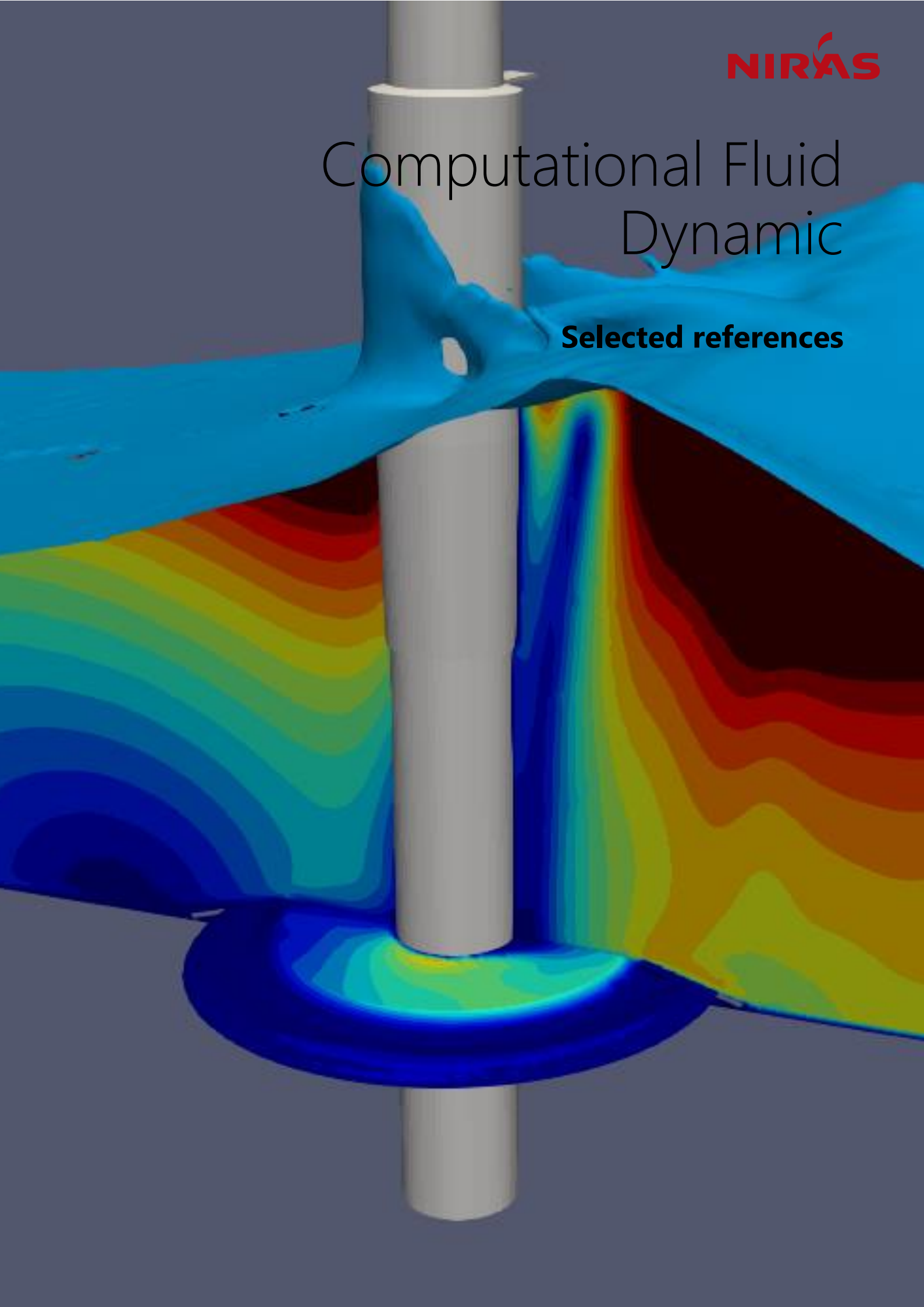


Computational Fluid Dynamic

Selected references



NIRAS - CFD as a tool to gain additional knowledge

NIRAS has established a broad level of experience in numerical modelling various challenges in the coastal, and offshore waters through the many integrated coastal projects we have implemented across the world. Coastal/offshore engineering is a complex discipline that requires extensive theoretical knowledge and genuine practical experience. Additionally, engineering projects are often multidisciplinary and concern several stakeholders making it crucial to successfully manage and combine all interfaces involved. This complexity sometimes requires numerical modelling. NIRAS uses state of the art software like MIKE by DHI and CFD to solve complex hydrodynamic challenges. NIRAS has a team of 17 skilled coastal engineers, several holding PhD's in Offshore coastal and estuarine engineering, and several are authors of acknowledged international papers of coastal engineering. Together the team holds over 250 years of experience in coastal engineering and numerical modelling. NIRAS also holds dedicated models of large portions of the world.

Optimized and tailored solutions

NIRAS stresses the importance of establishing a fundamental understanding of the natural environment and local conditions when developing sustainable solutions. We hold state-of-the-art numerical models (MIKE-software and CFD-models), GIS and 3D CAD software, which enable us to assist our clients in managing and monitoring the coastal environment as well as developing, optimizing, and presenting our assessments and designs.

We have extensive state of the art experience with modelling. Modelling is a tool which allows us to model, understand and visualize complex physical phenomena in the coastal zone. At NIRAS we take pride in understanding the physical phenomena before the model is setup in order to use the model correctly. NIRAS has also developed tools and methods to utilize the best available free data thereby saving time and money for the client.

A wide range of services

Our in-house specialists cover all required disciplines within numerical modelling and have decades of experience in solving complex challenges including:

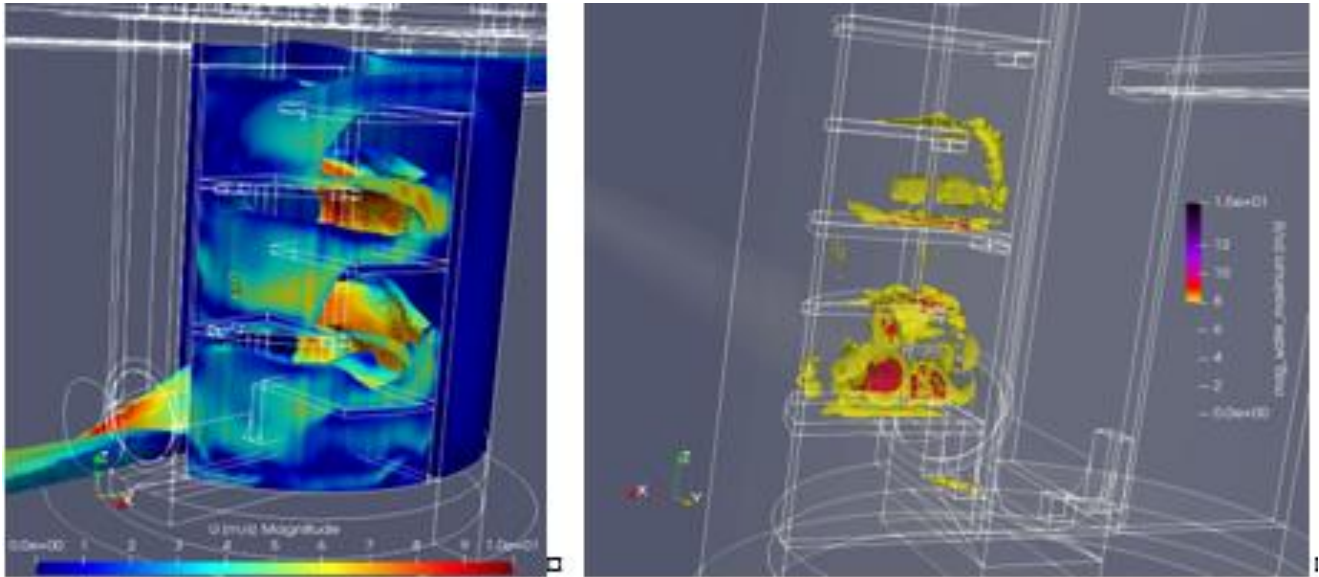
- Two Phases: Wave loads and run-up on offshore structures.
- Two Phases: Wave overtopping coastal defends.
- Two Phases: Residential time in tanks/basins.
- One Phases and tracer: Residential time in tanks/basins.
- One Phase: Wind comfort.
- Two Phases: Brine dissipation (wastewater from hydrogen production - excess salinity, and temperature) in the recipient.
- Three Phases: Detailed analyses of outlets this being the flow in the structure or the plume in the recipient.
- One Phase: Wind turbine down wake impact.



Klavs Bundgaard
Head of Department
+45 6040 5670
KLB@niras.dk



Signe Schløer
Team Manager
+45 6039 4411
SSC@niras.dk



Valby Cloudburst Tunnel, Denmark

With more frequent torrential rain and increased amount of everyday rain in the future HOFOR is establishing a tunnel of Ø3.4m to secure the city (Valby area) against flooding from the sewage system during cloudburst. Valby cloudburst tunnel will run from the FLS-grounds just north of the railway area by the old Grønttorv, above the approach road Folehaven with an outlet to Enghave Kanal in Valby Park – a complete distance of 2.400 m distributed over two tunnel stretches and four shafts.

The analysis phase and the sketch of the project is finished, and the design requirement to the system was along the design phase tested per main item and for the final design for the whole system with the use of CFD, OpenFOAM interFoam. The above figure shows the maximum velocities in the FLS shaft for the maximum design inflow. To the left as maximum at the surface and to the right the areas with velocities above 8 m/s.

Year

2020 - 2023

Customer

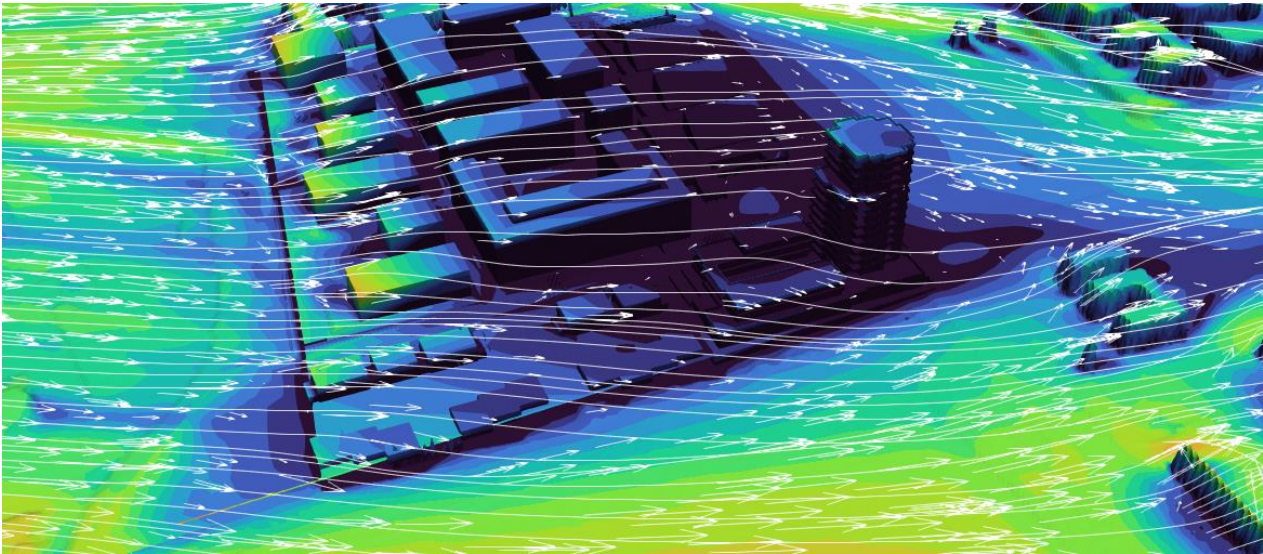
HOFOR A/S

Contract Fee

20.734.015 DKK

Project Category

Water environment



Wind Comfort Study for a new building

The construction project includes a tower with a top elevation of 125 m DVR90 corresponding to a height of approx. 45 m above the terrain at the light rail east of the building. The terrain varies by +/- 5 m around 80 m DVR90 within a distance of 200 m from the tower. The areas north and east of the construction site are relatively densely populated with relatively tall buildings.

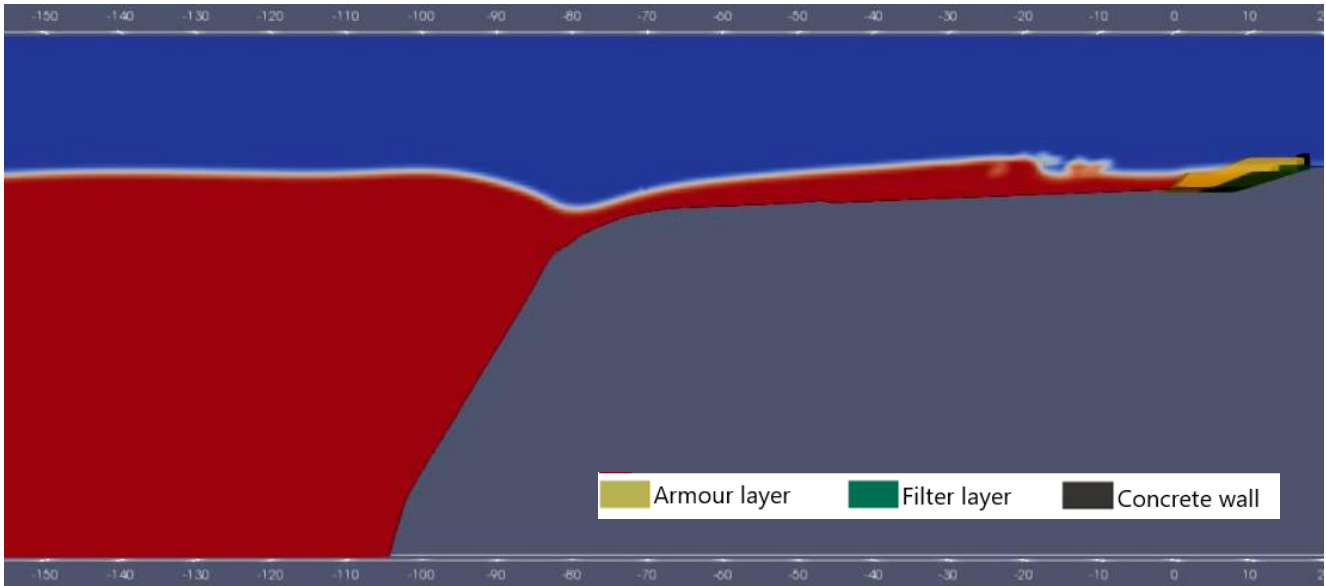
To investigate the wind comfort criteria according to SBI 128 for the building and nearby areas a CFD model was used to simulate the percentage of time were the conform criteria for different activities was fulfilled or not.

Year
2022

Customer
Innovater A/S

Contract Fee
DKK

Project Category
CFD



Detailed Design of Revetment on Fuvahmulah, the Maldives

NIRAS is sub-consultant for MTH Højgaard in establishing coastal protection along a 2.6 km coastal stretch on Fuvahmulah, the Maldives, where the sea level rise already is very evident. Especially the Eastern side of the island is exposed to large waves due to the fetch from the South Pole. The island is located on a coral reef, and when the waves hit the reef, large amounts of water is pushed upon the reef. This can lead to flooding of the island, which is only 2 m above mean sea level at its highest point. The processes on the reef are special, which is why the project has included hydraulic model experiments to verify and adapt the numerical models as well as the design of the revetment.

NIRAS has made the preliminary design for tender, inspected the coastline and the existing facilities as well as made geotechnical investigations, made the outline proposal, detailed design and drawings for the contractor using CAD. Additionally, NIRAS has defined the setup for 2D physical model experiments, assisted with tests, made MIKE modelling regionally as well as locally and done CFD modelling of waves propagating across the reef to get the overtopping and wave loads on the retaining wall.

Year

2021 - 2025

Customer

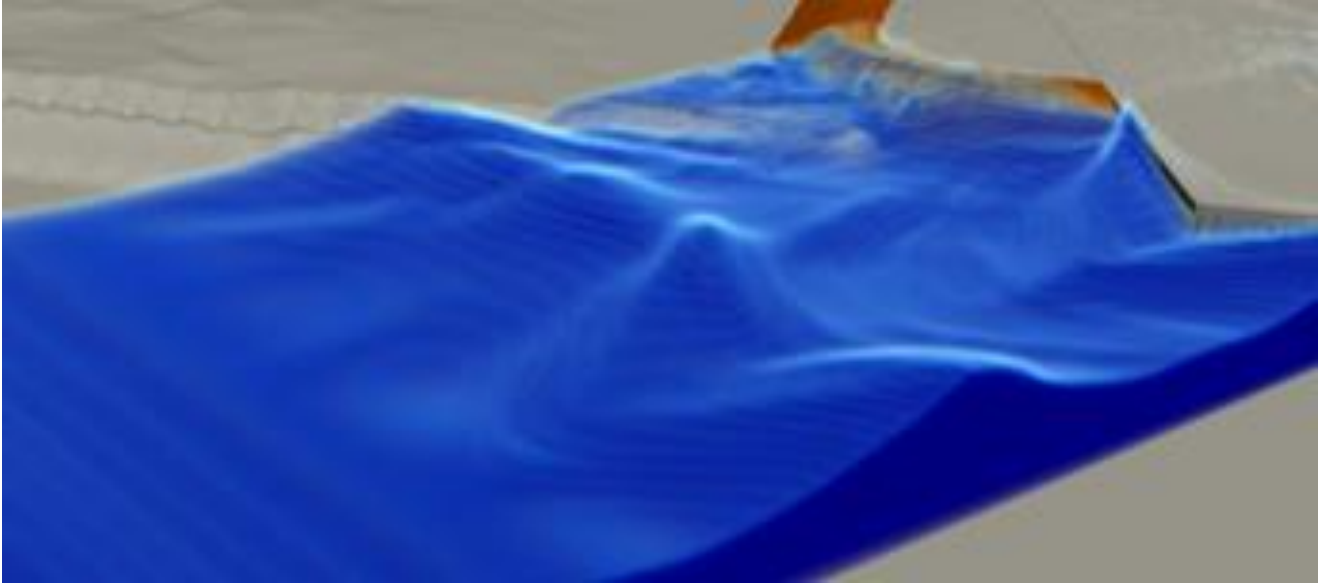
MT Højgaard Private Limited

Contract Fee

334.310 USD

Project Category

Harbours and Marine Structures



Stage 4 Expansion of Rønne Port, Denmark

The Port of Rønne serves all ferry services to Bornholm from Denmark, Sweden, Germany and Poland, both catamaran and conventional ferries. For this reason, the expansion of the port is an important part of the growth of Bornholm. The expansion is carried out in four stages. Stage 1 (2018-2019) and Stage 2 (2021-2022) are both completed, Stage 3 is planned to be carried out simultaneously with Stage 4, and is treated in a separate design basis.

For an interim stage of the outer breaker an issue was observed in the new harbour. To mitigate the issue a CFD model was set up to get the wave run-up and the forces/overturning moment on a temporary wall to prevent overtopping.

Year

2022 - 2023

Customer

Rønne Havn A/S

Contract Fee

1,840,360 DKK

Project Category

Harbours and Marine Structures