Validation Concept for Highly Morphodynamically Influenced Areas Using CPT Testing Results
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Offshore Wind Park Nordergründe

Located in the outer Jade-Weser-Estuary, on the sandbank “Kleine Tegeler Plate”

1. Total wind park area is 3.5 km²
2. Water depths between 4 and 14 m
3. High morphodynamic variability
Morphodynamics of the Weser Estuary

The morphology in the area is highly dynamic and influenced by several factors such as:

1. Natural seasonal changes
2. Storm events (exposure!)
3. Large-scale morphodynamics
4. Human intervention
   1. River and coastal protection
   2. Dredging and dumping

→ Difficult to predict future seabed developments, resulting in a large bandwidth of possible bed levels.
Morphodynamic Study

Estimation of the lowest seabed level for each pile (in 25 years):

- sand wave migration of up to 60 m per year
- physical limit of the lowest seabed level in a radius of 1,500 m

Curves for max./min. seabed levels over a period of 30 years

Approach does not consider the actual migration patterns of the morphodynamically active layers! **Can the outcome of the study be specified or validated?**
Previous Studies

1. Morphodynamics
   Bandwidth of estimated seabed developments based on data from 1976 to 2010

2. MetOcean Data
   Waves, currents, water levels

3. Geotechnical Investigations
   Cone Penetration Tests

A hybrid approach?

Deltares (2007)
A Quick Journey Through the Geology of the Wadden Sea

Extreme and abrupt climate changes in the past 2.6 m years

Water levels fluctuating between today’s level and 130 m below

Stratigraphy of the Wadden Sea is characterized by:

• Active surface layers (loose sediments)
• Transgression horizon (heavily pre-stressed Glacial Sands)

Idea:

→ Find the transgression horizon at each location to separate the stable base layer from the morphodynamically active surface layers!
Available Geotechnical Data for Validation

1. Preliminary soil exploration campaign (2007)
   
   Cone Penetration Tests (CPT) at 3 locations down to -37.7 m below seabed

2. Main soil exploration campaign
   
   CPTs at all other locations down to -24 m LAT
Exemplary Location 1

Pile Group C

Deltares (2007)
Exemplary Location 2

Pile Group D

Deltares (2007)
Results and Benefits

1. The application of two independent methods led to very comparable results:
   
   Confirmation of previous study

2. Reduce uncertainty by confirming:
   
   No exceedance of previously predicted maximum depths

3. Save costs:
   
   Reduction of previously predicted maximum depths by up to 2 m at a few locations

Validation of a hydraulic study by looking at geotechnical data from a geologist’s point of view!
Thank you for your attention!