BLADED

Wind Turbine Design Software
Bladed is the industry standard integrated software package for the design and certification of onshore and offshore turbines. It provides users with a design tool that has been extensively validated against measured data from a wide range of turbines and enables them to conduct the full range of performance and loading calculations.

Bladed offers a Windows-based interface and supports calculations of combined wind and wave loading, with full aerelastic and hydroelastic modelling. It was validated by Germanischer Lloyd for the calculation of wind turbine loads for design and certification.

- **Rotor**
  - 1, 2 or 3 blades, with cone and pre-bend.
  - Full and partial span pitch or aileron control.
  - Fixed or teetered hub.
  - Upwind or downwind orientation.
  - Clockwise or anticlockwise rotation.
  - Blade vibration dynamics.
  - Blade element momentum with dynamic inflow and stall hysteresis.
  - Comprehensive aerofoil interpolation.
  - Rotor mass, geometric and pitch imbalances.
  - Model for iced blades.

- **Drive train**
  - Stiff or torsionally flexible shafts.
  - Geared and direct drive layouts.
  - Flexible mountings on gearbox or pallet.
  - Interface for user-specified gearbox DLL.

- **Generator and electrical**
  - Variable speed, fixed speed, two-speed and variable slip models.
  - Range of electrical loss models.
  - Electrical models for current, voltage and network interactions.
  - Network transients, short-circuits, electrical flicker, etc.
  - Interface for user-specified electrical system DLL.

- **Control**
  - Stall, pitch or aileron control.
  - Fixed or variable speed.
  - Transducer dynamics.
  - Parked, idling, start-up, shutdown and power production simulations.
  - Yaw dynamics and yaw bearing friction.
  - Built in PI controllers with gain scheduling.
  - All turbine control functions can be user-defined through DLL interface.
  - Comprehensive pitch actuator models.
  - Rotary and linear pitch drives.
  - Load-dependent pitch bearing friction.

- **Waves and currents**
  - JONSWAP and Pierson-Moskowitz wave spectra.
  - Near-surface, sub-surface and near-shore current.
  - Regular and random wave histories.
  - Non-linear wave theory for extreme wave modelling.
Tower and nacelle
- Wind loading.
- Multimember towers e.g. monopile, tripod, jacket.
- Tower vibrational dynamics including twist.
- Foundation flexibility including non-linear P-Y models.
- Floating offshore support structures.

Graphics
A graphics facility allows the user to view results quickly and easily, and to incorporate graphs into any MS OLE compliant documents.
- Multiple line graphs.
- Cross plots.
- Bar charts.
- Linear and logarithmic axes.
- 3D surface and column plots.

Response Calculations
- Modal analysis of blades and tower.
- Blade aerodynamics.
- Performance coefficients.
- Power curves.
- Mean steady loads.
- Detailed simulations of performance and loading for all turbine states.
- Full order linearised models in Matlab format.
- Earthquake loading.

The user is allowed very flexible control of the calculation outputs:
- Forces and moments at specified blade and tower stations.
- Forces and moments at the hub and yaw bearing.
- Shaft, gearbox, brake and generator loads.
- Rotational speeds at rotor and generator.
- Mechanical and electrical losses.
- Blade and tower deflections and yaw motion.
- Nacelle accelerations.
- Blade pitch, controller and transducer signals.
- Detailed pitch actuator information.
- Active and reactive power output, currents and voltages.

Wind field model
- Wind shear models: standard and user-defined.
- Upflow.
- Tower shadow, upwind and downwind.
- 3-dimensional, 3 component models of atmospheric turbulence.
- Transients in wind speed, direction, and shear.
- Eddy viscosity model of upwind turbine wake.

Project management
- Rich graphical environment for defining entire sets of calculations.
- Example projects which set up IEC load cases.
- Batch framework for managing execution of multiple calculations.
- Distributed execution of batches across multiple CPUs on your network.
- Manage model updates across the entire batch.
- Rapid quality checking of simulation results using flexible plotting facility.

Post-processing facility
A powerful post-processing facility is provided for analysis of the results of calculations:
- Annual energy capture.
- Electrical flicker.
- Prediction of extreme loads.
- Extraction of periodic and random loads.
- Probability distributions.
- Autospectral analysis.
- Cross spectra, coherence and transfer functions.
- Calculation of stress histories from combinations of loads.
- Peak value and level crossing analysis.
- Lifetime fatigue analysis in a single calculation from multiple load cases.
- Rainflow cycle counting.
- Fatigue analysis.
- Damage equivalent loads.
- Ultimate loads analysis.
- Basic statistics.
- Fourier harmonics.
- Gearbox time and revolutions at level.

Support and training
After sales support and maintenance includes telephone and email support and incremental upgrades to the software.

Try a demo
For more information about Bladed and its individual modules or to request a demonstration version, please visit www.dnvgl.com/renewables. Alternatively, please contact our Bladed team by emailing bladed@dnvgl.com.
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DNV GL
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In the Energy industry
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