DIGITAL SOLUTIONS

SESAM™

For fixed offshore wind turbine structures

Software for ultimate strength and fatigue analysis of offshore wind turbine substructures

DNV GL's Sesam software offers a tailor-made solution for structural strength analysis of offshore wind turbine structures addressing the industry's need to account for the combined effect of wind and hydrodynamic loads, and is based on international standards.

Building on more than 45 years of experience as a leading tool for engineering of offshore structures, Sesam software is applicable for analyses of wind turbine structures of any complexity, from monopiles to tripods and jacket structures.

Modelling in Sesam
Sesam provides a 3D modelling environment for beam, shell and solid elements. Beams are typically used for the frame substructure and tower. The transition piece may be modelled by beams for global stiffness representation or shell/solid elements for a more refined stress response analysis. Local joints can also be transformed from beam to shell elements for determination of stress concentration factors and detailed fatigue analysis.

10 GOOD REASONS FOR CHOOSING SESAM:

1. One complete, intuitive and user-friendly solution
2. Powerful parametric modelling and scripting possibilities
3. Full 3D modelling in Sesam's proven software for offshore engineering including structure, pile/soil and hydrodynamic properties
4. Re-use of the model within the different analyses throughout the complete lifecycle
5. Post-processing of integrated design member loads from Bladed
6. Superelement/sequential analysis using wind turbine loads from Bladed or any 3rd party tool, such as BHawC, HawC2, Flex5 and others
7. Efficient and fast redesign process
8. Visualization gives more confidence in results
9. Easy import of models from multiple systems such as SACS, Ansys, Staad, Solidworks and others
10. 10x faster analyses using Sesam Cloud, enabling further optimization and cost reduction

Integrated design

Fully integrated dynamic analysis is possible using Bladed, which is well integrated with Sesam. Bladed is the world's leading wind turbine design tool. Models can be taken from Sesam into Bladed and member load can be converted from Bladed into Sesam format for post-processing in Sesam. The integrated analysis includes wind and hydrodynamic loads, control system and finite element model of the complete wind turbine, tower and substructure in a single solver. The user-friendly combination gives a complete tool for modelling, testing and code checking of offshore wind turbines. You will save time and money by optimization of the wind turbine design and work processes:

- Reduce uncertainties and improve work efficiency in design and verification of offshore wind turbines
- Use one consistent model throughout the wind turbine and substructure analysis
- Leave behind challenging interfaces and iterative work for tuning the wind turbine model and the substructure model

Superelement/ sequential analysis

Sesam offers an interface for easy use of time domain wind loads from commercial aero-elastic codes such as Bladed, BHawC, HawC2 and Flex5. The imported wind loads may be combined with the hydrodynamic loads from waves and current generated in Sesam to produce a single time series for structural analysis. In addition, model and load conversion into a superelement is available for Bladed and Siemens' BHawC. Conversion of interface loads back into Sesam is also included.

Fatigue and ultimate strength analysis

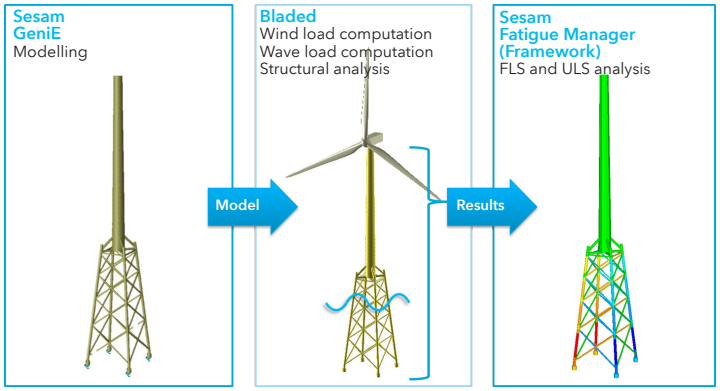
Sesam provides fatigue analysis of damage equivalent loads as well as time domain loads, based on IEC61400-3, DNVGL-ST-0126 and DNVGL-RP-C203, including libraries of SN curves and automatic computation of stress concentration factors (SCFs). It also enables ultimate strength analysis of simplified extreme loads, time domain loads and earthquake loads, based on API, AISC, Eurocode, ISO and Norsok. A list of all design load cases to be checked for fatigue analysis using the rainflow counting methodology can be specified, summing damage over all time domain analyses. Similarly, time domain analyses can be checked for ultimate strength

Sesam Cloud

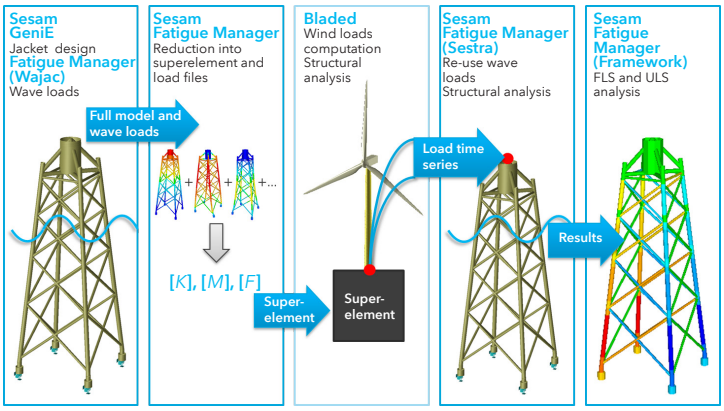
All time domain analyses can be run in parallel, either locally or in the Sesam Cloud, significantly reducing analysis time required. With Sesam Cloud, run times can be decreased by a factor of 10 compared to running multiple runs in parallel locally.

Verification reports

Verification reports exist for the Sesam interfaces with Bladed and BHawC. These include further details on and verification of the conversion process and a verification study of the results.



Integrated analysis workflow when using Sesam and Bladed



Superelement analysis workflow when using Sesam and Bladed

Why Sesam?

A fully integrated analysis system will reduce uncertainties and improve work efficiency in design and verification of offshore wind turbines. Besides primary steel design, Sesam can be used for secondary steel design of boat landings and J-tubes, including (operational and accidental) boat impact analysis and vortex-induced vibration analysis of J-tubes. Also transportation and lifting are available. All Sesam modules use the same model, thereby easing the process of running multiple analyses.

How is Sesam unique?

Sesam offers coupled dynamic analysis of a fully integrated wind turbine system, including wind turbine, substructure/foundation and environment loads. With Sesam you can do fatigue and ultimate strength analyses of the substructure, based on DNV GL's 45+ years of experience providing software solutions to the offshore industry.

Sesam modules for fixed wind offshore turbine structures

Sesam offers modules for modelling (GeniE), wave load calculations (Wajac), soil-pile-structure interaction (Splice), linear static or dynamic structural analysis (Sestra), fatigue assessment (Framework), and code checks (GeniE and Framework), with all time domain FLS and ULS analyses being controlled from an intuitive user interface (Fatigue Manager). Optional modules exist for result visualization (Xtract) and boat impact and non-linear analysis (Usfos).