Design of monopiles for multi-megawatt wind turbines at 50 m water depth

The design of a monopile substructure for wind turbines of 10 MW capacity installed at 50 m water depth is presented. The design process starts with the design of a monopile at a moderate water depth of 26 m and is then up scaled to a 50 m water depth. The baseline geometry is then modified to specific frequency constraints for the support structure. The specific design requirements including the soil boundary conditions of this large diameter monopile has been described and fully coupled hydro-aero-servo elastic simulations are performed for ultimate limit state design. Soil plasticization is also considered. Analyses have shown that the design of large diameter monopile is not a straightforward extrapolation process, but it requires specific checks and iterations. An appropriate design scheme is proposed with perturbation analysis for robustness.