Transmission and Reflection of Long Waves over Steep Bathymetry Variations using Large Floating Strips of Shallow Draft

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ABSTRACT

The present study focuses on the determination of reflection and transmission characteristics for the coupled hydroelastic system involving a strip of large extent and shallow draft, floating over steep bathymetry variations and interacting with long waves. Shallow water hydroelastic interactions have been analysed by many authors, mainly due to its significance in the analysis of floating breakwaters [1], Very Large Floating Structures (VLFS) and ice-floes/ice-selves [2, 3, 4]. The particular problem examined herein is of interest for the analysis and design of novel breakwaters, and the transmission of wave energy in specific areas for harvesting purposes.

The treatment of the problem is performed by means of the higher order hydroelastic finite elements developed by Papathanasiou *et al* [5] for time domain analysis. These elements feature 5^{th} degree Hermite polynomials for the approximation of the floating strip deflection combined with five-node Lagrange interpolation for the water velocity potential. The Newmark method is employed for the time integration of the resulting discrete system.

The reflection and transmission properties of the hydroelastic system are analysed in terms of the transmitted to reflected energy ratio, as calculated after the hydroelastic interactions are over. A parametric analysis with respect to the floating strip stiffness and the magnitude of the bathymetry variation for specific seabed profiles is conducted. This parametric study is expected to indicate optimum design characteristics, in terms of the strip flexural rigidity, for maximizing long wave reflection or transmission, depending on the specific application. For the efficient operation of breakwaters, reflection is desired to be maximized. Inversely, for wave trapping and harvesting in shallow water regions bounded by shoals, transmission characteristics of the proposed system need to increase.

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