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Breaking wave impact forces on truss support structures for offshore wind turbines

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Due to depletion of the conventional energy sources, wind energy is becoming more popular these days. Wind energy is being produced mostly from onshore farms, but there is a clear tendency to transfer wind farms to the sea. The foundations of offshore wind turbines may be truss structures and might be located in shallow water, where are subjected to highly varying hydrodynamic loads, particularly from plunging breaking waves. There are models for impact forces prediction on monopiles. Typically the total wave force on slender pile from breaking waves is a superposition of slowly varying quasi-static force, calculated from the Morison equation and additional dynamical, short duration force due to the impact of the breaker front or breaker tongue. There is not much research done on the truss structures of wind turbines and there are still uncertainties on slamming wave forces, due to plunging breaking waves on those structures.

Within the WaveSlam (Wave slamming forces on truss structures in shallow water) project the large scale tests were carried out in 2013 at the Large Wave Flume in Forschungszentrum Küste (FZK) in Hannover, Germany. The following institutions participated in this initiative: the University of Stavanger and the Norwegian University of Science and Technology (project management), University of Gdańsk, Poland, Hamburg University of Technology and the University of Rostock, Germany and Reinertsen AS, Norway. This work was supported by the EU 7th Framework Programme through the grant to the budget of the Integrating Activity HYDRALAB IV.

The main aim of the experiment was to investigate the wave slamming forces on truss structures, development of new and improvement of existing methods to calculate forces from the plunging breakers. The majority of the measurements were carried out for regular waves with specified frequencies and wave heights as well as for the irregular waves based on JONSWAP spectrum. The truss structure was equipped with both total and local force transducers which measured the response of the structure to the impact force. Also, the free surface elevations, the water particle velocity and the water particle acceleration were recorded during the WaveSlam experiment.

Both the total and the local force data have been analysed using the Frequency Response Function method, which has been already applied to the estimation of the wave slamming forces. The results of this classical approach were compared to the calculated slamming forces based on Goda and Wienke and Oumeraci theories. Slamming wave forces and slamming coefficients calculated using both models appeared to be very much larger than those obtained from the analysed recorded data, therefore there is a need for further research. Details of this research and modelling results will be presented in the final poster.