AKSELOS

STRUCTURAL ANALYSIS AND LIFE EXTENSION OF FIXED OFFSHORE ASSETS

Solution Brief

INDUSTRY CHALLENGE

The jacket structures that support oil and gas platforms' decks and topsides must operate in the most demanding conditions that are inherent to the offshore environment. As jacket structures have moved into deeper and harsher environments, operators increasingly need to assess their long-term reliability. Not only do engineers need top-notch skills to do that, they also must have the powerful digital tools that will help them ensure safety while reducing costs.

Today, conventional analysis tools such as finite element analysis (FEA) are used for structural asset integrity studies. But these analysis tools are computationally infeasible for large-scale jacket platforms, with their intricate structural details. The tools don't support global system models at a level that accurately reflects physical processes. Instead, engineers have to either use a global coarse FEA model, which simplifies the structural detail considerably, or local fine FEA models, which can't accurately capture cumulative effects in 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 modelling and supports the entire lifecycle.

AKSELOS SOLUTION

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

Companies in the offshore, power generation, mining and wind energy industries are using Akselos Integra to solve their most demanding engineering problems, reduce cost and inefficiencies, and gain a competitive advantage.

Akselos Integra supports structural analysis applications that cover the entire lifecycle, from the design to the operation

# Simulation at the speed of thought

phase, and to eventual decommissioning. Applications include static structural analysis, modal analysis, geometric nonlinearities, 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 the results needed for engineers to create safe designs and 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:

- enhance durability of offshore installations with greater upfront confidence in designs
- unlock spare structural capacity left in your assets
- build confidence around life extension decisions
- reduce OpEx costs by optimizing inspection intervals
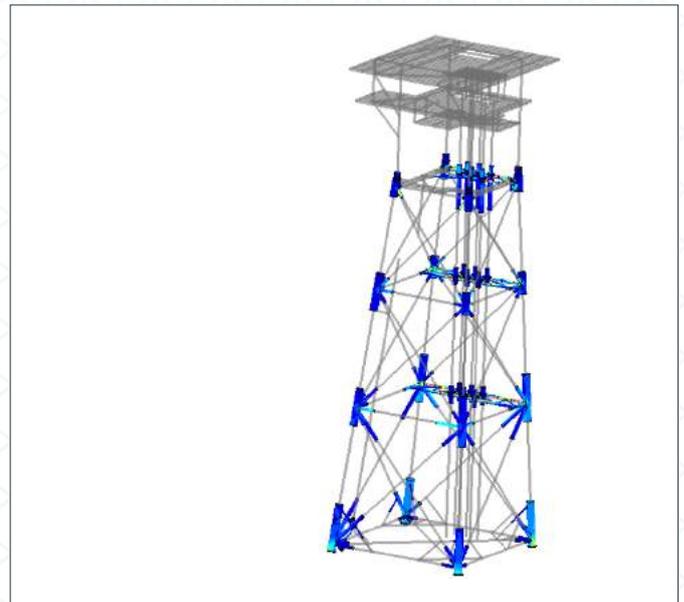
A jacket structure modeled with beam and solid elements.
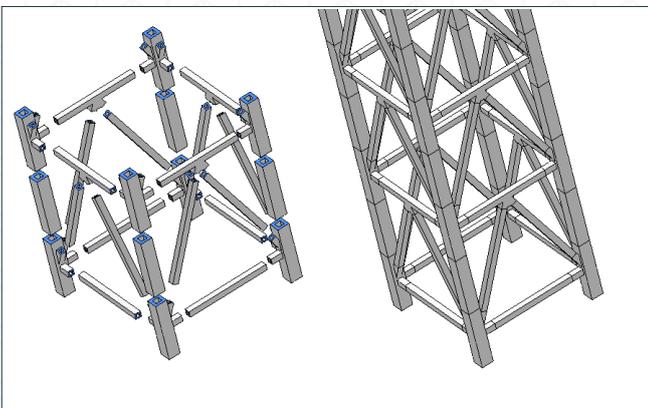
MODELING

Component-based modeling

Modeling jacket structures is challenging due to their complexity in a number of different areas. Akselos Integra offers a unique component-based modeling method that enables engineers to efficiently create large, reusable, and reconfigurable models constructed from smaller, parametrized components. In this component-based modeling approach, engineers can rapidly create custom model versions by changing 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.

The component-based modeling approach can be used to create high-fidelity models that include beam, shell, and solid elements without being restricted by the computational limitations imposed by FEA. This means that complex transition pieces and complex joints can be modeled using the right level of modeling detail to serve engineering needs.

Condition-based modeling

The ability to reliably model complex jacket behavior in order to provide a deep understanding of the structural response is paramount. With Akselos Integra, you can quickly produce the most challenging 3D models of existing conditions for an entire structure, whether a monopile, a tripod, or a full jacket-type structures. You can reliably build a fully detailed 3D model in less time than with conventional FEA tools and without risks of software limitations. This enables you to capture the system's exact

condition by incorporating real-life inspection data, such as corrosion and cracks, within a global finite element model. 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.

Wide range of load types

Understanding the performance under combined load conditions is essential to the analysis of jacket response. With Akselos Integra, engineers can assess the response of offshore platforms under different environmental loading conditions through integrated modules for static and time domain, wind, current, and wave loading.
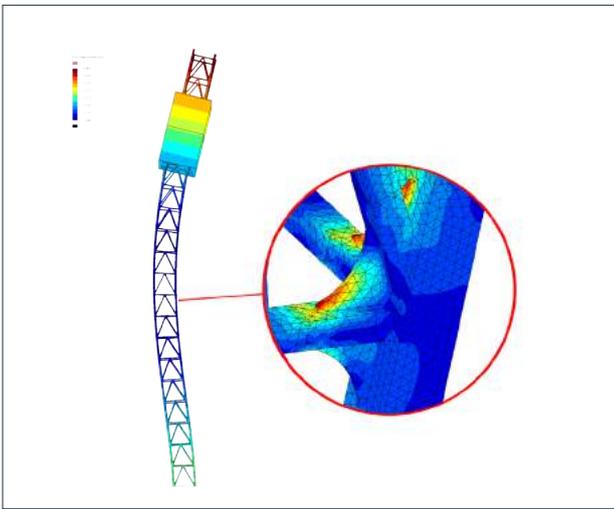
ADVANCED ANALYSIS

Linear

Akselos RB-FEA solver is ideal for solving static, dynamic, and modal linear analysis of large-scale structures 1,000 times faster than standard FEA applications. 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.

Component-based model of a jacket structure using solid elements
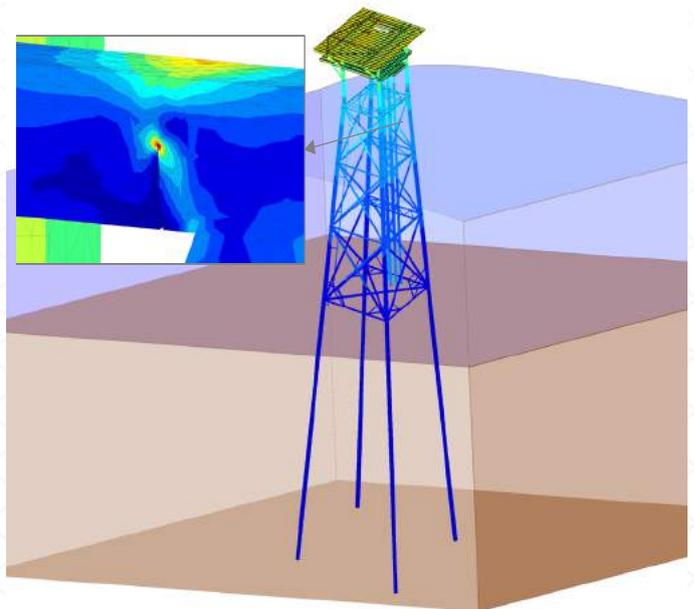
RB-FEA analysis for the full jacket using solid elements. This enables global detailed and condition-based models with solves at the speed of a beam element model.

Modal analysis for a full jacket structure using solid elements.

Waveloading and buckling codecheck analysis based on ISO 19902. to calculate critical load factors.
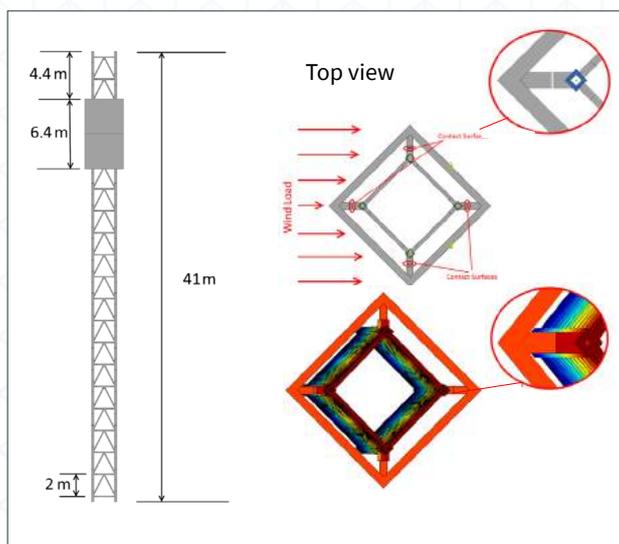
Nonlinear

In addition to providing linear analysis capabilities, Akselos Hybrid Solver enables fast analysis for the full range of nonlinear behavior related to materials, geometries, and boundary conditions within large and complex structures.
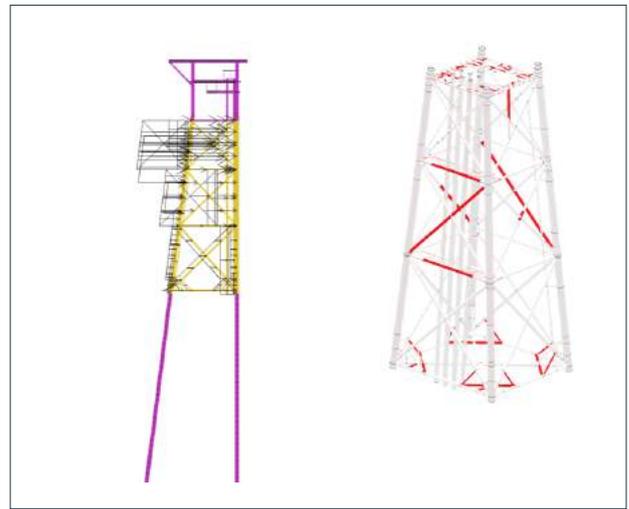
The Hybrid Solver uses FEA components in nonlinear regions in conjunction with RB-FEA components in linear regions. This provides a "best of both worlds" approach to nonlinear analysis. It gives the accuracy and flexibility of FEA for nonlinear analysis, while still bringing RB-FEA acceleration to regions of the model in which there is no nonlinear behavior.

Comprehensive fatigue analysis

The renowned speed and accuracy that are enabled by Akselos Integra allow users to perform the ultimate strength and fatigue analysis of offshore jacket 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. The ability to create high-fidelity 3D models enables engineers to obtain detailed stress information in highly stressed areas without the need to juggle between global and local models.

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 fatigue analysis and buckling evaluations based on ISO 19907 and API RP 2a and the analysis of a large number of load cases, and generate 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.

Contact analysis of the full 3D jacket model using the Hybrid Solver
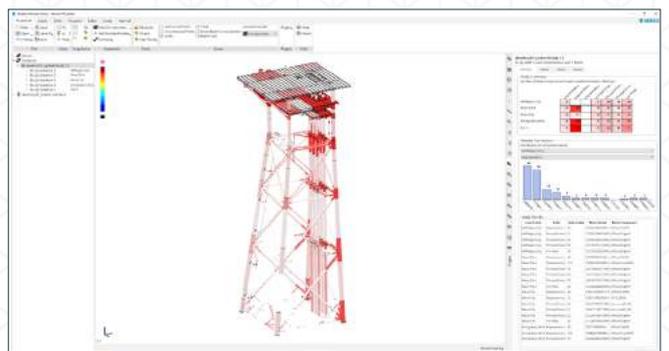
An automated study for load combinations using the Decision Support System.

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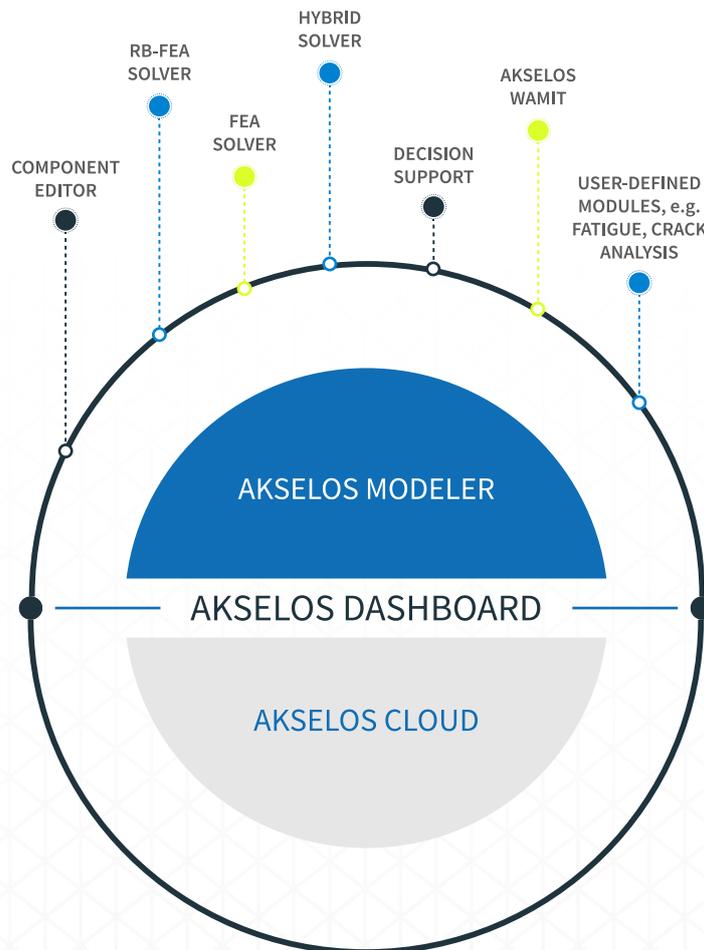
Our Akselos Integra platform is a leading engineering simulation platform that revolutionizes asset management and enables you to understand and manage structural safety risk for your entire asset more effectively than anything else on the market.

North America

AKSELOS, Inc
210 Broadway, #201 |
Cambridge,
MA | 02139, USA

Europe/Middle East/Africa

AKSELOS S.A.
EPFL Innovation Park,
Building D
1015 Lausanne, Switzerland

Asia-Pacific

AKSELOS Vietnam
125/167 Dinh Tien Hoang
street, Binh Thanh Dist.
Ho Chi Minh city, Vietnam