STRUCTURAL ANALYSIS AND LIFE EXTENSION FOR FLOATING OFFSHORE ASSETS

Solution Brief
INDUSTRY CHALLENGE

Offshore floating structures used within the oil and gas industry must, by their very nature, withstand extreme environmental loads – such as wind, waves, weight, and ice, while maintaining buoyancy without pitching and rolling. They must be designed not only for safety, but also for long-term performance and reliability. The engineers who design them need access to powerful analysis tools to help them ensure the structures’ safety and resiliency and, at the same time, reduce build costs and maximize lifetime.

Today, conventional analysis tools such as finite element analysis are used for structural analysis and asset integrity studies. But these analysis tools have major limitations for the analysis of large floating structures, with their complex structure, environmental load and safety considerations. FEA doesn’t support global system models at a level that accurately reflects physical processes acting on the structures. Instead, engineers have to either use a global coarse FEA model, which simplifies the structural detail considerably, or local fine FEA models, which don’t accurately capture cumulative effects occurring within the global model.

Whether your business is to design offshore structures or to ensure their ongoing operational integrity, Akselos provides the solution that enables extreme response modeling and supports the entire lifecycle.

AKSELOS SOLUTION

Akselos Integra™, the world’s most advanced and fastest engineering simulation platform, pushes the boundaries of what modern engineering can achieve. Akselos Integra’s patented algorithms enable full, condition-based models of large-scale assets that can be simulated 1,000 times faster than with conventional FEA tools. The results give a much more accurate representation of real-life physical scenarios in extensive detail than you’ll get with conventional FEA tools.

Companies in the offshore, power generation, mining and wind energy industries use Akselos Integra to solve their most demanding engineering problems while reducing costs and inefficiencies and gaining a competitive advantage.

Akselos Integra supports structural analysis applications that cover the entire lifecycle, from the design to the operation phase, and to eventual decommissioning. Applications include static structural analysis, modal analysis, static and dynamic wind and wave loading, and fatigue analysis. In addition, the software supports code checks such as fatigue checks, integrated buckling checks, and strength checks in accordance with the most-often-used standards in the offshore industry. These analyses give engineers the results they need to create safe designs and to assess the strength of their structures at the speed of thought.

Regardless of the complexity of your structures, Akselos Integra ensures more realistic modeling than ever before. With Akselos Integra, you gain a deeper confidence in your designs and ensure structural integrity of your most critical assets.

BENEFITS

Akselos is the only near real-time structural integrity tool providing holistic, detailed models that help you:

• Achieve 5x ROI on engineering workflow used to analyze inspection data.
• Enhance durability of offshore installations with greater upfront confidence in designs and life extension decisions.
• Unlock spare structural capacity left in your assets.
• Reduce OpEx costs by optimizing inspection intervals.
• Automatically check for compliance with the latest rules and regulations.

A semisubmersible structure modeled with beam, shell and solid elements.
Component-based modeling

Modeling offshore floating structures is challenging due to their complexity in a number of different areas and their need to withstand many types of extreme environments and loads. Akselos Integra offers a unique component-based modeling method with which engineers can efficiently construct large, reusable, and reconfigurable models from smaller, parametrized components. This component-based modeling approach lets engineers quickly create custom model versions by changing the parameters of individual components to support different analysis scenarios. This results in a powerful interface to perform trade-off studies and contingency planning quickly and efficiently.

Engineers use this component-based modeling approach to create large high-fidelity models that include beam, shell, and solid elements. This means that we can use the right level of modeling detail to serve engineering needs, without being restricted by the computational limitations imposed by FEA.

Condition-based modeling

Understanding the way offshore floating structures behave under certain conditions and loads and the ability to model them confidently is paramount. With Akselos Integra, you can quickly produce the most challenging 3D models of existing conditions for an entire structure, whether a semi-submersible, SPAR platform, floating-leg platforms, drillship, or floating production, storage, and offloading (FPSO) system. You can reliably build a fully detailed 3D model in less time than if you used conventional FEA tools and without risks of software limitations. This enables you to capture the structure’s exact condition by incorporating real-life data, such as corrosion and cracks, within a global finite element model.

Parametric Akselos models enable crack geometry or thickness data to be updated in seconds – speeding up analysis and studies. Akselos Integra also supports script-based (using Python) post-processing of key quantities, such as J-integrals on crack tips to assess and predict crack propagation.

5x ROI on engineering workflow used to analyze inspection data

Von Mises stress for a fully detailed and condition-based FPSO hull model computed with Akselos Integra.
**Linear**

The Akselos RB-FEA solver is ideal for solving static, dynamic, and modal linear analysis of large-scale structures at a 1000x speedup compared to standard FEA. This enables engineers to produce detailed stress analysis reports of thousands of load cases and load combinations to improve structural design integrity and ensure design code compliance.

**Nonlinear**

In addition to providing linear analysis capabilities, Akselos Hybrid Solver enables fast analysis for the full range of nonlinear behavior (e.g. nonlinear geometry, contact, plasticity) within large and complex structures.

The Hybrid Solver uses FEA components in nonlinear regions in conjunction with RB-FEA components in linear regions for a “best of both worlds” approach to nonlinear analysis. The Hybrid Solver allows for the accuracy and flexibility of FEA for nonlinear analysis and still brings RB-FEA acceleration to regions of the model in which the behavior is purely linear.

**ADVANCED ANALYSIS**

**Wide range of load types**

Analyzing the response of floating structures to the relevant met-ocean conditions is essential for assessing structural risks and accurately predicting fatigue life. The Akselos Integra platform provides plugins to import load data from industry-standard wave loading tools (e.g. WAMIT and WADAM). Combined with Akselos’s fast, global modeling capabilities, this provides unprecedented capabilities for wave loading analysis of complex floating assets.

**Wave loading analysis for the full semisubmersible model.**

**Crack analysis within a full FPSO model.**
Comprehensive fatigue analysis

The unprecedented speed and accuracy Akselos Integra offers allows users to perform the ultimate strength and fatigue analysis of offshore floating structures, including large deformations and extreme wave loading.

With Akselos Integra, users can perform stochastic fatigue analysis as well as deterministic and time-domain fatigue analysis for beams, shells, and solid finite element models. Engineers can create global models with highly refined local regions, enabling evaluation of J-integrals and other fracture mechanics quantities within the context of a global model.

Automated analysis generation

Decision Support System is a powerful tool within the Akselos Integra platform that provides engineers with a holistic view of the model’s strength and stability, at the same time, for different loading conditions.

It can be used to automate standards-based analyses by post-processing load case results using codes from class societies (e.g. Lloyd’s Register, DNV-GL, ABS, etc.) The tool then generates reports that summarize critical issues. Results are displayed on the model so users can see which specific components are over-strength or under-strength based on predefined tolerances. This is an immense timesaving tool that aids engineers in assessing the reliability of their designs and assets quickly and efficiently.

Buckling evaluation of an entire FPSO model based on thickness update data.
YOU MAY ALSO BE INTERESTED IN

- Akselos Cloud-based FEA Technology
- Accelerating Structural Analysis with Akselos RB-FEA Technology
- Hybrid Solver for Accelerated Nonlinear Analysis
- Analysis of a Stiffened plate
- Geometric Parameters for Solid Elements
- Linear Static Analysis of a Truss Structure
- Simulations with Changes to a Crack Depth Parameter
- Modal Analysis of a Stiffened Plate
- Modelling a Component with a Crack
- Eigenvalue Analysis of a Shell-Solid Beam
- Analysis of a Shell/Solid Model
- Decision Support System on a Beam System

HOW CAN YOU WORK WITH AKSELOS?

SERVICE LEVEL AGREEMENT
- Option for project initiation; digital twin set-up with a starter pack of support/services.
- We can help you to get your digital twin up and running quickly.

TRAINING CENTRE
- Training for your engineers to help and manage digital twins.
- Online knowledge base with detailed information.
- Fully documented self training centre.

FULLY CLOUD-BASED
- Accessible from anywhere on the internet.
- Promoting teamwork between geographies and companies.

SOFTWARE AS A SERVICE
- Akselos’ main offering is a SaaS software (Software as a Service) with a license-based subscription.
- Other licensing options are available on request.
- Please contact us: info@akselos.com.
About Akselos

Akselos is a digital technology company headquartered in Switzerland, with operations in Europe, the USA and South East Asia. The company has created the world’s most advanced engineering modeling, and fastest simulation technology, to protect the world’s critical infrastructure today and tomorrow. The technology has the power to revolutionize how we build and manage our critical infrastructure, and pushes the boundaries of what modern engineering and data analytics can achieve. Developed by some of the world’s best minds, the MIT-licensed technology builds something far beyond the capability of a conventional digital twin – a digital guardian that allows operators to not only monitor an asset’s condition in real time, but helps them to see the future.

Our Akselos Integra platform is a leading engineering simulation platform that revolutionizes asset management and enables you to understand and manage structural safety risk for your entire asset more effectively than anything else on the market.