

Sea loads and motions and its application to offshore floating wind farm platform

This course is recommended for senior undergraduate and graduate students with major on Naval Architecture and Ocean Engineering. Rigid body motion, basic wave mechanics, and probability theory are prerequisites.

The proposed course is of 32 hours (4 hours each week for eight weeks). It covers sea loads and motions analyses for moored floating structures. The sea loads include wind, current and wave loads. Since wave and wind loads are random in nature, wind and wave energy spectral are to be used in their loads analysis. AQWA hydrodynamic software will be used to model and solve the motions of the moored offshore structure. In addition, currently developed offshore wind farm platforms and their future trend as well as their sea loads and motions will also be covered in the course as an application.

With this course, students shall be able to understand and apply the latest technology on sea loads and motions analyses for any type of offshore structures.

Section 1: Introduction

1. What are the offshore structures
2. Why study sea loads and motions of offshore structures
3. Course outline

Section 2: Wave loads for fixed structures and floating structure in regular wave:

1. Morison equation
2. Wave loads for slender body
3. Wave loads for large volume structure
4. Wave impact loads

Section 3: Rigid body motions for floating structures in regular wave:

1. Rigid body motion overview
2. Equation of motion of floating structure in regular wave
3. Added mass and damping forces in linear wave
4. Restoring force in linear wave
5. Linear wave exciting forces including wave incident and scattering
6. Motions of offshore structure in linear wave

Section 4: Probabilistic theory and application to irregular wave

1. Introduction of probability theory

2. Random process and random variable
3. Frequency domain analysis
4. Wave spectral
5. Motion analysis in irregular wave
6. Long term statistics and extreme values

Section 5: Current and wind and nonlinear wave loads

1. Wave drift loads:
 - 1) Mean wave drift load
 - 2) Slowly varying wave drift load
2. Current load:
 - 1) Current profile
 - 2) Drag coefficient at each current direction
 - 3) Current load estimation
3. Wind load
 - 1) Wind and wind spectra
 - 2) Drag coefficient at each wind direction
 - 3) Wind load estimation

Section 6: Sea loads and motions calculation using ANSYS/AQWA

1. Introduction of ANSYS/AQWA
2. Floating structures in regular and irregular wave analysis using AQWA

Section 7: Effect of mooring system on motion

1. Mooring system introduction
2. Mooring system modeling
3. Motions of floating offshore structure with mooring system using AQWA

Section 8: Offshore floating wind farm platform

1. Currently developed floating wind farm platform
2. Future trend of the floating wind farm platform
3. Application of sea loads and motions analysis on the moored floating wind farm platform