Project Experience

Bi-directional O-Cell® testing of Port Foundations

Fugro LOADTEST have been performing O-Cell® tests for port foundations for more than 30 years and has been present in some of the most important port developments around the world. From the important connection for the Mediterranean in Barcelona to one of the busiest ports in the north of Europe.

The O-Cell method of testing the foundation capacity of piles used for port foundations provides numerous advantages over traditional top-down loading arrangements. Key benefits of using bi-directional testing is the elimination of the need for additional anchor piles or external reaction systems which are even more challenging and costly to assemble in restrict areas and over water.

Further, the test load applied can be transferred directly to the foundation strata so it can be characterised and the design reviewed with potential to be optimised.

The following examples are just a small selection of some of the most important ports that have successfully used the O-Cell technology to test the foundation elements.

Port of Barcelona - Spain

The ninth largest container port in Europe has a history going back some 2000 years and a vital importance for trading in the Mediterranean. The port of Barcelona has been developing continuously over recent years.
Fugro Loadtest has provided foundation testing services for several of the port's expansion projects. Numerous full scale loading tests have been performed using the O-Cell methodology in both preliminary and working piles.
The tested piles with lengths varying between 33 and 48 metres were constructed in silty and sandy stratum. In some tests the applied test load surpassed the 10 MN without the necessity of external reaction frames and with a small test footprint.

Port of Aberdeen – UK

The history of the Port of Aberdeen starts in 1136 and since that date is a fundamental structure to Scotland's east coast. The port expanded along the years, passing from just being a fishing and ship building centre to an important offshore oil and gas hub.
For the North and West Quay expansion of the port, two preliminary piles were tested using the O-Cell methodology. Each 1500 mm diameter test pile was installed with 2 x 530 mm O-Cells capable of providing a total loading capacity of 40 MN.
Both tests surpassed the client's expectations providing valuable information of the foundation stratum (Gneiss and Granite), allowing the optimisation of the project's foundations.

Port of Hamburg - Germany

The Port of Hamburg is not just the largest seaport in Germany but also the third largest in Europe and a crucial import-export hub. Founded in 1189 the port currently covers an area of 74 km^2.
Fugro Loadtest provided specialist testing services on 4 preliminary test piles constructed in a Micaceous clay or Marly clay stratums.
The 1200 mm diameter piles were constructed with depths between 37 and 43 metres and each installed with an assembly with 2 x 430 O-Cells .
All the piles were successfully tested, and a maximum test load of 24 MN was mobilised on one of the piles.
The acquired geotechnical data regarding both stratums of interested was fundamental for the designer's calculations and allowed an optimization of the foundations.

Port of Vigo - Spain

The port of Vigo is a valuable infrastructure to the region of Galicia in Spain and accommodates commercial, touristic and fishing activities.
It's considered one of the biggest fishing ports in the World, unloading more than 750,00 tonnes of fish per year.
To accommodate all these operations and to offer the best conditions, the Port of Vigo has been expanding and improving over the years. For the latest expansion project a 32 metre deep working pile was tested using the O-Cell methodology. The test pile was loaded up to 6.6 MN and allowed the confirmation of the client's design.
Following conclusion of the test, the gap around the O-Cell assembly and its interior was grouted to reinstate the structural continuity and the test pile was integrated into the foundation group.

Queensland Curtis LNG Jetty - Australia

To increase the exploration of liquefied natural gas in Australia several projects were executed. One important expansion project was the jetty for the three LNG plants on Curtis Island. The structure included several loading platforms, interconnecting walkways and specific structures to the LNG exploration.
To have a complete picture of the geotechnical conditions where the jetty would be constructed, two 1500 mm diameter preliminary test piles over water were executed ahead of the installation of production piles.
The test elements were driven tubular steel piles and were tested using the push out method with the use of O-Cells. The execution of the tests over water without the need for reaction structures was a big advantage taking in consideration the working conditions.

Port of Richards Bay – South Africa

Situated on KwaZulu-Natal's fertile south coast, Richards Bay, once a holiday town, has developed into a major port.
As part of the development and expansion of the port, a dry bulk terminal was planned to allow deep-water access. This new terminal extends 300 metres from the previous quay.
Due to the offshore location of the piles, traditional top-down load testing system would have been extremely difficult and costly to implement and for that reason the tests were performed using the O-Cell methodology. The two test piles with 1200 mm and 1800 mm diameter and depths up to 66 m were tested to loads of 17.3 and 24.3 MN respectively.
With these tests, it was possible to assess the skin friction characteristics as well as isolate end bearing.

Combwich Wharf – UK

The Combwich Wharf infrastructure in the South West of England was subject to significant refurbishment and modernization. The project created a new berth hardstanding that allows vessels to be unloaded when the tide is out.
To obtain geotechnical information for this sensitive project two tubular piles grouted into Mudstone rock socket were tested using the O-Cell methodology. Both piles were constructed by installation of 711 mm diameter steel pipe piles inside a 1070 mm excavation.
An additional length below the test piles was constructed to allow sufficient reaction to be available to push the full length of the steel test pile upwards.
A single O-cell was used in each test to apply approximately 7 MN upwards directly on the steel pipe pile to evaluate the skin friction.

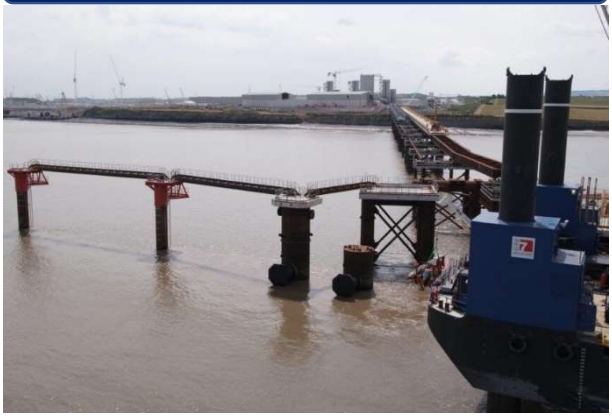
Marina Botafoc in Eivissa Port – Spain

On the north shore of Ibiza harbour, lies Marina Botafoc. It is one of the most important ports and marina in the Mediterranean with 428 berths and moorings for cruise liners.
With the main objective of characterizing the end bearing behaviour of the foundations under load for a new jetty, one working pile over water was tested using the O-Cell methodology.
The 1650 mm diameter test pile was 41.3 metres deep, installed in 10 metres of water. The test was safely executed applying 32 MN, without the need for constructing a reaction system at the pile head and allowing the working piles have a shorter penetration into the rock.
After the conclusion of the loading test, the void created around the O-Cell assembly and the inside of the O-cells were grouted and the pile was used as part of the foundations for the marina.

Brighton Marina - UK

Brighton Marina is an artificial marina situated in Brighton, England. It features a working harbour and residential housing alongside a variety of leisure, retail and commercial activities. The construction of the marina itself took place between 1971 and 1979, although developments within it have continued since. The marina covers an area of approximately 127 acres.
As part of a more recent planned development of several tall apartment blocks, various new retail provisions including shops, a new central square and an ECO park. These 28 storey and 16 storey buildings would require their foundations to be founded in chalk and a testing programme of a CFA pile in chalk was commissioned using an O-Cell bi-directional test which demonstrated the competency of the foundations for such loads.

Aggregate delivery Jetty, Sommerset - UK



Construction of a 500 metre long jetty to allow materials for the local project to be delivered by sea was required. This would keep many hundreds of lorries off the local roads, reducing carbon emissions and disturbances to the local communities.
As part of the geotechnical design verification a first preliminary smaller sized steel pipe of 914 mm diameter, grouted into a Mudstone rock socket of 1180 mm adjacent to the intended location of the origin of the Jetty on shore. The assembly was tested to nearly 20 MN in each direction (above the rated capacity of the loading assembly) using a 690 mm O-cell.
Subsequent vertical working pile load test was successfully performed over water using the O-Cell methodology. Also a full-scale lateral load test was performed.