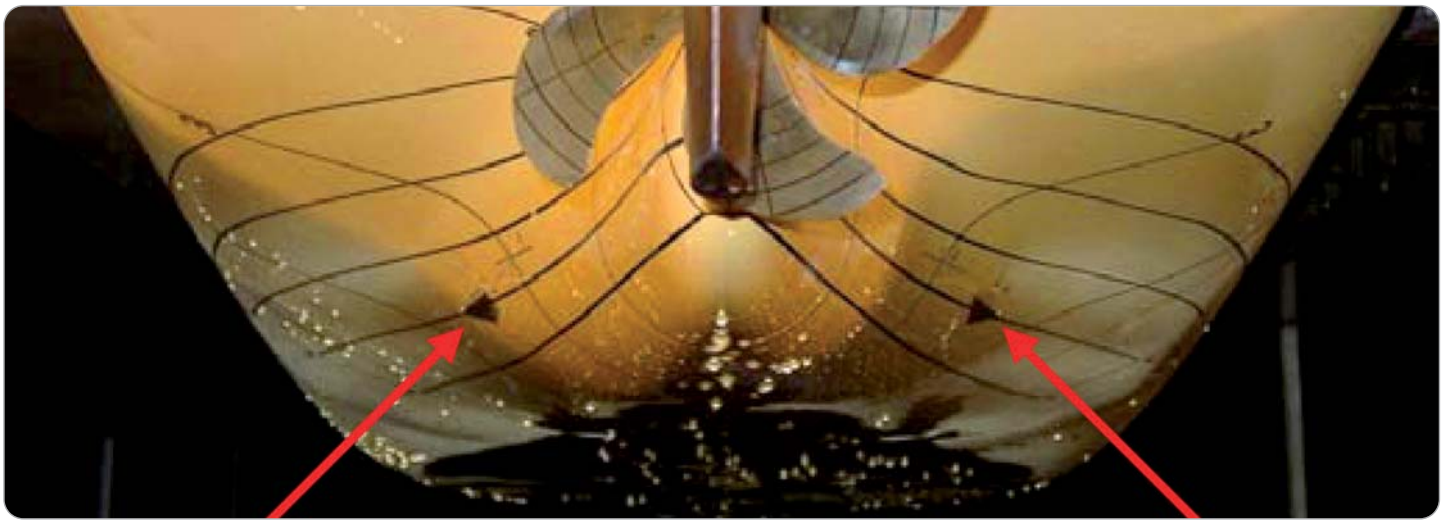
by Hilmar Klug

The Taiwanese shipyard CSBC performed the integrated research project ES-10 in close co-operation with HSVA. Aim of this research project was reducing the power consumption of container ships by 10%, thus reducing emission of the global warming gases and enhancing the transport efficiency of CSBC's new building projects.

A 1700 TEU containership was subject to an intensive optimization of the hull form within this research project. A parametric optimization of the fore body was performed using the Friendship-Framework. Five different aft body designs have been developed by CSBC and HSVA and tested in the large towing tank. Potential flow computations have been performed by the partners as well as viscous flow computations.



CV 12600: Computed wake at two draughts



CV 1700:VGF-Investigation in HYKAT

Further investigations were done on the rudder design (two rudder designs, one featuring a twisted leading edge), on the rudder head box, pre-swirl vortex generator fins (three designs tested), the propeller design (two design propellers, one featuring tip fins) and propeller boss cap fins.

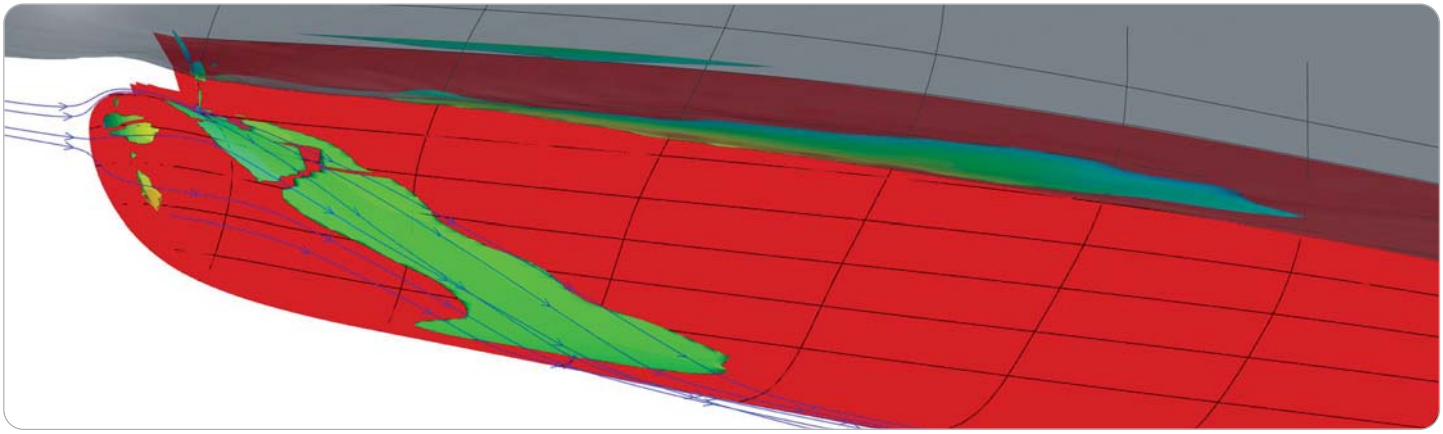
Some of the investigated measures showed only little influence on the performance of the ships. Others have been proven to be a major step towards low fuel consumption and less emission of greenhouse gases.

In total a reduction of the power consumption by about 9% was achieved with a major contribution from the optimized aft body design. A significant reduction of the pressure fluctuations above the propeller has been achieved by the optimization of vortex generator fins (viscous flow computations, cavitation tests in HYKAT, self-propulsions and resistance tests).

Trim optimization tests at different speeds and different drafts were performed for this container feeder ship, too.

Besides the ES-10 project HSVA was contracted to optimize the hull lines design for further containerships and to perform related computations and model tests.
A 12,600 TEU container ship was subject to an intensive optimization of the hull form. Potential flow computations and viscous flow computations have been performed as well as a parametric optimization of the fore body using the Friendship-Framework. Calm water tests completed the first step of the optimization.

A 4,500 TEU container ship with two different combinations of main dimensions (L,



CV 12600:Viscous free surface flow computation

More Information – No Extra Charge

Cavitation Test Reports now Include Pressure Pulse Levels also for the Non-Cavitating Propeller – Without Extra Charge

by Christian Johannsen

The intensity of hull pressure pulses generated by a propeller acting underneath the stern of a ship is an essential information for the naval architect, because these pressure pulses can represent a significant excitation source for hull vibrations. It is for this reason usual, to perform a measurement of the hull pressure pulses at model scale simultaneous to the cavitation observation. For twenty years now this has been a standard measurement in HSVA's large Hydrodynamics and Cavitation Tunnel HYKAT for our clients. Here the whole ship model is installed together with propeller(s) and all appendages so that the propeller is operating in the realistic three-dimensional inflow while the pressure pulses can be measured in the three-dimensionally curved hull shape (Fig. 1). Most of the readers certainly know the diagrams given in HSVA's cavitation test reports to display the information on hull pressure pulses generated by the cavitating propeller. The most meaningful one is shown exemplarily in Fig. 2. Here the first five harmonic components of the Fourier Transformation of the hull pressure time function are shown for all locations P1 to P13 at the hull, where pressure pick-ups had been placed. Delivery of such a diagram is standard at model basins all over the world – indeed with differing reliability regarding the predicted values.

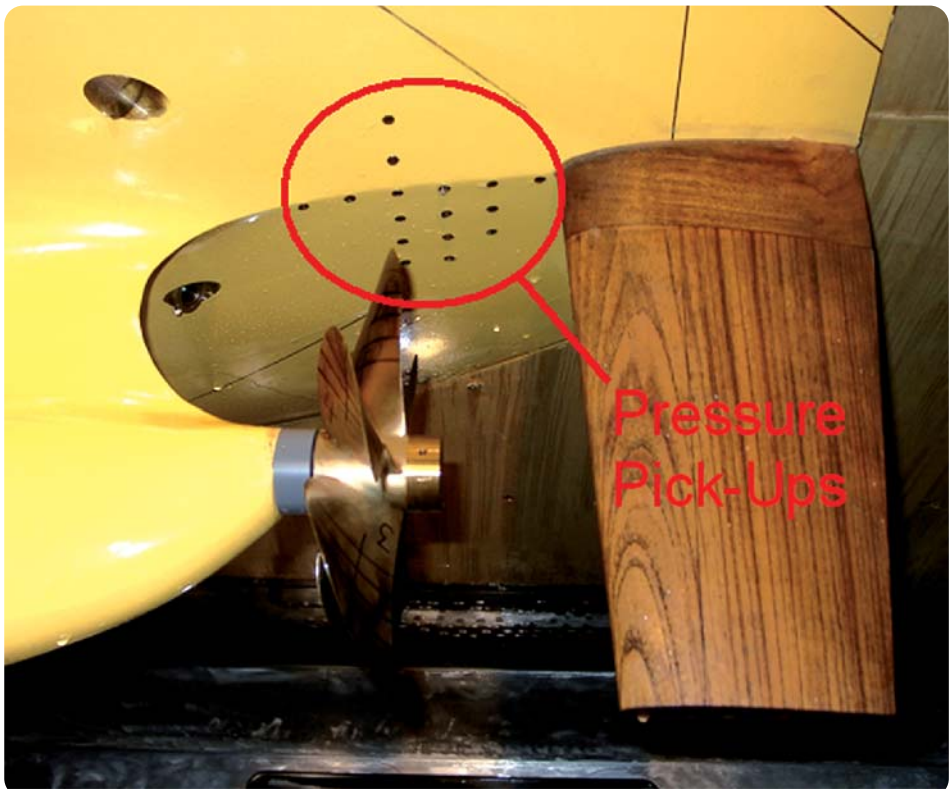


Fig. 1: Installation in HYKAT

In cases where the pressure pulse level is judged as being too high for the ship structure, all available information would be helpful to seek for remedies. In this context it is necessary to know, that there are three main contributions from the propeller to the hull pressure pulses:

The contribution from the propeller loading:
The propeller works like a rotating airplane wing generating low pressure on its suction side and high pressure on its pressure side. This intended pressure difference propagates to the hull in terms of pressure variations there.

The displacement effect of the propeller blades:
The propeller blades represent a certain volume quickly moving beneath the hull plating and displacing water. This periodic displacement generates pressure waves propagating to the hull as well.

Last but not least the cavitation effect:
The turning propeller blades experience different static pressure levels and – due to the non-uniformity of the ship's wake field – different inflow conditions during their rotation. Consequently the cavitation volume grows and shrinks periodically during the rotation, giving periodic pressure pulses since water is rapidly displaced by vapour of much less density.

Neither the pressure pulse generation due to the propeller loading, nor the displacement effect of the blades can be influenced significantly by the propeller designer. The pressure difference between back and face of the propeller blade is necessary to gene-

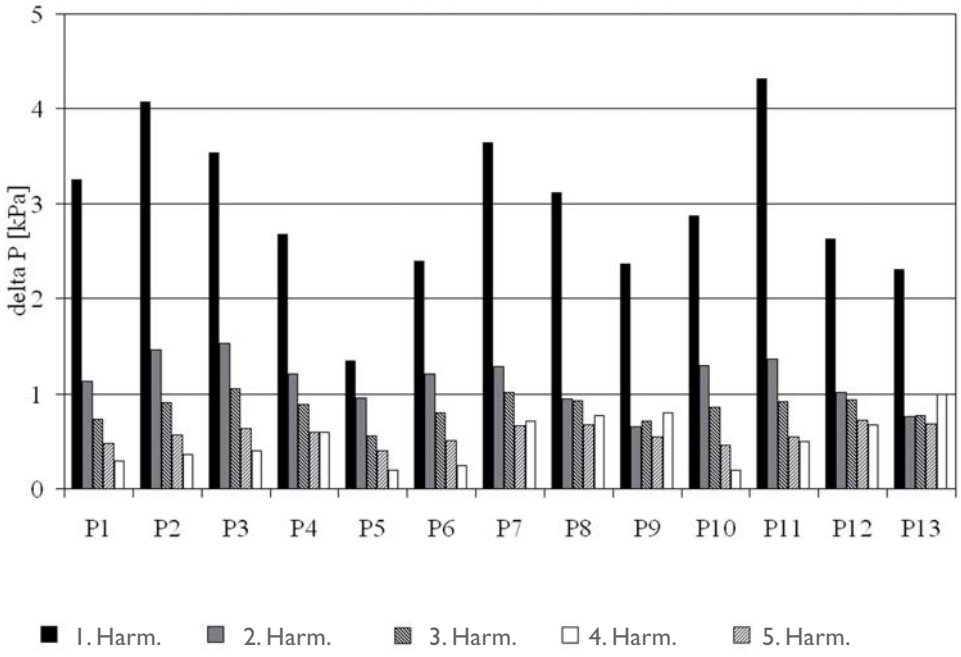


Fig. 2: Hull Pressure Amplitudes (Full Scale)
Single Screw Vessel

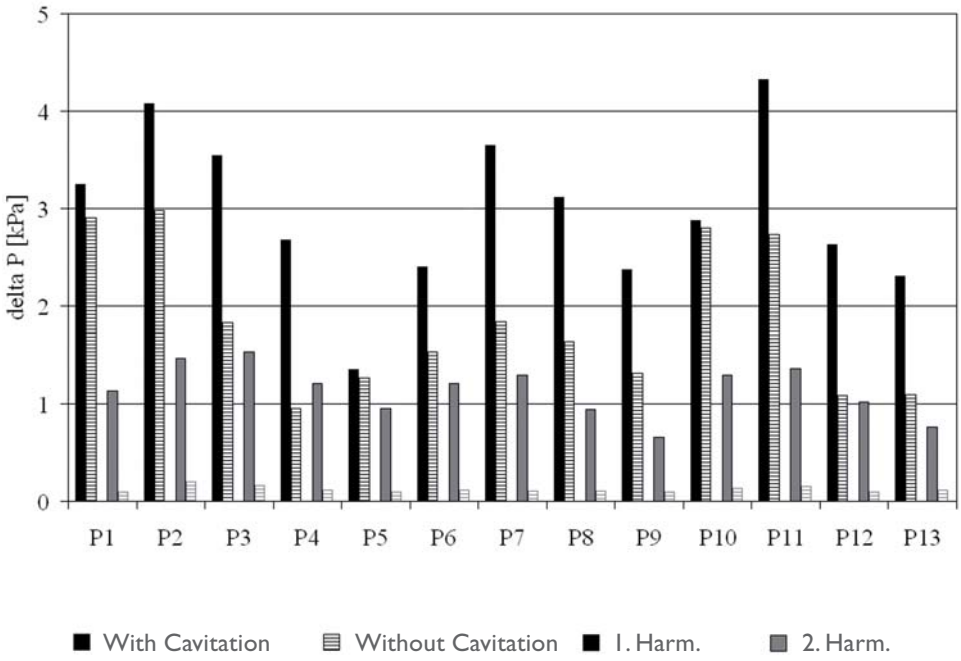


Fig. 3: Influece of Cavatation on Hull Pressure Amplitudes
Single Screw Vessel

rate the propeller thrust – and that is what the propeller is made for.

The displacement effect of the blades results from their thickness, which is ruled by the classification societies with respect to strength requirements. So it is mainly the cavitation effect that can be influenced be the propeller designer.

A change of propeller blade area, radial load distribution or even propeller diameter are the main parameters in that respect. Tuning those, however, means a new propeller design, most likely accompanied by a new series of model tests, additional costs, time delay and so on. To support such a serious decision it would sometimes be helpful to know, how much of the pressure pulses is generated by the cavitation. Of course, in most cases a certain amount of cavitation can not be avoided realistically. But as will be seen later in this article, there are cases, where the cavitation induced hull pressure pulses are extremely small, indicating that there is almost no room for further improvement.

To make these things visible, HSVA's cavitation test reports from now on include a number of valuable new diagrams, separating the cavitation contribution to the pressure pulse level from the other effects. Generating this information is quite easy in a cavitation tunnel: By simple raise of the pressure inside, cavitation can be avoided completely.

The remaining pressure pulses are caused by propeller loading or the displacement effect of the blades. In Figs. 3 to 5 the new diagrams are shown exemplarily for a single screw vessel. In Fig. 3 the Fourier coefficients for the first two harmonics of the hull pressure time function are compared for the cavitating and non-cavitating condition. It is typical that in the non-cavitating condition the second harmonic – and all

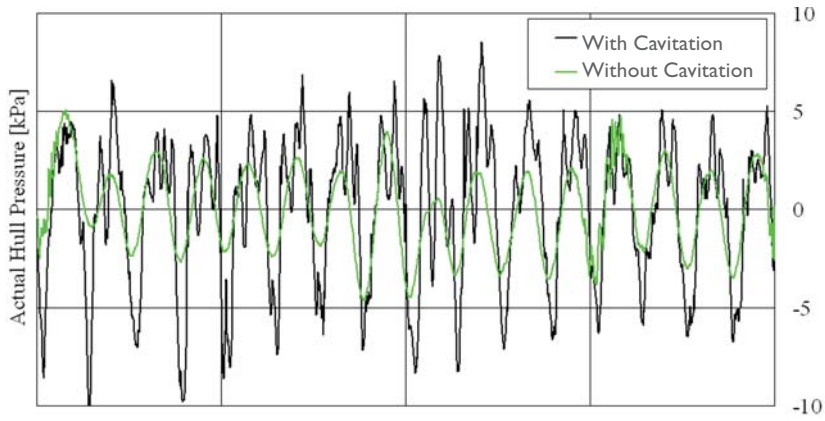


Fig. 4: Piece of the Hull Pressure Time Function (Full Scale) Single Screw Vessel

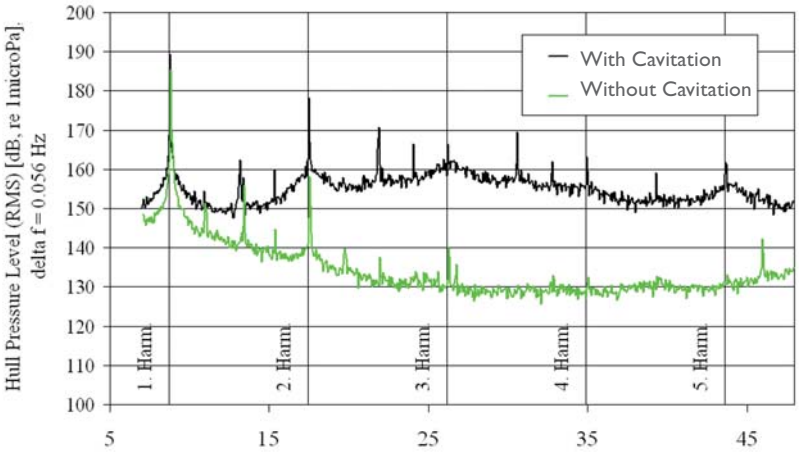


Fig. 5: Frequency Spectrum (Full Scale) Single Screw Vessel

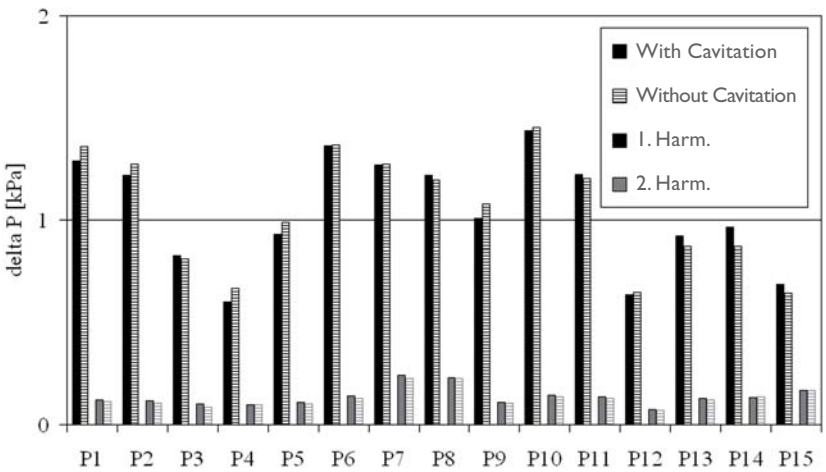


Fig. 6: Influence of Cavitation of Hull Pressure Amplitudes Twin Screw Vessel

higher harmonics as well – is extremely small, while the first harmonic is reduced to some extent only.

Fig. 4 compares short pieces of the hull pressure time functions, which had been the basis for the Fourier Transformation. Here the almost sine-shaped regular behaviour in the non-cavitating condition is remarkable when compared to the irregular peaks superimposed in the cavitating condition. Finally, Fig. 5 shows a comparison of the frequency spectra. Here it can be seen that cavitation does not only generate higher harmonic amplitudes but is also responsible for considerable broad band excitations.

A completely different picture is shown in Fig. 6, which was obtained with a twin screw vessel. Here the differences between cavitating and non-cavitating condition are extremely small. In some locations in fact, the amplitudes are even a bit higher when cavitation is missing. This is due to a certain phase shifting between the pressure pulses generated by cavitation and those generated by load and displacement effects. Consequently the presence of cavitation may cancel out the other effects to some minor extent. The potential, however, to reduce hull pressure pulses in case of this twin screw vessel by propeller blade modifications, is obviously almost negligible.

All the above information is available right after the measurements to allow judgment with the experts around the table. All this new information is made available for our clients without extra charge!

Polar Sea Ice replicated in Hamburg at HSVA

by D. N. Thomas & K.-U. Evers

As northern Europe enjoys a rather warm start to autumn, an international team of 20 polar scientists have brought icy winter conditions to the middle of Hamburg, Germany. They are studying the effect of pack ice on carbon dioxide and instead of travelling to the Arctic or Antarctic they have reproduced realistic ice conditions closer to home.

At a time when the Polar oceans, in particular the Arctic, is such a focus of scientific and general interest, it is important that we understand the fundamental chemical processes that govern the transfer of carbon dioxide between the atmosphere and the ocean.

Since September the team of researchers from Belgium, Denmark, Finland, Germany, Norway and U.K. under the leadership of Prof. David Thomas from Bangor University have frozen a tank the area of a tennis court filled with seawater to investigate, on a small scale, the effect of sea ice on the concentration of carbon dioxide in the underlying water as well as the atmosphere above it. They have continued their investigations until October.

Sea ice covers millions of square kilometres in the frozen oceans of the Arctic and Antarctic. However, to study the ice scientists normally have to plan research expeditions years in advance and take long, and expensive voyages aboard icebreaking research vessels. The scientists of the above mentioned team are using the unique facilities at the Hamburg Ship Model Basin (HSVA) a testing facility that has a specially designed environmental basin in which the air temperature can be kept at an icy -15 °C (about the same temperature of a domestic freezer).

Preparation of the Ice Tank

The current experiments are conducted in large bags (1 cbm) suspended in the basin. By using the bags the scientists can change the nature of the water to simulate possible different chemical conditions found in nature. The scientists are measuring the daily changes in the chemical properties of these experimental bags, and in particular have concentrated on what happens to the carbon dioxide in the seawater. Each of the experimental bags contains 1 ton of seawater shipped to Hamburg after sampling from the North Sea and the scientists are using in total 24 bags to investigate the basic chemical reactions that take place when seawater freezes.

"The use of tanks such as those at the HSVA helps to replicate polar environmental conditions with a high degree of reliability without having to travel to the polar regions. Each researcher comes with a different set of scientific skills that will be combined to give a detailed understanding of the chemistry of freezing water. It is rather like the team that comes together to go on research expeditions such as on the RV Polarstern. However, the big difference is that at the end of the day you can step out of the ice tank and go back to normal life," explains Prof. Thomas. "Although it probably seems extravagant that we are doing this, it is far less expensive than taking a research vessel to the Arctic or Antarctic. We learn a lot from these experiments that will form the basis for our future fieldwork in the high latitude frozen seas".

Seakeeping Tests on a DP Heavy Lift and Pipelaying Vessel SAPURA 3000 using Transient Wave Packets

by Katja Jacobsen

SAPURA 3000 is a DP heavy lift and pipelaying vessel dedicated to the Asia Pacific area. The vessel has been employed for S-Lay operations in shallow water. Consequently it is equipped with a stinger connected to the ship stern. In order to enable pipe laying operations also in deep water, the vessel can be equipped with a tower for J-Lay operations. The absence of the stinger, however, is considered to have an effect on the vessel's motion behaviour, especially with regard to rolling. The main purpose of the present investigations was to ascertain the influence of the stinger's underwater part on the vessel's motion behavior.

The seakeeping behaviour of the SAPURA 3000 was investigated both with model tests and with numerical calculations. The model testing of the vessel included roll decay tests in calm water at zero speed, tests in transient wave packets as well as tests in irregular seas. The main focus of the studies was set on the vessel's motion behaviour in the S-Lay as well as in the J-Lay condition: The model was tested in three different configurations: S-lay condition with thrusters and stinger, J-lay condition with thrusters and no stinger, J-lay condition with no thrusters and no stinger.

The S-Lay method refers to the fact that the pipeline moves horizontally from the welding station to the stern of the pipelaying vessel. Behind the stern the pipeline is lowered over the circle shaped supporting stinger into the water forming an elongated "S" from the water surface to the ocean bottom. The purpose of the stinger in the S-lay configuration is to control the curvature radius of the pipe during installation. Whereas with the J-Lay method the pipe joints are assembled vertically in the J-Lay tower and lowered to the ocean bottom in a "J" form.

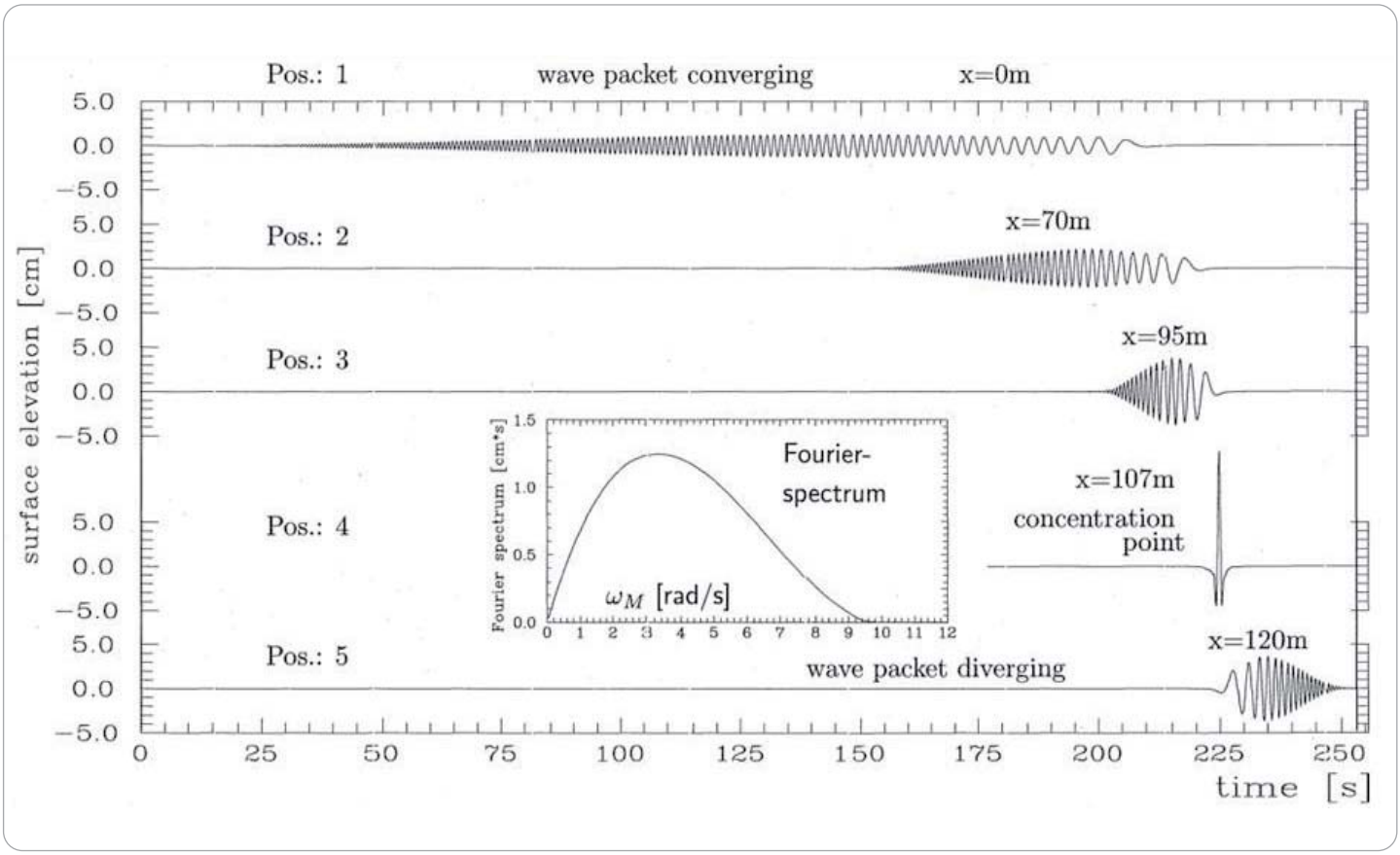


Fig. 1: Genesis of a wave packet at different positions and the related (invariant) amplitude spectrum.
At its starting position at the wave maker (position 1) the wave train is very long.
At downstream locations (pos. 2 and 3) the wave packet shortens until the concentration point (pos. 4) is reached and only one high wave is observed in the tank, while all wave components are in phase.
After the concentration point the wave packet diverges again (pos. 5), the longer waves have now overtaken the short waves.

Transient Wave Packets - RAOs

The Response Amplitude Operators (RAOs) of the vessel's motion in six degrees of freedom were determined with the transient wave packet technique. The significant advantage of this technique is that a wide range of wave frequencies can be realized within one test run, thus saving time and reducing cost.

The RAO is determined using in general only one single test run of very short duration. The wave packet technique exploits the dispersion characteristic of the waves: longer waves travel faster than short waves. The wave maker generates first the short waves, followed by longer and longer waves. In the concentration point all waves are superimposed without phase shift, resulting in one single high wave peak. The development of wave packets is illustrated in Figure 1.

At each moment and at each position the wave packet is defined by its complex Fourier spectrum. During propagation the amplitude spectrum remains invariant. This means that the energy remains constant at each moment. The phase distribution and therefore the related shape of the wave train, however, vary within its position in the tank. Due to the invariant amplitude spectrum the model can be located arbitrarily in the tank, although the best position is in general not far from the concentration point. If special investigations are required, e.g. the impact of a freak wave on the ship, a model position directly in the concentration point may be of interest. Note that in front of and behind the wave packet the water level remains undisturbed, as shown in Figure 2. Reflections of waves from the side wall or even from the end of the tank do not disturb the measurements, which may be the case when testing in regular waves.

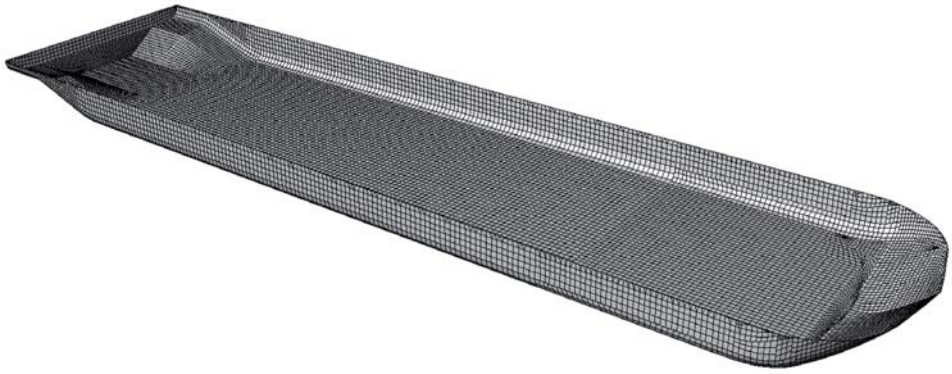


Fig. 3: Discretization of the mean wetted surface of the hull.

The obtained RAOs, defined by the amplitude and the phase spectra, covers the whole frequency range of the spectrum of the input wave train.

Test runs in wave packets were performed for the vessel in each test condition with one low and one high wave packet at the 5 wave encounter angles. In addition a test series of forty test runs in irregular seas was performed with the model of the project vessel moored at different encounter angles and sea conditions.

Fig. 2: Model of the pipelaying vessel SAPURA 3000 in a wave packet from the beam.

Numerical Calculations

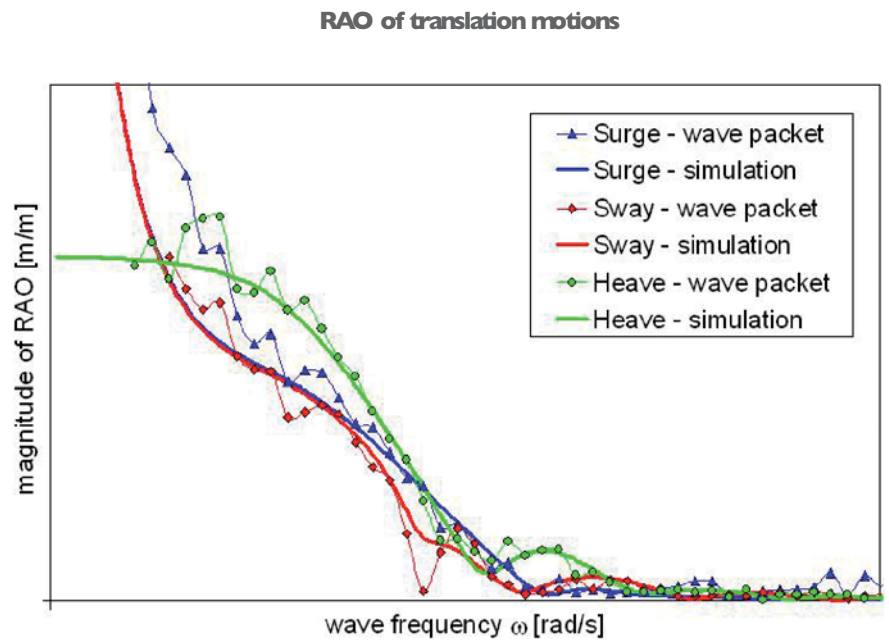
Additional seakeeping calculations were performed with a diffraction-radiation program based on a three-dimensional panel method for the analysis of wave-structure interactions. First the vessel's RAOs were determined. The RAOs of the roll motion were calculated using different roll damping coefficients corresponding to different roll angles. A subsequent simulation of the time-dependent motions was performed for the SAPURA 3000 operating in the same sea and operational conditions as during the tests in irregular seas.

Numerical simulations with a panel method based on potential theory do not consider any viscous damping effects. In the calculations, however, a viscous damping coefficient for the roll motion derived from the roll decay test was used. This additional roll damping coefficient accounts for the influence of bilge keels, appendages etc. on the roll motion. The motion behaviour of the vessels was studied at zero speed, in a water depth corresponding to the water depth of the HSVA's Towing Tank.

Good correlation

The tests with the model of the pipelaying vessel Sapura 3000, operated by SapuraAcergy, demonstrate well the suitability of the wave packet technique for the determination of Response Amplitude. The Response Amplitude Operators shown in Figure 4 were derived from the measured motions in the wave packets. The comparison with the numerical simulations shows very good agreement.

The conclusion is convincing: Using the wave packet technique the curve characteristic of RAOs can be achieved much more accurately over a wider frequency range than in regular waves – and in addition together with a pecuniary advantage.



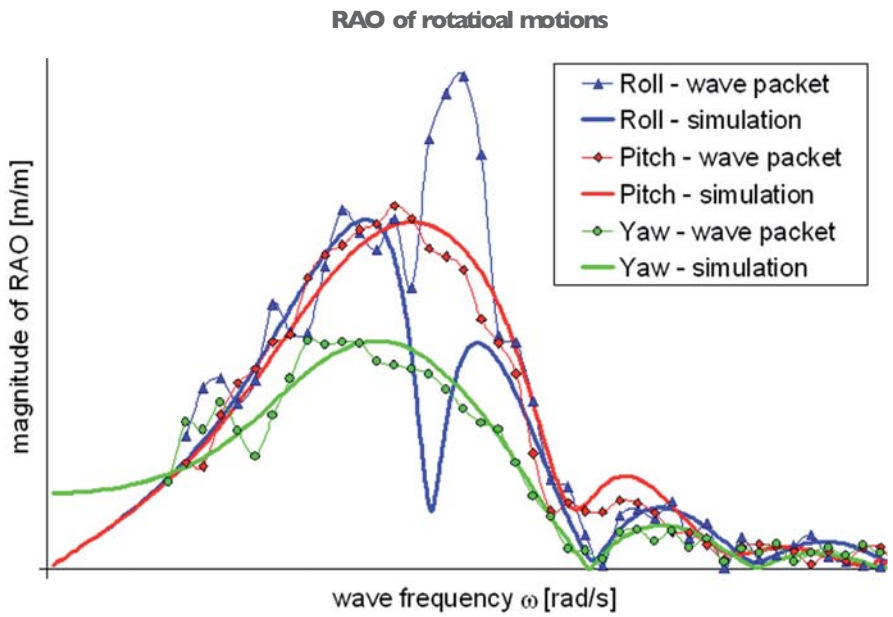


Fig. 4: RAOs of the motions – comparison between the RAOs from the tests in wave packets and numerical simulation

Model Manufacturing at HSVA

by Norbert Kohlmetz

HSVA produces an average of 75 ship models up to 12 m in length and more than 30 propeller models each year. Additionally about 30 larger model modifications were performed year by year, as well as all the different test set-ups, not only for HYKAT and open water tests but also for the harsh environment of the two ice tanks.

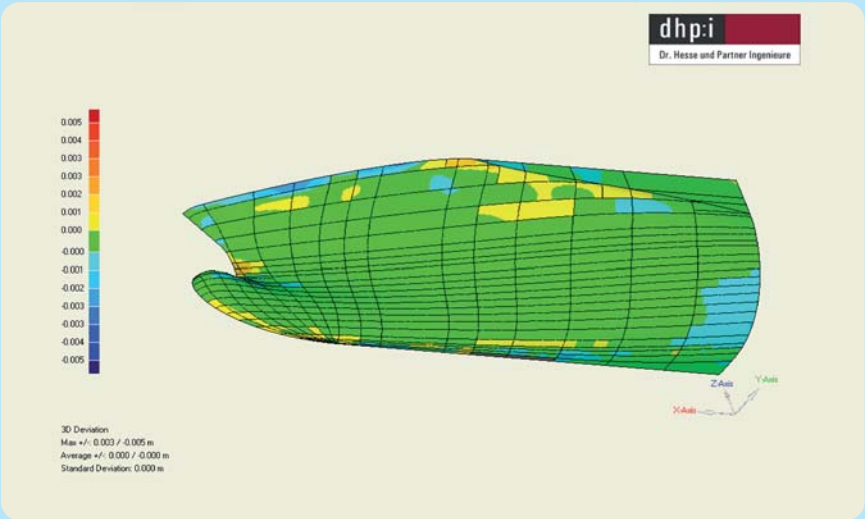
How can this be done in an efficient way?

All starts with drawings, prepared in the CAD office. Based on 2 D drawings and/or freehand sketches a computerized 3 D model is created, using state of the art software. The wide variety of software modules enables us to work with many different data formats for input and output. The program mostly used is NAPA. This software allows many different calculations, e. g. computation of hydrostatic data. The excellent output quality can also be used for the final fairing of lines for shipyards.

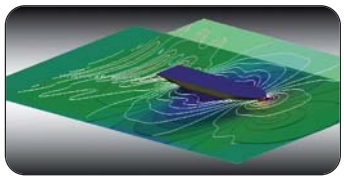
These are additional services, the CAD office offers to our clients. Parallel to the work in the CAD office the production of the hardware starts in the model workshop.

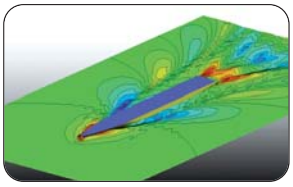
The wooden ship models are assembled parallel on up to 3 slipways to assure a really flexible time schedule. The 3D model is used to prepare the input for the CNC machines in the model and metal workshops. The CAM software is used to run the 5 axis high speed milling machine which finally shapes the models to the geometry given by the designer. Our large milling machine for ship models covers a machining space of **12.0 m x 4.0 m x 2.0 m** This gives us the possibility to produce also other model shapes like aircraft mock-ups or sailing boat hull forms. Appendages like shaft bracket arms, nozzles, rudders, fins as well as model propellers are manufactured by another 5 axis HSC milling machine in our mechanical workshop. The material for model propellers and shaft bracket arms is brass, while many of the rudders, nozzles and fins are manufactured from wood or plastics.

To fasten production times, rapid prototyping is used more and more, mainly for fins, sometimes rudders, thruster housings and grids and many others. This work is given to specialized companies outside which use our 3 D models to produce the pieces in only some days or even hours. The manufacturing accuracy of models can be checked by Laser scanning. The scanned surface is combined with the CAD model, and the deviations between model shape and CAD data are visualized.



HSVA's 6th customer seminar on CFD in Ship Design entitled „Design for Efficiency – How CFD can help to improve ship performance"

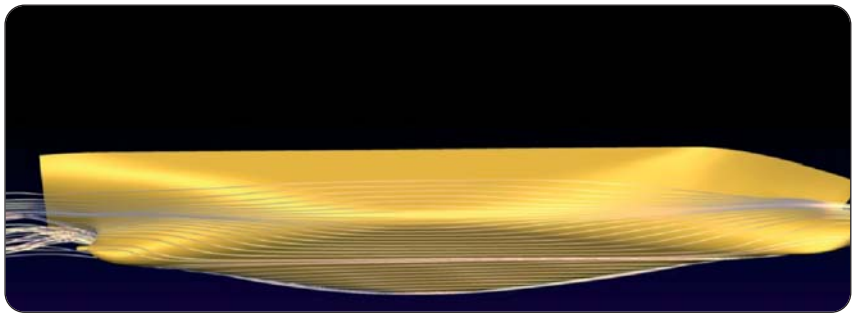


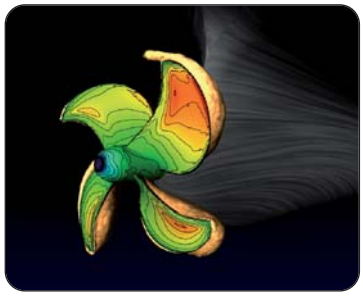


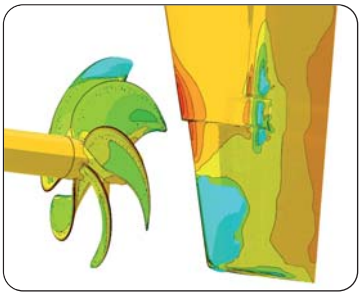
was held at HSVA on November 3, 2009. We presented latest research results and how they find their way into routine applications to the benefit of our customers.
The presentations focused on:

- **A survey of computational fluid dynamics applied to ship design and optimisation problems**
- **Hull form optimisation using CFD (Potential flow methods, RANSE methods, Integrated platforms)**
- **Propulsion improvement devices – an optimisation study using the RANSE code FreSCo**
- **Design and optimisation of propellers, rudders and other appendages**
- **Numerical manoeuvring predictions**
- **EMSA RoPAX damage stability study**
- **The future of CFD methods and their application in ship design & analysis.**

Many of our customers attended this seminar and exchanged new ideas with our specialists.







Member of staff

Dr. Petri Valanto has been appointed head of Seakeeping and Manoeuvring department in October 2009. He joined HSVA first in 1990 as a project manager in the Ice Technology department, becoming the head of Icebreaking Technology group in 1993. Valanto concentrated on the numerical modelling of the icebreaking process on a ship advancing in level ice. His solution of this fluid-structure interaction problem is well-known in this field.

In 1994 he changed to the CFD department working on various customer research projects related to free surface and ship signatures.

Since 2001 he has worked mainly on the numerical modelling of seakeeping problems concerning the damage stability and evacuation of damaged RoPax ships in seaway. This work has yielded several information documents to the IMO SLF-Meetings. As a natural follow-up was the chairmanship of the HSVA-Consortium set up for the investigation of the Sinking Sequence and Evacuation of the MV Estonia in 2008. In the same year followed the investigation for the European Maritime Safety Agency (EMSA) on the damage stability of RoPax ships satisfying only the new SOLAS2009 rules. Both the numerical simulations and the damage stability tests in seaway suggest that amendments in the new rules will be necessary.

Petri Valanto obtained his diploma in solid mechanics and naval architecture at the Helsinki University of Technology with distinction in 1983 and a PhD in Naval Architecture and Offshore Engineering at the University of California, Berkeley in 1989.

Today he lives in the very north of Hamburg with his wife, daughter and cat, where the river Alster makes its way through the oak forests towards the sea.

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