World Academy of Science, Engineering and Technology
International Journal of Marine and Environmental Sciences
Vol:12, No:05, 2018

Long Waves Inundating through and around an Array of Circular Cylinders

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Abstract : Tsunami is characterised by their very long time periods and can have devastating consequences when these inundate through built-up coastal regions as in the 2004 Indian Ocean and 2011 Tohoku Tsunami. This work aims to investigate the effect of these long waves on the flow through and around a group of buildings, which are abstracted to circular cylinders. The research approach used in this study was using experiments and numerical simulations. Large-scale experiments were carried out at HR Wallingford. The novelty of these experiments is (I) the number of bodies present (up to 64), (II) the long wavelength of the input waves (80 seconds) and (III) the width of the tank (4m) which gives the unique opportunity to investigate three length scales, namely the diameter of the building, the diameter of the array and the width of the tank. To complement the experiments, dam break flow past the same arrays is investigated using three-dimensional numerical simulations in OpenFOAM. Dam break flow was chosen as it is often used as a surrogate for the tsunami in previous research and is used here as there are well defined initial conditions and high quality previous experimental data for the case of a single cylinder is available. The focus of this work is to better understand the effect of the solid void fraction on the force and flow through and around the array. New qualitative and quantitative diagnostics are developed and tested to analyse the complex coupled interaction between the cylinders.

Keywords : computational fluid dynamics, tsunami, forces, complex geometry
Conference Title : ICT 2018 : International Conference on Tsunami
Conference Location : Tokyo, Japan
Conference Dates : May 28-29, 2018