

Design Basis for Offshore Wind Structures



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Overview



- Introduction
- Design waves
- Ice loads
- Wave slamming loads
- Corrosion protection
- Grout material / grouted connection
- Conclusion

- Design basis
- Design briefs
- Design documentation
 - Drawings
 - Calculations



Design waves



- Determination of extreme design waves:
 - Definition of design wave
 - Basic wave data
 - Statistical methods
- Wave kinematics:
 - Shallow water
 - Breaking waves (surging, plunging, spilling)
- Fatigue wave climate

- **Determination of extreme design wave**
 - Should be based on *measured* data rather than *observed* data.
 - Data quality and coverage should be assessed.
 - Statistical methods, definitions and guidance notes are given in *Design of Offshore Wind Turbine Structures*, DNV-OS-J101.

Relevant for wind farms in e.g. the Baltic Sea

- Data sources

- Thickness, dimension and distribution
- Type
- Mechanical properties (compressive and bending strength)
- Velocity and direction of drifting ice

- Methods for calculation of load

- Cone/ no cone

Wave slamming loads

- Horizontal members and other items in the splash zone
- Dynamic response must be considered
- Design requirements and guidance are given in DNV Classification Note 30.5 *Environmental conditions and environmental loads*.

Corrosion protection

- Monopile design driven by fatigue
- Corrosion reduces fatigue performance
- Repair necessary
- \$\$\$\$\$\$

- Surface preparation
- Coating application
- Qualification requirements
 - Prequalification of products
 - Qualification of companies and personnel
 - Qualification of work procedures
- Inspection and testing
- In-service inspection

References

- NORSOK Standard M-501, *Surface preparation and protective coating*. 2004.
- DIN 8566/2 (TSA)
- ISO 2063 (TSA)
- BS 2569 (TSA)
- ISO 12944-5
- ISO 12944-7

- Atmospheric zone
 - Ref. to ISO 12944-5, C5-M Systems S7.09 or S7.14
- Splash zone
 - Glass flake reinforced epoxy, DFT 1.5 mm
 - Glass flake reinforced polyester, DFT 1.5 mm
 - Thermally spayed aluminium with silicone sealer DFT 200 μm
- Submerged zone
 - cathodic protection

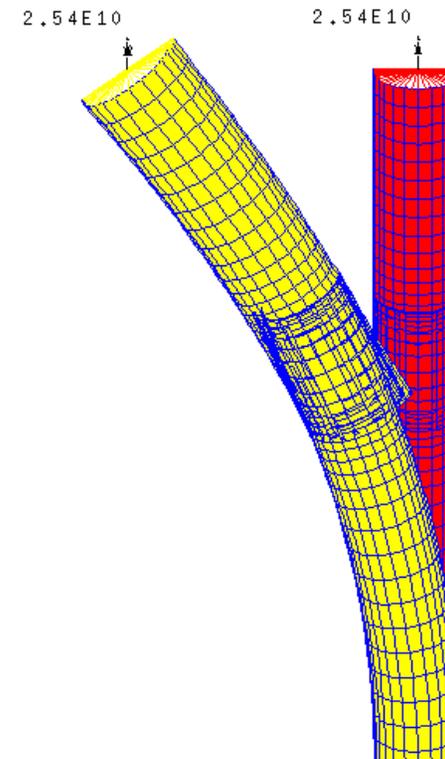
Material Qualification - Grout

- High strength grout typically required.
 - Density
 - Air content
 - Workability
 - Viscosity
 - Stability (separation and bleeding)
 - Setting time
 - Compressive strength
 - Shrinkage/expansion
 - Effect of admixtures

- Properties must be well documented.

Material Qualification - Grout

- Approval by building authority necessary in e.g. Germany
- Documentation
 - Design documents
 - Test reports



Conclusion



MANAGING RISK

- Experience transfer:
- Determination of design waves
- Corrosion protection in general
- Coating
- Wave slamming loads
- Grout
- Etc.





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