OpenWindPower™ Fixed Foundation
Offshore Wind Turbine Analysis

OpenWindPower Fixed Foundation software provides a comprehensive set of capabilities for the design and analysis of offshore wind turbine structures subject to wave, wind, and mechanical loading. The analysis approach is capable of predicting both fatigue and extreme loads for the substructure and nonlinear foundation.

The CONNECT Edition

The SELECT® CONNECT Edition includes SELECT CONNECT*services*, new Azure-based services that provide comprehensive **learning, mobility,** and **collaboration** benefits to every Bentley application subscriber. *Adaptive Learning Services* helps users master use of Bentley applications through CONNECT Advisor, a new in-application service that provides contextual and personalized learning. *Personal Mobility Services* provides unlimited access to Bentley apps, ensuring users have access to the right project information when and where they need it. *ProjectWise® Connection Services* allow users to securely share application and project information, to manage and resolve issues, and to create, send, and receive transmittals, submittals, and RFIs.

Wave Loading Analysis

The wave loading can be represented by either a time history or in spectral form. A random wave surface profile may be determined from a wave height spectral density function using multiple random seeds. The following wave spectra are available:

- Pierson-Moskowitz
- JONSWAP
- Ochi-Hubble
- User-defined
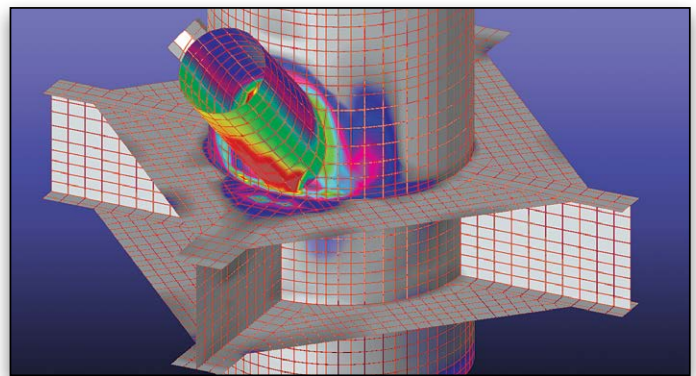
Wind Loading Analysis

Similarly, the wind loading can be input as time history or as a random loading developed from the following available spectra:

- Von-Karman
- Harris
- Kaimal
- User-defined

Fully Coupled or Uncoupled Analysis

The software features an interface to the GH Bladed and FAST* software, accounting for the full coupling between wave, wind, and the wind-induced mechanical loading for a multimodal response analysis. The GH Bladed multicore interface is fully automated, allowing the user to handle hundreds of time history simulations required for a typical fatigue analysis. The optional multicore capabilities allow for a dramatic reduction in runtime.

Alternatively, the wind-induced mechanical force time history can be assumed to be independent of the wave and wind loads for an uncoupled analysis.

Color-coded stress contours

For a random analysis, equivalent static loads—representing both inertia loading and hydrodynamic/aerodynamic loading—may be created as part of the analysis at time points selected automatically by the program, user-specified times, or time increments.

Dynamic Superelement

OpenWindPower applications include a dynamic superelement module based upon the Craig Bampton approach. The dynamic superelement is completely compliant with Siemens BHawC aeroelastic code.

Fatigue Analysis

The OpenWindPower Fixed Foundation fatigue analysis method uses the Rainflow counting approach to predict the stress cycles resulting from a time history analysis—including the ability to sequentially accumulate the damage from multiple analysis simulations for numerous wind speeds and seastates.

Scenario Services for OpenWindPower Fixed Foundation Analysis

Analyze large and compute-intensive models on the cloud without consuming your desktop's bandwidth. Full set of analysis and design outputs from your cloud analysis can be downloaded for detailed post-processing on the desktop. Achieve full design code compliance by considering all possible load scenarios in a fraction of the time it would take on your desktop. Using Cloud Scenario Services for OpenWindPower Fixed Foundation, thousands of load cases can be executed in parallel on the cloud. Achieve 100 times or more time savings by leveraging the unlimited computing power of the cloud. Stay connected wherever you go.

*FAST: "Fatigue, Aerodynamic, Structure & Turbulence" is a National Renewable Energy Laboratory (NREL) software code available at www.nrel.gov.

OpenWindPower Fixed Foundation At-A-Glance

Professional Static Offshore Package

- Contains capabilities for offshore jackets, wharfs, and dolphin structures

- Includes interactive graphics modeled with advanced 3D capabilities and interactive graphics post processor, seastate, joint can, pile, combine, gap, tow, and LDF large deflection

- Features automatic model generation, beam and finite element capability, steel code check and redesign, environmental load generation, tubular connection check, single pile/soil interaction, inertia and moving load generation, tension/compression nonlinear elements with initial gap, load case combination, linear large deflection analysis, and full output report and plotting capabilities

Plastic Nonlinear Add-on

- Includes nonlinear foundation, and nonlinear and plastic analysis capabilities

- Plastic analysis includes pushover, ship impact, and blast nonlinear analysis

- Collapse view interactive collapse results processor

Pile-soil Interaction

- Features the PSI nonlinear soil/pile/structure interaction program module

### Advanced Dynamic Fatigue Package

- Contains the modules required to perform any dynamic deterministic, time history, or spectral fatigue analysis

Fatigue Life Evaluation and Redesign

- Spectral, time history, and deterministic fatigue analysis

- Cyclic stress range calculation procedures include wave search, curve fit, and interpolation

- SCF calculations recommended by API (including 21st ed. supplements), HSE, DNV, DS449, and Norsok Codes

- Automatic redesign

- API (including 21st ed. supplements), AWS, HSE, and Norsok thickness dependent recommended S-N curves

- Multiple run damage accumulation

- Pierson-Moskowitz, JONSWAP, Ochi-Hubble double peak, simplified double peek, and user-defined spectra

- Automated or user-specified connection details

- Pile fatigue analysis

- Wave spectra creation from scatter diagram

- Paris equation used to predict crack growth rate due to cyclic stresses

- Load path dependent joint classifications

- Includes wave spreading effects

- Reservoir (rain flow) cycle counting method

- ISO 19902
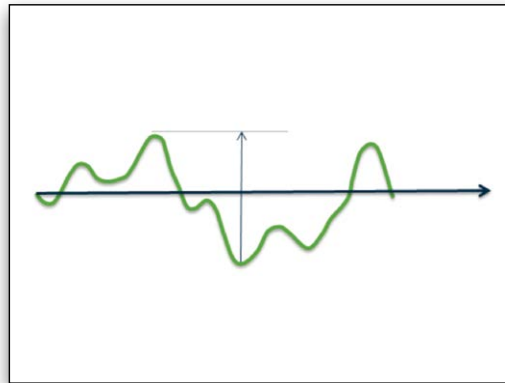
Rainflow counting approach to predict the stress cycles resulting from a time history analysis
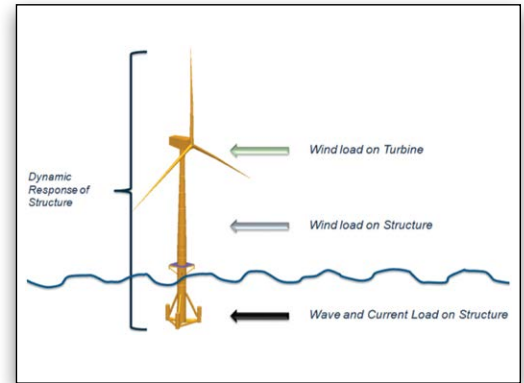
Wind turbine fatigue analysis loading on structure