Case study

Bi-directional O-Cell® testing of barrettes for Campus Pictet de Rochemont, Geneva Switzerland

Project
Campus Pictet de Rochemont (https://campus.pictet/)

Contractor:
Orlatti (VD) SA

Piling Company:
Orlatti (VD) SA

Location
Geneve, Switzerland

Period
2022

Services
O-Cell® load tests

O-Cell® tests of barrettes

Campus Pictet de Rochemont project in Geneve will consist of a 23 floor building with 55,000 m^2 of office space and will provide 2,500 workplaces and nearly 100 residential units.

Challenge

In order to verify and improve the design of the foundations of the project, three preliminary test barrettes were required. The barrettes for this project were founded in Moraine deposits.

One of the unique features of bidirectional testing is that the load can be applied directly to the desired shaft zone. For this project each O-cell assembly was placed at different depths in each test barrette to obtain the desired information of each soil stratigraphy.

Reinforcing cage delivered to site ready for installation

loadtest@fugro.com

Solution

The orignal test plan was three 1,350 mm diameter test piles with a view of scaling up the unit friction for use in the barrette foundations. The O-Cell® loading methodology can be used directly in barrettes or diagphragm walls without the need for scaling or other assumptions.

The three preliminary test barrettes were 800 mm by 2800 mm and 71.5 m, 72.5 m and 35.5 m deep. Top of concrete was left at the design cut-off level, between 8.3 m and 15.6 m below the platform level.

Two 530 mm or two 430 mm O-Cell® devices placed side by side in each test barrette allowed the tremie pipe to pass the O-cell® assembly with ease and provide a maximum total gross test capacity of 40 MN and 25MN respectively at rated pressures.

For each test, the load was applied in general accordance with the Swiss norm SIA 267-1. All the tests were loaded further than thie rated capacity without any complication or safety concern.

In each barrette, at least nine levels of strain gauges were placed to assess load distribution and mobilised skin friction values during the test.

The tests revealed both the upwards behaviour in skin friction above the O-Cell® assembly, and the combined downward skin friction and end bearing characteristics below the O-Cell® assembly.

Conclusion

The O-Cell® tests were able to safely mobilise the high loads required on a small site without needing a traditional top down loading reaction system.

The parameters obtained directly from the barrtte tests without scaling assumptons, were crucial for the designers allowing a better understanding and optimization of the barrette foundation design.

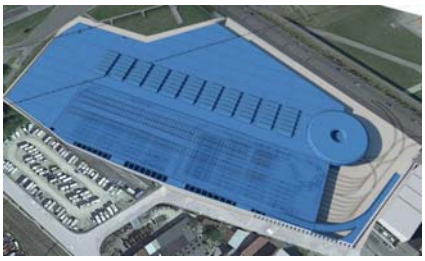
O-Cell® cage assembly in the factory

Concrete tremie pipe ready for filling the panel

O-Cell® test in progress.

LOADTEST O-Cell® Technology in Geneva, Switzerland

Project:	"Centre de Maintenance Secondaire" CMS
Location:	Vernier (Canton Geneva), Switzerland
Client:	*Implenia.*
Project Description:	Tram and bus depot and maintenance center



Tram and bus depot (artists impression)

Lifting of the "T" shaped reinforcement

Installation of reinforcement with O-cell arrangement

Location:

Implenia is constructing a new depot and maintenance center for trams and busses to be ready in 2019. The Transports Publics Genevois (tpg) will use this depot on the "En Chardon" site to provide garaging for 70 trams and 130 buses on two underground levels. Over the last 15 years in the Greater Geneva region the public transport fleet has steadily expanded. The new "Centre de Maintenance Secondaire" (CMS) shall provide the space required.
The buildings have to comply with strict height restrictions and construction work has to meet specific conditions due to closeness of the Geneva Airport.

Project:

Fugro Loadtest carried out a bi-directional O-cell test on a twin section test barrette. Nominal dimensions for the upper section of the barrette were 4000mm x 800mm and 1500mm x 800mm for the lower section. The oversize upper section was to provide additional reaction for the test without the need for any additional reaction at the barrette head. Implenia constructed the 16.50 metre deep barrette under bentonite slurry. Sub-surface conditions at the test barrette location consist primarily of moraine deposits.

Summary:

With the bi-directional O-cell test, Loadtest was able to isolate end bearing and ultimate skin friction, mobilising a total reaction of over 41 MN using two 530 mm O-cells. Sister bar vibrating wire strain gauges were placed at 7 levels along the smaller section of the barrette allowing a profile of mobilised unit skin friction along the shaft. This test provided evidence of the foundation design, technical merits and economic benefits of O-cell technology.

LOADTEST
O-Cell® Technology in Switzerland

Project:	**N16 Transjurane, Court to Loveresse**
Location:	D48 Pont Champ Argent, Switzerland.
Client:	Direction des Transports et de l'Énergie du canton de Berne
Contractor:	Implenia Construction SA
Consultant:	De Cerenville Geotechnique SA and MFR Geologie- Geotechnique SA Joint Venture

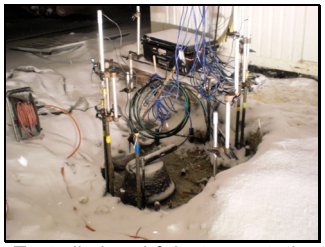
Project Description:

Motorway network around Switzerland (2010)

O-cells assembly at the cage fabrication yard

Installation of the cage with two 405mm O-cells

Test location



Test pile head & instrumentation

The N16 starts at the northern border of Switzerland and France. It goes south and crosses the Jura mountains, hence its name N16 Transjurane. The long, winding highway reaches to the flat part of the canton of Berne on the Swiss plateau east of Biel/Bienne. Along its course, the N16 has many engineering structures, mainly tunnels and viaducts. These large viaducts have required foundations into the molasse. The geotechnical properties in this mountainous area are relatively unknown. Pile tests had been recommended to verify the foundation designs. Bi-directional testing using O-cells was employed for the first time in Switzerland, to verify the skin friction and end bearing behaviour. Tests were performed on 1300 mm diameter piles, located near to the viaduct's pier at km 61 of N16 between Court and Loveresse.

The N16 will be one of the most expensive road projects in Switzerland. For the whole line, a total cost of 5.6 billion Swiss francs is estimated. When completed, it will connect the French motorway network with the rest of the Swiss national road network, vastly improving the travel time across the Jura mountains.

Project Summary:
Access to the construction site was the major obstacle for this project since it consisted of steep narrow roads with tight bends. If the tests were to be carried out by traditional top down load testing it would have been necessary to devise expensive anchor piles or large bulky kentledge. With such a difficult access to the site, the logistics of mobilising the reaction system would have been impractical.

The test piles was fully cased to the toe and excavated in the dry. The reinforcement cages with O-cell assemblies and instrumentation were built in the nearby cage fabrication yard and transported to site ready to be lowered down into the excavation. The temporary casings were gradually removed as the pile was concreted.

Sub-surface conditions at the test pile location consist primarily of weathered sandstone overlying the Molasse. To validate the geotechnical design, two preliminary test piles of different lengths, both with two O-cells assembled near the pile toe. The longer 31 m pile was designed to assess the end bearing of the pile using the skin friction as reaction while the shorter 11 m pile was designed to mobilise the skin friction using the end bearing as reaction.

Test results:
Despite testing in snow and freezing weather conditions, the testing program at the N16 site was very successful. The mobilised capacity in each of the test piles was carried out to and beyond the desired maximum loading and was pressurized to above the rated capacity of the O-cells, mobilizing approximately 38 MN in the longer test pile.

Placement of strain gauges within the pile shaft allowed the mobilised unit skin friction to be assessed in the various soil layers. The piles were tested in accordance to Swiss standard SIA 267/1.

Conclusions:
These first O-cell tests in Switzerland succeeded in providing the Client with confidence that the pile design was more than sufficient for the loads required, the tests had also provided invaluable geotechnical information in terms of actual skin friction and end bearing parameters in the Molasse thus allowing the design to be optimized.