

ENGINEERING SERVICES

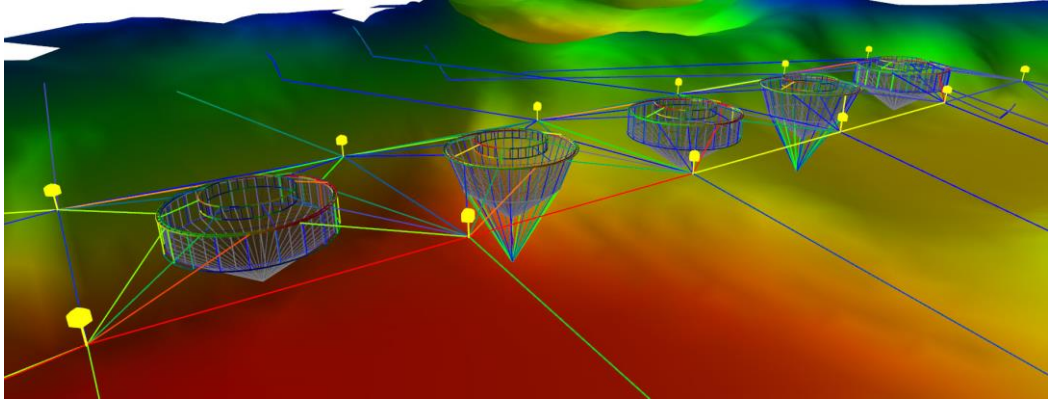


SAFETY THROUGH TECHNOLOGY

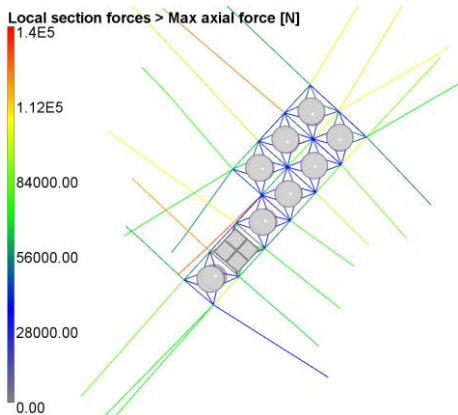


aquastructures

Mooring Analyses

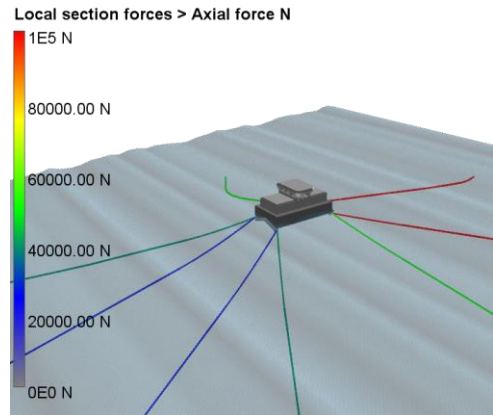


A mooring analysis calculates the load effects in the mooring system of a fish farm plant, a barge or other floating structures. We aim to calculate a cost-efficient mooring configuration and provide safe solutions. [Aquastructures](#) holds the necessary approvals to perform mooring analyses for the aquaculture industry in accordance with the NYTEK23-regulation, Norwegian standard NS 9415 and the Scottish technical standard for Finfish Aquaculture.



Fish farm

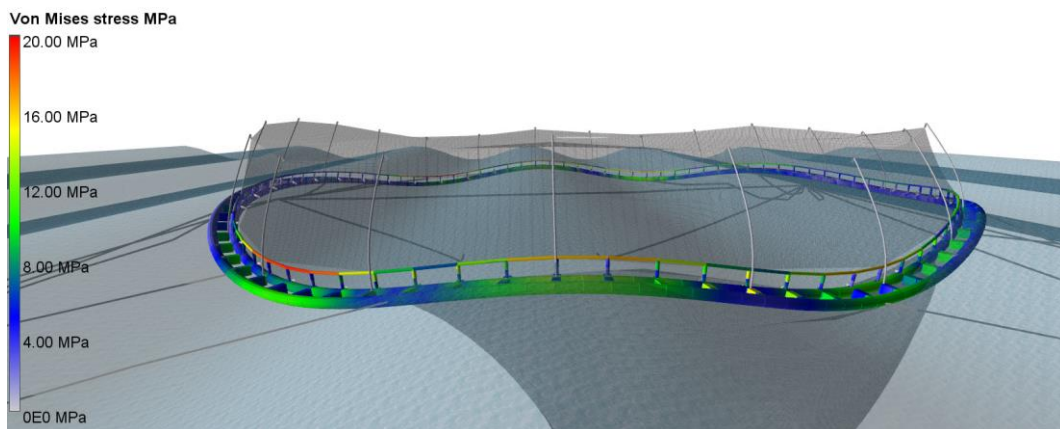
To reduce the risk of fish escape, Norwegian authorities require a design verification for all fish farm plants. We include all vital components in the mooring system. Through the accreditation INSP 004, we provide the required mooring analyses.



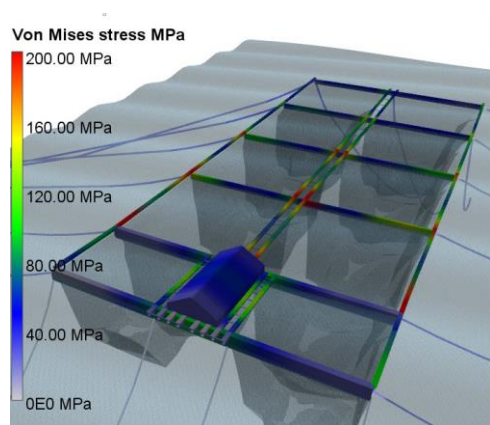
Feed Barge

Barges are often sensitive to wave- and wind loads. [Aquastructures](#) perform analyses in both regular- and irregular sea states. Providing accurate calculations of the load effects and assessment of fatigue problems.

Structural Analyses

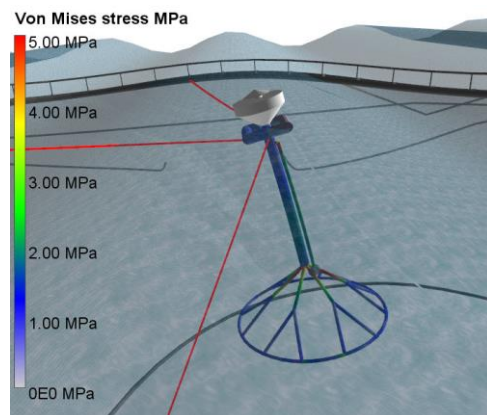


Floating or fixed structures, such as aquaculture facilities, wave power converters and oil- and gas installations, will be exposed to wave forces as well as current- and wind loads. [Aquastructures](#) has extensive experience with analyzing the strength of marine structures, applying our engineering software tool [AquaSim](#).



Floating collars

Floating collars, for use in the aquaculture industry, are constructed to move **with** the waves, rather than against them. The deformations that will arise will give a continuous change in loads over time. In some cases, stiffness and direction of the mooring system is essential to achieve the correct response of the installation. Coupled analyses, with the use of [AquaSim](#), provides accurate and reliable results.

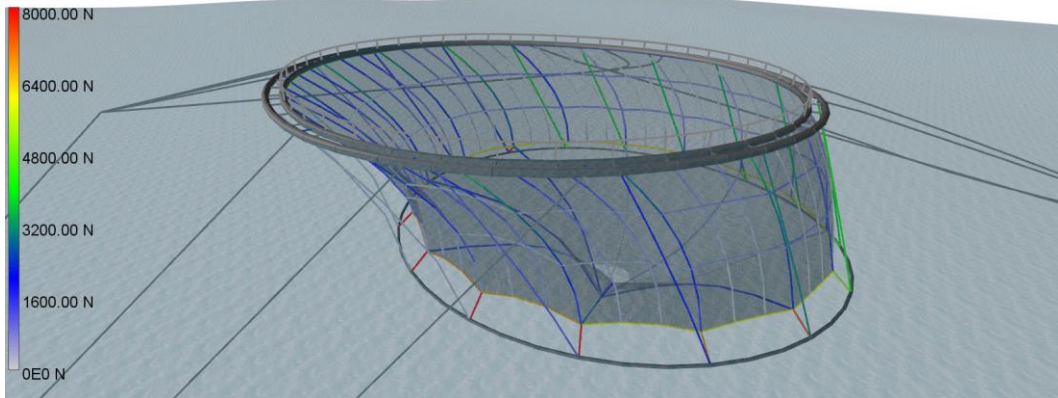
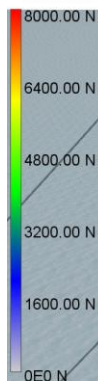


Secondary equipment

Secondary equipment will, in varying degrees, inflict other main components such as floating collars, nets or mooring. The strength of the equipment must be sufficient to reduce the risk of damaging other main components. Equipment weight and center of gravity is crucial for the forces transmitted into mooring and connection joints. Proper design will be important to prevent damages to nets or similar.

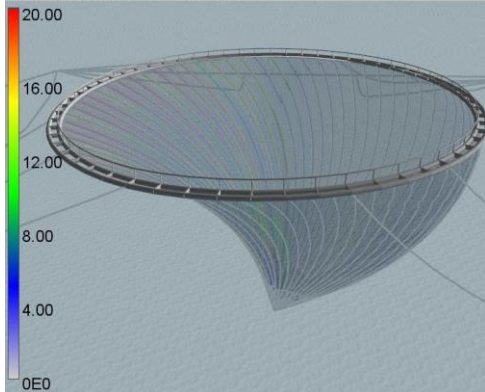
Net Analyses

Local section forces > Axial force N

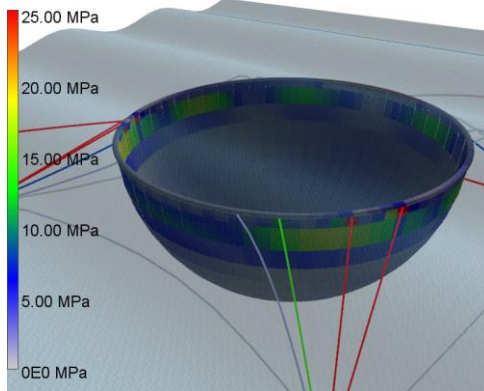
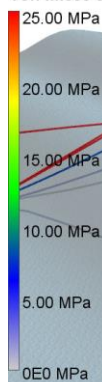


AquaSim is specially designed to perform analyses on flexible aquacultural nets. The flexibility of the nets causes the structure to be continuously altered when exposed to waves and currents. **Aquastructures** provides calculations and analyses of soft, flexible as well as rigid constructions.

Net > Force in vertical twines



Von Mises stress MPa



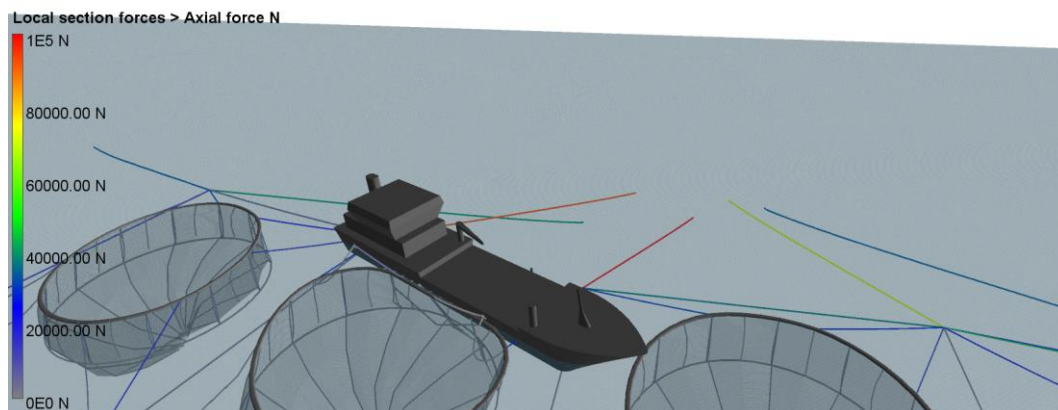
Standard Nets

Nylon nets of different shapes are widely in use by the aquaculture industry. Our net analyses account for all components in the net. Secondary equipment, such as lice skirts, will cause an increase of drag forces providing higher loads to the mooring system. It is therefore of great importance to include all relevant components in such analyses.

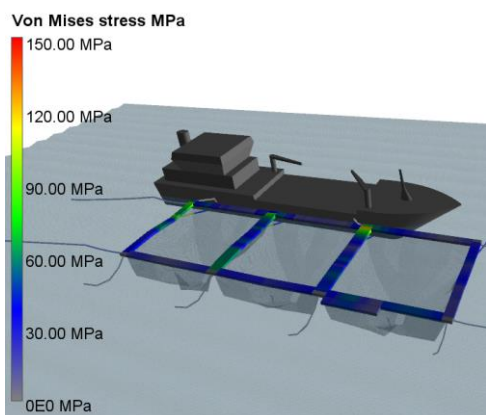
Tarpaulin- and shell structures

New products are emerging in the industry, and impermeable tarp solutions, or other stiff plastic and glass fiber constructions are becoming more popular. **AquaSim** holds the technology to analyze the response and forces for such solutions.

Marine Operations

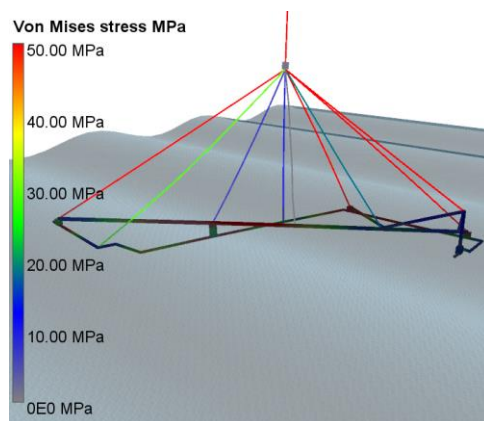


Large service vessels and operations in demanding weather situations cause the need for calculations of the loads that occur during operation. Our experienced engineers perform calculations and analyses for different types of marine operations with the use of [AquaSim](#).



Service Vessel Operations

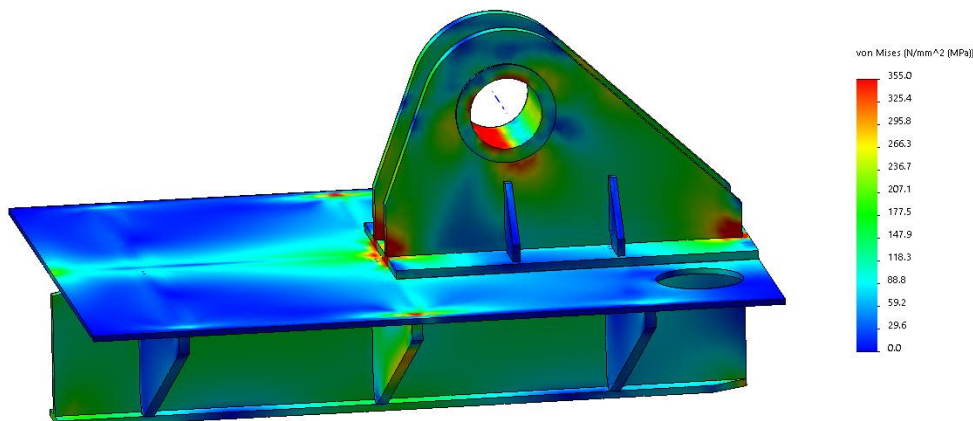
Service vessel operations in rough weather conditions may cause high loads in the mooring systems and other installations. This can lead to capacity exceedance of components in the structure. It can be difficult to determine when it is safe to perform an operation based on weather conditions. Wrong decisions could cause damaged equipment, escape of fish and high costs. [Aquastructures](#) can perform calculations of operations and recommend suitable weather windows.



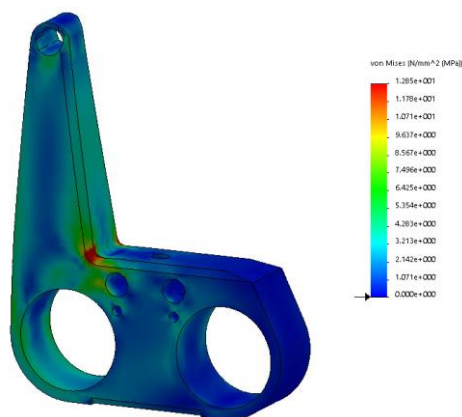
Lifting operations

Lifting operations of various equipment require knowledge of the weather windows where the structure can withstand the loads caused by winds, waves and current. Wave loads on the lifted structure will often be the limiting factor. [AquaSim](#) provides the possibility to calculate and visualize the internal stress distributions in the component, as well as the interaction with fluid and structure.

Detail FE Analyses

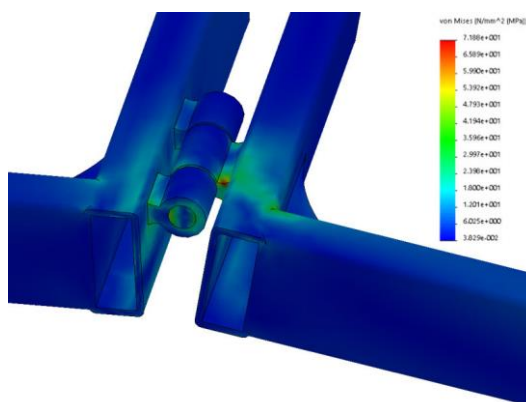


Detail FE Analysis (FEA) provides an accurate view of stresses around structural connections, hubs, hinges etc. Appropriate design of local details is crucial to prevent failures based on high stresses or fatigue. **Aquastructures** has extensive experience with analyses of plastic- and steel components..



Plastic Components

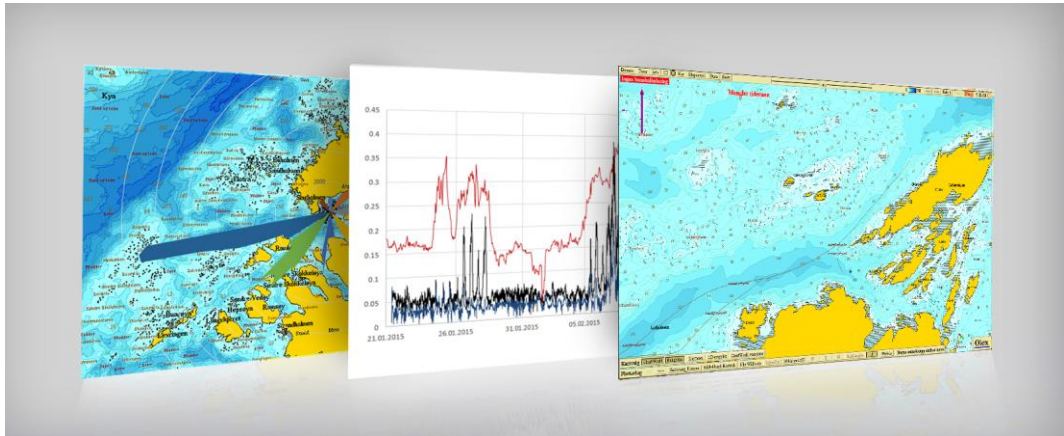
In the aquaculture industry there is a wide use of plastic components in flexible floating collars. Brackets made of plastic connects the floating tubes to the handrail, as well as to the net, sinker tube and mooring. The strength of the plastic brackets is therefore crucial in order to keep the collars integrity in exposed locations and during operations.



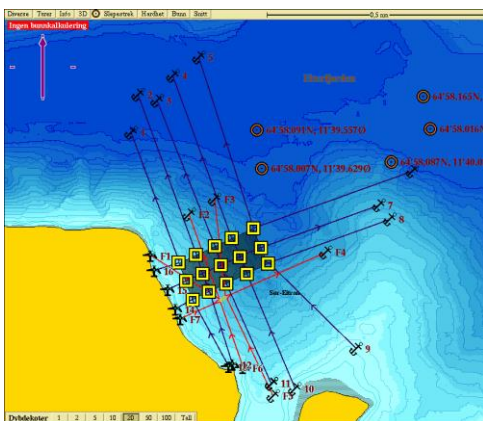
Steel Components

Aquastructures provides analyses on several types of steel components, such as hubs, mooring connections and hinged constructions. Details in constructions that are exposed to waves, can be subject to fatigue problems. Fatigue calculations can also be performed with input from the structural analysis.

Site Surveys



In site surveys, wind, wave and current is calculated. In addition, conditions like icing, mapping of seabed and tidal effects are documented. **Aquastructures** utilize developed methods for processing measured current data, which can provide a more accurate current description and reduce mooring equipment costs.

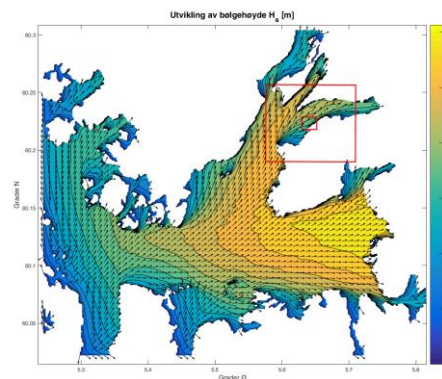


Site Survey Report

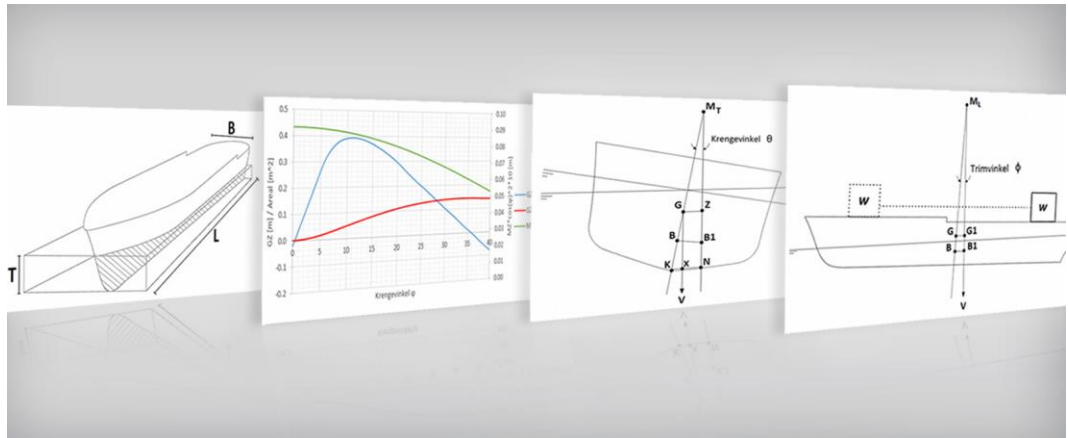
The findings from a site survey are summarized and presented in a Site Survey Report. The report forms the basis for a mooring analysis, which in turn determines the design of the fish farm. The Site Survey Report is hence the foundation of a properly designed fish farm. **Aquastructures** performs numerical calculations of both wind-generated waves and ocean swell. We also perform a thorough control of current data.

Calculation of Ocean Swell

Assessment of the influence of ocean swell must be conducted for each site according to NS 9415. In such cases, the impact of ocean swell must be determined based on numerical calculations, wave measurements or other methods. Applying the software **AquaSwan**, we provide detailed calculations of wind generated waves and swell combinations. The software is based on a cooperation with the University of Delft, Netherlands.

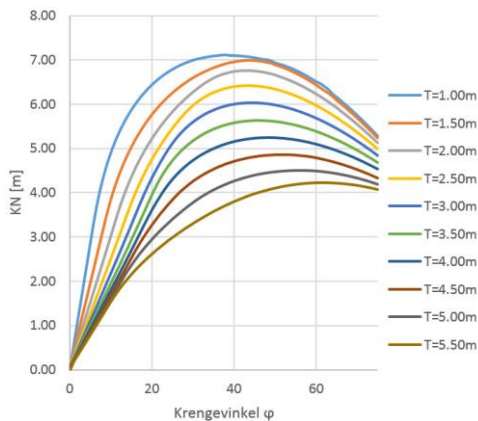


Stability Calculations



Stability is a fundamental part of a vessel's characteristics. Ensuring a satisfactory level of stability is essential for its safety, as well as for people and cargo on board.

Aquastructures applies the software **AquaStab** for analyses of barges and floating structures. The results are compared to requirements set by relevant standards.



Stability calculations are performed for intact and damage conditions. Key parameters for these conditions are center of gravity, center of buoyancy, metacentric height and righting moment. The analysis determines overturning moments, in order to determine the hydrostatic properties of the floating structure.

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