Geotechnical Aspects on the Selection of Gravity Based Foundations

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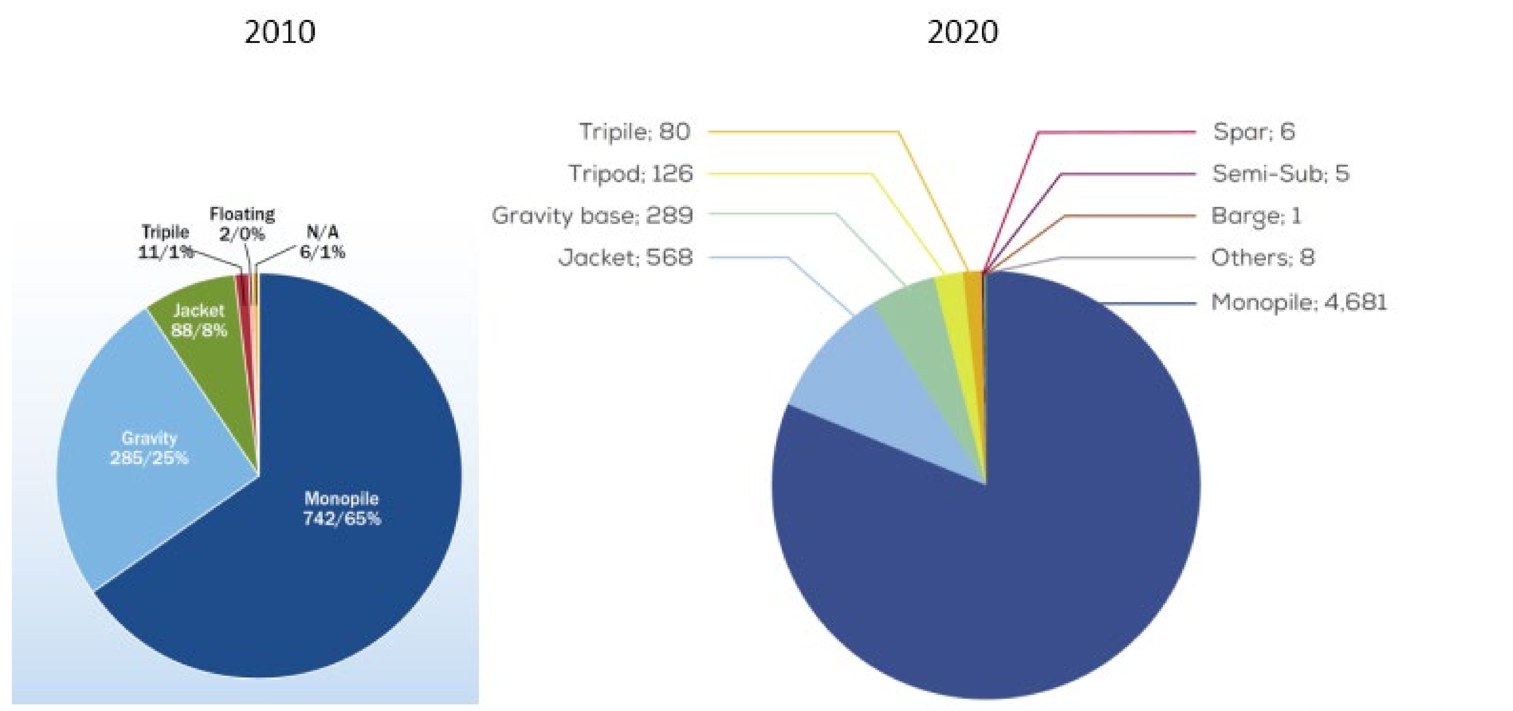
There is a need to develop Offshore Wind Farms in areas with deeper water and rocky subsoils where pile driving is challenging or where underwater pile driving noise must be avoided to protect the marine environment. Here, Gravity Based Foundations (GBF) are an obvious alternative. However, despite the rapid growth in number and sizes of Wind Turbine Generators (WTG) in general, the use of GBF has practically stopped since around 2010, mainly for economic reasons. Today, more OWFs are planned in areas with problematic soils.



Source: WindEurope

Characteristics of a GBF

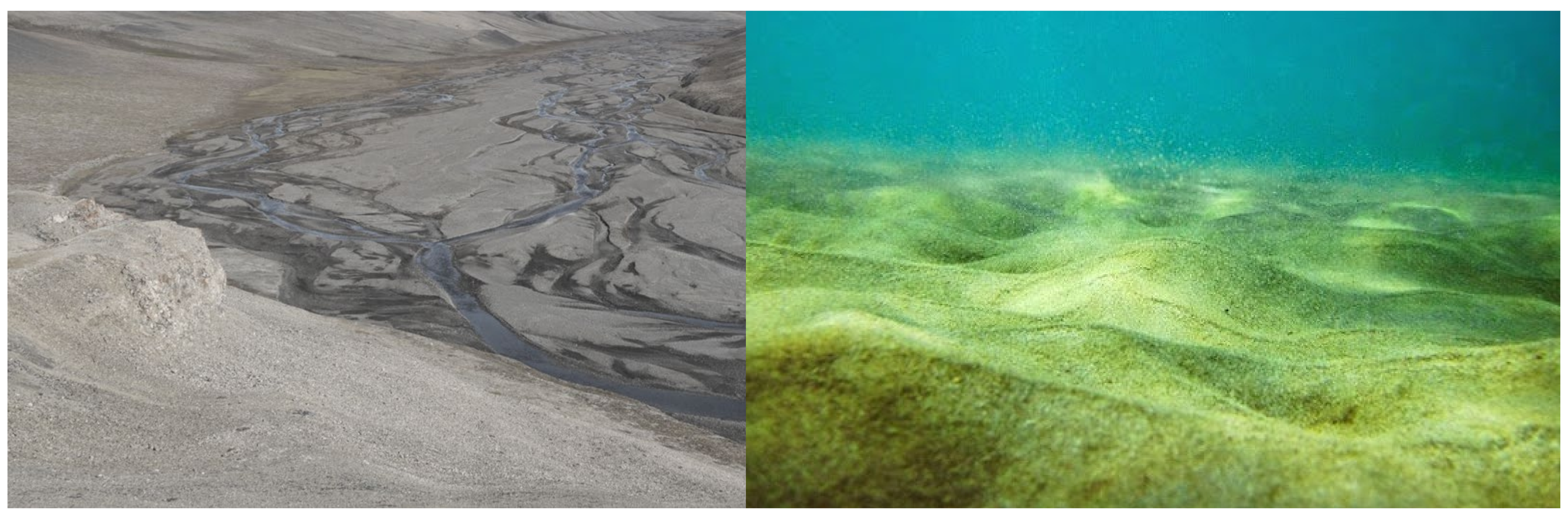
GBF allows assembling and testing all parts of the wind turbine (foundation, tower, blades etc) onshore before towing to site. Almost by definition, a GBF is a contradicting foundation type, where an optimum design should consider the following:

- Minimum self-weight is beneficial for transport and installation, maximum self-weight is required for operational conditions.
- Large structural volume is required to accommodate solid ballast for foundation bearing capacity, large structural volume attracts high foundation loads.
- Large footprint area is beneficial for foundation bearing capacity, small footprint area is beneficial for fabrication, handling and seafloor preparation.
- Large turbine capacities require fewer WTGs. Larger WTG sizes require also longer offshore operations, more maintenance and larger vessels.

Optimum GBS foundation concepts rely depend on details related to Fabrication and Transport & Installation.

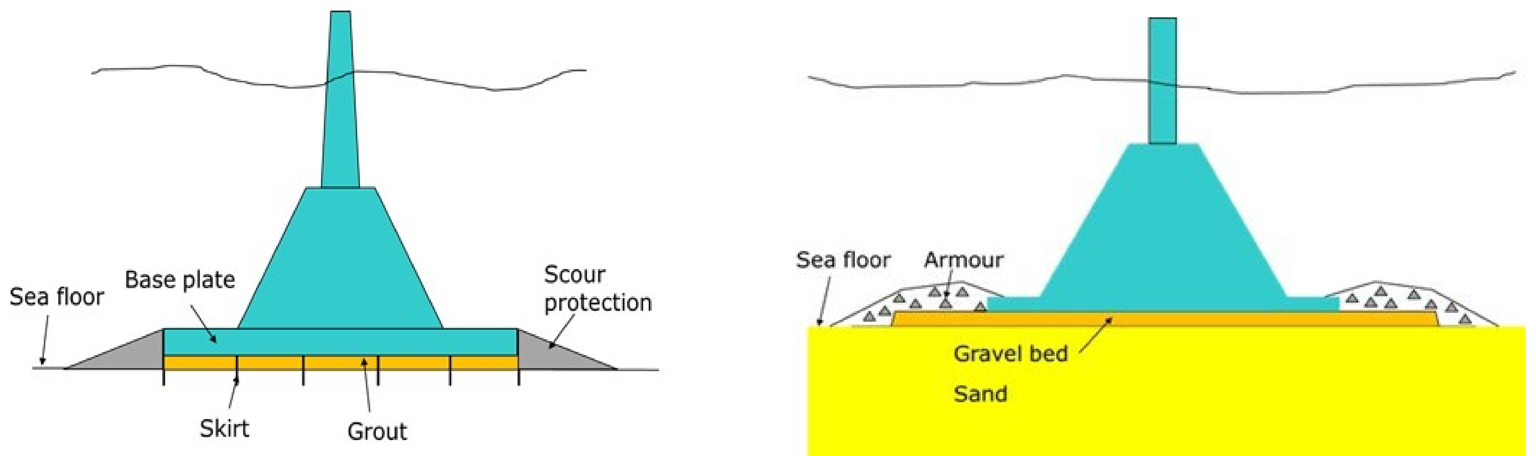
Importance of the subsoil

Optimum GBS foundation concepts vary from case to case and depend on local subsoil conditions.



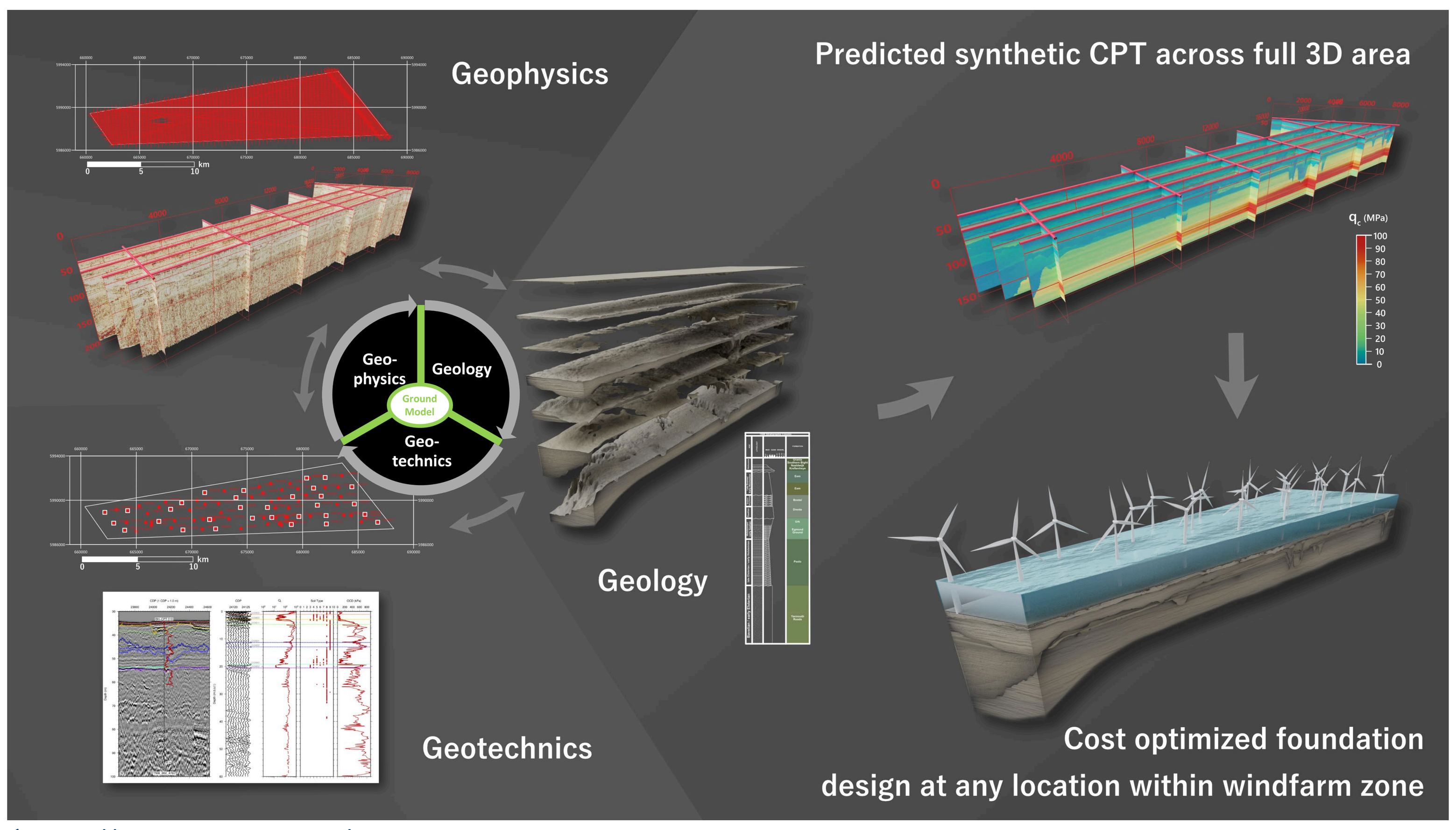
Possible soil variations that could also be found on a seafloor. Sometimes covered by a blanket of moving sand waves or mud.

The suitable GBF concept, with or without skirts, underbase grouting or a preinstalled gravel bed depends on local subsoil conditions and varies in details for each WTG location.



Importance of integrated ground modelling

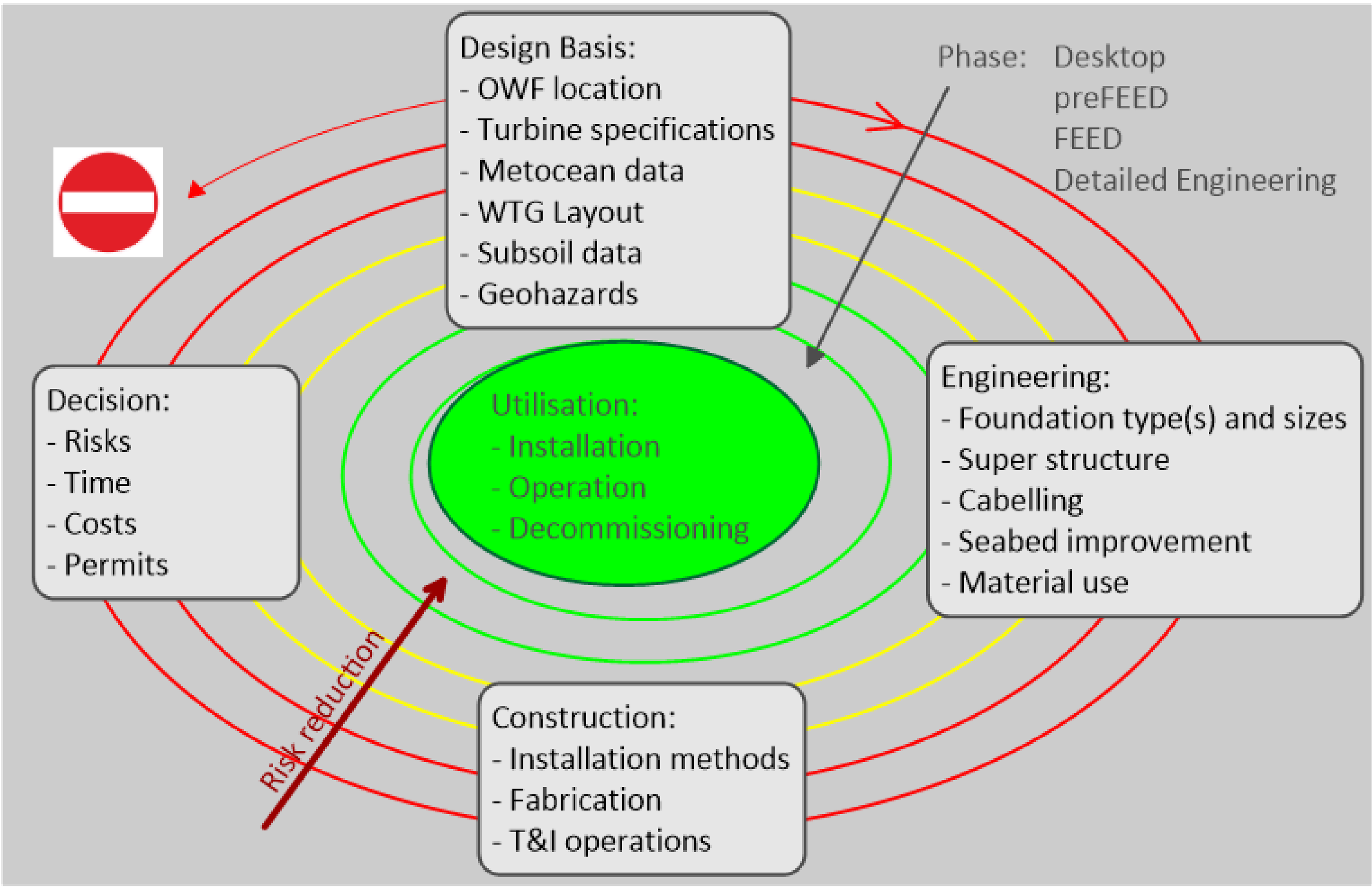
Lack of subsoil information in the very early stage of OWF development has been experienced as a hindrance for a rapid and cost-effective realisation[1]. Early-stage Integrated Ground Modelling has proven to provide optimal tender results.



[1] https://offshorewind.rvo.nl/

Opportunities

- First round with desktop studies
- Perform offshore site investigations in rounds, as needed
- Define requirements for engineering, fabrication and installation
- Prepare a basis for (political) decision



Related projects and literature

- G. Sauvin, M.E. Vardy, R.T. Klinkvort, M. Vanneste, C.F. Forsberg, A. Kort (2022). State-of-the-art ground model development for Offshore Renewables – TNW case study. 3rd EAGE Global Energy Transition Conference & Exhibition.
- Kort, D.A., Nagula, S. and Gundersen, A. (2023). GBS foundations for Offshore Wind from a geotechnical concept. In preparation for Journal of Physics: Conference Series volume 2626.

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