

# O-Cell<sup>®</sup> Pile Load Test Technology Solutions For Railway Projects



Project: **Perth City Link**  
Location: Perth, Western Australia  
Client: Government of Western Australia  
Project Team: Perth City Link Rail Alliance (PCLRA)

Perth City Link, formerly known as the Northbridge Link, is a collaborative project of three tiers of Government. The transport infrastructure work around Perth Station is the catalyst to bring Perth City Link's vision to life. Taking the Fremantle Line between William Street and Lake/King Street underground will reconnect the CBD and Northbridge area for the first time in 100 years.



*O-cell Instrumented Pile Cage Being Lifted*

Maintained load tests were carried out on bored cast in-situ production piles and barrettes to confirm construction quality and to verify the pile settlement behaviour at serviceability load. The PCLRA project team chose the O-cell<sup>®</sup> technology as the most suitable and economical load test method to perform the load tests due to the high load to be applied to the test piles and the challenging ground conditions.

Soil conditions at the test locations comprised soft clay and loose sand layers overlying the stiff clay Guildford Formation to 30 m below ground level and the Kings Park formation to pile toe level.

Fugro performed maintained load tests on bored cast in-situ concrete piles of Ø1050 mm up to nearly 45 m in depth and a 20 m deep 600 mm x 2400 mm rectangular diaphragm wall panel.



*O-cell Instrumented Barrette Cage*

Each O-cell<sup>®</sup> loading assembly was fixed to the reinforcing cage before being lowered into the test pile and concreted. Strain gauges were used in addition to standard O-cell<sup>®</sup> instrumentation.



*O-cell Test in Progress*

Testing of the piles was carried out at ground level. All gauges were read automatically using a data acquisition system. To eliminate the erection of a reference frame, pile head movement was monitored automatically by two digital levels.

All piles tested were successful in verifying pile service load capacity and construction quality. Fugro Australia, through its Loadtest Division is proud to have played a small but significantly important part in this project.



# FUGRO LOADTEST

## O-cell Technology at QCLNG, Gladstone, QLD, Australia



Project: **QCLNG Project, Jetty Construction**  
Location: Curtis Island, Gladstone, Queensland  
Main Contractor: Bechtel Australia Pty. Ltd.  
Subcontractor: John Holland Pty. Ltd.  
Consulting Engineer: Arup Pty. Ltd.



*Fixing O-cell Assembly to Cage*

The tests were carried out on preliminary piles ahead of the installation of production piles. Soil conditions at the test locations comprised soft alluvial soils overlying a Mudstone bedrock stratum.

Upon driving each steel test pile casing, soil was excavated to below casing toe level for construction of the concrete reaction pile and tension socket (tension pile only). The O-cell loading assembly was fixed to the reinforcing cage before being lowered into the test pile and concreted. Strain gauges were used in addition to standard O-cell instrumentation.



*Testing Platform Being Lowered on to Pile*



*Testing in Progress Over Water*

Testing of the piles was carried out from a working platform lowered onto the test pile. All gauges were read automatically using a data acquisition system. To eliminate the erection of a reference frame, pile head movement was monitored manually by digital level off the adjacent test pile.

Fugro Loadtest performed maintained load tests on two Ø1500 mm driven tubular steel piles using O-cell bi-directional maintained load test push out method.

The pile tests were successful in providing geotechnical data to verify soil design parameters and pile load capacity.



# LOADTEST O-Cell® Technology in Brisbane, Australia



Project: **Gateway Bridge Upgrade Project**

Location: Brisbane, Australia

Client: Leighton Abigroup Joint Venture

**Project Description:** Loadtest performed the first Osterberg cell tests in Australia on the Gateway Bridge project in Brisbane. Due to the test loads required 88 MN, the O-cell was the perfect choice to determine the 1500 mm diameter pile capacities and socket friction parameters.



O-cell Cage ready for lifting

The original Gateway Bridge, opened in 1986, is close to vehicle capacity due to steady growth in Brisbane. To relieve congestion, the Gateway Project Upgrade was launched in 2005 as the largest road and infrastructure project undertaken in Queensland.

The scope involves construction of a second Gateway Bridge 50 m downstream from the existing bridge and several kilometres of motorway approaches.

The main bridge piers require a total vertical loading of 395 MN requiring 24 x 1.8 m diameter bored piles 46 m to 50 m long, socketed into the siltstone rock up to 6 m.

The piles would be constructed with steel liners driven into the weaker mudstone layers followed by the main rotary boring through the liners into the rock.

Verifying sufficient load capacity required a static load test on two dedicated test piles. These tests would also yield socket friction characteristics and end bearing capacity. Conventional top-down loading techniques would not provide this valuable rock socket information.

#### Bi-directional load test arrangement:

Four 540 mm diameter O-cells were installed at a pre-determined elevation in each of the 1500 mm test piles, one on each bank of the Brisbane River. The O-cells would provide a minimum gross loading at rated capacity of 88 MN [44 MN in each direction].

To ascertain the properties and loading characteristics of the rock socket, the O-cell assemblies were positioned within the rock sockets, 3 metres above the base of the piles. Vibrating wire strain gauges (Geokon 4911-4 model) were placed within the pile section to assist with skin friction distribution characteristics of the piles.

#### Test results:

The maximum sustained upward net load resistance on skin friction above the O-cell level was 51.81 MN with an upward top plate movement of 9 mm. Combined end bearing and lower skin friction below the O-cell level was 56.62 MN with a downward bottom plate movement of 19 mm, 1.3 mm of which was measured as compression within the lower shaft section.

The resulting overloading verified a factor of safety of approximately 3.7. At this loading, the calculated top loading equivalent would result in a maximum displacement of 10.7 mm, of which 9.8 mm is estimated to be the additional elastic compression of the pile.

#### Conclusions:

The two test piles confirmed the geotechnical design characteristics within the rock socket and the factor of safety required. Over 100 MN\* total loading was applied providing the highest test load on any piles in Australia (\*Capacity in excess of the rated capacity is possible using the O-cell method).



O-cell Assembly ready for placement



May 2009-Construction of the main span

Source: gatewayupgradeproject.com.au



Source: gatewayupgradeproject.com.au

Artist's impression of Gateway Upgrade, scheduled for completion in 2010



Source: gatewayupgradeproject.com.au

