Load calculation methods for offshore wind turbine foundations

Calculation of design loads for offshore wind turbine (OWT) foundations is typically performed in a joint effort between wind turbine manufactures and foundation designers (FDs). Ideally, both parties would apply the same fully integrated design tool and model for that purpose. However, such solutions are rather limited as it would require exchanging confidential data and the need of sophisticated modelling capabilities for all subsystems of the OWT. In practice, this leads to an iterative and sequential load calculation process involving different design tools. In this process, the wind turbine manufacturer provides the FD with dynamic responses obtained from aeroelastic simulations at a predefined interface. These responses are subsequently expanded to the corresponding dynamic responses in all structural parts of the foundation. In this article, a novel load calculation method, for the expansion to dynamic foundation responses based on an inverse dynamics algorithm, is introduced and described in detail. Furthermore, a summary of load calculation methods currently applied for the design of bottom-mounted OWTs foundations is provided and compared with the proposed method. While emphasis is given to jacket-type foundations, the methods are considered applicable for other bottom-mounted foundation types as well. All load calculation methods are applied and evaluated for an exemplarily fatigue design scenario from the perspective of an FD in order to establish more confidence in these methods. The article concludes with an assessment and recommendation for all presented load calculation methods.