CFD versus model tests, which one will be the winner?

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IHC, Ballast HAM (now Van Oord), Boskalis and MARIN, initiated the HOppers in Shallow WAter (HOSWA) project when they realised there may be a glut of information about manoeuvring in deep water but the impact of shallow water is not yet fully understood.

Within the project, a study into the viscous-flow around the ship, sailing at a drift angle in shallow water, was defined. IHC naval architect Arie de Jager and Serge Toxopeus, one of the HOSWA project managers of MARIN, debate the results and tackle the thorny issue of whether computer calculations will ever replace model testing.

Computational Fluid Dynamics (CFD) were fundamental to the project. "We wanted to know more about the physics, to get information on the flow field", says Serge. "We had actually been using CFD for deep water conditions but CFD for shallow water was something new for us. But this fitted in with our long-term plans. The project came along at exactly the right time. Based on experience, we know how to change the manoeuvrability, but why it works is not fully understood."

Arie replies: "For us viscous-flow calculations are very important due to the characteristics of our vessels and for manoeuvring, turbulence is a determining factor. We only really get the relation between speed and power from model tests. Optimising a model is a time consuming and expensive procedure. CFD on the other hand, is more flexible and gives more insight into the physics. Therefore, CFD plays a very important role in optimising hulls nowadays."

They talk about their expectations from the project. "I'm interested to hear what Serge has to say here", Arie grins. Serge seeks diplomatic words. "Some clients expect everything from CFD, Arie, but you are one of the few that realises that it can be difficult. A mutual understanding facilitates alternative approaches and then solutions can be found. We can try things, without having an angry client!

"However, since it was the first time that we had used PARNASSOS – the viscous-flow solver of MARIN – to calculate the flow around a ship at a drift angle in shallow water we had some reservations."

Arie adds: "In former days there was the idea that scientists live in Ivory Towers. But I think we need each other from the very beginning. Nearly 30 years ago, IHC had a bad experience with a single screw dredger. A new project forced us to investigate but we had no funding for an in-depth model test programme. Then I remembered the existence of PARNASSOS and asked MARIN to do calculations. We were very lucky we took that decision because we delivered a successful ship. That was IHC's first use of PARANASSOS."

"The beauty of CFD is that it allows IHC to actually use the information practically", Arie stresses. "We used the information for propeller design, appendages were changed. We used it as a tool for improvement."

Four vessels have now been optimised successfully using the code. The present results were in line with practical experience, but MARIN was positively surprised by the possibilities of the flow

Courtesy IHC.

solver, Serge adds.

He explains that the increase of the speed on the "windward" side was expected but the increase of the cross-flow underneath the ship "was quite substantial and surprising". Some unexpected flow separation was also predicted and needs more investigation, he says. Arie agrees: "Now we have the information, we can do something with it." Serge thinks it will be interesting to look at more drift angles and Arie wants to use the results for dynamic tracking studies so that time and therefore, money, can be saved during sea trials.

And the future?

"In the near future, CFD will be used more for research purposes but in daily practice, it is still too complicated. But it definitely facilitates more insight into the flow around the ship and helps with integrated design", says Serge.

Arie nods: "It is rather unpleasant to do calculations with the same hull, one after each other, with different computational tools. Furthermore, PARNASSOS is especially good for the model-scale effects problem."

"In the future, calculations will be done earlier, design decisions made earlier but because some calculations can never be 100% correct, model tests will be carried out for final verification," Serge says to Arie. Vessels are becoming more complicated, making simulations more difficult.

"I agree", says Arie. "We believe we can trust PARNASSOS. To convince clients however, we attempt to validate the investigations as often as possible. One should realise that we always have to satisfy our clients with good and reliable results, within a short time-span and with minimal costs. CFD will help us with this. But sometimes they require model tests in the design stage to be convinced of the performance of the vessel. So, calculations will not fully replace model tests but they will be used more often." Despite being convinced of the possibilities of viscous-flow calculations, he adds: "I still like to do model tests because the performance data can be used for adjustment of our prediction tools but that's me." Both are pleased with the results but agree that it looks like calculations and model tests are set to work alongside each other for a few more years to come!

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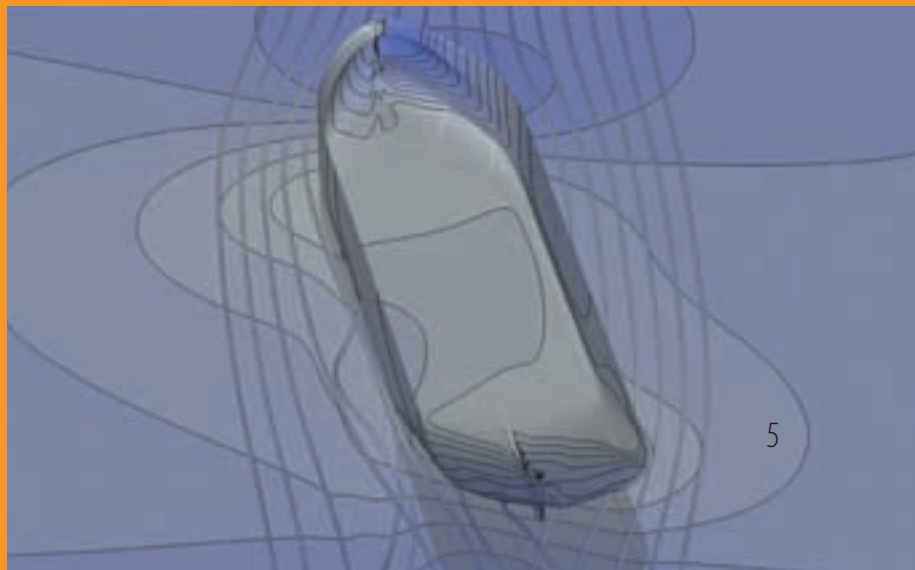

Streamlines and pressure distribution around hopper dredger in oblique viscous flow in shallow water.