Soil structure interaction in offshore wind turbine collisions

Vessel impact is one of the load cases which should be accounted for in the design of an offshore wind turbine (OWT) according to design codes, but little guidance or information is given on the employed methodology. This study focuses on the evaluation of the distress induced in a wind turbine after a ship collision, thus providing an insight on the consequences of a collision event and on the main aspects to be considered when designing for this load case. In particular, the role of the foundation soil properties (site conditions) on the response of the structural system is investigated. Dynamic finite element analyses have been performed taking into account the geometric and material nonlinearity of the tower, and the effects of soil structure interaction (SSI) have been studied in two representative collision scenarios of a service vessel with the turbine: a moderate energy impact collision, characterized by a vessel drift velocity of 2 m/s; and a high energy impact collision, characterized by a velocity of 5 m/s. The results of the investigation show that SSI modifies the behaviour of the OWT mainly by introducing additional deformations at the OWT base and by absorbing a portion of ship impact energy in these deformations. Since moderate and high energy impacts both result in rather similar energy absorption by the foundation, disregarding the effects of SSI leads to substantial overestimation of permanent deformations in the case of a moderate energy impact.