Case study

Bi-directional O-Cell® for safely and economically load testing piles over water

Project
Danube Bridge, Paks,

Contractor:
HBM Kft.

Piling Company:
HBM Kft.

Location
Paks-Kalocsa Danube
Hungary

Period
2021

Services
O-Cell® load test

Two O-Cell® test piles in the middle of the river Danube

Fugro Loadtest have performed O-Cell® tests for the Paks-Kalocsa Danube Bridge Project, a new bridge located in Hungary featuring a 1,133 m long mid span, the longest in the area.

Challenge

In order to verify and improve the design of the project's foundations, two preliminary test piles were requested by client HBM Kft. The sub-surface stratigraphy at the general location of the test piles is reported to consist mainly of grey sandy gravel and gravelly sand.

Two 1,500 mm nominal diameter preliminary test piles with depths of 30 m were constructed by HBM Kft in the river and fully load tested to reveal their in-situ performance.

Artist impression

Installation of O-Cell and reinforcing cage

Solution

A single level O-Cell® bi directional loading arrangement with one 530 mm diameter O-Cell® was utilised for each test pile, allowing for a potential 20 MN gross loading capacity to be applied.

O-Cell® technology proved a perfect solution for static load testing of these test piles as the top of the pile concrete was at the river bed elevation, 11 m below the pile construction level.

Sister bar strain gauges were placed at multiple elevations along the shaft on each pile in order to assess the load distribution mobilized during the testing.

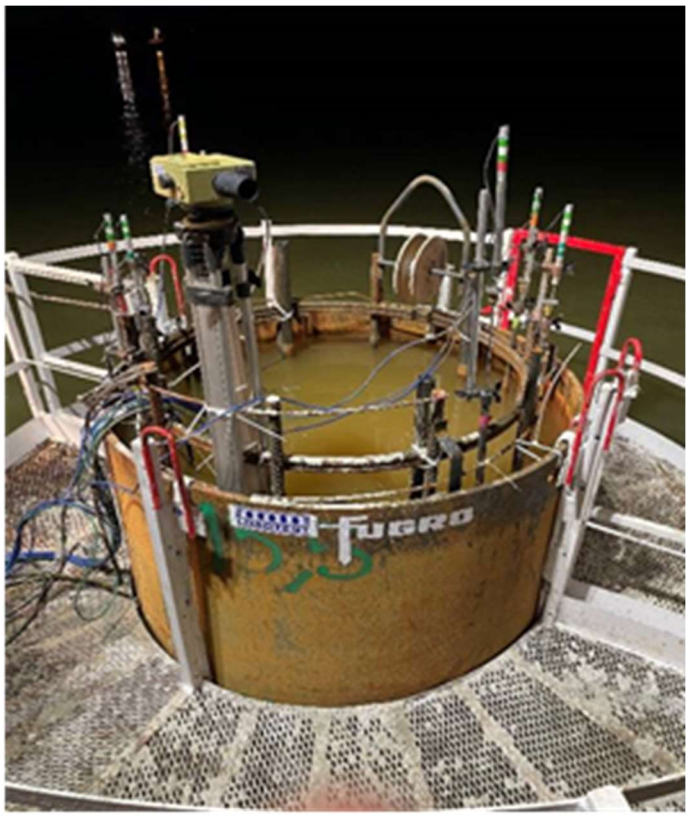
By use of Cemsolve® pile load movement analysis, the total ultimate pile skin friction capacity and ultimate end bearing load and stiffness could be determined, and by combining upward and downward models, a Cemset® prediction of the pile head load / settlement could be made.

Conclusion

Full-scale static load testing was able to be carried out using O-Cell® methodology without the need to provide potentially unsafe and very costly anchor piles over water, revealing the geotechnical behaviour of the base of the piles as well as the skin friction parameters along the pile shaft. These results were critical for the project foundation designers and demonstrated the actual in-situ behaviour exceeded design expectations.

Integrity testing of one of the piles.

Concrete wagons on a barge ready for their delivery into the pile in the middle of the river



O-Cell® test in progress.

FUGRO LOADTEST
DANUBE BRIDGE - HUNGARY

Overcoming challenging conditions, Fugro Loadtest successfully tested two piles for a new bridge over the Danube River in Hungary using its proprietary Osterberg Cell (O-Cell®) bi-directional testing.

The new bridge over the river Danube will connect the town of Komárom in Hungary with the town of Komarno in Slovakia. In 1892 Komárom and the then town of Újszőny were connected by an iron bridge and in 1896 the two towns were united under the name Komárom within the Austro-Hungarian empire.

After the empire was split, the towns developed separately in Hungary and Czechoslovakia. The two sides of the town were then connected by an iron bridge, replaced more recently by a 'lifting' bridge. This new bridge will allow a more efficient and continuous fast flow of traffic between the two towns and each country's respective highway systems.

PROJECT SUMMARY

In order to verify and improve the design of the bridge foundations, two preliminary test piles were required by consultants Geoterra. The preliminary test piles were to be installed close to the centre of the river. Providing a traditional reaction system with anchors or using dead weight with kentledge to perform these pile tests was impractical. The O-Cell® method of loading was chosen as the ideal static loading test method, using the pile itself to provide the reaction for the test.

Two 1500 mm diameter bored test piles were constructed, each containing a single level assembly comprising of a 540 mm O-Cell, of 20 MN nominal capacity.

Client: HBM kft (Soletanche Bachy)
Period: 2017
Location: Hungary
Consultant: Geoterra

From Komarom in Hungary to Komarno in Slovakia (photo: Pont-Terv engineering consultants)

CASE STUDY

The piles were installed from a jack-up barge with a permanent casing placed into the strata below the riverbed to above high water level. Each pile was concreted up to the mudline so they could easily be removed after the tests. Strain gauges were placed along the 2 m long concreted sections of the piles to assess load distribution in the sandy clay soils.

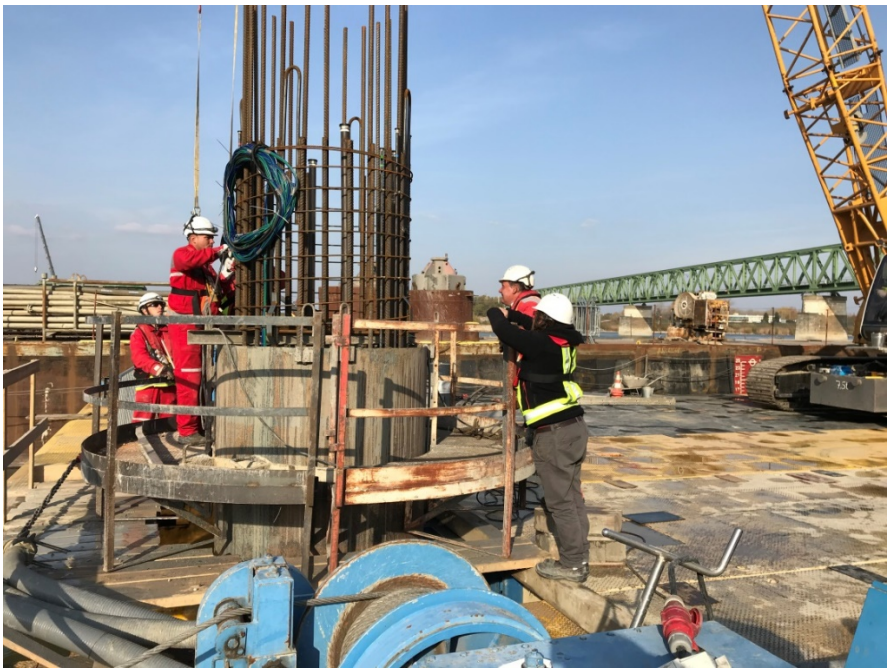
TEST RESULTS

The soils at each location were substantially different. The loads applied to each pile were below the capacity of the O-Cell with the end bearing dominating the behaviour.

The results from each pile were analysed using the Cemsolve® pile settlement analysis program to determine the ultimate skin friction capacities and end bearing characteristics, with the pile head load / movement prediction achieved by combining the results in Cemset®.

CONCLUSIONS

What was at first considered an extremely difficult task of performing a full-scale static load test over water with loading capacity up to 20 MN was made a simple by using the Osterberg bi-directional load testing method. The results provided the designers with full-scale insitu results so they could optimize their design.



Installation of test pile

Pile after installation in the Danube River

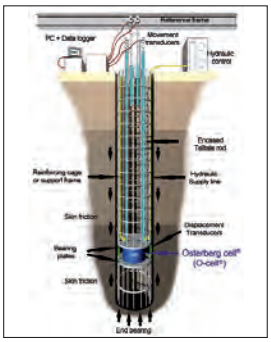
Pile under test in the Danube River

Concrete arriving by barge

Project Description

Vidin – Calafat Bridge

Project	**Vidin – Calafat Bridge**
Location	Vidin – Calafat, Danube River, Border between Bulgaria and Romania EGIS Route / EGIS Géotechnique
Client	Fomento de Construcciones y Contratas (FCC), Bulgarian Branch
Period	July 2008 – September 2009
Project Description	*Purpose*



Schematic of O-Cell Test

CPT truck and bridge construction site

The Vidin-Calafat-Bridge is a newly planned road and railroad bridge linking the cities of Vidin, Bulgaria and Calafat, Romania. It will be the second bridge on the shared section of the Danube between Romania and Bulgaria. The bridge is to be built by the Spanish company Fomento de Construcciones y Contratas (FCC), and the cost is projected to be $160 million. Construction officially began on May 13, 2007 in Vidin and is planned to finish by 2010. The bridge will be part of Pan-European corridor IV (Dresden–Istanbul) and will measure 1,971 meters in length. The construction of this bridge is one of the major infrastructural projects in this region. These development corridors are distinct from the Trans-European transport networks, which include all major established routes in the European Union, although there are proposals to combine the two systems, since most of the involved countries now are members of the EU.
During the construction of the bridge FUGRO was asked to provide geotechnical services to assist FCC and its consultants to optimize the foundation design and to measure the capacity of the installed foundation piles for the bridge foundations.

Realization

Between July 2008 and September 2009 Fugro Loadtest performed 9 bi-directional static load tests using the O cell® bi-directional testing method. Preliminary piles of 1200 mm diameter were tested to determine their geotechnical behavior and evaluate the soil parameters used in the pile design on both the Bulgarian and the Romanian sides of the river some of which were 65–68 m deep and tested to 24 MN. Testing of the 2000 mm working piles to similar depths and loads have been carried

CPT interior with in-situ vane shear testing equipment

out, with more tests planned before completion of the piling program. The working piles are grouted after the test and incorporated into the bridge foundations.
Since the information from the initial site investigation campaign did not provided sufficient information about the subsoil conditions, especially the settlement behavior to allow the designers to estimate the duration of the consolidation and settlement of the embankments FUGRO CONSULT GMBH was asked to perform 38 Piezo-Cone Penetration Tests, 25 Dissipation Tests up to 5 h duration and 95 In-Situ Vane Shear Tests along the proposed 10 km long bridge approach.
The investigations were performed in order to obtain information of the subsurface soil conditions and the settlement behavior along the proposed combined road and railroad bridge. The results from Fugro's CPT site investigation campaign as well as available data from laboratory test results and test fields were used for precise time-settlement calculations of the subsoil. This was the basis for an optimized schedule for the proposed embankment construction activities.
Our services helped the designers and geotechnical engineers to reduce the construction costs and to achieve confidence in the design and the built piles.

Scope of work / Overview

- 9 bi-directional pile load tests using the O-cell bi-directional technology up to 26 MN
- 38 CPT's with pore water pressure measurement
- 25 Dissipation Tests up to 5 h
- 95 In-Situ Vane Shear Tests
- Geotechnical Calculations, Recommendations and Consultancy

Installation of O-cell test pile

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