WIND TURBINE MECHANICAL DYNAMIC ANALYSIS THROUGH ABAQUS STANDARD

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ABSTRACT

A wind turbine is considered as a flexible structure with low damping. Consequently, a modal analysis has to be performed in order to avoid catastrophic failure due to instability and vibration events.

The modal analysis of the global wind turbine is focused on the analysis of the possible excitation of the flexion frequencies of the tower due to the rotor excitation.

Regarding the drive train, its analysis is also critic because the excitation of any resonance frequency produces high dynamic loads that affect notably gears' and bearings' life. The Gamesa wind turbines have a flexible drive train design (therefore the drive train frequency is low) and the main excitation frequencies to be considered are the ones arising from the rotor. Anyway, the internal excitation frequencies due to imbalance of internal components and the gearbox meshing frequencies must be considered as well.

An ABAQUS/Standard model of the whole wind turbine has been developed. The Finite element model is based on 0-D elements defining concentrated properties of mass and inertia and 1-D elements that define the blades, shafts and tower. The rotational speed relations between the three gearbox stages are defined using equations. The use of a quite simple model allows to perform simple variation in the parameters (rotor type, tower height, stiffness and inertia of components) dealing to quick sensibility analysis and, therefore, see their influence on the main Wind Turbine natural frequencies.

The results have been compared with analytical methods and experimental data, getting good correlations.