



DIGITAL SOLUTIONS · SESAM™

PIONEERING GRAVITY-BASED OWT SOLUTIONS USING SESAM

Customer story - TYPESA

TYPESA has forged a new path designing gravity-based solutions for offshore wind turbines (OWTs). Their designs have been supported by innovative Sesam developers at DNV GL.

DNV GL has developed its Sesam software for structural engineering to include functionality for TYPESA's pioneering solutions. TYPESA started using Sesam for the design of meteorological masts installed in Scotland at water depths greater than 40m. These structures were the first gravity-based solutions installed for this purpose. The design consisted of a 16m tall cellular concrete caisson and a steel shaft that supports the deck and the meteorological mast. The conceptual design was carried out using analytical solutions and in-house models, but the complexity of the design required the application of more powerful tools that could cover the entire scope of the detailed design.

On this basis, the wide range of solutions that Sesam provides matched TYPESA's needs. The design of this pioneering project succeeded in the certification process despite the absence of regulations and recommendations at that time due to the innovative aspects of the solution.

"As the project was pioneered, the knowledge about the development of this kind of project was quite limited," says Dr Javier Abanades, responsible for hydrodynamic modelling at TYPESA. "To some extent, this project contributed to bridge the gap

in the knowledge of gravity-based structures," he says. The main advantage of TYPESA's solution is that limited maritime resources are required for the marine operations. As the structure is self-buoyant during its transport (the cells of the caisson are empty), it can be fully assembled in the port and towed to the installation area by several tugs, where it can be deployed through the water ballasting of the cells. This considerably reduces the costs of the commissioning operation, as there is no need of using the scarce, and consequently expensive, maritime resources such as jack-ups and heavy lift vessels.

Motivated by the success of this project and based on the same approach, TYPESA created its patent for the foundation of offshore wind turbine generators, Gravi3.

"Gravi3 is the consequence of the new trends of the market," says Carlos Garcia, Head of Offshore Projects at TYPESA. "As we go towards deeper water, gravity-based solutions are one of the most optimal solutions from an economic and a technical point of view. The Gravi3 concept consists of a self-buoyant GBS comprised of three concrete caissons supporting a steel tripod. The design is suitable for depths between 35m and 60m, with WTG up

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- Carlos Garcia, Head of Offshore Projects, TYPESA

to 8 MW. The structure is fully assembled in the project and transported to the site, where it is ballasted with water until it reaches its final position. The design of the solution is divided at the different stages of the project: the transport from the port to the final location, the stability during the installation (ballasting process) and the wave loading characterization once it is a fixed foundation. The European Project DemoGravi3 funded the demonstration of the prototype in Aguçadoura, Portugal.

The complexity of the modelling lies in the different wave-structure formulations applicable to the elements of the structure, as it is comprised of large bodies (three caissons, which are governed by the diffraction theory), and a slender element (tripod, which is governed by Morison’s equation). Furthermore, as the tripod is the element that joins the three caissons, the loads experienced by the tripod are dependent on the movements of the caissons, particularly during the towing of the structure. The accurate representation of the loads is strongly linked to the adequate representation of the joints between caissons and tripod.

For calibrating the different numerical models, testing was done at a scale of 1:50 in one of the most cutting-edge facilities of Europe (CEHIPAR).

Calibration of numerical model

“One of the greatest challenges of the design was the calibration of the numerical model during the towing,” says Abanades. “Morison elements were integrated on the caissons in order to simulate non-linear effects, particularly the viscous damping,” he says.

For this purpose, the Response Amplitude Operators (RAOs) obtained in the physical campaign were established as the target of the numerical model output. “Once we calibrated the structure response, the wave loading was compared between the physical and numerical model, and the successful correlation between the models must be noticed. The same accurate results were found with the fixed model during the service life. This is proof of the capacity of Sesam to examine the wave-structure interaction and the associated hydrodynamic loads,” he says.

“Sesam has opened new markets to TYPESA,” says Garcia. “The use of Sesam for the design of gravity-based solutions has allowed us to participate in the design of other types of offshore foundations, improving our knowledge in the sector.”



TYPESA IN BRIEF:

TYPESA, founded in 1966 in Spain, is a leading consulting engineering group in the fields of transport, buildings, water, environment, energy and rural development. It has a long-standing relationship with public, private and institutional clients worldwide, assisting them in the development of infrastructure projects from concept to completion. In addition to providing world-class engineering services, TYPESA has extensive experience in building the capacity of local firms and in strengthening institutions to guarantee the sustainability of the infrastructure. TYPESA’s integrity and professionalism are strengthened by its full independence. The company is owned by company employees and has no ownership links with contractors, manufacturers or financial groups.

PROFILE

- Customer name: TYPESA Group
- Web address: www.typsa.com
- Market: Engineering and design
- Employees: 2500
- Solution/Product: Sesam

BRIEF ACCOUNT

Why we chose DNV GL - Digital Solutions

- wide range of software that allows the client to address any type of offshore project
- prompt and friendly support
- capacity of coordinating inputs/outputs between the different packages of Sesam
- flexibility of tools for modelling different scenarios: during towing, installation or service life (fixed structure)

This is what we gained:

- materialization of pioneering projects in the field
- output that allowed us to optimize the design of the gravity-based solutions, making them very competitive in the current market
- constant update of trends in the field thanks to the intense development of the software from DNV GL