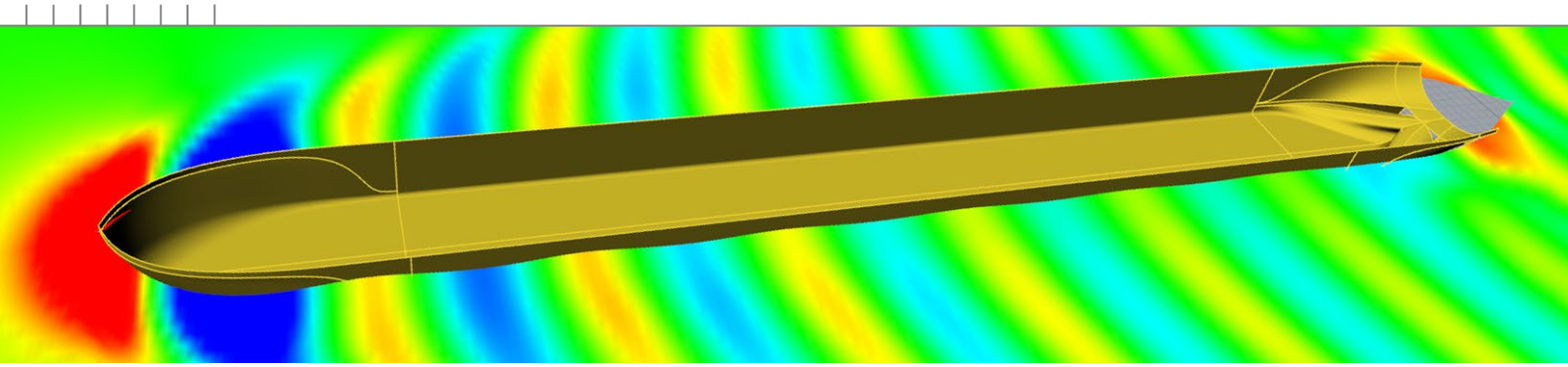
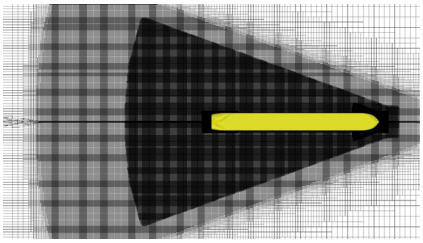


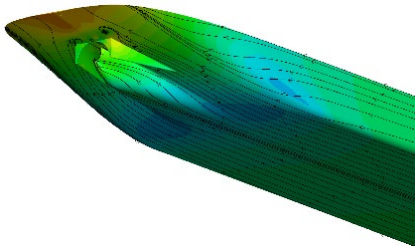
Hull form optimisation

Minimization of fuel consumption using computational methods

Fuel consumption is a major contributor to the operating costs of a ship. Also, the amount of emissions produced by a ship is highly related to it. Therefore, investing in the minimization of fuel consumption during the design of the ship is money well spent. A reduction of fuel consumption can be achieved by optimisation of the ship's hull form, using an improved propeller design, or decent appendage positioning and alignment. MARIN offers services to assist you, or your ship designer, to optimise your ship design and reduce fuel consumption. These services are available already at limited investment, thanks to improved computational methods and resources including over 85 years of experience.



Thanks to a powerful computing cluster, high density CFD grids can be applied to obtain accurate results



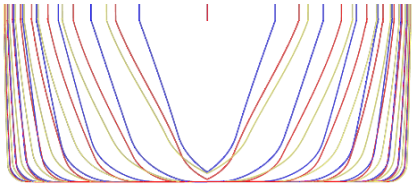
Flow lines at an inland ship stern, aiding in the alignment of appendages and assessment of the flow towards the propellers

The MARIN hull form optimisation approach

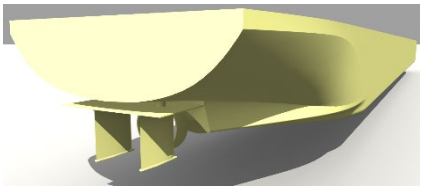
A hull optimisation project starts with either a hull form provided by you (the client) or a hull form from our database adapted to your needs with our experience. The initial hull form will be analysed using computational fluid dynamics (CFD) to identify promising options for improvement. Aspects that are focused on include the ship's resistance, propulsion power requirement, propeller wake field and the wave pattern. These options are then analysed using CFD software, in a cost-efficient process for the optimisation of the complete hull form. Also the impact of shallow water on the required power or sustained speed can be addressed.

The result

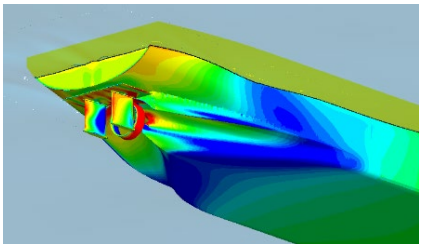
When the optimisation process is completed, the hull form is provided in a digital format such as IGES, which can be opened in most CAD programs. It is worthwhile noting that the resulting hull form will be your property: MARIN does not hold any patents on the produced lines drawings. You are therefore free to use the same hull form in other projects and for other ship designs. Apart from the final hull form, a report is written in which the steps taken during the optimisation process are described. Reasoning behind proposed hull form modifications is included, as well as a discussion on why one hull form variant performs better than another.



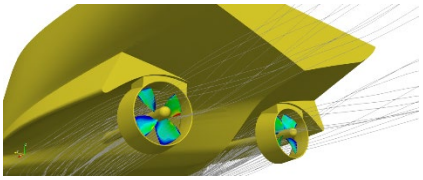
Using parametric models, many variations from the base hull form can be easily generated and analysed to find the optimal shape



The most important appendages such as ducts, flow cover plates, tunnels and headboxes will be included in calculations if deemed necessary



The pressure field around the stern is useful to identify options for improvement



Flow details can be obtained through CFD. At additional costs, 3D propeller modelling can be applied for even more accurate power estimation

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Your input matters

It is important that the result of an optimisation effort meets your requirements. Therefore, any proposed changes to the hull form will be discussed with you (the client) to ensure that the hull form fits with the general arrangement and critical points are not exceeded. However, it is also possible to adapt the ship in a more rigorous way, requiring changes to the general arrangement, for example. By showing the impact of such modifications, you can decide whether the gains (reduced fuel consumption) outweigh the impacts on the general arrangement.

Optimisation package

A standard optimisation project aims at the minimization of fuel consumption for a single operational condition (one draught, speed and trim). The flow in ballast condition can be assessed as well to ensure ship performance at ballast draft. The process focuses on optimisation of the hull only, but major appendages such as a propeller duct will be included in the calculations. Further appendage alignment is possible based on computational results. Propeller modelling is done through the simplified actuator disk model. The result, an optimised hull form, will be provided to you, and will be your property. Detailed computational results can be provided upon request.

Duration

The optimisation procedure takes approximately four weeks to complete. This depends on the complexity of the ship at hand and the input provided. In these four weeks, the hull lines drawing is prepared for optimisation, the CFD calculations are performed and the final hull form is delivered.

Costs

The exact costs of the project depend on the complexity of the ship design. However, for conventional ships, a realistic cost estimate is +/- € 15.000,-. This applies to most low-to-medium speed vessels with a conventional propulsion configuration: inland ships, tankers, bulkers and container vessels.

Note that the stated budget does not include propeller optimisation. However, based on the results from the optimisation process, the estimated propeller thrust and a wake field will be provided, which can be used for a propeller design.

Only looking for advice on improvements?

Instead of ordering a complete optimisation package, it is also possible to order a single CFD hull form evaluation including speed/power prediction. The results show the estimated ship speed at given power and includes advice on hull form improvement. For this work, the costs are +/- € 4.000,-