FUGRO LOADTEST
Osterberg Cell Technology in St Petersburg, Russia

The historic Russian city of St Petersburg will be the location of the new Gazprom headquarters, owner of around 16% of the world's gas reserves. St Petersburg, sometimes referred to as 'The Venice of the North', is a World Heritage site and of global importance. It is also home to the World Famous Hermitage Museum.

Project Description:

Building the tallest tower in Europe in such a city brings great challenges for the designers to make the building prominent but not overshadowing the historic value of the city. The building was also designed to be Eco-friendly with many innovative solutions employed. A second challenge involved the foundation designers. How to build such a tall building in soils where little or no experience from previous designs of deep foundations could be called upon. A preferred solution at this time was to employ barrettes instead of foundation piles.

Owner: Gazprom
Main Contractor: Bovis Lend-Lease
Specialist Consultants: NIIOSP

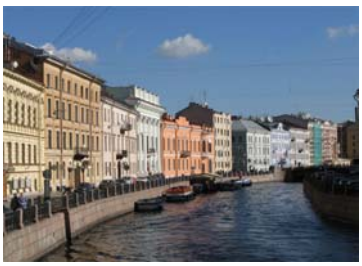
Okhta Centre; Phase 1:

One pile and one barrette were chosen for the initial preliminary testing on this project. The barrette would be tested by both traditional top down static load testing and by bi-directional techniques using O-cell technology.

Testing the barrette using the top down method required the manufacture and construction of a reaction system capable of providing more than the required 30 MN as reaction. This involved placement of anchor bars around the barrette location to tie down the steel reaction frame setup. After the top down test had been unloaded, the single level bi-directional O-cell testing was commenced. O-cells capable of a gross test load capacity of 90 MN were installed in the barrette reinforcement. The correlation between the top down static load test and the O-cell test proved to be excellent. The test results indicated that the load settlement characteristics that might be obtained from using longer barrettes would be appropriate.

Okhta Centre; Phase 2:

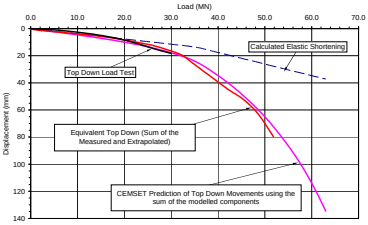
The density of barrettes envisaged for the overall foundation solution prompted evaluation of a group of three adjacent barrettes to be tested simultaneously. Five test barrettes were constructed at three separate positions to give more detailed geotechnical information. Two independent test barrettes were constructed, with a further three with multi-level O-cell arrangements for the group tests. The O-cell loaded barrette tests provided information on the soil characteristics under loading of the Vendian Clay deposits, both in the short term and in the longer term both independently and as a group of three. Testing took place over several weeks in order to evaluate long term settlement. The 2.8 m x 1.5 m barrettes were installed to 85 m in depth. Each barrette of the group was fitted with twin levels of 2 O-cells, each capable of providing 54 MN gross loading at each level.



Historic St Petersburg (Venice of the North)

Artists Impression of Okhta Centre

Top down 30 MN Static Load testing reaction system



Top Down and O-cell Tests results on the same barrette

Bi-directional static load testing surrounded by Top-Down anchors

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The group test was performed by simultaneously loading each of the three barrettes. A load of 50 MN was applied in each direction in each of three barrettes.

The use of the bi-directional load testing method negated the need for anchor piles or kentledge systems which would have not been feasible for the magnitude of loads required and would have disturbed the surrounding soils in such a way that separating the loading effects of the reaction from the measured soil characteristics under applied load might have proved impossible.

Group barrette test with reference beam across all three barrettes

Lakhta Centre;

During the development of the Okhta centre's design there was public protest over the project's potential effect on the architectural integrity of the city's World Heritage historical centre, with the tower height infringing the city restrictions. As a consequence, the project site was moved to the Lakhta District, further from the city boundaries. Following a similar design to Okhta, The Lakhta Centre is planned to incorporating a scientific and educational complex, sports and leisure facilities together with an outdoor amphitheatre, and a 463 metre tall tower being the centrepiece.

Artists Impression of Lakhta Centre

Fugro Loadtest Ltd. commenced a multiple O-cell testing program on 2 m diameter test piles consisting of two levels of O-Cells constructed by Geostroy. The 85 metre deep bored piles were founded in the Vendian Clay deposits. As no previous piles of this length had been placed in these soils, there was no previous experience on how the piles would perform. A complex testing program was formulated by NIIOSP, the Moscow based research centre.

Installation in mid-winter at the Lakhta Centre

Test results:

Four test piles were chosen for the initial preliminary testing on this project. The piles were tested by multilevel bi-directional techniques using O-cell technology. All four piles were tested simultaneously as the pile concrete aged to 28 days for each test pile. With the settlement criteria set so stringently, the whole testing program lasted approximately 5 months. Testing began during a cold and heavy winter in Russia, one of the coldest on record, and after 5 months the weather changed making the ground unstable as the topsoil thawed.

Two levels of two 870 mm diameter O-cells were installed in each test pile, one level located 2 m above the pile toe with the second level 25.5 m above the base. To study the effects of long term loading, rheological testing was performed using the lower O-cells requiring a settlement rate of 0.1 mm / 16 hours on one load step. The need for stable and controlled load application and quality data acquisition was paramount to the success of this program.

Fugro Loadtest were extremely privileged to have been part of this project with many lessons being learnt with regard to long term testing in harsh environmental conditions and group behaviour of barrettes.

Pile head during bi-directional static load testing