Permanent accumulated rotation of an offshore monopile wind turbine in sand during a storm - DTU Orbit (07/11/2019)

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Offshore wind turbines exposed to storm situations are subjected to static and dynamic loads from the same direction over a considerable period of time. Such cyclic loading can potentially result in soil degradation, leading to an undesired permanent rotation of the wind turbine. This paper presents a workflow to predict the permanent accumulated rotation of an offshore monopile wind turbine in sand during an extreme storm event incorporating the use of fully nonlinear irregular waves versus linear waves in current practice. The fully nonlinear irregular waves are realized from a potential flow solver OceanWave3D previously validated at up to near-breaking wave conditions. Given the wave kinematics, the aero-hydroelastic code HAWC2 is used to calculate horizontal loading and bending moment acting on the embedded pile head. The irregular load series is then decomposed into a set of constant-amplitude load parcels using rainflow counting. Eventually, the permanent accumulated rotation is predicated using the method proposed by LeBlanc et al. (2010b) with Miner’s rule-based superposition. In this paper, a case study of the DTU 10MW wind turbine supported by a monopile at 33 m water depth in sand is presented, where the pile is primarily laterally loaded. The simulation results suggest the importance of taking accumulated rotation into design. The permanent accumulated rotation is primarily decided by soil capacity, loading characteristics and pre-loading history. Furthermore, the results show that wave nonlinearity has only limited influence on the permanent accumulated rotation.

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