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AERATED WAVE PROPAGATION AND WAVE IMPACTS ON STRUCTURES

Peter R. Wellens[1*] **and Martin van der Eijk**[1]

[1] Maritime & Transport Technology, Delft University of Technology, 2628 CD Delft, The Netherlands {p.r.wellens, m.vandereijk}@tudelft.nl

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Free surface wave impacts can cause damage to structures. Adequate numerical simulations of wave impacts on structures can be used to determine the pressures and forces necessary for design purposes. Focused breaking wave impacts can be considered models for determining the maximum wave impact pressure and force on a structure in a specific sea state. Sea states for which it is relevant to determine impact loads are steep and would involve many occurrences of whitecapping and wave breaking before the maximum impact on a structure takes place, which entrains air. Aerated water near the structure is highly compressible and, as such, can reduce the peak of the wave impact and make it last longer. On the other hand, density wave interference can cause pressures to become higher. Aeration, therefore, is an effect to consider.

We have developed a numerical method which takes compressibility of air and aerated water into account. It is based on the Navier-Stokes equations with a Volume-of-Fluid approach for displacing the free surface through a fixed, cartesian grid. A cut-cell method takes care of representing moving structures of arbitrary geometry. Free surface and structure are reconstructed after transport by a piecewise linear interface construction method. Our latest developments focus on wave propagation, wave breaking and impacts.

The numerical method is applied in simulations of wave propagation through a homogeneous mixture of water and air with an air content varying between 0% and 5%, followed by a focused breaking wave event against a fixed wall. Other simulations will let the focused breaking wave impact against a horizontal cylinder suspended as a pendulum above the mean free surface. The simulation results are compared to experiments from literature [1, 2], after which the effect of aeration on the wave impact pressures is discussed.

REFERENCES

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