A LAGRANGIAN SMOOTHED PARTICLE HYDRODYNAMICS – SPH – METHOD FOR MODELLING WAVES-COASTAL STRUCTURE INTERACTION

E. Didier[*†], M.G. Neves[*]

[*]DHA-NPE, LNEC
Av. do Brasil, 101, 1700-066 Lisbon, Portugal
e-mail: edidier@lnec.pt, gneves@lnec.pt

[†] MARETEC
IST, Av. Rovisco Pais, 1049-001, Lisbon, Portugal

ABSTRACT

Wave-structure interaction generates very complex phenomena involving nonlinear processes, like wave propagation and transformation, run-up, wave breaking, and overtopping. Additionally, complex coastal structures are constructed, with impermeable or porous structures, composed by blocs or arc crown wall structures, etc. Consequently, in practical engineering projects, there are a large number of cases for which there is no appropriated empirical formula. For those cases, physical modeling is currently employed due to the accuracy of this approach and the possibility to model large areas. However, its accurate simulation on physical models strongly depends on the model scale used and needs an understanding of model and scale effects for the correct representation of the phenomenon.

For studies of interaction between waves and complex structures as coastal structures, numerical modeling presents a very attractive complement to physical modeling. However, only some numerical models allow simulating wave breaking and wave overtopping correctly.

The SPH (Smoothed Particle Hydrodynamics) method is a relatively new method that computes trajectories of fluid particles which interact according to the Navier-Stokes equations. The recent advances on SPH models show that Lagrangian method is a very promising alternative approach to simulate wave-structure interaction due to its completely mesh-free technique.

This paper presents an application of a free surface modeling by means of the SPHysics numerical model based on Lagrangian approach [1, 2]. SPHysics was used with success in previous studies [3], where numerical results of seawall overtopping agree well with experimental data.

A typical impermeable coastal structure of the Portuguese Atlantic coast is considered in the present study and features of free surface elevation and overtopping are analyzed for two different geometric configurations, differing in the crest level. These two cases represent a range of overtopping conditions varying from small discharges, more difficult to model numerically, to a considerable amount of overtopping.

The SPH model provides information about the free surface and the overtopping discharge, through maximum height and water velocity, and pressure. In the final paper, the results will be presented and discussed.

References

[1] A.J.C. Crespo, M. Gómez-Gesteira and R. A. Dalrymple, Modeling Dam Break Behavior over a wet bed by a SPH technique, *Journal of Waterway, Port, Costal, and Ocean Engineering*, Vol 134(6), 313-320 (2008).

[2] R.A. Dalrymple and B.D. Rogers, Numerical modeling of water waves with SPH method, Coastal Engineering, 53/2-3, 141-147 (2006).

[3] E. Didier and, M.G. NEVES, Numerical modeling of wave interaction with an impermeable seawall using a SPH Model. *Mediterranean Days of Coastal and Port Engineering* (Palermo, Italy), (2008).