

## CASE STUDY



# GEOFEM

## Prelude FLNG Turret, Dubai



*"Geofem's careful analysis of ground bearing areas and quay walls at Drydocks World-Dubai allowed us to increase safe working loads in critical areas and significantly improve the productivity of our yard."*

**Batista Cardozo, Facilities Manager, Drydocks World – Dubai**

When you need to load-out the largest (4,000 tonne) piece of the world's largest turret mooring system for the largest floating offshore facility in the world, who do you call to check that the quay wall can support this behemoth?

## AT A GLANCE

### THE CHALLENGE

- A 4,000 tonne turret section needed to be loaded onto a barge from a quay wall designed for a much lower surcharge.
- Constructing a purpose-built load-out facility at this location would cost around \$5 million, but was this absolutely necessary?

### THE SOLUTION

- Advanced site investigation was recommended to get the latest information on the quay wall's engineering properties.
- The proposed load-out was simulated using geotechnical finite element analysis (FEA) to predict the quay wall's response.
- The quay wall was judged to be well capable of supporting the proposed load-out, well above its original design load.
- Site monitoring during the load-out showed the quay wall's response to be even better than predicted.

### THE BENEFITS

- The heavy load-out proceeded without any structural modifications to the quay wall.
- This negated the need to construct a purpose-built load-out facility at this quay, saving about \$5 million as well as the considerable time and carbon emissions associated with such a construction project.
- The quay wall continues to be used with higher allowable working loads, significantly increasing the yard's productivity on this asset.

## THE CHALLENGES

The quay wall at Drydocks World Dubai where the turret mooring system sections were assembled was not equipped with a dedicated load-out facility to transfer the sections onto barges for transport to South Korea and final installation. Constructing such a facility would have cost around \$5 million, so it was well worth checking what loads the existing quay wall could actually support.

The designs of such quay walls adopt uniform surcharges at the ground surface of, for example,  $5\text{t/m}^2$ , tend to assume conservative engineering properties for the fill material used in the reclamation and often use basic or conventional analysis methods.

These all leave a lot of potential to increase allowable loads for specific load-outs, firstly with some post-construction investigation of the facility and then more advanced analysis of proposed loadings.

## SOME CAREFUL ANALYSIS

Cone penetration tests (CPT) were previously performed immediately after construction to check the liquefaction



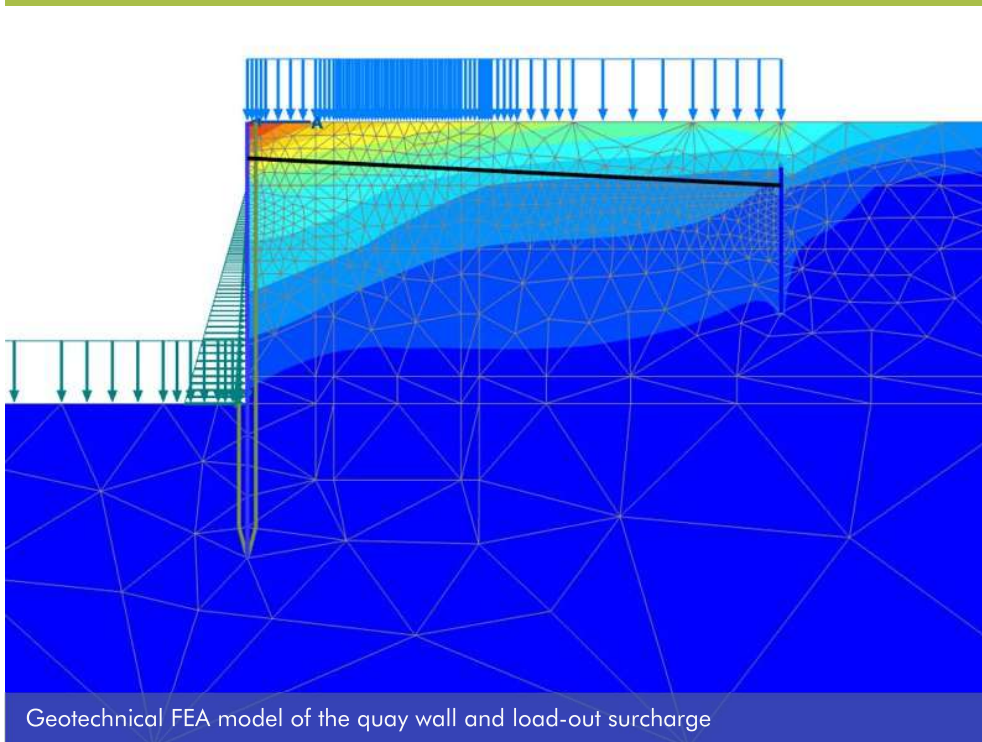
The Prelude floating liquefied natural gas (FLNG) facility in operation

prevention ground improvement measures.

It was recommended to repeat these measurements, this time with a seismic cone for precise stiffness measurement, to determine whether the fill properties had improved in the years since construction. Remarkably, the fill had strengthened to the point that the CPTs met refusal every time. Consequently, boreholes were made for downhole seismic testing and the fill was found to have very high stiffness properties due to ageing effects in the calcareous sand fill.

The proposed load-out was simulated using geotechnical FEA with the new enhanced fill stiffness and taking full account of the quay wall structures and crane rail piles. The quay wall was found to have the additional load capacity to support the proposed load-out.

During the load-out itself, total stations were used to measure the quay wall and SPMT settlement just in case they turned out to be higher than predicted and to provide validation for the FEA models for future load-out simulations. In the end, settlements were found to be even less than predicted.



Geotechnical FEA model of the quay wall and load-out surcharge

## THE BENEFITS & ON THE NEWS!

The heavy load-out proceeded without any structural modifications to the quay wall. This saved needing to construct a purpose-built load-out facility, about \$5 million as well as the considerable time and carbon emissions associated with such a construction project.

The quay wall continues to be used with higher allowable working loads than the original design, significantly increasing the yard's productivity on this asset.

The load-out even made it on to the news! Check <https://bbc.in/3km6ybB>



Satellite analysis with engineering insight