Influence of Soil Stiffness and Damping on Dynamic Response of Offshore Wind Turbine

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ABSTRACT

The offshore wind turbines are highly dynamically loaded by sea waves and wind and they operate in a narrow range of frequency close to the excitation frequency. Therefore, the foundation stiffness and damping is very important in order to have a reliable estimation of the dynamic behavior and cost effective design of the wind turbines supporting structure.

Several soil-foundation models are available such as static condensation methods, spatial reduction methods, cone models or lumped-parameter models, few of them have been developed in aeroelastic tools to consider the soil stiffness and damping in the simulations[1]. In addition, design guidelines for offshore structures usually ignore any structural damping.
This paper is devoted to the implementation of simple geotech model in ASHES software [2] which is a servo-hydro-aeroelastic analysis code for wind turbine simulation. In order to investigate the model and the significance of foundation damping, two 20 m monopile-supported and 60 m jacket with NREL 5 MW offshore wind turbine were considered as the case studies. The offshore wind turbines were subjected to extreme wind and wave loading. The loads and dynamic response of supporting structures were obtained corresponding to different damping and stiffness. The mudline fore-aft moment was calculated for turbine shutdown and idling wind turbine. Furthermore, rain flow counting results estimate the fatigue life with and without considering the soil damping. It is expected that the soil damping increases the lifetime of the supporting structure and also decreases the loads on the structure.

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