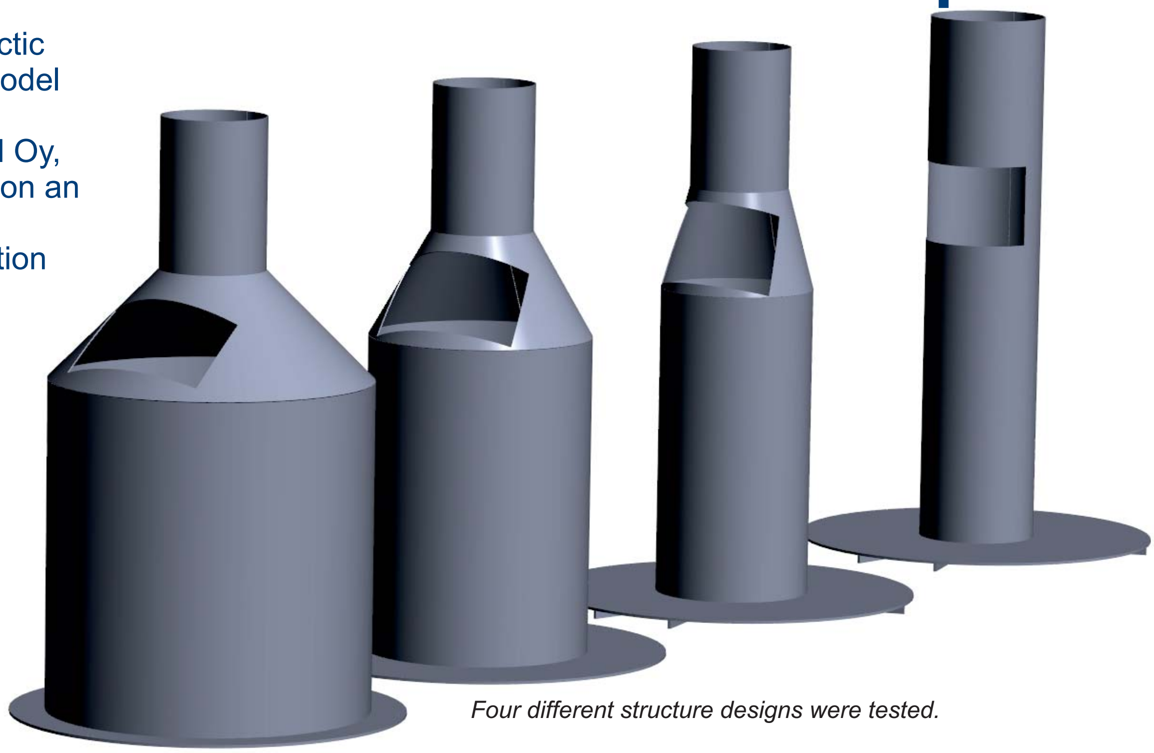
Ice model tests for Technip

In 2014, Aker Arctic performed ice model tests for Technip Offshore Finland Oy, where ice loads on an offshore wind turbine's foundation structure were studied.



Four different structure designs were tested.

Four different structure designs were tested during the test series, one straight cylinder and three conical structures, with various cone angles.

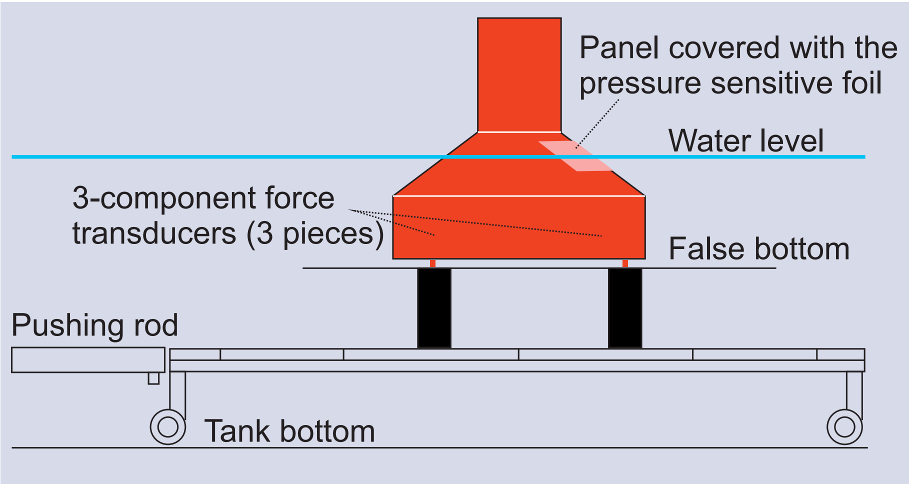
Three separate measurements were made for each structure: global ice loads were measured from the base of the structure, local loads were measured from the panel, which was located at the water line and, additionally, the pressure distribution of the panel was measured with pressure foil provided by the Technical Research Centre of Finland (VTT Oy).

Testing method

"The test series consisted of six test days. Each model was tested in 0.6 m thick ice and two of the models also in 1.0 m thick ice," says Topi Leiviskä, Riikka Matala and Jukka-Pekka Sallinen from Research and Testing Services, who planned, performed and analysed the tests.

“The ice movement was simulated by moving the model instead of ice. The model was fixed to an underwater carriage, which was pushed through the ice field at the desired ice drifting speed.”

"The test ice conditions were level ice and an ice ridge. A triangular ice ridge was constructed for this purpose. The models were first moved through the ice ridge and then through the level ice. We tried to find the most challenging situations possible," Ms Matala continues.



Test arrangement

“Tests were recorded with several video cameras from various angles. Three of the angles and a load measurement signal were synchronised to a quad-view video feed, which gave us an opportunity to visually observe how ice impacts affect the ice loads,” Mr Sallinen explains.

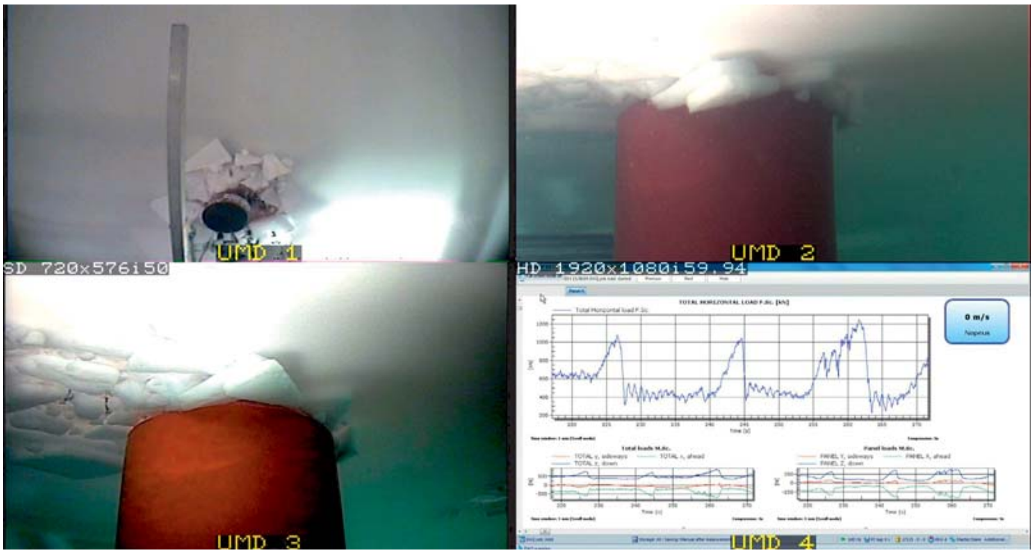
Reasons for testing

There were two reasons for performing the tests. The main reason was to survey the cone angle effect on ice loads and vibrations on structure in order to find the technically and economically optimal design, because the customer plans to build wind turbines in areas where there is ice movement.

The potential wind turbines are intended for the Baltic Sea area, where ice thickness is usually about 0.6 m. Only in extreme situations can the ice grow up to 0.8 m thickness.

"The second reason was to calibrate a new mathematical model for ice loads, which is created by the Technical Research Centre of Finland (VTT). For this purpose the test series included additional ice measurements, e.g. ice-ice friction, compressive strength and punch-testing," Ms Matala outlines.

Ice conditions at testing



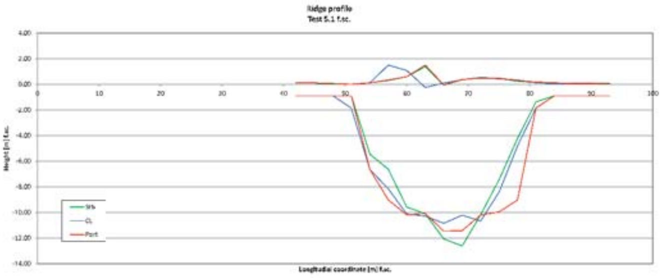
Three video views and a load measurement signal were synchronised to one video to improve analysis.

Benefits of tests

The test results will be used to choose the optimal structure design.
Additionally, ice-induced vibrations can become a challenge and by using the results from the tests the chosen structure can be optimised with structural design to bear vibrations.

"Our customer Technip Offshore Finland was actively involved in the model testing and analysing work and we are now planning further testing," Mr Leiviskä says.

"This systematic test programme provided new information from the interaction between the ice and the structure," adds Senior Engineering Manager Jukka Leppänen from Technip.



For this project a new technique to create a triangular profile ice ridge was used. This method can also be used for other tests in the future.