DHI SOLUTION

UNDERSTANDING WATER-STRUCTURE INTERACTION

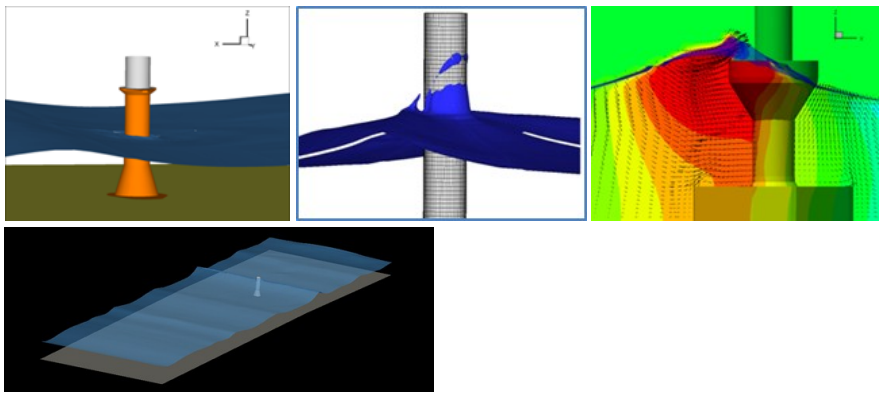
CFD modelling – our virtual physical laboratory

Almost since our founding nearly 50 years ago, advanced physical and numerical modelling have been our core tools. With the help of these tools, we solve a range of hydraulic challenges related to marine and other types of structures in all kinds of water environments. We initiated significant in-house Research & Development (R&D) and utilisation of Computational Fluid Dynamics (CFD) codes in the early 90's. Thanks to the continued development and access to high performance hardware, CFD is now a powerful tool to provide detailed description of the hydrodynamics around structures. We also use it as an engineering design support tool – often in combination with or as a supplement to physical model testing.

OUR FAST-TRACK APPROACH

Our solutions are drawn from decades of experience in hydrodynamics and hydraulics as well as our global pool of knowledge capturing the value of our expertise.

Typically we apply a phased approach. We use a range of efficient numerical models (such as potential flow solvers or MIKE by DHI modelling technologies) before any other analyses or in combination with initial CFD calculations. This fast-track approach ensures the efficient use of computational power and provides a quick overview of flow dynamics and its complexity. Thus it optimises the setup and subsequent execution of CFD models.



CFD modelling of hydrodynamic loads, wave run-up and flow fields around gravity based structures used eg. as a foundation for an offshore wind turbine enables testing of various design configuration efficiently.

SUMMARY

CLIENT

- Oil & gas industry
- Offshore renewable industry
- Port and terminal operators
- Water and Energy utilities
- Consultants and contractors
- Developers

CHALLENGE

- Insufficient knowledge of hydrodynamics
- Inadequate or inaccurate engineering design
- Cost-ineffective solutions
- Uncertainty about safety and risk levels
- Unproven solutions

SOLUTION

- Understanding of vital hydraulic design parameters
- Computation of pressure, flow velocities and hydrodynamic loads and motions
- Proof of innovative concepts
- Recommendations for optimal design

VALUE

- Solid foundation for informed decisions
- Reduced risk-modelling support design
- Enabling of cost-efficient design of structures
- Provision of insight into complex physics
- Support of sustainable solutions

We are a research-based company, aiming to constantly develop and improve our methods and models. In so doing, we strive to facilitate higher performance and value for our customers, and ensure sustainable and cost-efficient solutions at the same time.

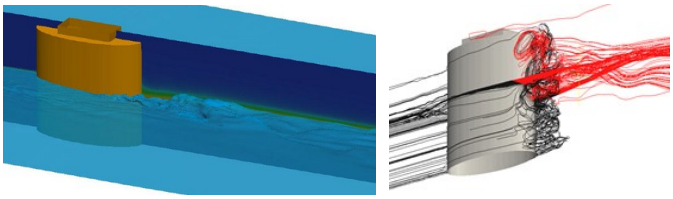
We apply in-house CFD codes and the open-source toolbox platform OpenFOAM®, which is widely used by commercial and academic organisations today. Access to the source code allows us to implement new or enhance existing features and develop customised solutions to difficult problems.

TURBULENCE CAUSED BY STRUCTURES

CFD can be very effective in analysing and understanding:

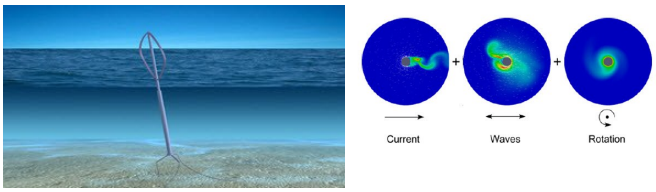
- the amount of hydrodynamic resistance or blocking of a structure
- the level of boundary turbulence
- the characteristics of the surrounding vortex structures

A subset of model results is often verified against experimental data.



We use CFD to simulate the wake and mixing of a two phase flow around a bridge pier located in highly stratified water.

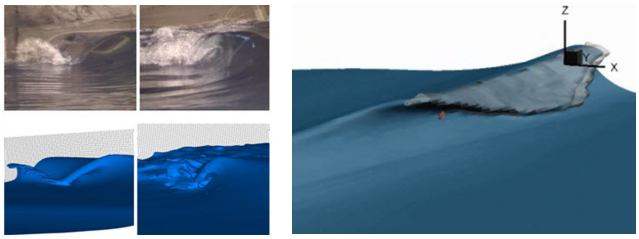
We contribute with our knowledge of CFD modelling of hydrodynamics for complex type of structures. An example is an innovative 20MW vertical axis wind turbine with a rotating offshore sub-structure, forced by ocean currents and waves. In combination with physical modelling, CFD supported the design optimisation. The developed CFD model will be used for scaling it up to prototype scale.



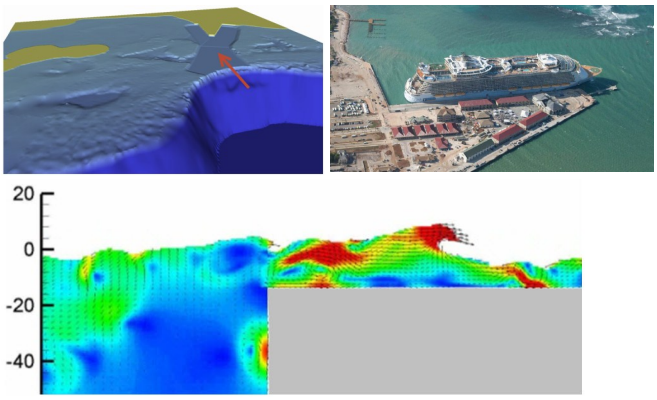
Artist illustration (left) of the DEEPWIND concept (www.deepwind.eu) and commutated flow fields around the fixed and rotational cylindrical foundation.

WAVE TRANSFORMATION

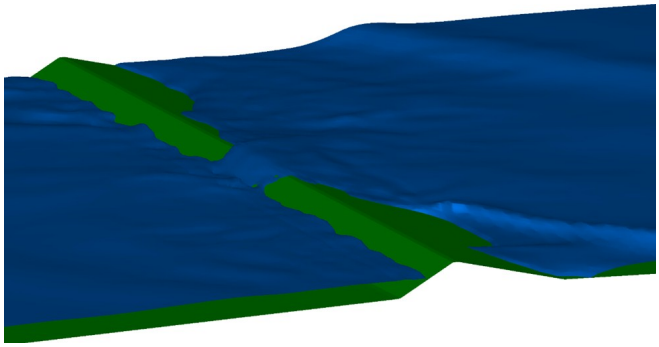
Accurate transformation of extreme offshore (design) wave conditions towards a shoreline and beyond is required in marine and coastal engineering. We have been a pioneer in this field and proven CFD to be a powerful tool.



Visual comparison between model results and camcorder recordings of plunging wave breaking (left). We use CFD to test performance and design of surfing reefs (right).



Transformation of extreme waves across an almost vertical reef towards a terminal was made by use of CFD and other type of models (numerical and physical). The lower panel shows an instantaneous plot of the wave induced flow field.



The illustration shows the computed wave overtopping on a sea dike for an obliquely incident irregular wave train during a possible future climate scenario. CFD is an efficient tool for assessment of wave run-up and wave overtopping on complex topographies for extreme sea states

WE HAVE THE SOLUTION

We possess nearly 50 years of experience and extensive knowledge in solving challenges in water environments related related to marine and other kind of structures. As such, we are confident that our efforts to constantly develop and apply CFD tools will continue to support our customers in finding and developing safe, solid and cost-efficient solutions.

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