Structural dynamic analysis of offshore wind turbines with jacket foundations.

Iván Couceiro *, José París, Fermín Navarrina, Ignasi Colominas, Manuel Casteleiro

Universidade da Coruña
Spain
ivan.couceiro.aguiar@udc.es, jparis@udc.es, fermin.navarrina@udc.es, icolominas@udc.es, casteleiro@udc.es

ABSTRACT

Nowadays, there is an increasing interest in the design of offshore structures as the wind energy field is currently changing its usual onshore location to offshore spots. The analysis of offshore structures is subject to many uncertainties regarding the applied loads and the computational models. The uncertainty in the loads arises from the determination of the loads themselves and the impact they have in the structure. On the other hand the computational models commonly used for this type of structures most often deal with simplified versions of the problem decoupling it in parts of the global structure. Usually the foundation, the tower and the blades of the wind turbine are modeled separately and the interaction between them is estimated.

This work presents a computational model of the whole offshore structure including the rotating blades, and its dynamic analysis subject to in-place loads as wind, waves, current, and buoyancy. The foundation modeled for the offshore wind turbine in this case is a jacket type steel structure. The aerodynamic loads are computed through the Blade Element Momentum Theory with the aerodynamic properties of the blades and considering wind shear and the tower blockage. The wave loads are computed in the submerged elements of the foundation using common wave theories along with the Morison’s equation for the calculation of the exerted pressure.

The computational model of the structure is based on beam elements for all the parts of the structure; jacket, tower, nacelle and blades, each with its corresponding properties. The mass of the structure is modeled with a consistent mass formulation and the Rayleigh damping is considered in the model. The natural frequencies of the whole structure are computed and the integration of the dynamic equations of motion and the time-history analysis are carried out by means of the Newmark Integration Method.

References