Seismic response and kinematic interaction of monopiles foundations

Motivations

Monopiles foundations are, at present time, the most used foundation type for offshore wind turbines and with ongoing spreading of offshore wind farms in earthquake regions, understanding their behavior under earthquake loads is becoming increasingly important for the offshore wind industry. Large diameters shafts, that can also be considered as very large piles, are also used for bridge foundations in some earthquake prone regions. Recent academic and joint industry projects outcomes have shown that conventional methods and practices used for seismic design of piles foundations may not be suitable for seismic design of offshore wind turbines/bridges on large diameter piles/shafts. One important aspect of this is related to “kinematic interaction” effects, which are strictly connected to the difference in stiffness between the foundation and the soil and to how monopiles/shaft “modify” the earthquake ground motion.

Intended activity

Statistical analyses considering variable piles geometries, soil profiles and earthquake motions will be carried out. For this purpose suitable numerical and analytical solutions will be used. The analyses will allow to obtain formulas that are function of the above parameters (piles geometries, soil profiles and earthquake motions) and that can be used to estimate the effect that the interaction, between large diameter piles foundations and soil under earthquake loading, has on the earthquake ground motion transmitted to the structure (e.g. offshore wind turbines/bridges). The derived functional forms will be applicable both when earthquake response/loading are represented in the form of earthquake response spectra/earthquake time histories. The obtained results will be made publicly available for the intended benefit of both practicing engineers and researchers.

Involved parties

The research activity is formulated by Dr. G. Li Destri Nicosia and it is carried out mostly in COWI, department "Wind Energy and Renewables Management". External review and collaboration, of the proposal and with the research, is provided by Dr. Amir Kaynia, Professor at Department of structural engineering, NTNU.

Time frame

The activity starts in July 2021 and lasts approximately 6 months.