Supply operation

Safe, motion compensated offshore lifting

Successful testing campaign for the Barge Master

Officially launched in December 2012, Barge Master is an innovative solution to the common problem of sea-induced motions during offshore installation work.

Martijn Koppert, creator and director of Barge Master, explains how the success of a test campaign at MARIN paved the way for the start of this pioneering product, which is already being warmly welcomed by the industry as a solution for safe, motion compensated offshore lifting.
Headquartered in Rotterdam, Barge Master develops and produces wave compensated platforms for the marine and offshore installation industry. The first Barge Master, the S700/C400 can carry a 400mt crane or, alternatively, compensate loads up to 700mt when used as a supply platform. The first Barge Master, BM-001, is now on the market for commercial use. Barge Master asked MARIN to prove the concept could work by carrying out both scale model tests and numerical modelling.

Spending his whole career in marine services and marine construction, Mr Koppert was well aware of the problems of crane loads starting to swing when there is a swell. He drew on his engineering knowledge to formulate a possible answer to the problem. "For some time, jack-up barges have been used offshore but these are a fixed and very expensive solution and difficult to mobilise." "Around five years ago I asked, "Why not solve the problem with hydraulics?" This was the start of Barge Master and his efforts to compensate the motions of the vessel using hydraulics, whilst taking roll, pitch and heave into account.

Martijn Koppert, creator and director of Barge Master

Huge potential Barge Master teamed up with drive and control company Bosch Rexroth to explore opportunities. The first major issue to be addressed by the partners was to check whether the Barge Master would influence the behaviour of a barge. "We wanted to make sure that it wouldn't exaggerate vessel motions and we needed to analyse whether the combination of a barge or a crane, plus the Barge Master, could result in a stable platform." And as well as determining the whole stability of the configuration, Barge Master wanted the tests at MARIN to show people that the concept worked from the scale model to convince the market and investors of its huge potential.
Mr Koppert was already familiar with the work of MARIN because several former colleagues worked there, so it was a natural choice for the tests. MARIN developed a model scale version of the Barge Master, where the hydraulic system was modelled with electronic motors and an electronic control system. This system mimicked the exact behaviour of the Barge Master's hydraulics and its controls. The MARIN model facilitated the careful validation and fine-tuning of the Barge Master system.
It was an enormous challenge, he admits. Barge Master had to hire the Shallow Water Basin for several days in February 2011. The scale model was tested with suspended loads in various wave periods and headings. Working with MARIN was very easy, he comments. "We are very enthusiastic about MARIN's performance." Small project teams from each organisation worked closely together during development. "We speak the same technical language and MARIN has the right spirit! This is also an interesting project for MARIN and the Classification Societies because it is a complete first. Everybody wanted to make it happen."

Results better than expected Tests with the crane showed that the hook and the load were perfectly still and this was proven in real life during sea trials in the North Sea. The results were even better

Crane operation at North Sea

than expected, with the hydraulic platform compensating wave percentages upward of 95%. Numerical models also showed that the system would be stable. The Barge Master can handle significant wave heights of up to 2 m. It is suitable as a motion compensation platform for any type of crane on flat top barges and vessels or for stabilising cargo during vessel to platform transfers.

During the testing period the team also found that the original 2 m maximum stroke for the cylinders was not enough and this had to be changed to 2.5 m. Barge Master decided to compensate at three degrees of freedom: roll, pitch and heave. "Even with enormous forces, it provides a very stable platform on the horizontal plane. We knew it was possible but now it was proven that we could compensate motions for enormous loads of up to 700mt."

Additionally, MARIN and Barge Master jointly developed a numerical model, which can show the performance of the Barge Master on any type of vessel. "We can run the program and predict the performance in any wave conditions. We can show potential customers the performance and workability and most crucially, can quantify this workability."

Quantifying workability Once the tests were concluded, construction got underway and sea trials took place in the North Sea in 2012. Tests along with maritime contractor, GeoSea, were undertaken using both a crane configuration and also using the Barge Master as a supply platform. GeoSea provided a jack-up barge and all the maritime services. The North Sea tests encompassed an offshore supply operation involving GeoSea's jack-up barge, Goliath and the Barge Master platform mounted on a standard barge. An offshore supply scenario was staged in the concession zone of the future wind farm, Rentel, in the Belgian North Sea. During an earlier test in the Dutch North Sea, the motion compensated installation solution was tested involving a standard crawler crane mounted on the Barge Master, which in turn, was mounted on a standard North Sea barge. Tests were performed in a variety of sea-states and mooring setups. With the Barge Master switched "on", the crane hook and load hung perfectly still.

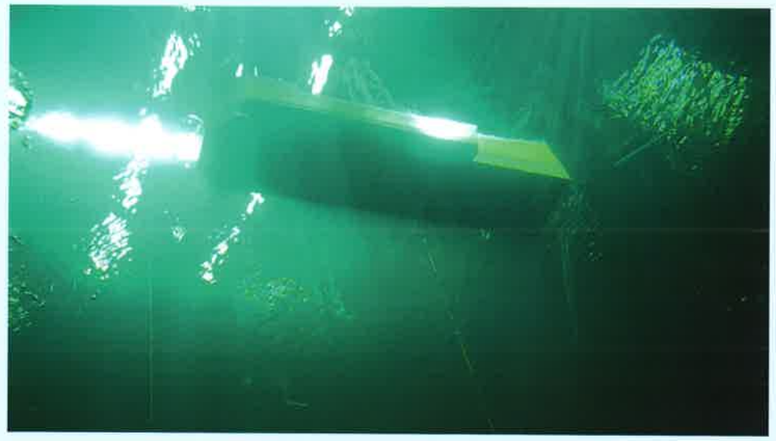
Mr Koppert says: "Wind farms are normally built by jack-up barges whereby components are loaded on the jack-up and then sailed to the location. But this is restricted because they can only take one or two turbines at a time. The Barge Master means it is possible to avoid leaving the field and returning to port continually."

Wind farms Barge Master is ideal for the offshore, salvage, oil & gas industries, as well as for decommissioning. "It provides increased safety and workability during offshore lifting and supply operations. It is a flexible solution using standard barges, cranes and vessels and a low cost solution. Marine lifting operations up to 1,000mt can be performed safer, quicker and under more adverse sea conditions," he emphasises. Its flexibility is shown in that the 700mt Barge Master is easily mobilised because it is fully containerised in only 12, 40 ft containers. "It can be placed on any vessel and deploy any crane - be scaled up and down." Barge Master is currently developing adapted versions to accommodate different uses. At the moment, a small mechanism using a cylinder for compensating roll, pitch and heave is being developed, suitable for a payload of 50mt and the company is also considering versions going up to 1,500mt.

Certainly the newly launched solution is making its mark in the industry. Clearly, the Dutch government also has confidence as it has been endorsed by the Innovations Office Agentschap NL and the government had guaranteed loans for its development. For the new applications, Barge Master is happy to return to MARIN. "For additional testing we look forward to working with the team again. It has been very interesting to work together with MARIN and see this pioneering product develop from a concept to reality." ⌐

Investigating the challenges of the deep

New deepsea mining concepts were under test in MARIN's Deep Water Offshore Basin.



Recent developments in the offshore deep-sea mining sector have resulted in new concepts for deep and ultra-deep systems to recover natural resources from the sea bottom. At water depths ranging from 300 m up to 6000 m, valuable materials can be recovered. Last February MARIN organised a demonstration model test to show the feasibility of two typical systems and to investigate their hydrodynamic challenges.

Natural resources can be found in the proximity of so-called "black smokers", which are active subsea volcanic areas that produce sulphates and metallic nodules that settle down on the sea bottom. Various deepsea mining concepts are being developed to recover these resources at water depths ranging from 800 m to 3000 m and even deeper. Typical concepts involve a vertical riser system with mid-water pumps, gas lift systems or a deep water lifting arrangement to bring the material to the surface.

A demonstration test was designed to show two systems in parallel deployed from one vessel. The vertical riser system was hung off from the centre of the vessel (including two mid-water pumps, modelled as 120t mass) and the deepsea lifting arrangement was located at the stern. A stock model was used at scale 1:80 to model the deepsea mining vessel and this was tested in the deep pit of the offshore basin at a water depth of 1530 m.

From hydrodynamic research experience for the oil & gas industry in deep and ultra-deep water we know that there are challenges such as the dynamic response of floating systems in waves and current. Vortex induced vibrations and excitation of natural modes of the vertical transport system could occur. During the tests visual observations were made and accelerations in the vertical transport system were measured and these will be reported in a conference paper next year. ⌐

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