

SONICALIPER™ Project Profiles



Fugro LOADTEST have been performing **SONICALIPER**[®] profiling for many years, both in circular and in rectangular foundation elements. The system is patented (U.S. Pat. No. 7,495,995; WO 2007/075756) and the equipment has been and is being deployed around the world on some of the most prestigious construction projects, onshore and offshore, as well as on a few not so conventional project requirements.

The equipment is designed to be portable and compact so that it can be deployed quickly and positioned soon after shaft construction without the need to move the construction equipment or interfere with the set up for the subsequent concreting process. The sonar head contains both an electronic compass and a gyroscope (depending on head unit requirements) which enables the sonic head to accurately determine profile orientation at all times down the bore. Performing a sonic calliper profile before commencing concreting can allow the user to ensure there are no unexpected issues with the shaft construction, such as collapse, bulges, or verticality problems, and can give an assessment of the volume. It can complement thermal integrity or other integrity profiling techniques designed to produce the shaft profile after concreting and assist in determining the size of the shaft when assessing local strain gauge assessment.

Some examples of **SONICALIPER**[®] deployment and applications are illustrated below:

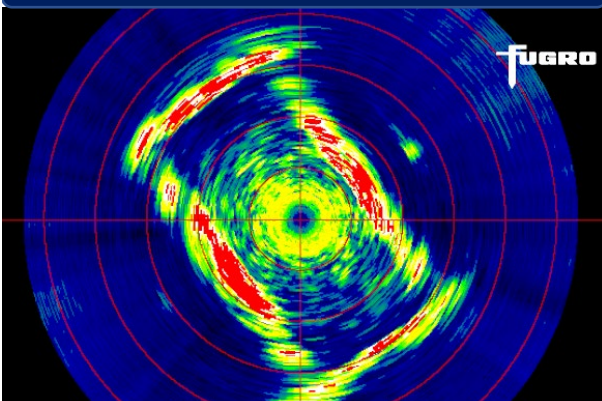
River Don – Aberdeen - Scotland



The Aberdeen Western Peripheral Route (AWPR) is a new road construction through challenging ground conditions. Balfour Beatty Ground Engineering were contracted as piling experts on this project which required 1500 mm diameter bridge abutment piles between 39 m and 46 m to be constructed founded into 9 m rock sockets under polymer.

The requirement for the profiling was to determine both the shape and verticality of the excavations and determine the quality of the face of the rock socket for the poured concrete to bind to. To determine the profile in the rock socket, the 360 degree profile was examined at 50 mm intervals for the whole of the 9m rock socket section rather than the standard 500 mm normally used for bored piles.

Star-Orion diamond Project - Canada



The Star-Orion South project was located in Prince Albert, Saskatchewan, Canada. This project was not the conventional foundation project Fugro Loadtest were used to but were able to deploy the system to another similar application. It is estimated that 66 million carats of diamonds could be extracted from the surface over the 38 year lifespan of the mine. In order to get to the deposits a shaft was excavated using a hydro-mill. Profiling this type of excavation is common, the problem to overcome was the depth of the deposits, from approximately 110 m to 250 m from the surface. The excavation was successfully profiled by modifying the existing cabling to allow a depth of up to 300 m to be reached. The resulting profiling enabled the client to determine the stability and shape of the shaft for the full 360 degrees of the excavation, which was profiled in a single pass.

Suez Canal - Egypt



Seven new tunnels were under construction under the Suez canal in the Port Said and Ismailia area. Fugro Loadtest were asked by both Züblin Egypt LLC and Trevi-Arab contractor JV to assist in determining the stability of the excavated panels which had been subject to collapse when left open. The panels were 2800 x 1250 mm section, constructed using a grab to 50 m depth under bentonite. It was important not only to produce a profile of the excavations, but to determine changes of the panel over time. Profiles were performed 3 days apart, determined as the maximum time the excavations might be left open before concreting.

Providing accurate verticality and stability records were vital for both clients enabling them to modify excavation methods to reduce potential movement of the walls during the construction period.

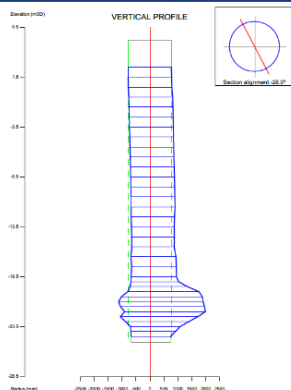
Elbtower Project – Hamburg - Germany



The Elbtower skyscraper under construction, will be third tallest tower in Germany at 244 m tall, located in the Hafen City district of Hamburg. Fugro Loadtest were engaged in an extensive test program of preliminary piles and would see the construction of the deepest bored piles ever installed in Germany at over 110 meters in length. The four 1850 mm diameter piles were installed with O-Cell® loading assemblies capable of mobilising a total load of 64 MN.

To compliment the load tests, the piles were also fitted with fibre optic and vibrating wire strain gauges. TIP® (Thermal Integrity Profiling) strings would determine the profile of the bores after concreting with Sonicaliper checking the excavation profiles and verticality prior to concreting, giving a perfect opportunity to compare pre and post concreting profiles for both techniques.

Barrow-in-Furness - UK



Several piles on the site exhibited very large overconsumption of concrete. Fugro Loadtest were requested at short notice to investigate by profiling the bored pile shafts with the Sonicaliper system. The shafts were drilled under polymer and it was expected that the polymer would prevent collapse of the 30 m long bore. The soils were thought to be stable with only a 4.5 m long steel casing holding the upper soils in place.

After the profiling was completed, it was obvious from the results that the pile bore was collapsing at depth, more than 20 m below the piling platform level and producing the large additional concrete requirement above theoretical. Knowing the extent and location of the collapse assisted the client in planning remedial action for the remaining bores on the site, ensuring sufficient concrete was ordered to complete the construction.

Plaistow Wharf, London - UK



Plaistow Wharf is an important historical site in East London as Tate and Lyle's Golden Syrup factory. It would have been one of the busiest locations along the Thames when the wharf was in full use.

Modern times has seen the wharf buildings being developed and changed significantly over the years. However, the legacy of previous building works leaves a lot of unknown sub-surface problems to overcome.

The latest building phase saw 900 mm diameter bored piles constructed by Keltbray being installed to a concreted length of over 40 metres under polymer. As part of their Quality Assurance program, 3 pile bores were profiled to ensure the working piles were constructed both vertically and without pile wall issues.

Lockwood Beck - UK



Lockwood Beck, located in Lingdale, UK, is a critical ventilation shaft for the Sirius Minerals Polyhalite mine constructed beneath the North Yorkshire moors. Although not a conventional pile shaft, the same methods of profiling using the Sonic calliper were utilised on this extremely deep shaft, with a calipering depth of 292.6 m, this is by far the deepest shaft ever profiled in Europe. An unexpected additional weight on top of the drill head at depth was thought to be due to falling debris from above the drill head in the 3.5 metre diameter RCD bore. With some adaption to our existing equipment for piling programs, Fugro Loadtest were able to profile the bore, identifying areas of concern at between 170 and 180 m depth, enabling the drilling company, ShaftDrillers UK, to implement remedial action. The remediation works were verified by reprofiling at a later stage.

Lighthouse Tower, Aarhus, Denmark



The Lighthouse Tower in Aarhus is Denmark's tallest residential building at a height of 143 m. Situated on a spit of reclaimed land, consolidation of the land fill on a long term basis, required a testing program of the foundation piles. O-Cells were installed in two preliminary test piles, together with strain gauges. For the quality assurance of these piles, both Sonic callipering of the open bore and TIP profiling of the finally constructed piles was required.

The piles were 70 m long, one 1850 mm diameter and one at 2000 mm diameter, both equipped with bi-directional loading arrangements capable of providing 70 MN gross test load. Using both Sonicaliper and TIP gave the opportunity to compare the profile of the open bore and the concreted structures, with the Sonicaliper data being input into the O-Cell reporting to allow accurate assessment of load distribution.

Rental On-Shore



Due to the simplicity of use of the Sonicaliper equipment, one major benefit to the piling industry is that the equipment may be rented on a long term project. With a simple 2 day training for on site engineers, the piling team can have the equipment on hand, enabling them to provide detail profiles, not only of specific test piles or problem piles, but for every pile on the project. The equipment has successfully been deployed with clients in Denmark, Germany, Belgium and the UK, as well as sites across North America and beyond.

Rental, negates the need for a specialist engineer to attend site on a regular basis and for the piling program to run at the pace of the piling contractor work rather than waiting for an engineer to attend.

In-house assistance by Fugro Loadtest specialists is available should anomalous results require further analysis.

Rental Off-Shore



As Wind Farm and other offshore structures increase in number, so does the need for quality assurance. The foundation of these structures often requires precision engineering to locate and fit the foundation elements into drilled shafts. Ensuring the foundation element, whether steel tube or concrete, fits precisely into the shaft with ease is critical in an off-shore environment of changing tides and weather patterns.

A two-day training exercise, which can be undertaken on-shore, enables jack-up crew to provide profiling to suit the pile installation program without the requirement of a specialist engineer to attend and the delays and complications of mobilisation. Although Fugro Loadtest engineers have off-shore training certificates, it is more cost effective to use on board trained staff already on location with remote support from Fugro Loadtest if required.