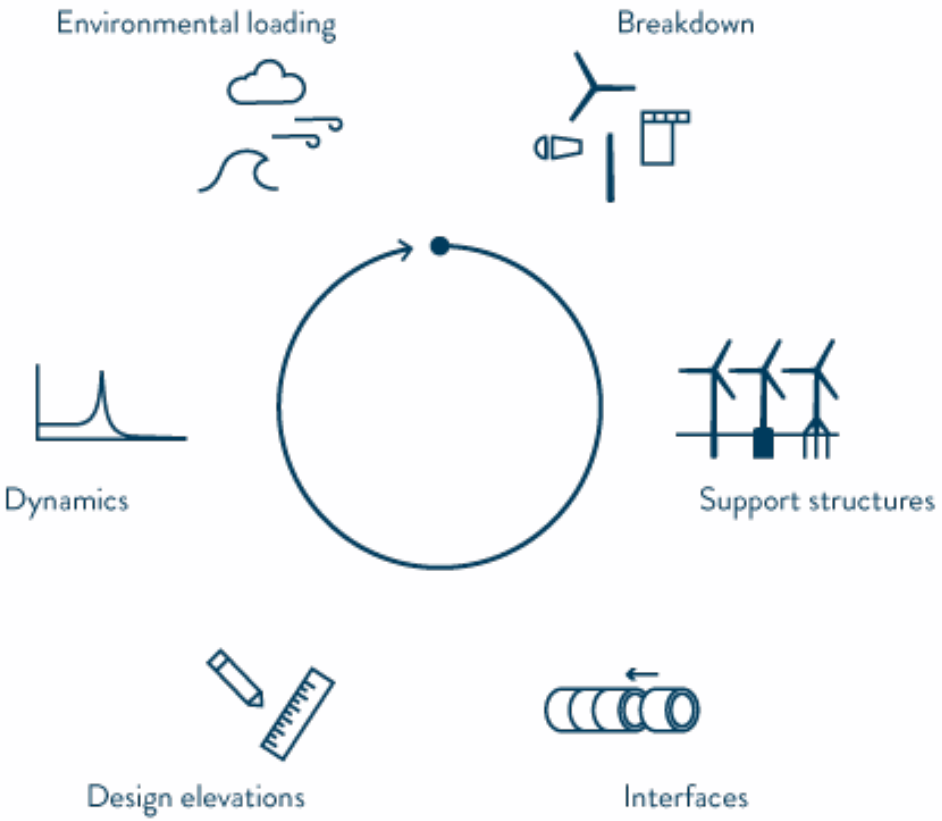
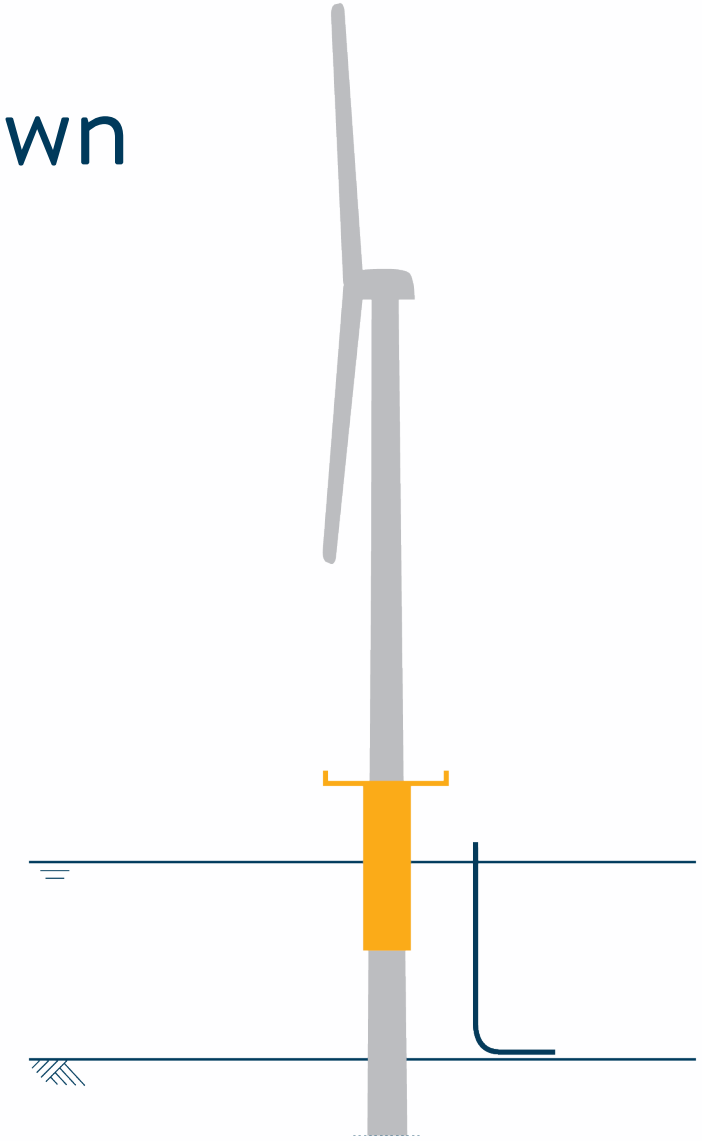
DE OUDE
BIBLIOTHEEK
ACADEMY

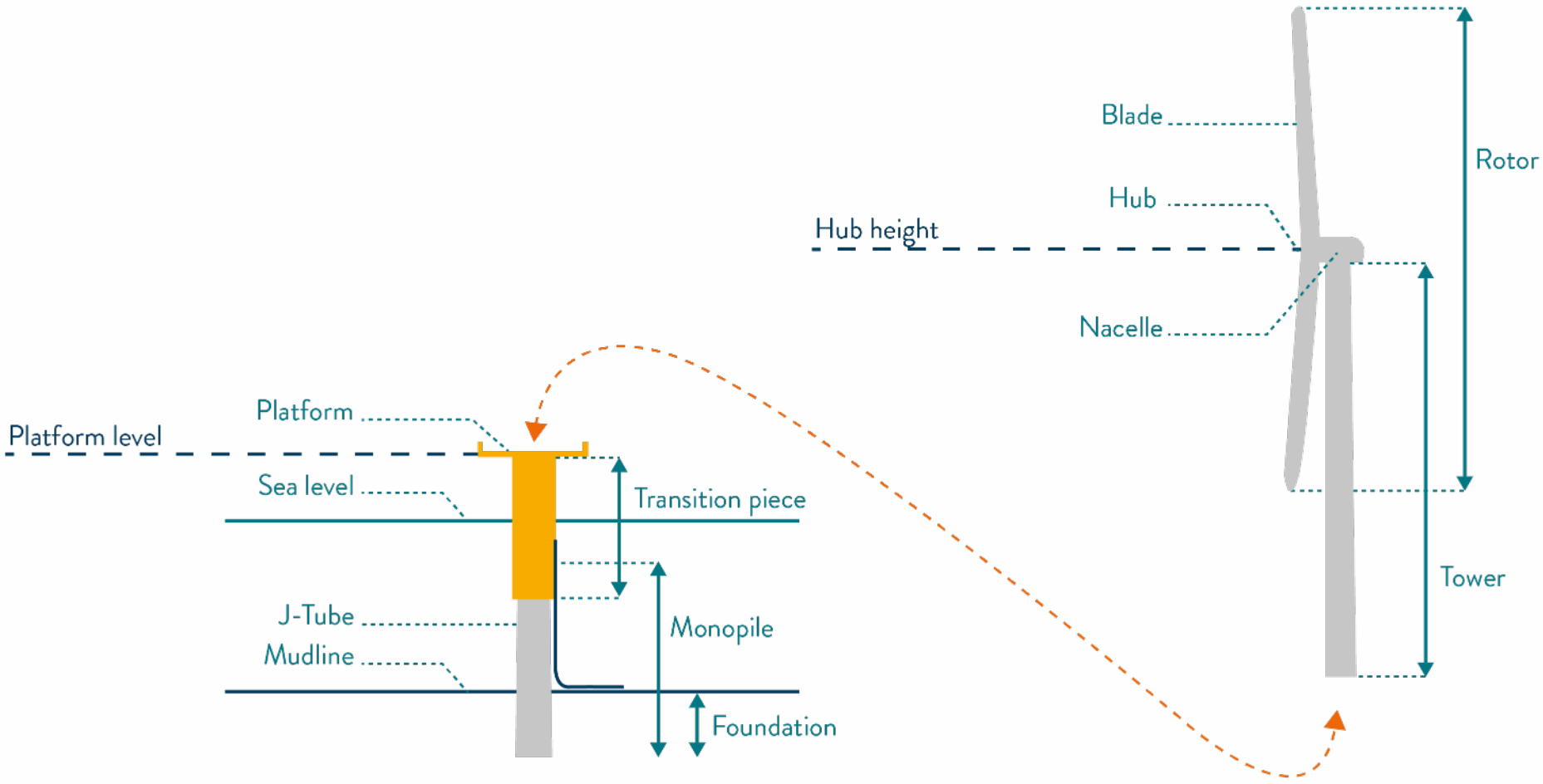
Support structure design considerations



Offshore turbine breakdown



Offshore turbine breakdown



Offshore turbine breakdown

Blades / Rotor

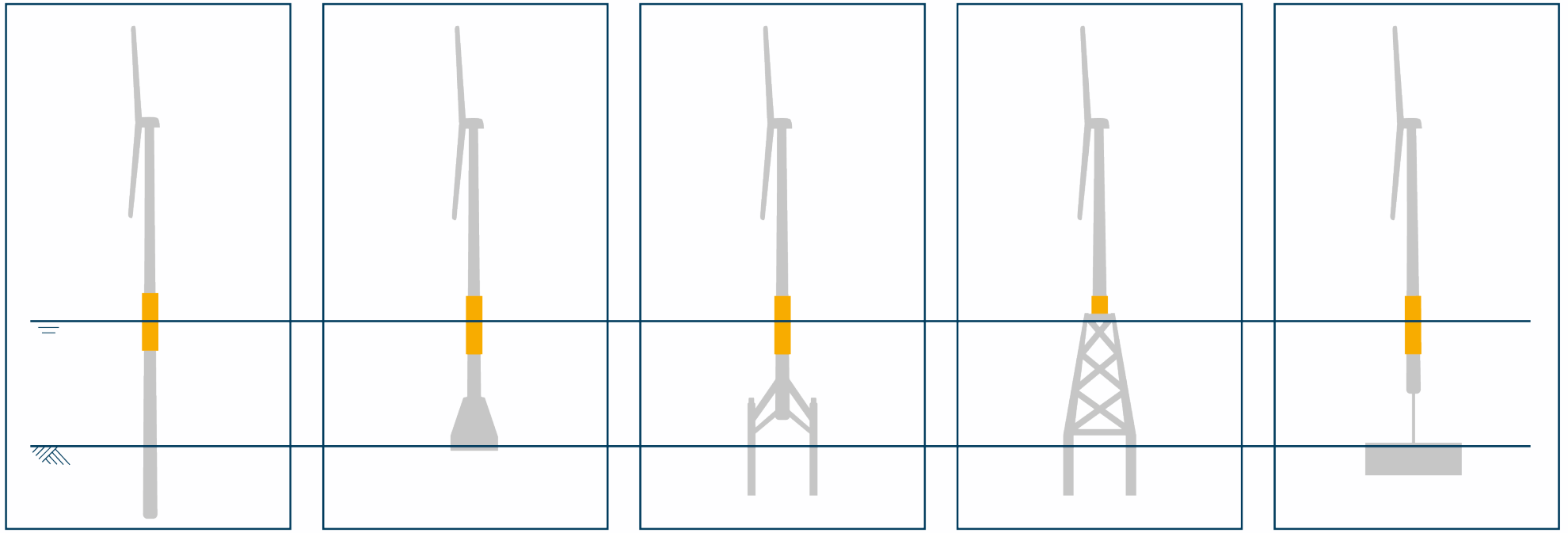
Nacelle

Tower

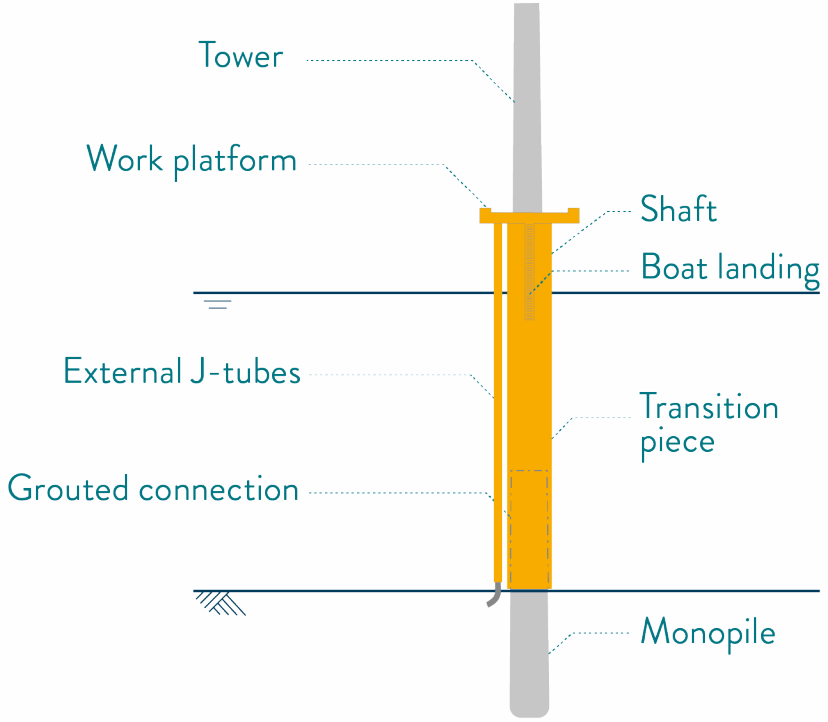
Transition piece

Support structure

Support structures



Monopile



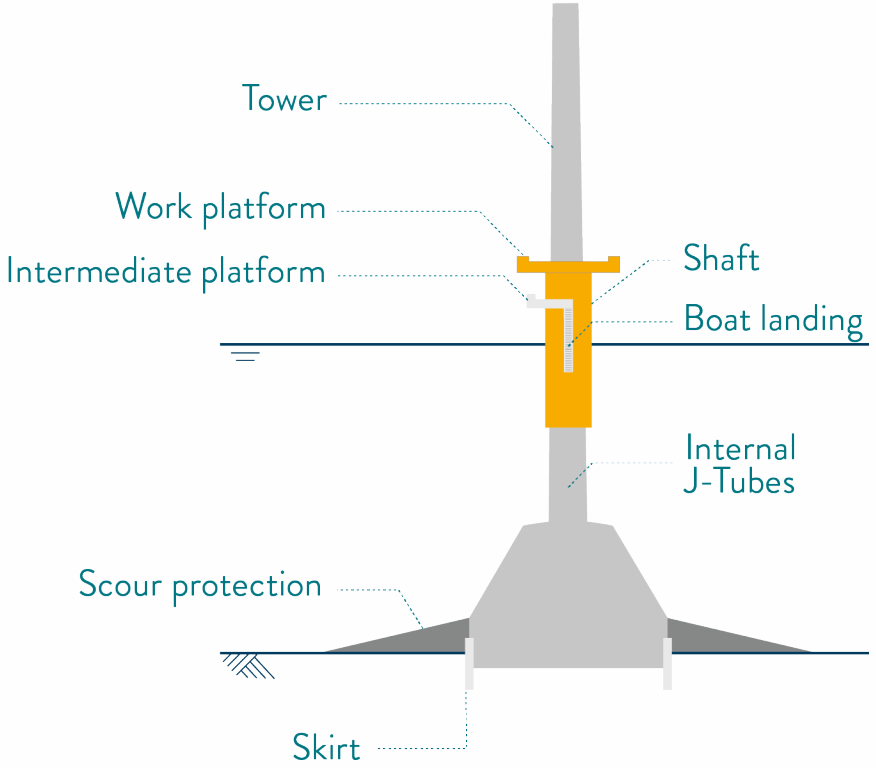
EWEA

Monopile

- Straight pile or with conical section
- Segments of 4 meter
- Longitudinal welds should not coincide

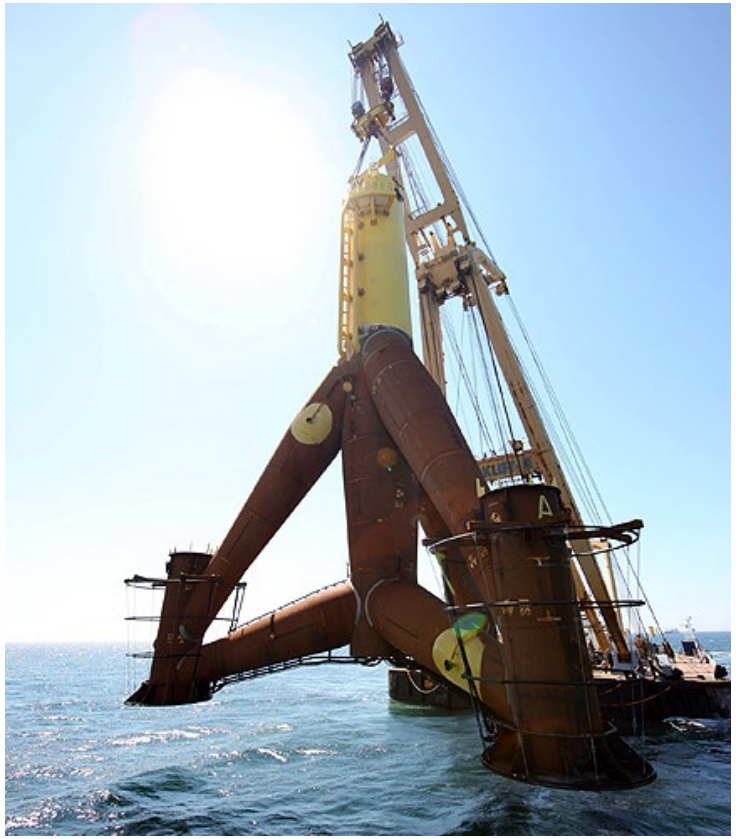
EWEA

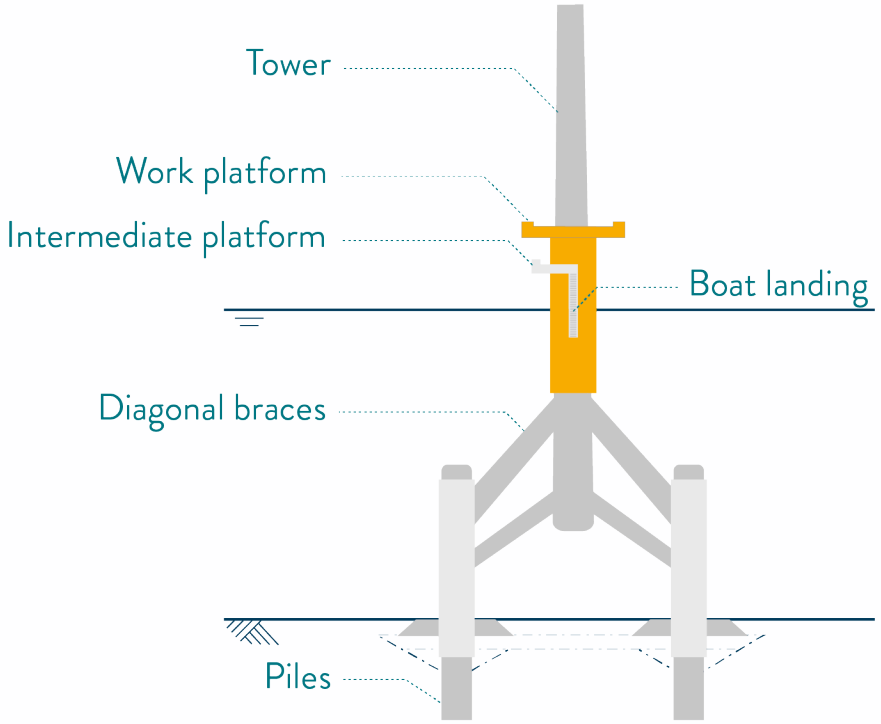
Gravity based



OffshoreWIND.biz

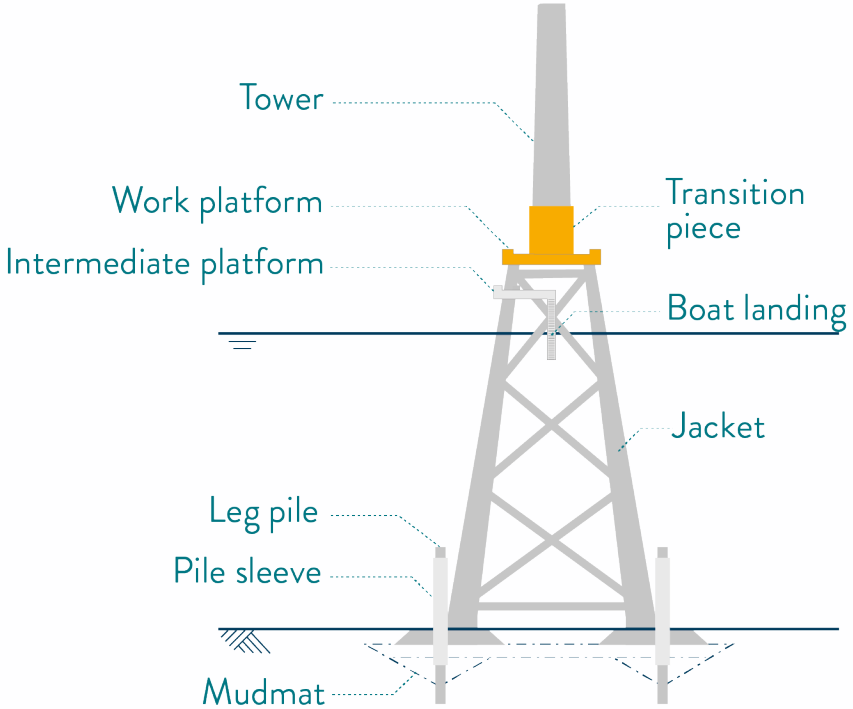
Tripod




Tower
Work platform
Intermediate platform
Boat landing
Diagonal braces
Piles


GT1-020
WEA033
sarens

Jacket



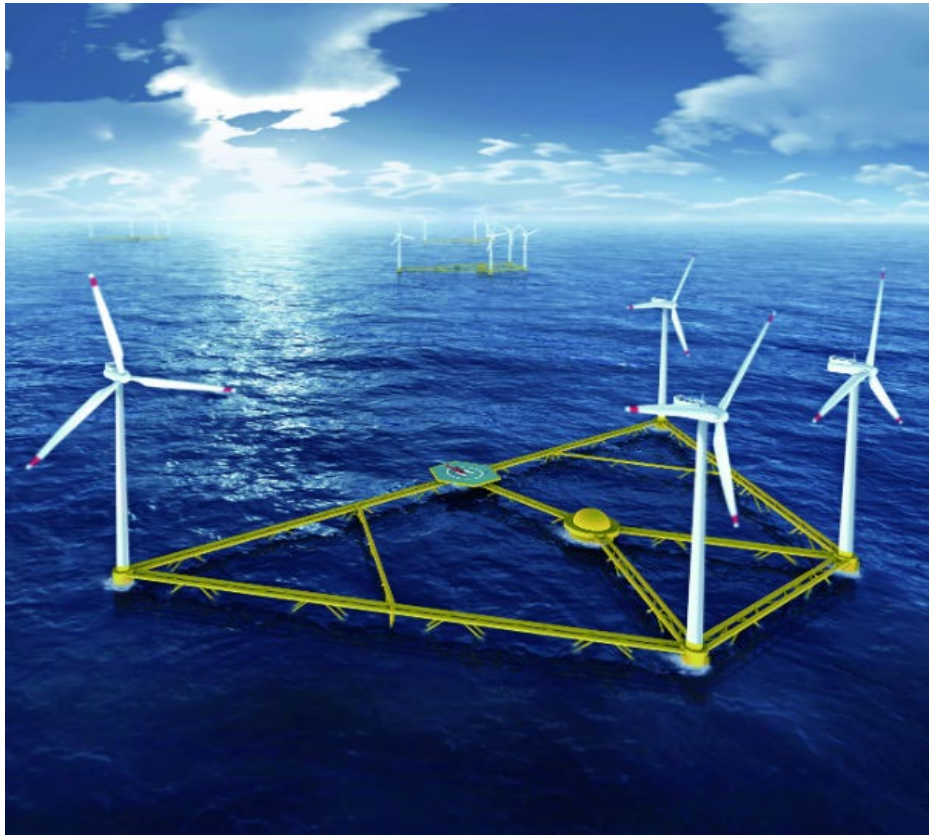
Dredgepoint.org

Jacket

- 40-80 meters water depth
- Construction and transportation in sections
- Exponential cost increase
- Sensitive to corrosion
- High maintenance costs

Dredgepoint.org

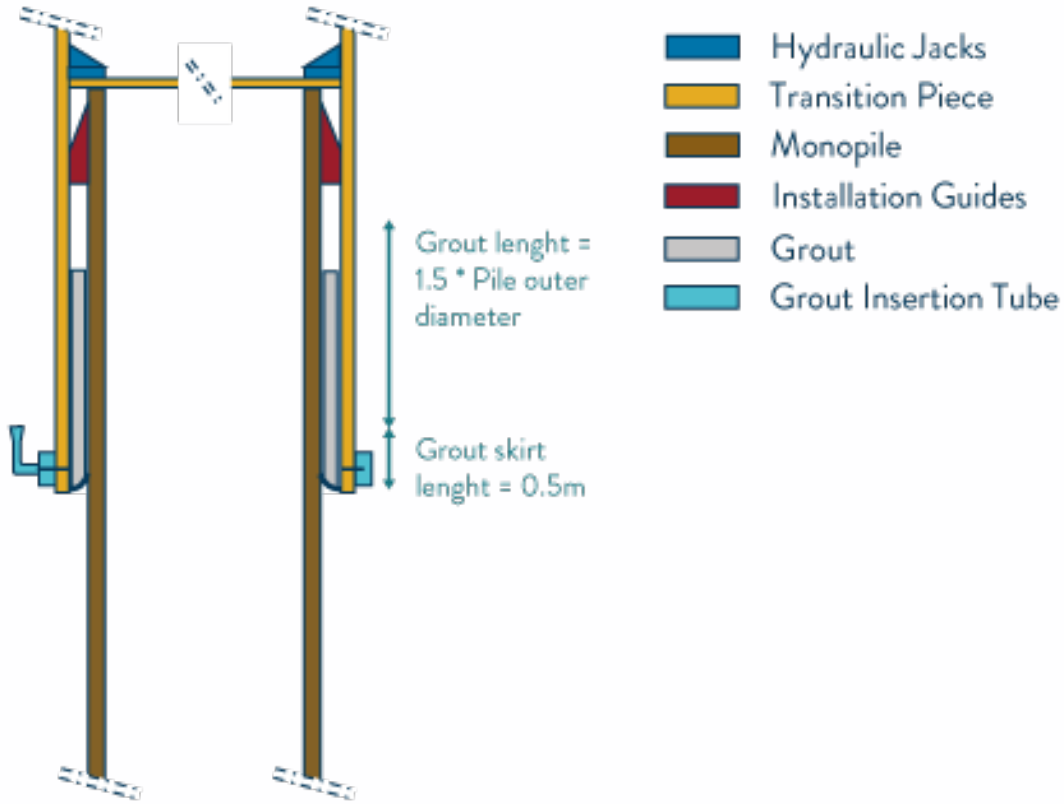
Floating



University of Tokyo

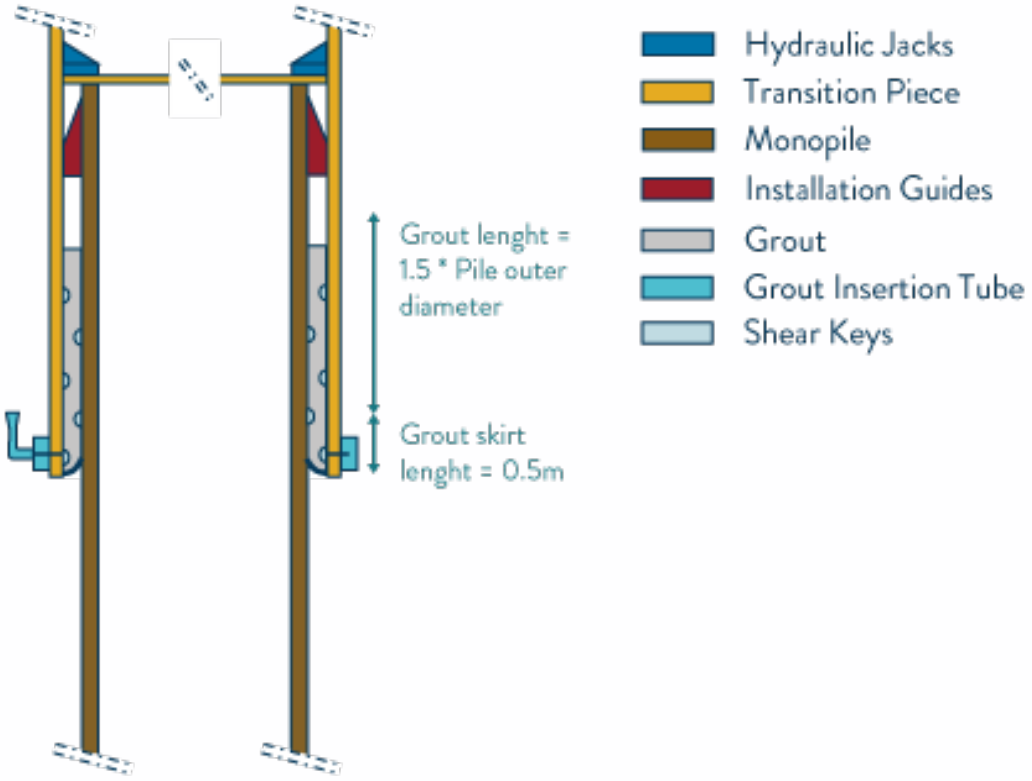
Windpower

Interface: grouting



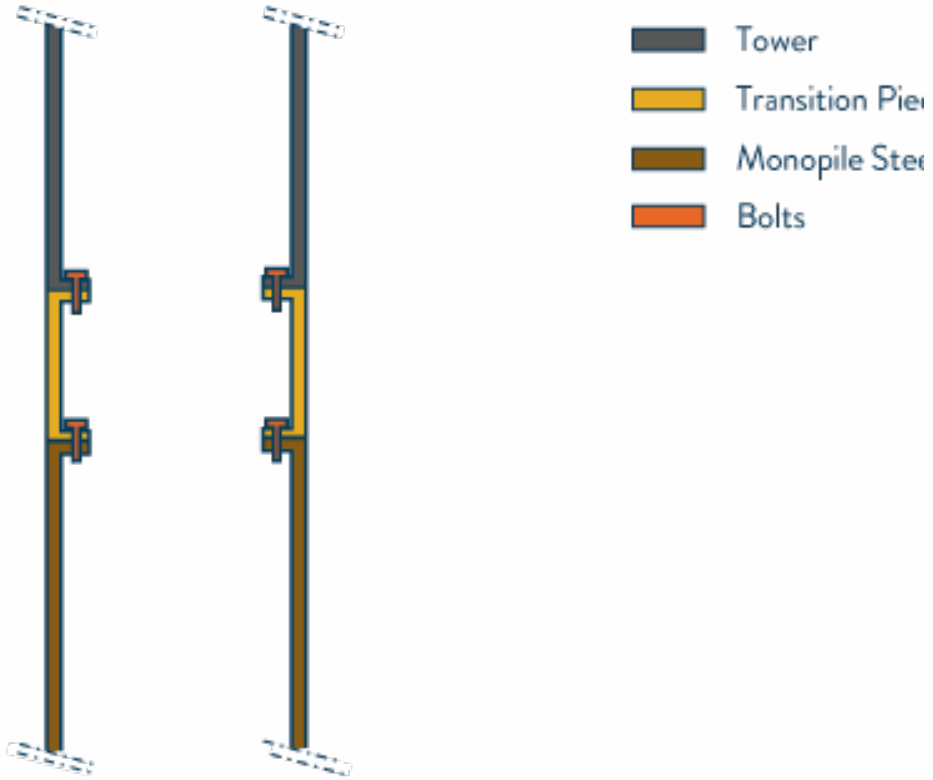
DOB-Academy

Interface: grouting + shear keys



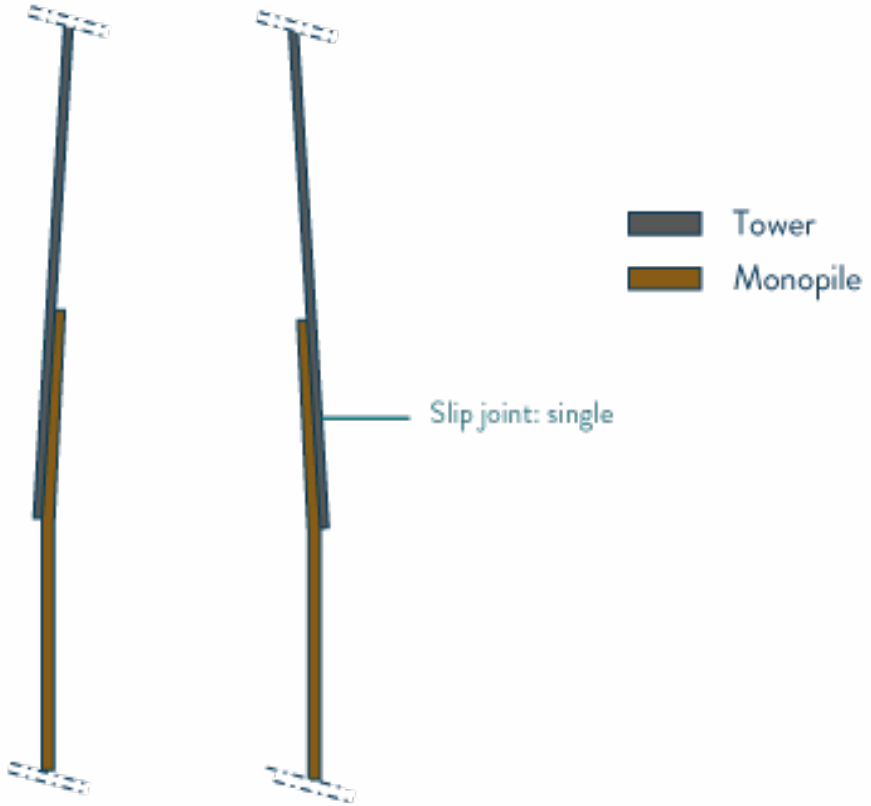
DOB-Academy

Interface: bolted

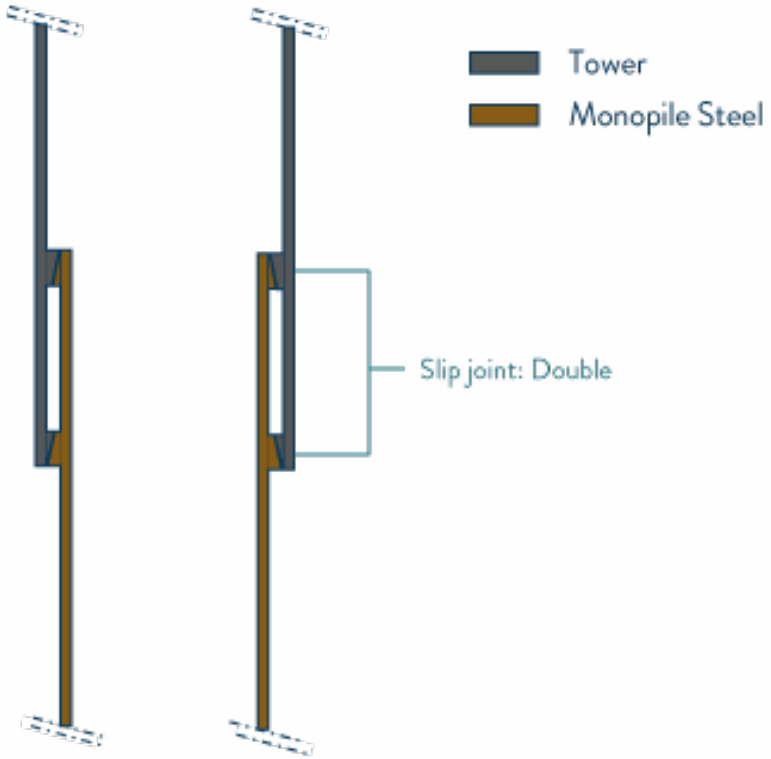


DOB-Academy

Interface: single slip joint



Interface: double slip joint



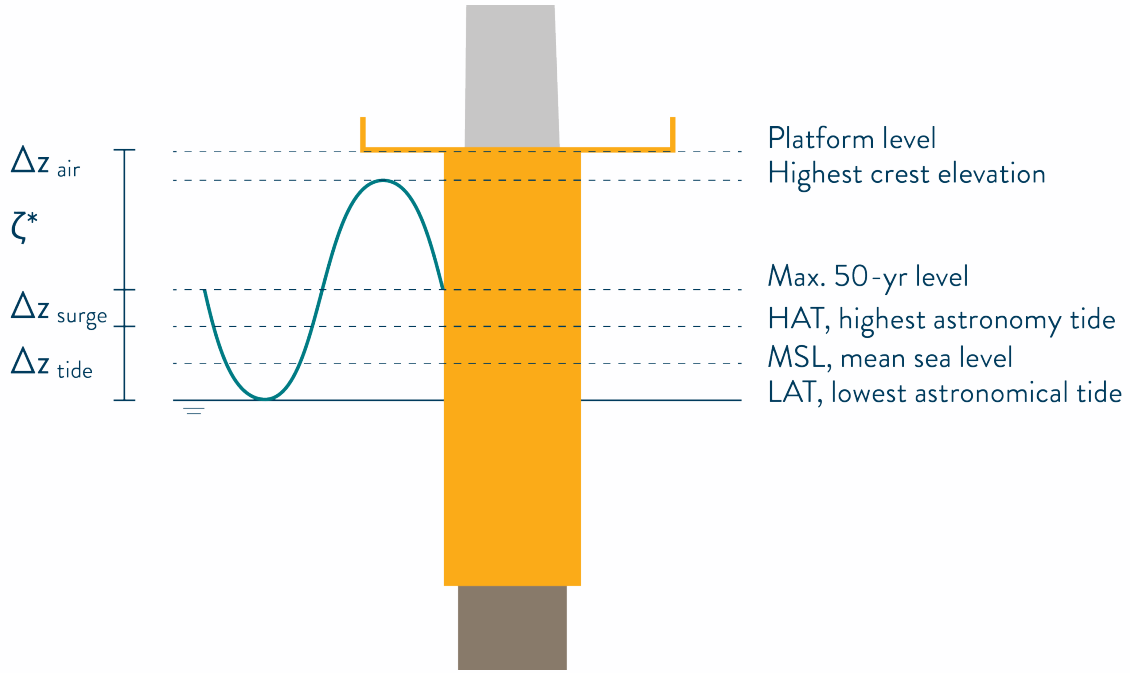
DOB-Academy

Design elevations

Platform level

$$z_{platform} = LAT + \Delta z_{tide} + \Delta z_{surge} + \zeta^* + \Delta z_{air}$$

$z_{platform}$ = Platform level
Δz_{tide} = Tidal range
Δz_{surge} = Storm surge
ζ^* = Design wave amplitude
Δz_{air} = Air gap

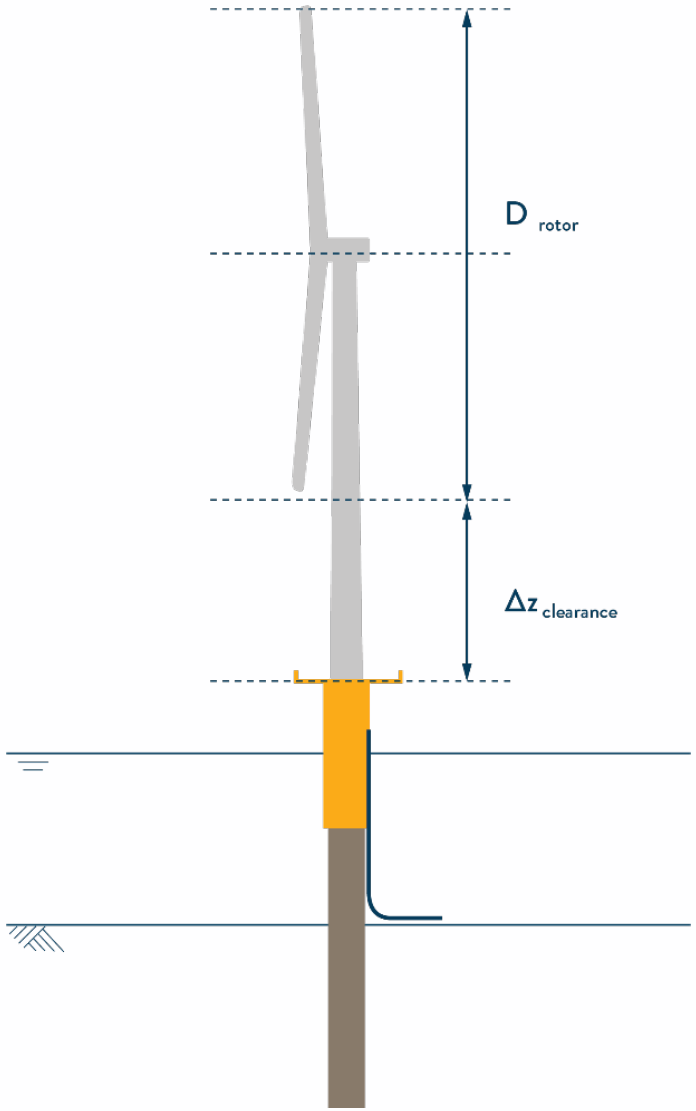


Design elevations

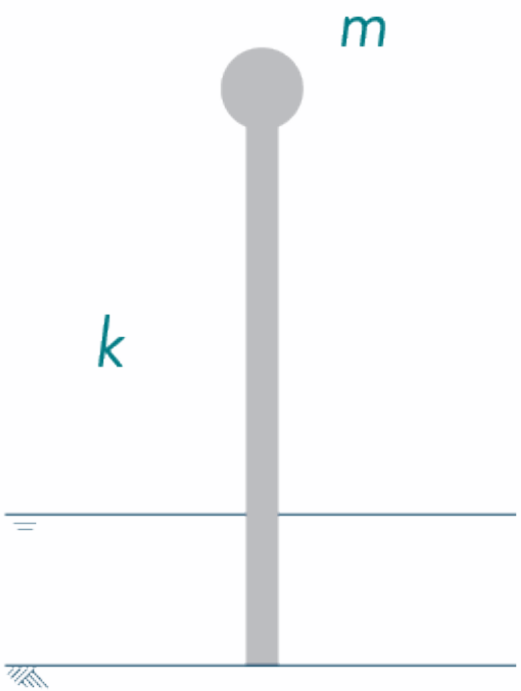
Hub height

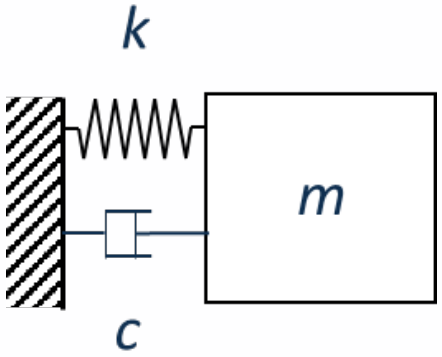
$$z_{hub} = z_{platform} + \Delta z_{clearance} + \tfrac{1}{2}D_{rotor}$$

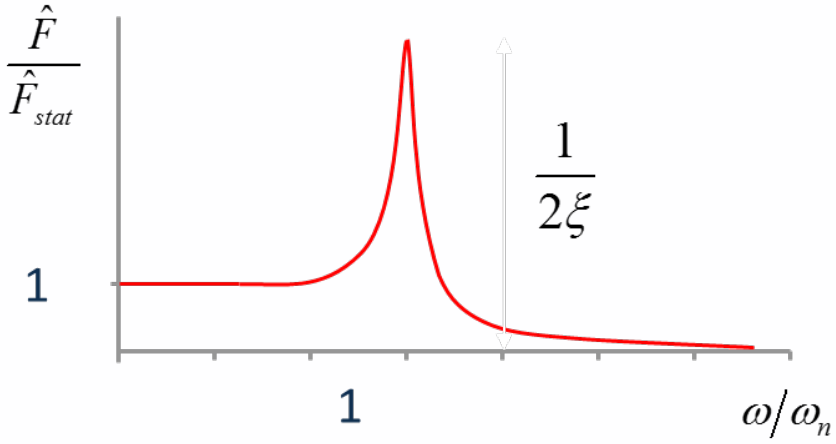
z_{hub}	= Hub height
$z_{platform}$	= Platform height
$\Delta z_{clearance}$	= Blade clearance
D_{rotor}	= Rotor diameter



Natural frequencies

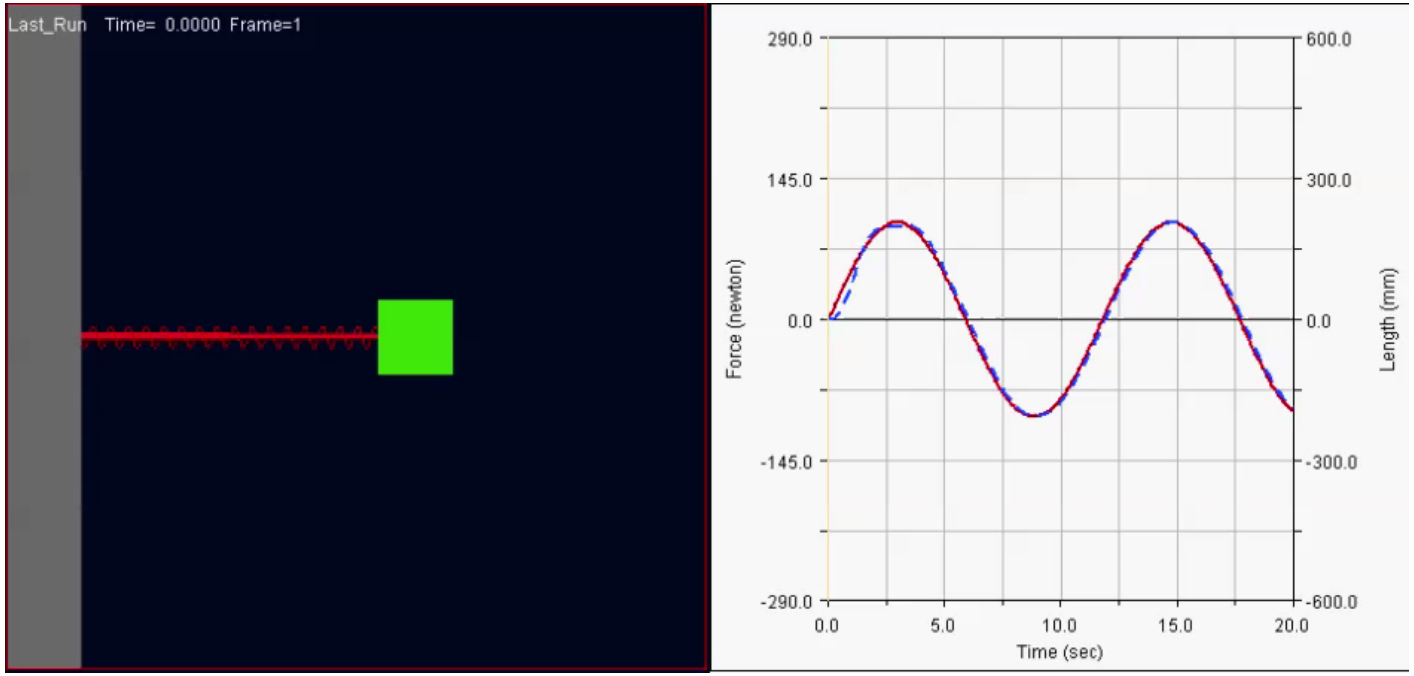


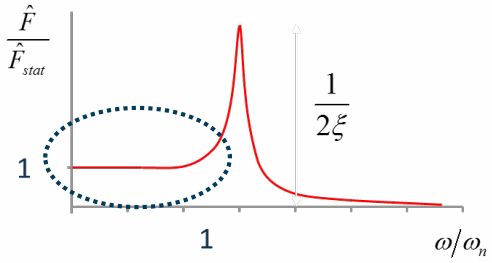




Natural frequencies

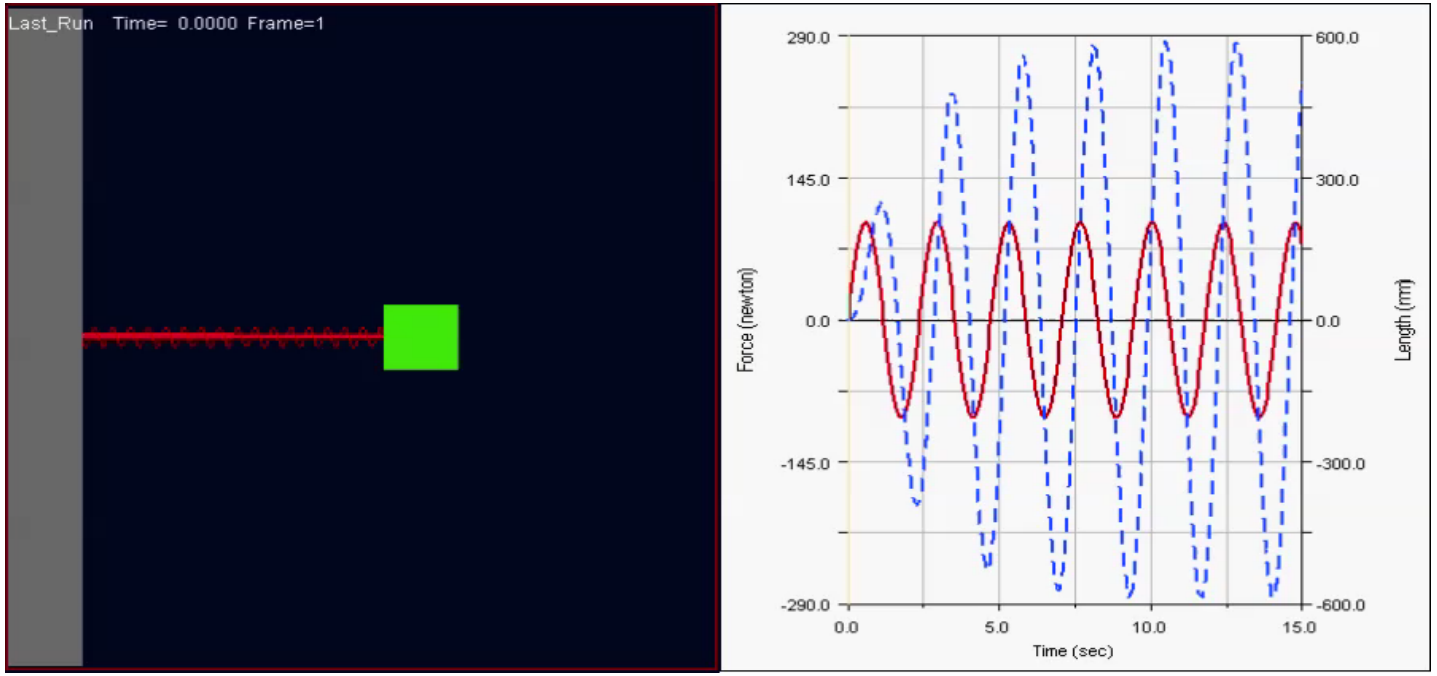
Quasi-static response

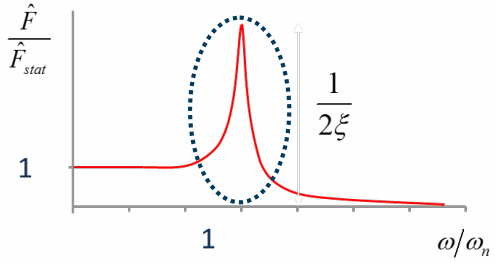




Natural frequencies

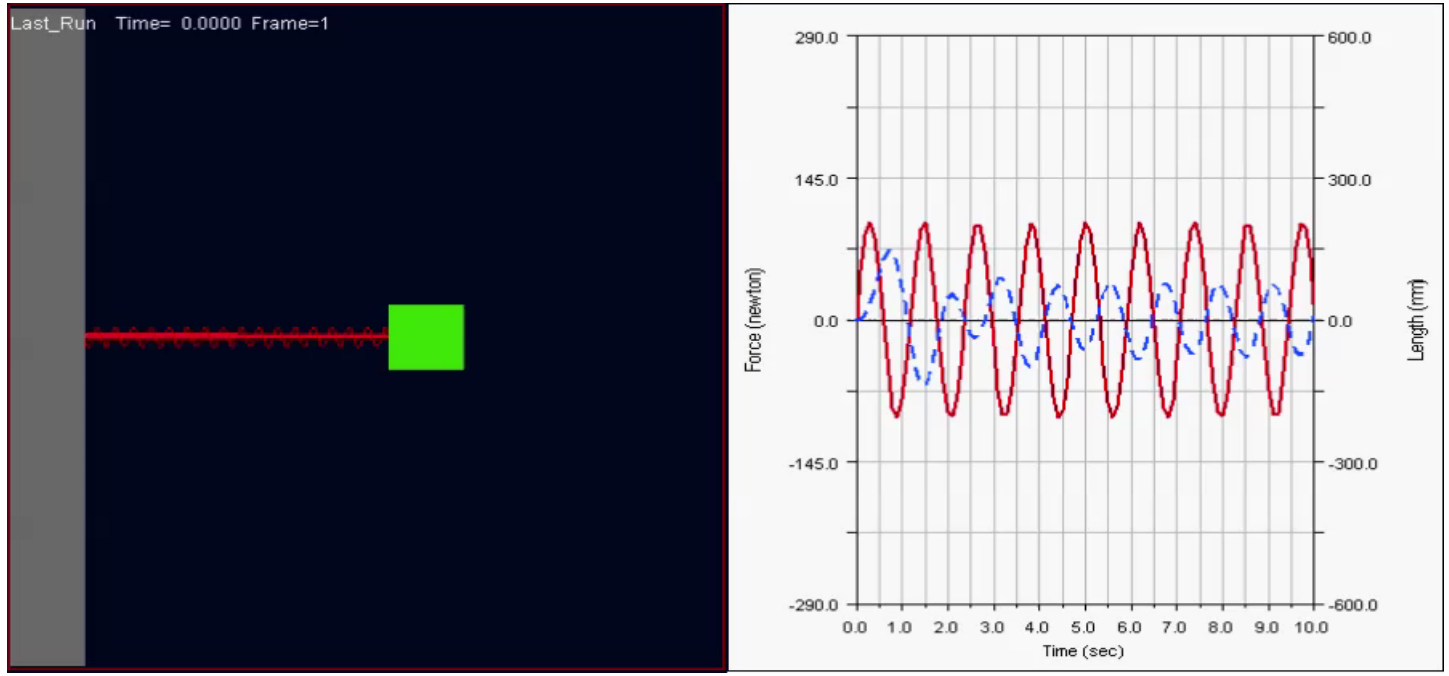
Resonant response

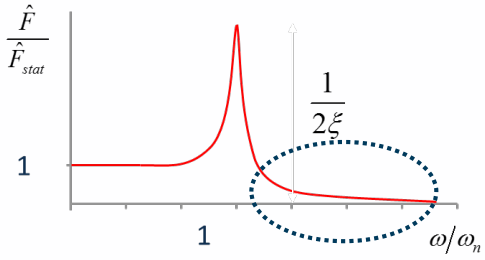




Natural frequencies

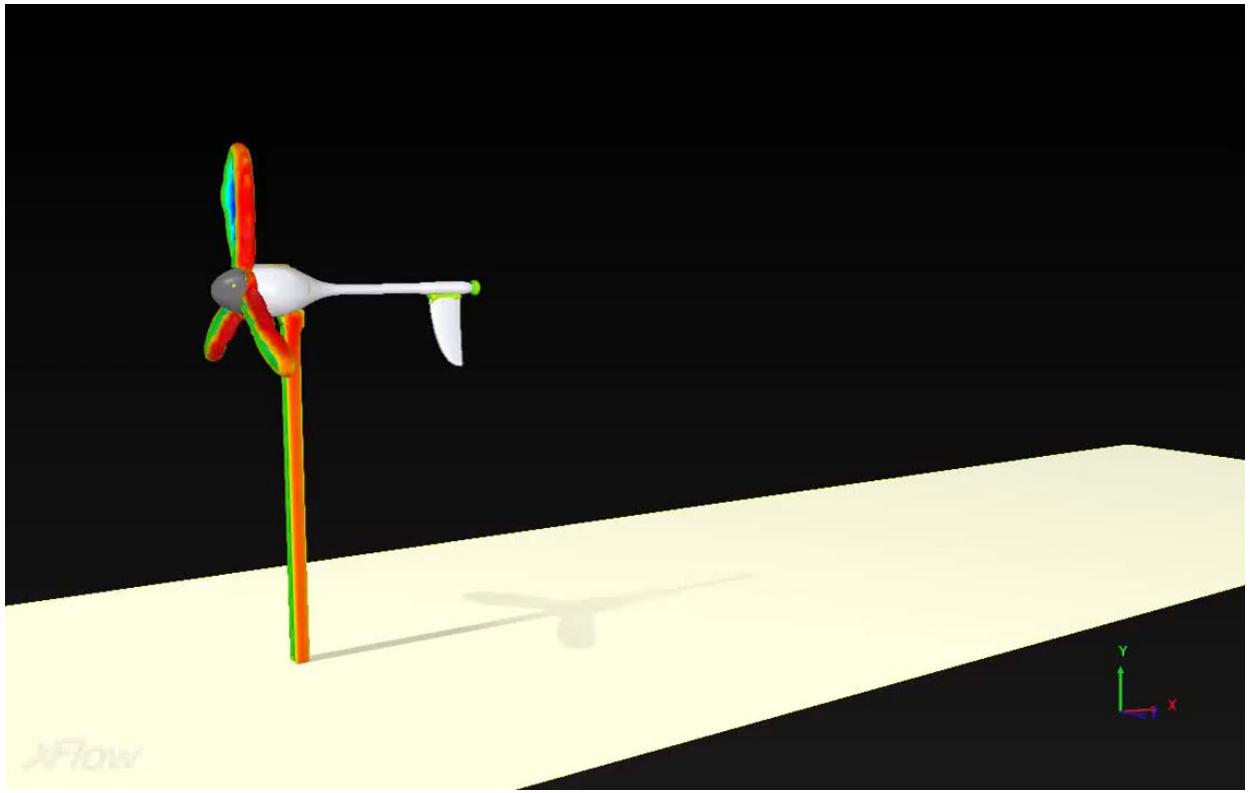
Inertia dominated response





Excitation frequencies

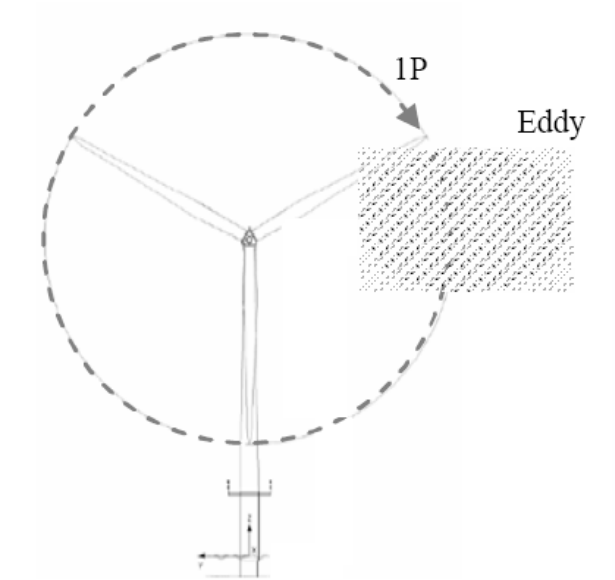
- Wave frequencies
- Turbine induced frequencies

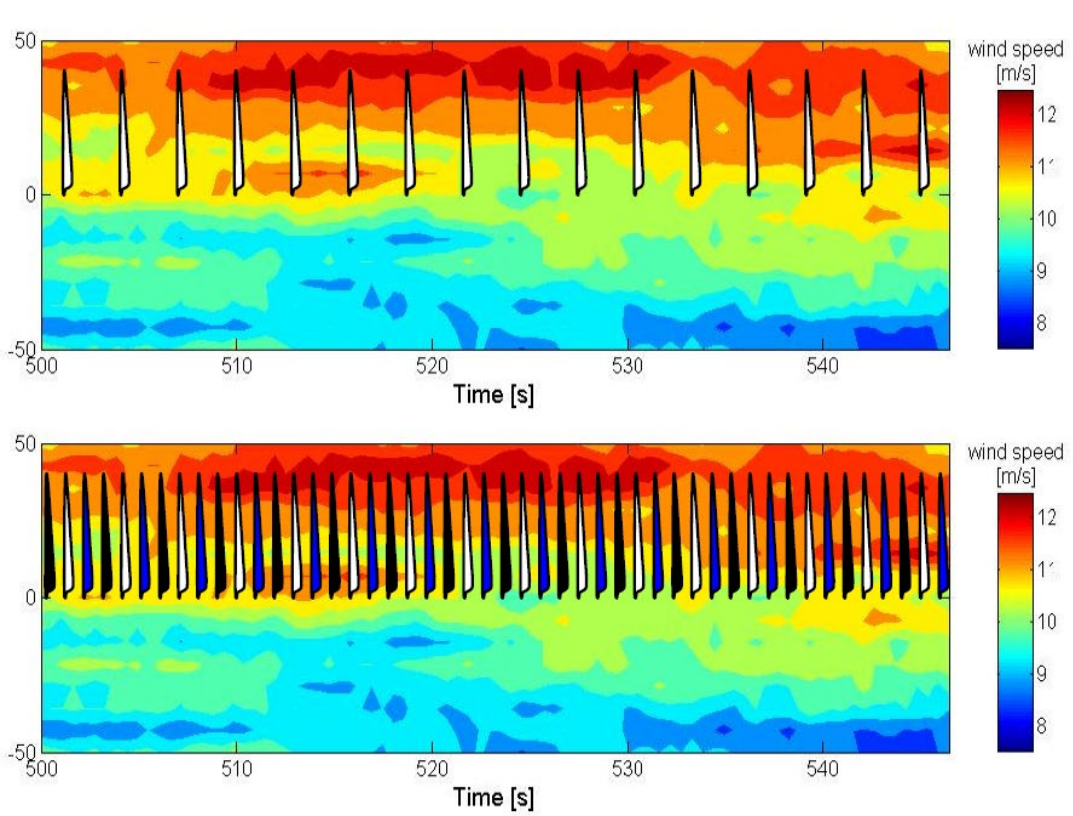


Excitation frequencies

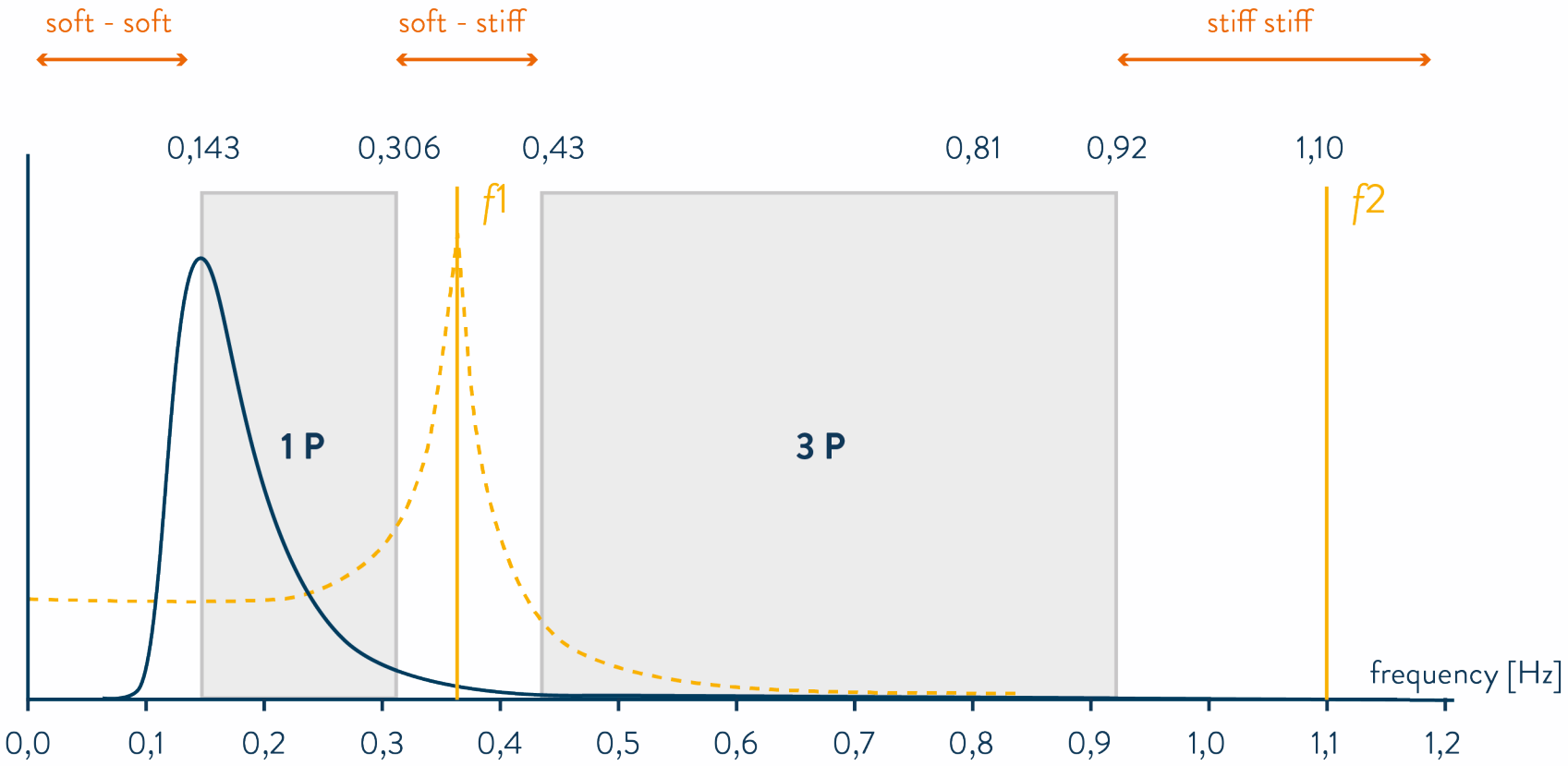
1P = Rotational frequency of the rotor

3P = Blade-passing frequency





Design frequencies



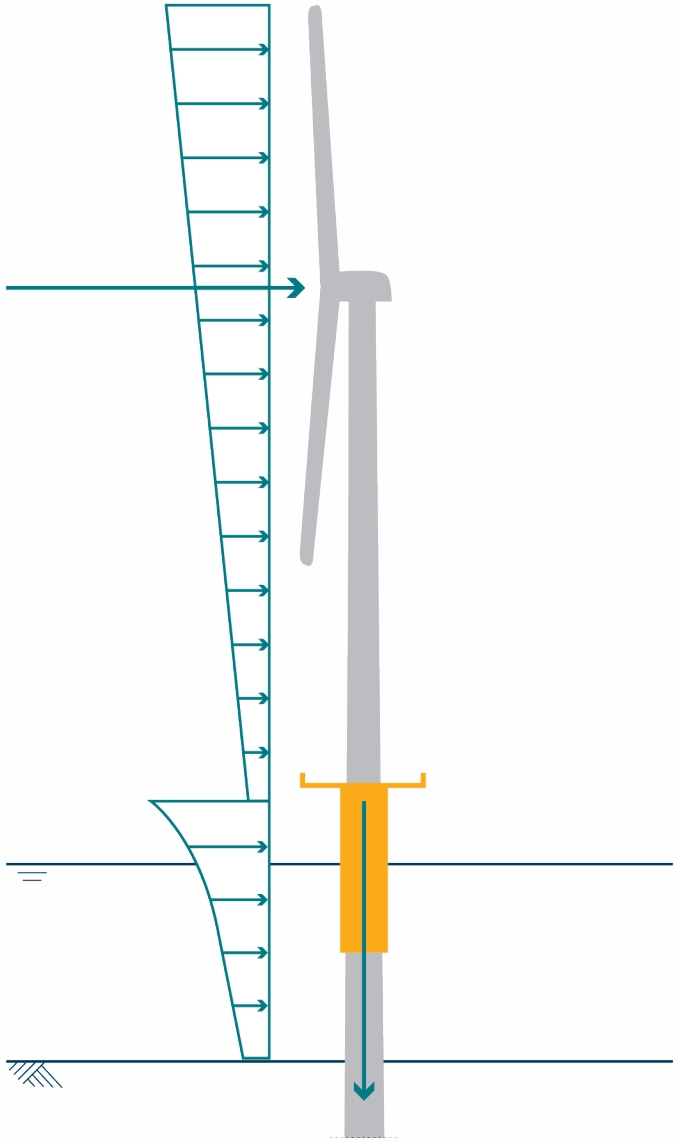
Type of loads

Initial dimensions are known

→ Aerodynamic loads

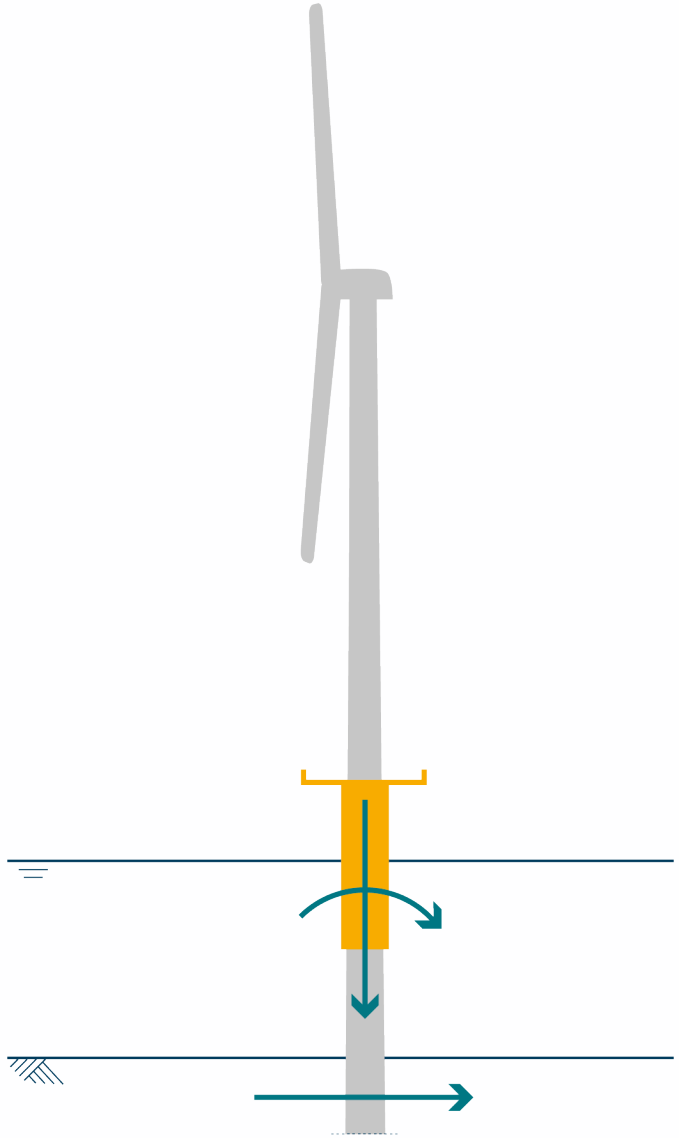
→ Permanent loads

→ Hydrodynamic loads



Resulting forces

- Addition of all forces gives
  - Base shear
  - Overturning moment
  - Axial force



The design process