Understanding the physical mechanisms behind the increased damping added by perforated heave plates of floating wind turbines

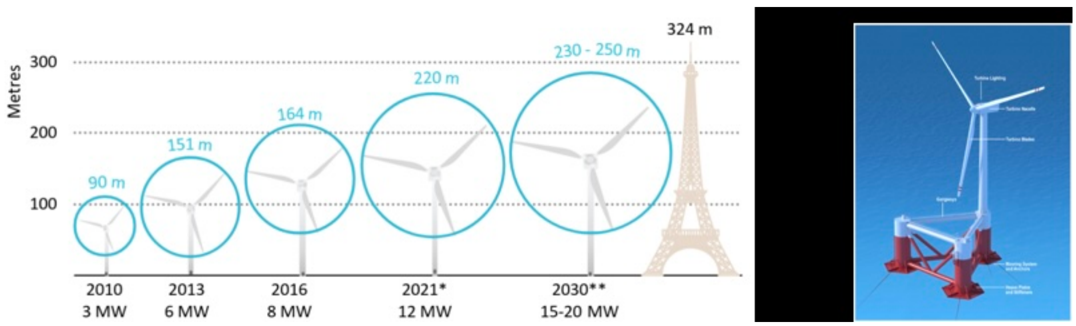
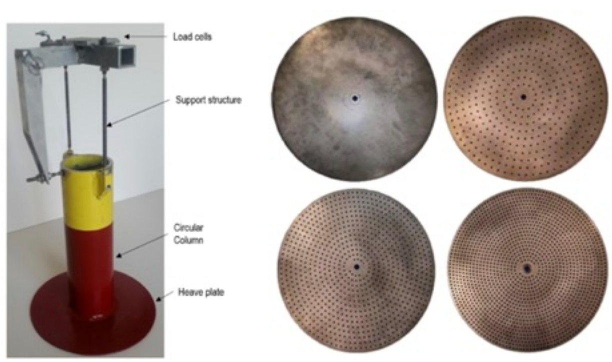


Figure 1 : The evolution in the size of floating wind turbines (left; source: [1]) and an example with heave plates (right; source: [2]).

Wind energy appears to be the most promising renewable source of energy. The appeal of installing larger wind turbines (i.e. with greater installed capacity, see Figure 1) further offshore stems from the fact that winds are stronger, more consistent and more predictable. However, far from the coast, it is no longer possible to install wind turbines on the ocean floor without significantly increasing the cost of installation. To remain competitive, wind turbines must float. However, there are still technological challenges to be overcome in order to deploy this technology and ensure its survival in the most extreme wind, wave and current conditions.

A major problem with floating structures at sea is their heave motion — the vertical motion around their equilibrium point, which cannot be prevented by anchors alone [3,4]. Current technologies involve installing heave plates at the base of the platform legs, designed to increase the added damping of the oscillating structure. However, it is not yet possible to predict the dissipation of a particular structure: a great deal of experimental testing in the laboratory is still required



(Figure 2). Our objective is to make progress in the design of stable structures, by first validating our understanding of the physical mechanisms involved.

Figure 2 : Examples of different heave plate technologies. Spar with heave plate (left; source: [5]) and porous discs (right; source: [6]).

The objective of this internship is to develop a numerical model that reproduces the experimental campaigns carried out in a wave channel and visualises the flow around a heave plate (Figure 3). The model will be developed with the open-source and massively parallel code_saturne [7] using the ALE (Arbitrary Lagrangian Eulerian) finite volume algorithm, which allows simulation with reasonable CPU costs. A series of numerical tests were already conducted in a previous internship, with an aim to assess convergence (in space and time) and select the turbulence model. The simulations carried out in this project will be compared the experimental results obtained in the Fricfloat project.

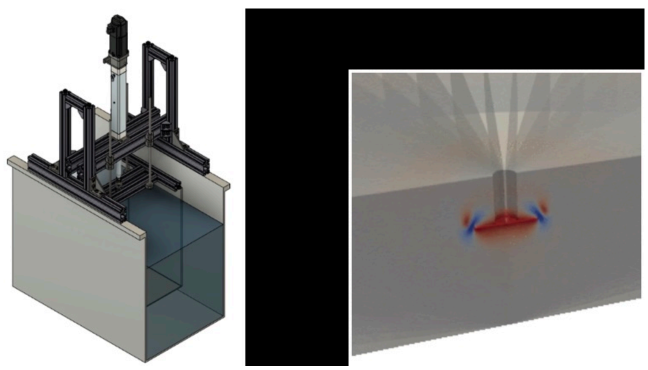


Figure 3 : Model diagram of the Fricfloat project (left) and first code_saturne test with an heave plate (right).

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