XI International Conference on Computational Methods in Marine Engineering

Numerical Modelling of Pore Pressure Distribution inside a Rubble Mound Breakwater using OpenFOAM®

A. Imbò[1*], G. Scaravaglione[2] and A. Saponieri[2]

[1] Dept. of Environmental, Land, Building Engineering and Chemistry (DICATECh), Polytechnic University of Bari, Bari, Italy.
[2] Dept. of Engineering for Innovation (DII), University of Salento, Lecce, Italy.

[*] a.imbo@phd.poliba.it

ABSTRACT

Evaluating the pore pressure distribution in a rubble mound breakwater is essential, due to its direct influence on the structure's stability and hydraulic performance. Nevertheless, the current breakwater design methods do not always consider the pressure field inside the structure body and the lack of experimental data on wave-induced pressures, especially, in depth-limited conditions, leaves significant knowledge gaps. This study investigates the pore pressure distribution inside the structure under depth-limited water conditions, using the strategy of Irías Mata et al. (2023) on wave overtopping, to provide a dataset in terms of internal pressures of the breakwater. A numerical approach was adopted, implementing Computational Fluid Dynamics through OpenFOAM for wave simulation in a 2D channel, as shown in Figure 1. The methodology combines wave and pressure data acquired from a recent experimental campaign conducted by Scaravaglione et al. (2024) to calibrate and validate the numerical model and investigate the internal pressure fields under a wider range of wave boundary conditions and structure geometries. The results involve the development of new empirical formulation for the prediction of internal pressure in different structure and foreshore configurations, providing key insights during the design phase of rubble mound breakwaters and enhancing their hydraulic stability.

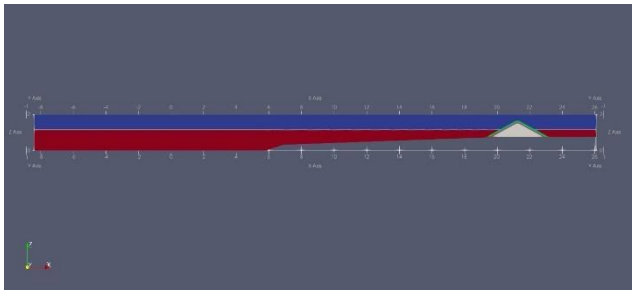

Figure 1: Numerical set-up in OpenFOAM framework.

References

M. Irías Mata and M. R. A. van Gent. Numerical modelling of wave overtopping discharges at rubble mound breakwaters using OpenFOAM®. Coastal Engineering, 181:104274, 2023. ISSN 0378-839. doi: 10.1016/j.coastaleng.2022.104274. URL https://www.sciencedirect.com/science/article/pii/S0378383922001879

G.Scaravaglione, S. Marino, A. Francone, L. Damiani, G. R. Tomasicchio and A. Saponieri. Laboratory investigation on pore pressures inside a rubble mound breakwater in depth-limited waters. Applied Ocean Research, 147:103988, 2024. ISSN 01411187. doi: 10.1016/j.apor.2024.103988. https://www.sciencedirect.com/science/article/pii/S0378383922001879