CASE STUDY

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MOSES Minimizes Redundant Steel in ORCA Offshore's Analysis of Self-installing Platform

Transport and Installation Specialist Demonstrates Validity of Dynamic Load and Structural Strength Analysis Using Bentley Software

Project Summary

Organization:
ORCA Offshore

Solution:
Offshore Engineering

Location:
Dutch sector of the North Sea

Project Objective:

- Safely deploy the F3-FA self-installing offshore platform on time and on budget.
- Utilize the best available analytical tools to minimize redundant steel.
- Minimize the size of the sea fastening to allow for safe handling.

Products used:
MOSES

Fast Facts

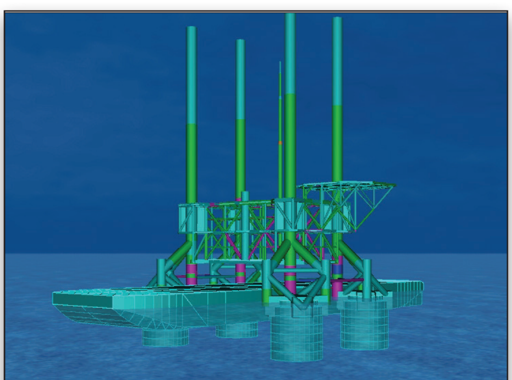
- Single-body marine transport analysis included ballast condition, intact and damaged stability, bollard pull analysis, motion analysis, and barge longitudinal loading.
- Multi-body marine transport analysis resolved leg and deck support loads.
- Structural transport and fatigue analysis looked at deck, joint, and leg-member utilization; and grillage and sea fastening.

ROI

- Complex analysis and model tests reduced both steel quantities and project risk.
- The self-installing platform design was easy to install, which saved project-delivery time.

Massive but Movable

When Centrica acquired the F3-FA field in the Dutch sector of the North Sea, it planned to develop the field for four years of production and then relocate to another field. A EUR 200 million reusable platform was crucial to the project's success. ORCA Offshore joined a team of design, fabrication, and installation contractors to provide the naval architectural analysis for transport and installation of the nearly 9,000-ton, self-installing platform. ORCA Offshore provided motion and stability analysis, multibody dynamic analysis, structural spectral analysis, and scale model testing. Bentley's MOSES offshore platform design and installation software simulated and analyzed the transportation and installation of the unique production platform.



Optioneering enabled by MOSES reduced material costs.

Tapping Marginal Fields

The F3-FA field was discovered in 1971, about two miles below the surface of the North Sea. Centrica is the third owner and acquired the field along with its acquisition of Venture Production in 2009. With only about four to five years of production life, it would be too costly to develop the F3-FA field by installing a conventional fixed platform. Instead, Centrica planned to deploy a self-installing platform that is constructed in harbor, transported by barge, and installed by putting down legs on the seabed and elevating the platform. When the field is exhausted, the supports are taken up, and the platform is transported by barge to the next location. The cost savings across three or four marginal fields would be significant.

The F3-FA platform footprint measures 63-by-45 meters, and the structure reaches a height of 133 meters above the sea floor. Each of four 440-ton suction piles is 13 meters high and 15 meters in diameter. The design weighed in at about 8,800 tons. During transport, the platform's piles would be raised and attached to the barge with temporary sea-fastening beams. Because of the size of the piles and the proximity to the wave zone, huge hydrodynamic loads would act on the piles. For the design to be viable, the team had to know the size of these loads at an early stage.

Unconventional Analyses

It quickly became clear that the F3-FA platform design posed a challenge in strength management, in part because the four legs were without braces and subject to the direct force of the waves. The team used finite element analysis to model the entire platform including about 200 load cases. These included the static and dynamic loads, which had to be balanced to optimize steel quantities. Bentley MOSES offshore analysis and design software was used for the static calculation, in combination with an ANSYS model.

ORCA Offshore used MOSES to provide the multi-body dynamic analysis for the extreme conditions during transport. The challenge was to convince the project stakeholders that this unconventional method would give reliable results. The loads during transport and upon lowering the suction piles and legs had to be accurate to size the steel to hold them. MOSES determined those loads using a five-body model, with each body having its own hydrodynamic database to derive the motions and loads acting between bodies. A model test verified the MOSES results to the stakeholders' satisfaction.

MOSES was also used to confirm the structural strength of the platform during transport and installation. The spectral structural analysis allowed ORCA Offshore to derive the structural loading without being unnecessarily conservative. Conventional methods would have determined the maximum load acting on each pile and combined that with maximum

“MOSES software can perform real-integrated analysis for any type of marine structure in a dynamic sea environment, which contributes to the realization of innovative offshore structures.”

– Herm Bussemaker, managing director, ORCA Offshore

Find out about Bentley at: www.bentley.com

Contact Bentley
1-800-BENTLEY (1-800-236-8539)
Outside the US +1 610-458-5000

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motion loads acting on the whole structure. The MOSES approach considered the natural relationship between loads to reduce the quantity of steel required for the platform itself and for the temporary sea fastenings.

Integrated simulation capabilities in MOSES ensured safe installation.

Model Tests Prove Valid

Compared to conventional analysis, ORCA Offshore’s analyses provided a more realistic representation of the loads and stresses during transport. Model tests carried out in a towing tank validated the transport plan for the F3-FA platform. After an initial attempt scuttled by severe weather, the successful transport journey to the F3-FA field in the North Sea took about three days. The platform withstood extreme wave loading, which proved the reliability of results produced by the project team’s unconventional methods of analysis.

Installation work in the 40-meter-deep water was concluded within 52 hours. The leg sea-fastening system required no steel cutting or welding. Suction piles were driven into the seabed using submerged water pumps, the entire topsides attached to the four legs with 16 two-ton super-bolts, and the 4,000-ton deck lift system used strand jacks to maximize workability. The whole design concept proved to be easy to install.

ROI Across Fields

With the integrated capabilities of MOSES, ORCA Offshore was able to perform the numerous analyses required to ensure fast, simple, and safe installation of the F3-FA platform. Optioneering support enabled design exploration to eliminate redundant steel work in the topside and legs, resulting in reduced material costs.

Validating the self-installing platform concept and design had both environmental and economic benefits. All remnants of the self-installing platform are removed from the seabed upon relocation. The ability to reuse a self-installing platform three or four times over the course of its lifetime not only reduces field production costs but also taps smaller reservoirs in marginal fields that would otherwise be too costly to operate. This ensures that energy resources are fully exploited.

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