**Tytuł pracy doktorskiej:** Breaking sea wave impact loads on truss structures


**Abstract:**

Offshore wind energy is one of the most economically efficient renewable energy sources and represents the fastest-growing energy market in recent years. An offshore wind turbine comprises two major components: the upper turbine and the lower support substructure. Jacket substructures are becoming more common in shallow water areas where they are subjected to the slamming force from breaking waves. Due to the large number of physical parameters involved in the breaking process, the nonlinearity of the breaking process and the degree of complexity of the structure, the wave-structure interactions, in the case of jacket structures, are very complex. Investigations regarding these forces on jacket substructures are limited. This research aimed to investigate and describe the relationship between breaking wave characteristics and the slamming forces, acting on a jacket structure in shallow water, based on the experimental data, collected during the large-scale WaveSlam experiment.

Based on the wave measurement data, the evolution of the wave along the wave flume and the link between the breaking wave characteristics and the initial wave conditions were investigated. The breaking wave characteristics show a high degree of variability, even under the same initial conditions, which must be considered a source of uncertainty in the metocean analysis. The formulae proposed in this study allow reasonable estimation of the breaking wave characteristics based on the deep water wave conditions.

Two separation methods, combined with low-pass filtering, were proposed to separate the slamming force from the force measurements: the frequency response function method to separate local response forces and the empirical mode decomposition method to separate total response forces. The total and the local slamming forces generated by plunging breakers show a very high degree of variability from wave to wave. The variabilities are mainly caused by the combined effects of the wave-breaking process and nonlinear interactions between the truss structure members. One source of uncertainty is the air entrapped between the structural element and the wave front.

The total and local slamming forces correlate strongly with the wave's breaker depth index, the crest front steepness, the horizontal asymmetry and the breaking wave celerity. A formula linking the combined total slamming and

curling ($C_S\lambda$) coefficient and the local slamming ($C_S$) coefficient with the breaking wave crest front steepness and the characteristic diameter of the jacket structure were proposed. This approach improves the estimation of the peak total slamming forces and the peak local slamming forces for a whole range of crest front steepness compared to existing models.