Case study

Bi-directional O-Cell® testing safely mobilising high test loads in barrettes

Client
Lantis NV

Monitoring:
Research Institute and Geotechnics Division of the Flemish Government (Department Mobility and Public Works)

Piling Company:
SOETAERT-SOILTECH

Location
Antwerp, Belgium

Period
2018

Solution
O-Cell® load tests

Each barrette was fitted with a gross O-Cell® loading capacity of 24MN

As part of a large infrastructure project to close the R1 ring road around the city of Antwerp, a series of full scale O-Cell® bi-directional loading tests were performed on barrettes to calibrate the design parameters.

Challenge

To verify and improve the geotechnical design elements for the project, a programme of four test barrettes was vital to determine the in situ bearing capacity of the diaphragm walls. These 40 – 45 m deep test barrettes were founded in stiff Tertiary Boom overconsolidated clay found at depths over approximately 30 m.

Due to the site space restrictions and the magnitude of the desired test loads, the Osterberg Cell® (O-cell®) method of bi-directional loading was chosen as the means for performing the required static loading tests. The method splits each foundation element into sections and uses the resistance upwards and downwards of each element to generate the loads required.

Solution

One of the unique features of O-Cell® bi-directional load testing is that the test loads can be applied directly to the desired zone within the panel, allowing the acquisition of detailed strata performance.

The four test barrettes, 800 mm wide by 2800 mm long, were installed in close proximity to each other and concreted up to the design cutoff level below the working platform level.

Two 430 mm O-Cell® devices were placed in each test barrette allowing plenty of space for the concrete tremie pipe to easily pass the O-Cell® elevation with ease. This arrangement provided a gross test capacity of 24 MN (12 MN in each direction). For each test, the load was applied in equal load increments until the base displacement of the barrette exceeded the required specified limit. A relatively rapid constant rate of loading test was also performed on one of the barrettes.

Assembly of the O-Cell® arrangement into the reinforcing steel

To obtain as much geotechnical information as possible, each barrette was fitted with two levels of four vibrating wire strain gauges. In addition, the panels were extensively instrumented with FBG (Fibre Bragg Grating) and BOFDA (Brillouin Optical Frequency Domain Analysis) fibre-optic systems by others to assess load distribution and mobilised skin friction values during the test as well as temperature measurement during pouring and concrete hydration.

Installation of the reinforcing cage and instrumentation into the panel

The tests revealed both upward behaviour in skin friction and the combined downward skin friction and end bearing characteristics under loading.

On a restricted site, not suitable for a large loading frame and more traditional load testing methods, the O-Cell® method was the ideal solution to independently test each panel. Moreover, the influence of loading each barrette on adjacent panels could also be monitored.

Conclusion

The O-Cell® tests were able to safely mobilise the high loads required, revealing the geotechnical behaviour and aspects of group behaviour. The results of this testing program were critical to the client allowing design confirmation and providing vital feed-back for more detailed analysis.

Top of barrette instrumentation setup. Note the reference beams across each of the O-Cell® tests

The use of the O-Cell® methodology solved the site challenges, without the need to provide multiple anchors and creating a zone of influence around the barrettes, or construction of a large and potentially unsafe reaction frame. The working area was fully accessible during the test phase allowing the client to proceed with other activities.