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2D AND 3D PHYSICAL MODEL TESTING FOR THE REHABILITATION ON THE FRIOUL PORT BREAKWATER (FRANCE)

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1 INTRODUCTION

A white archipelago anchored in the Mediterranean Sea 2 km off the coast of Marseille (France), the port of Frioul is made up of the Pomègues islands (to the south) and Ratonneau (to the north). It is protected on the west side by the Berry breakwater (renovated in 1984), and on the east side by the Condorcet breakwater (figure 1.a). The port was built in the early 1820s (Berry breakwater) to take care of the quarantine of ships coming from areas infected by yellow fever, then developed in the 1850s (Condorcet breakwater in the East) to make it a military port.

The current findings highlight that the eastern breakwater is seriously damaged and must be rehabilitated (figure 1.b). Accordingly, the rehabilitation solution, which consists to replace the actual rock armour unit, was physically modelled, and tested for its hydraulic stability and the overtopping performance as well as the forces and pressures acting on the crown wall. The process includes recreation of breakwater cross sections in a 2D wave flume at a scale of 1:35 (figure 2.a), and a optimized breakwater configuration proposed in a 3D wave basin at a scale of 1:50 (figure 2.b).

These two campaigns made it possible to compare and optimize the design, first with the state of the art (Van Gent, M., et van der Werf, I., 2019) (Mares-Nasarre and van Gent, M., 2020), then with the observations and measurements collected from the modeling.

2 CONCLUSIONS

As a result of the study, the following conclusions may be drawn:

- The replacement scenario for the current rock armour unit present significant advantages in terms of respecting environmental issues, particularly on the seagrass bed in front of the breakwaters. In this case, supplies of filler materials are minimized.
- The 2D campaign (figure 3.a). made it possible to pre-design the breakwater structure. However, in the specific case of the Frioul breakwater, the site local effects were not well assessed and the 2D campaign led to overdesign the breakwater.
- The 3D campaign (figure 3.b). it was particularly well adapted to this project with the strong oblique wave attack and the diffraction effect due to local cape ‘Pointe d’Ouriou’. It led to a significant optimization of the crown wall design (height and forces reduced due to the decrease of wave impact and overtopping).
- Both campaigns enable us to validate the rock size armour unit and the toe directly laying on the existing breakwater

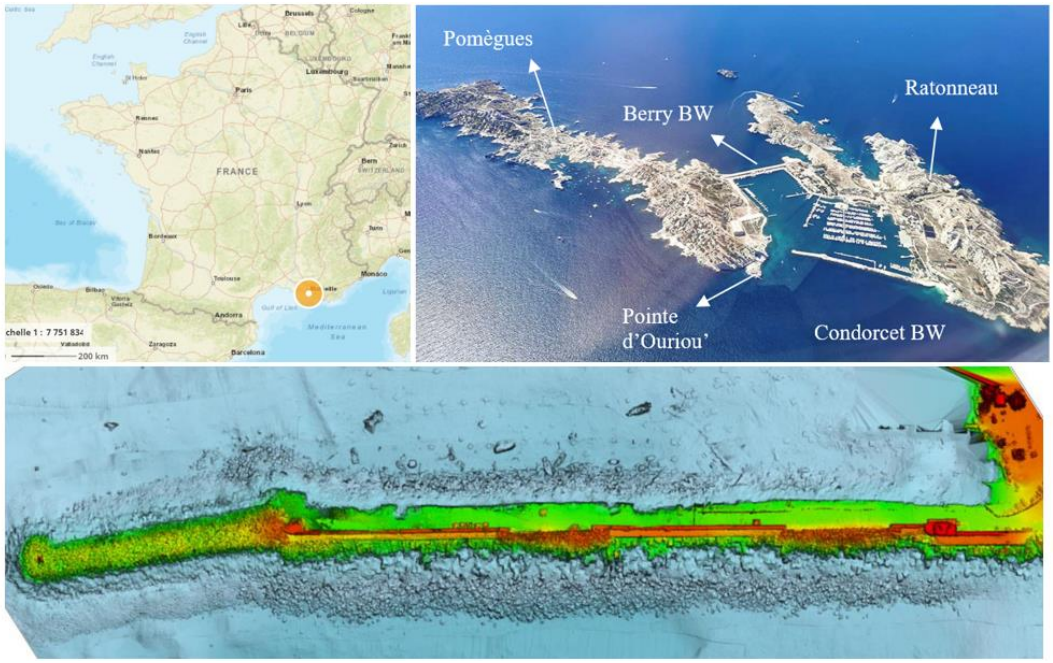

Figure 1. (a), (b) Frioul Port geolocation and (c) current condition of the Condorcet rubble mound breakwater

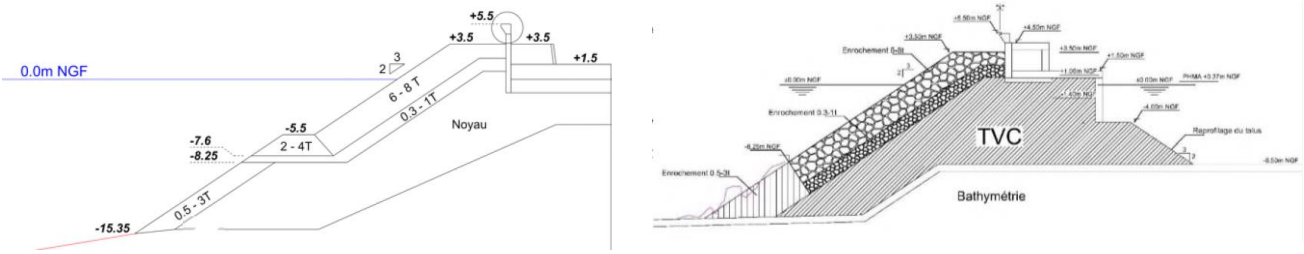

Figure 2. Breakwater cross section (a) Model 2D initial configuration (b) Model 3D optimized configuration

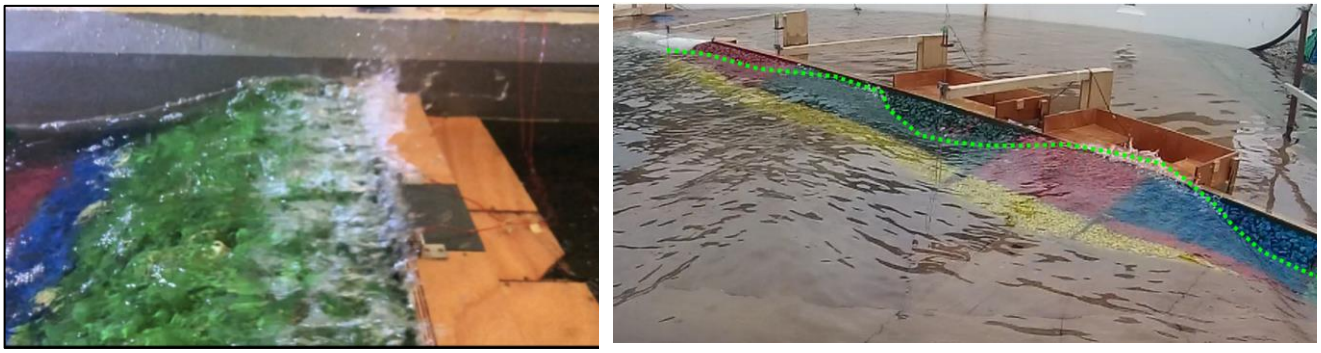

Figure 3. Physical model test (a) Modelled typical section in 2D flume and (b) Modelled breakwater in 3D basin

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REFERENCES

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