SVA items

SCHIFFBAU-VERSUCHSANSTALT POTSDAM GmbH No. 7 September 2002

Complex Design and Special Tasks

Hamburg SMM 2002

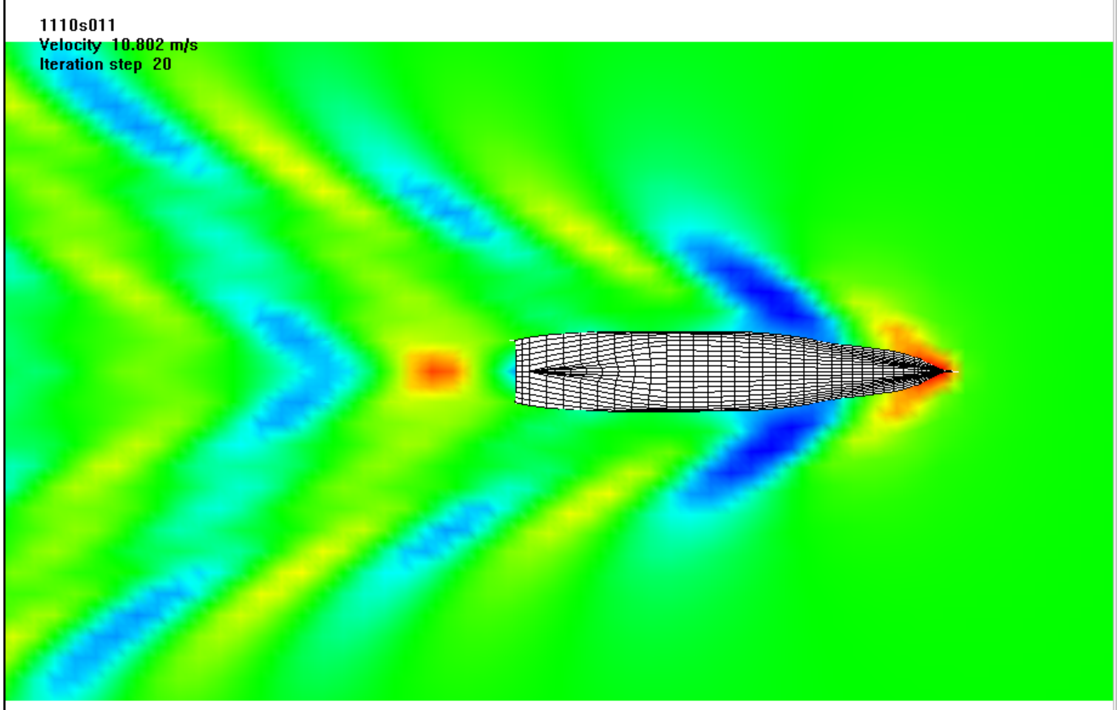
Ship Model Basins play an important role in the world-wide shipbuilding as centres of competence for the ship hydrodynamic and as connecting links between the basic research at the universities and the product development in the industry.

The ships become greater, faster and lighter, etc. and the demands to improve propulsion efficiency, manoeuvring qualities, cavitation and vibration behaviour are increasing permanently. Ship Model Basins are involved in the design and optimisation process of the ship hull and the propulsion systems long before the first model test is taken place today. Consequently theoretical investigations, potential theoretical and viscous calculations as well as design services are coupled with model testing.

The fair stand of the Potsdam Model Basin in Hamburg at the SMM 2002 shows exemplary the design process of a ferry together with the yard Estaleiros Navais de Viana do Castelo (ENVC) as well as with the propeller manufacturer SCHOTTEL GmbH & Co. KG.

The basis of a successful work are experienced, high motivated staff members as well as modern calculation and test methods and test facilities. The experiences are accumulated by common work with companies all over the world. Furthermore the SVA Potsdam works permanent at R&D projects to reach the necessary advantages in theory and measuring techniques as well as to support the product development in the industry.

Focal points of the development works in the SVA Potsdam were the use of CFD-methods for the integrated optimisation of the ship and the propulsion systems, the creation of modern propeller design methods as well as the development of measurement techniques in the last years.



Wave pattern of the optimised form

For the optimisation of the hull design were used the potential theoretical method KELVIN. For detailed information regarding the effectivness the viscous flow calculation program CFX-TASCflow was applied. For the design of the propeller optimisation tools on basis of inverse calculation programs were utilized.

Join us in Hamburg **at SMM 2002 in exhibition hall No. 10 at stand 10027**. We would be pleased to meet you there.

Extensive Investigations on an ENVC Fast Ferry Project

SVA Potsdam was commissioned by ENVC to carry out extensive investigations for a fast ferry project. The investigations included form optimisation, self propulsion, manoeuvring and cavitation tests. The initial design was delivered by ENVC.

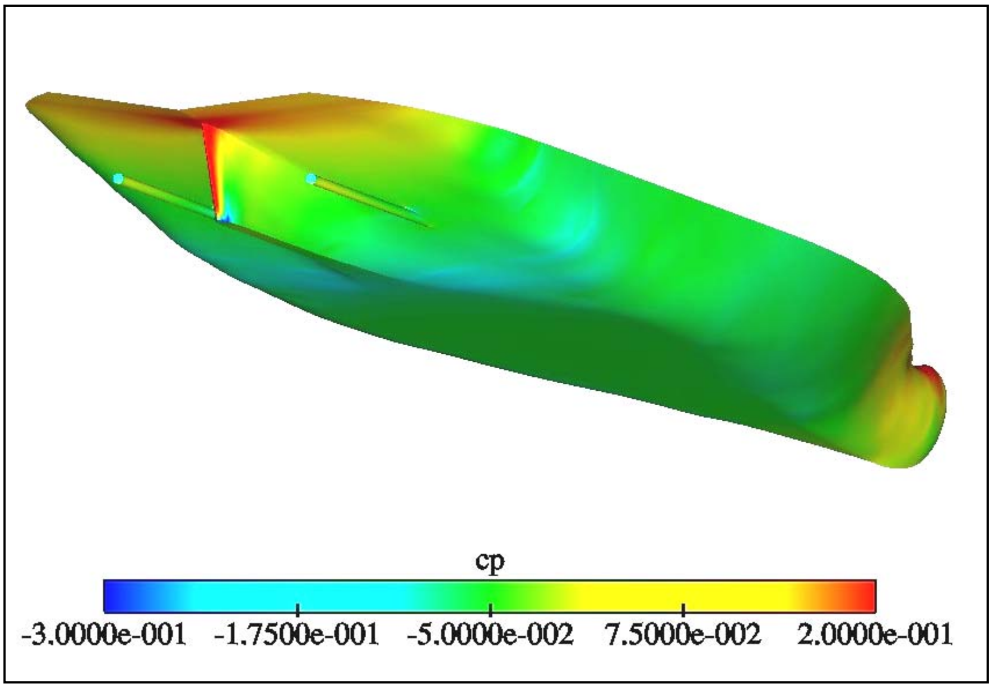
Form Optimisation

This ferry is a slender conventional twin screw ship with shaft brackets, two rudders, bulbous bow and a deadwood at the aft body. At the basic design the aft sections had extreme U-formed sections to the transom.

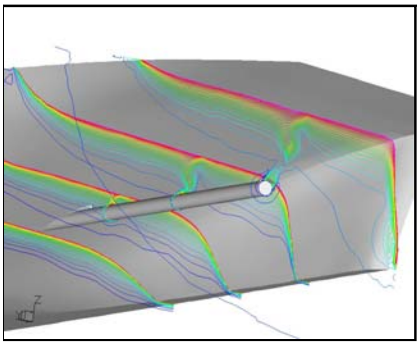
Because of the risk of flow separation and slamming at stern a new design of the aft body was recommended and made at SVA.

To check the effectiveness of this form the flow around the ship was calculated using the viscous flow calculation program CFX-TASCflow.

Only at the deadwood a small modification was necessary. The inflow to the propellers was checked having a look on the wake distribution at different sections.



Very smooth pressure distribution at the aft body



Wake distribution at different sections

The results of the viscous flow calculation also were used to find out the optimal alignment of the shaft brackets. For that reason the angle of flow vectors were ascertained at orthogonal sections of the struts.

At the fore body the bulbous bow was checked with regard to its effect on resistance. Three different forms were developed and the wave resistance of each form was calculated. This was done using the potential flow calculation program KELVIN. The best form was selected to be built at the ship.

With this one extensive model tests were carried out to predict the propulsion and the behaviour in sea. One of the important criteria for the design was the manoeuvring behaviour in the harbour.

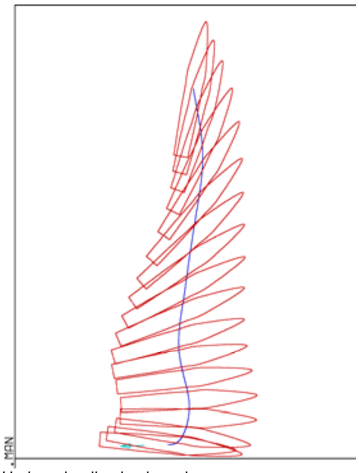
Manoeuvring Tests

The model was equipped with all necessary facilities of the state of the art for free running tests. For simulation the harbour manoeuvres within the towing tank a pier and a partial sea bottom was arranged. Wind forces were generated by some ventilators fixed on the main carriage. By driving the main carriage in a steady distance from the moving model a constant wind force acting on the model was accomplished.

The model was investigated with a series of a special type of test manoeuvres, similar to zig-zag tests, to obtain the coefficients of ist motion equations. By means of these coefficients, standard manoeuvres were simulated numerically. This procedure had been developed at SVA and validated to ensure that simulation results correspond to reality. Any further manoeuvres are calculable. Turning circles, zig-zag tests and Dieudonné spiral tests were simulated.

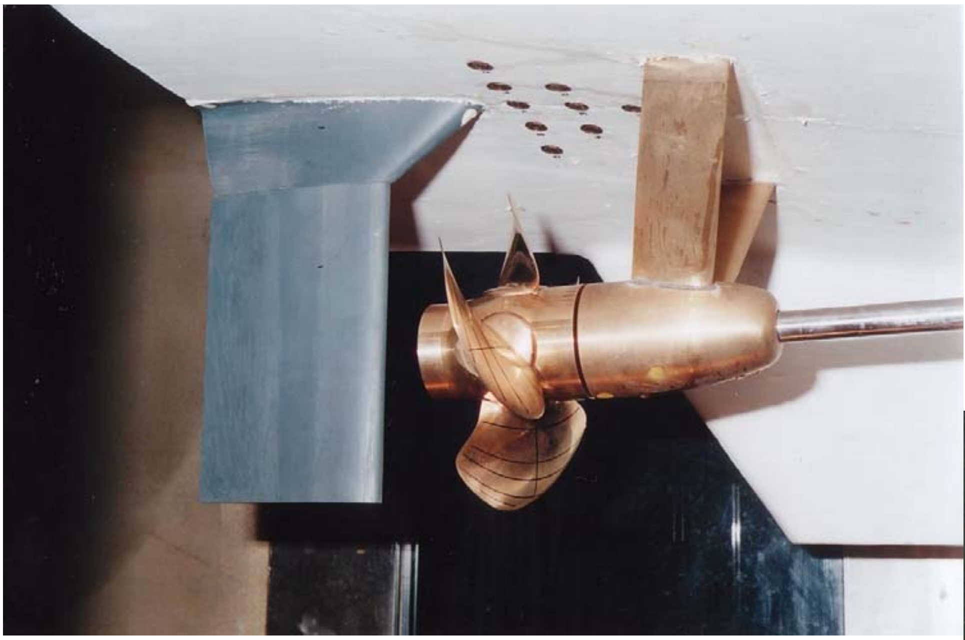
The model was dynamically stable, and its manoeuvring properties comply with IMO A751.

For demonstration the ability of the model to take off and land backwards within the harbour under the influence of wind, harbour manoeuvring tests were carried out. Three wind speeds were investigated. The wind was directed in all cases towards the pier. Rudders, propellers and bow thrusters of the model was navigated manually. An example for one case of landing backwards is given below.



Harbour landing backwards

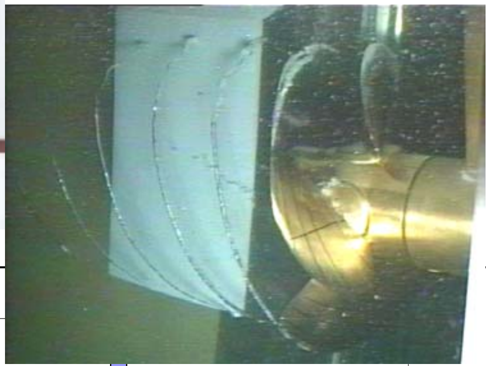
Cavitation Tests



Dummy model with basis rudder and pressure pick ups

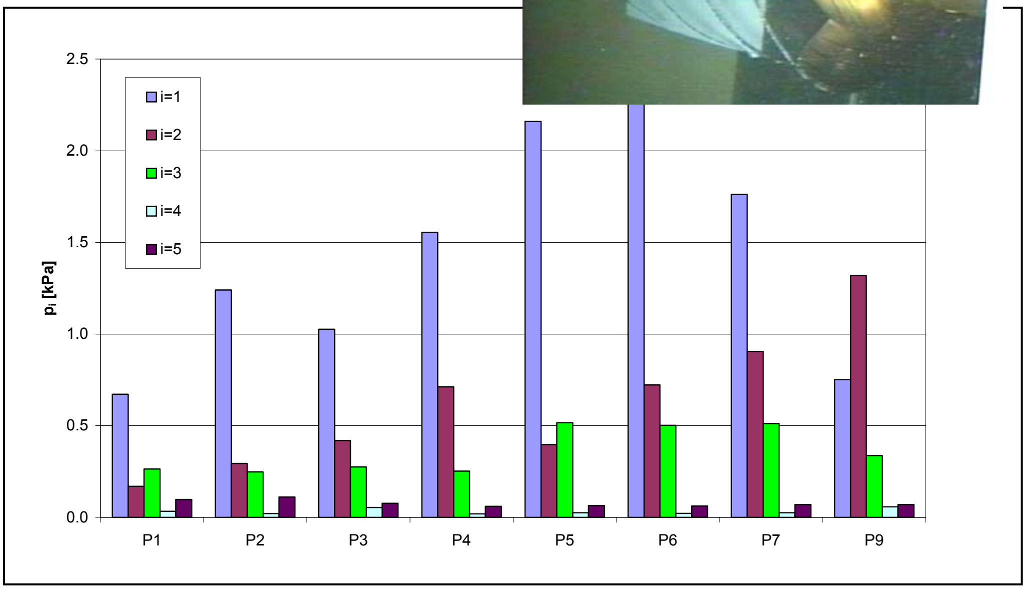
The rudder form was modified to find the form for a minimum danger of cavitation erosion. On the pressure pulses the rudder form has no influence.

Because of the good propeller design the pressure pulses are in moderate height. For the maximum speed the maximum pressure pulses lie below 2.5 kPa. The pressure pulses of the higher order are also relatively small.



Further a dummy model was tested in the large test section of SVA's Cavitation Tunnel. The controllable pitch propeller of the ship was designed by SCHOTTEL GmbH & Co. KG. The dummy model was equipped with nine pressure pick ups and a rudder with several modifications.

The cavitation number σ_n = 1.52 is very low, so that a strong propeller cavitation and high pressure pulses must be feared.



Pressure pulse amplitudes at high speed

Hydrodynamic Tests with a Grab Model

Seatools BV had ordered hydrodynamic tests with a grab model. The aims of these tests were

- determination of the resistance and most favourable resistance conditions for dragging the shovel to the place of work
- determination of the additional load of the shovel due to the movements and oscillations in the water
- determination of the most favourable motion conditions for dragging the shovel
- estimation of the added hydrodynamic masses and moments of inertia

In the result of the tests the customer got all the necessary information for doing manoeuvrability simulations.

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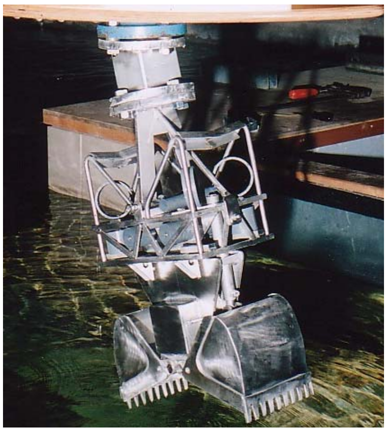

Investigations of Operating Characteristics of a Towed Underwater Vehicle

The Howaldtswerke Deutsche Werft AG had ordered investigations of the operating characteristics of a towed underwater vehicle.

Model tests with the towed body in the towing tank were carried out. Preliminary investigations had shown that the planned towing speed could not realised because of instable motion behaviour of the body. That's why the main focus was concentrated on the visual observation of the operating characteristics of several towing configurations.

As a result recommendations were given related to dimension depressors and stabiliser fins, trim conditions and shaping of the body. Furthermore the SVA gave constructive proposals for an improved variant of the body in analysis of the tests to the customer.

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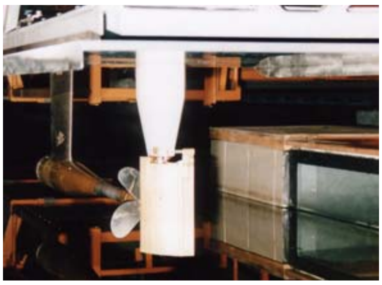
Open Water Tests of Flapped Rudders with and without Propeller Influence

The SVA Potsdam GmbH was commissioned of Rolls-Royce to carry out model tests with three different flapped rudders in the towing tank under homogeneous and inhomogeneous conditions as well as to calculate the results for full-scale conditions.

The rudders were fitted with a flap mechanism which was leading the flap angle in dependence of the rudder angle. The results of the tests are the forces and moments in all directions. Because the conditions in model scale lead to low Reynolds numbers, additional calculations were necessary to find out the results for natural scale. For this purpose numerical simulations with the rudder and an actuator disk in model and natural condition were conducted.

These results are very helpful for the design of rudders and for investigations of the propeller-rudder-arrangement.



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Planar Motion Mechanism for Submarines

SVA Potsdam has a new test facility. In co-operation with the Hydronautics Inc. a SUBPMM (Submarine Planar Motion Mechanism) was installed in the towing tank of SVA.

The Planar Motion Mechanism at makes it possible to conduct model tests with submarines and other submerged bodies.

The Planar Motion Mechanism System is a complete system for obtaining hydrodynamic coefficients from model tests. The main components of the system are model support and positioning equipment, forced motion mechanism, support frame, carriage adapter frames, model support struts and dynamometry.

The Planar Motion Mechanism System incorporates in one device a means for experimentally determining all of the hydrodynamic-stability and control coefficients required in the equations of motions for a submerged body in six degrees of freedom.

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Members of the Staff

Lars Lübke

Lars studied naval arcitecture in Hamburg and obtained his Diploma in 2000.

During that time he gathered his first practical experiences in the HSVA ice department, enabeling him to participate at the ARDEV research voyage to the artic in 1998. After focussing his preceeding studies on the application of RANSE-methods in naval arcitecture, he wrote his diploma on the subject of free-surface flows around different trimaran configurations.

In March 2000 he became member in the Numerical-Simulation Department at the SVA-Potsdam, managed by Dr. Maksoud.

Since that time he works in the SVA team and tries in a joined effort to get a more profound understanding of the complex flows around naval vessels with special attention to propulsion systems. Lars is involved in different research and customer projects.

His new discovered hobby is scuba-diving but has not jet obtained much expertice, due to a lack in suitable diving locations near Berlin.

Impressum

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