

MARIN's new Depressurised Wave Basin ready for the future

The Dutch Minister of Economic Affairs, Agriculture and Innovation, Maxime Verhagen, officially opened MARIN's new Depressurised Wave Basin (DWB) in Ede on 19 March. The new facility combines a depressurised towing tank with a wave maker, which is the first time this has ever been done. The project represents an investment of 17m Euros, for which MARIN receives a 14m-Euro subsidy.

At the DWB, MARIN can now both make waves and reduce the ambient pressure. This offers advanced testing possibilities concerning the performance of cavitation observations, hull pressure measurements, wave added resistance tests, the way in which water enters damaged ships and ship drag reduction by air lubrication for mild to severe weather conditions. *GoGracht* spoke with Ir. Johan H. de Jong, who was a member of the steering committee that initiated the DWB, or "Cathedral" as the facility is called at MARIN.

"We are an independent maritime research institute and test anything that gets wet, whether it sails, floats or is connected to the sea basin", says De Jong. The DWB facilitates the testing of ships and offshore structures in the most realistic operational conditions possible today.

"The basin in Ede was built in the 1970s", De Jong explains. "It was a highly modern basin then, ahead of its time, specially built for cavitation research in calm water. With an eye to the then near future, the basin was designed large enough to facilitate tests with large crude carrier models. These very large crude carriers never entered the shipping market, but MARIN did have a modern depressurised basin measuring 220x18x8m that was to stand the test of time for a long time."

Offshore industry

However, after forty years the test facility no longer met MARIN's changing demands, especially in the field of propeller cavitation in real-life circumstances. Also, the offshore industry became more important. "Onshore resource depletion is resulting in an increase in offshore activities, especially deep sea mining. Furthermore, the number of studies into wave energy convertors is increasing as well as the actual number of wind-



Ir. Johan H. de Jong. (Photo: EK)

mill parks. We are talking here about semi-permanent constructions that are connected to the sea bed and are subject to wave loading. Carrying out model scale research including enclosed air volumes, generated by waves beating against a structure at sea, is becoming important." The enclosed air pockets require the proper scaling of air pressure, read lowering the pressure. Thus, in order to modernize the Ede basin and establish a pioneering facility again that would cater to new demands, MARIN decided to upgrade it and install wave makers.

As MARIN states in its April issue of *Report*: "In the DWB a large ship model of a Very Large Container ship of about 350m can be tested at a model scale ratio of 1 to 30. In our Seakeeping and Manoeuvring Basin (SMB) the scale ratio typically doubles, which means that a 1.5m wave for the ship would require a 2.5cm wave in the SMB and a 5cm wave in the DWB. This increase, in combination with the increased measurement accuracy, improves the prediction of wave added resistance in typical service conditions."

Meanwhile, the DWB is almost fully booked with employees working a two-shift system.

As for the new facility, a 120m long wave maker has been placed on the long side of the basin, a 160m beach on the opposite side and a 14m wave generator on one of the short sides. By using two wave generators, waves can be produced from any direction, not only head waves. The steel "beach" is needed to damp the waves fully and

while reflecting not to disturb the created wave pattern. The flaps of the wave generators can be folded in, aligning the basin's sides, so that the original functionality of the facility (i.e. shape) can be restored whenever necessary. As an add-on, a silent towing carriage, which has rubber tyres, has been installed, reducing generated external noise. Using hydrophones, MARIN can measure flow noise, the noise of breaking bow waves and propeller noise. The existing towing carriage remains in use and has been fitted with a new sub-carriage that facilitates free running sea keeping tests (i.e. no connection to the carriage during testing). It enables an unmanned operation and automatic catching of the models at the end of a run and during the return run.

Because of the reduced ambient pressure, the system needs to be operated remotely controlled. A mechanism had to be invented that would pick up the model at the end of a 'ride', which is normally done by hand by personnel standing on the carriage. A system has been developed in which the model is linked to four slack threads that are only pulled straight when the model needs to be 'caught' at the end of a test run.

Another issue was cooling. All motors and wires had to be placed in pipes or chests and in order to cool the system, air is actively pumped round. It takes eight hours to create the right air pressure in the basin, which can be decreased to 2.5 percent of the atmospheric pressure.

Propeller cavitation

"The avoidance of propeller cavitation [the formation and then almost immediate implosion of cavities in a liquid, which usually occurs when a liquid is subjected to rapid changes of pressure] is of great importance to the Navy", De Jong says. Again, the correct scaling of the pressure is needed to allow the proper existence of these cavities. "In order to let their vessels operate as quietly as possible, the Navy wants propellers that delay the cavitation inception as long as possible. Cruise

vessels and luxury ferries also have high demands when it comes to ship noise. "Now we can carry out research into cavitation behaviour in waves. As for commercial shipping, it is cavitation erosion that is important, i.e. the moment when cavitation causes damage to a propeller. However, now that the IMO is getting interested in reducing ship-introduced noise, we can expect new requirements for cargo vessels within a foreseeable time. Crews will benefit too, when vessels operate quieter. However, there is no demand yet for research into ship-introduced noise from the shipping sector yet, except for cruise vessels and ferry operators. Again, MARIN is ahead of its time. For when the shipping industry requires vessels producing less noise, we are ready to step in. The silent carriage was merely an add-on for the DWB, but may prove to be important in the future"

The DWB is said to be unique in the world, although China apparently has a depressurised wave basin, too. At the question whether the new facility will lead to new ship designs De Jong says: "I do not expect major changes in the field of shipbuilding, which is based on experience that goes back centuries. Perhaps it will affect the shape of bows and other wave exposed structures. Surely the ongoing studies into air lubrication will affect the shape of ships. In the offshore industry it might

The silence carriage. (Photo courtesy MARIN)



Marine research institutes

Marine research institutes assist Spliethoff Group members in optimising their vessels and specific operations.

BigLift and MARIN, for instance, cooperate in a number of research projects, such as a crane simulator for heavy lifts (which will be used for engineering and training), and in optimising the routing

of ships with an eye to minimal impact of ship and cargo. Also, MARIN's expertise was provided in the BigLift newbuilding project.

Wijnne Barends' latest newbuilding design, the Lady 'A' class, was tank tested at HSVA's facilities in Hamburg just like most Spliethoff newbuilding designs. This in order to optimise the vessels' hull lines. In the HSVA wave basin, dynamic tests under seagoing conditions were executed which will be addressed to in one of the next issues of *GoGracht*.



The DWB under construction. (Photo courtesy MARIN)

well be possible that new research into waves, wave impacts and wave energy conversion will lead to innovations.”

At the DWB, both waves and air are scaled down. It is not possible yet to ‘scale down’ the water, i.e. change for instance its viscosity, De Jong says. “Replacing the water by alcohol, for instance, is not an option. So we have to deal with these kinds of scale effects and learn about their magnitudes and effects. However, all this is part of 80 years experience at MARIN.”

The DWB project started in February 2010 and on 1 April 2010 work started on emptying and cleaning the tank and on site preparation. Two years later, the DWB was operational. The facility contains 35 million litres of water and it took two weeks to fill the basin.

At the question why other maritime research institutes do not have depressurized basins with wave makers, De Jong says that both the government and MARIN were ahead of their time when deciding on what kind of depressurised facility was to be built in Ede forty years ago. “Instead of a cavitation tunnel, which would have been much cheaper and which is far more common, they decided on a cavitation tank. A cavitation tunnel is

a large tube in which water is pumped around and the model hangs at the top of the tube. Since the water circulates round the tube, it is impossible to create waves. Where other research institutes would have needed to build a completely new basin, in Ede, we could just add wave makers to create a DWB.”

The scale models MARIN uses in its test are all made in-house at the research institute’s facilities in Wageningen and Ede. The models, which are usually made of wood, are milled automatically and can have lengths of up to 12 metres. Some models are made of synthetic material, some are made of carbonfibre. Small, complicated parts are made by a 3D-printing machine.

Government

“It is time to shine a positive light on the government, which made the Ede basin possible in the 1970s and now enabled us to set up the DWB, for which we have received a E14m subsidy to which MARIN added E3m. Much of what we do at MARIN strongly focuses on research. We largely aim at joint-industry projects in which several parties are brought together. “We keep our ears open when customers have questions and bring them together for major research projects.”