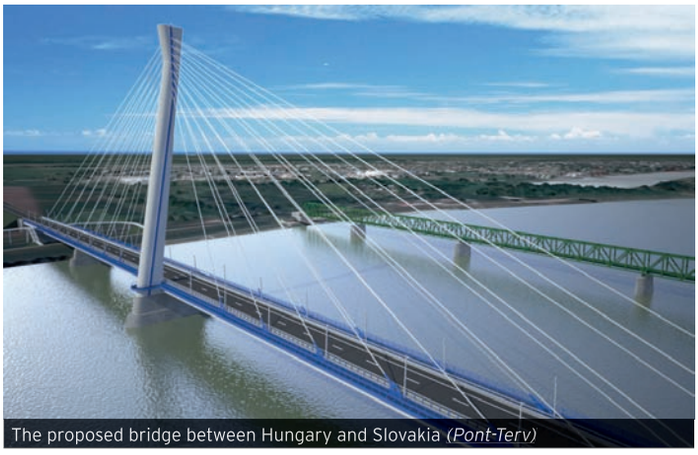
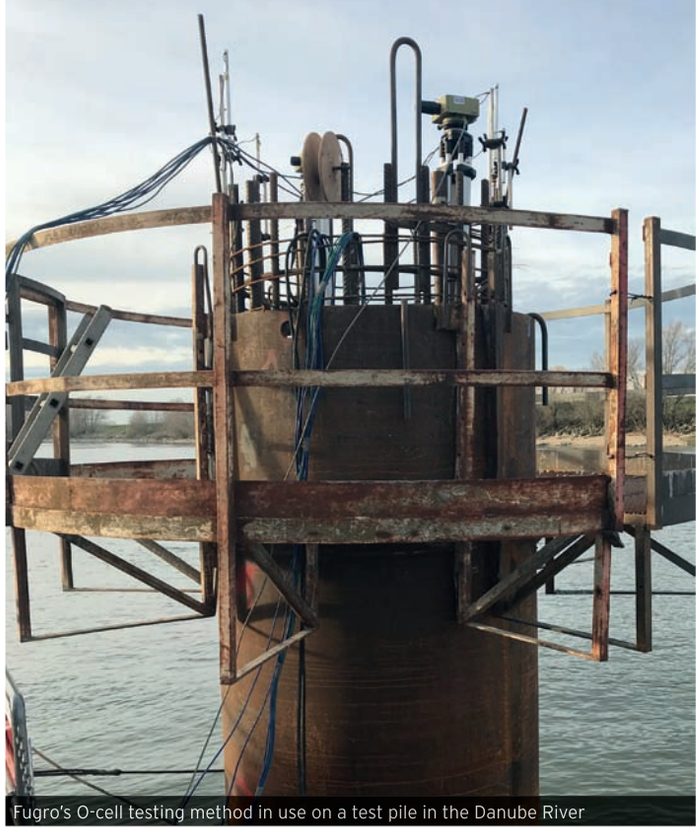
TESTING TIMES



The proposed bridge between Hungary and Slovakia *(Pont-Terv)*



Fugro's O-cell testing method in use on a test pile in the Danube River

A bi-directional testing system is being used in the development of foundations for a new cable-stayed bridge between Hungary and Slovakia

Offshore piles for a new bridge over the Danube River have been tested using a proprietary bi-directional system. Specialist contractor Fugro overcame challenging conditions to carry out the work using its Osterberg Cell equipment on the new 600m-long bridge that will connect the towns of Komárom in Hungary with Komarno in Slovakia.

Due for completion by the end of 2019, the new bridge is being built for Hungary's National Infrastructure Development Company. The two towns — Komárom and Komarno, which was previously known as Újszöny — were connected in 1892 by an iron road bridge before being unified in 1896 under the name Komárom, within the Austro-Hungarian empire. A railway bridge was later added, although the towns evolved separately following the empire's dissolution.

The proposed new cable-stayed bridge is intended to allow a more efficient, faster flow of traffic between the two banks of the river, and improve connections between the national highway systems of the two countries.

Fugro worked with Hungarian consultant, Geoterra, to undertake tests for the bridge contractor HBM Soletanche Bachy at the start of this year.

In order to verify and improve the design of the bridge foundations, two preliminary test piles were required by Geoterra's consultants. Since the piles were located towards the centre of the Danube, the use of conventional reaction systems or dead weight kentledge loading systems to perform the pile test was considered impractical. Fugro's O-cell method of loading was chosen as the ideal static loading test, using the pile itself to provide the reaction for the test within the pile shaft.

The O-cell is an hydraulically-driven, calibrated, sacrificial jacking device installed in the foundation unit, that derives all reaction from within the soil and/or rock system itself. Working in two directions — upwards against skin friction and downwards against end-bearing and skin friction — the O-cell automatically separates the resistance data. By virtue of its installation in the foundation member, the load test is not restricted by the limits of overhead structural beams and tie-down/anchor piles.

HBM constructed two bored test piles of 19.2m to 20m long, measured from the river bed, with a diameter of 1.5m, and supported by bentonite slurry. Each contained a single 540mm-diameter O-cell which enabled a potential test loading of up to 20MN to be applied.

The piles were installed from a jack-up barge, with a permanent casing of 13m placed into the strata below the river bed, extending above high-water level. Strain gauges were placed along the 28.5m-long piles to assess load distribution.

The challenges of pile construction in the middle of the river required implementation of particular measures, including concrete delivery by barge and use of a mix that gave workability for five hours.

Results were analysed using the Cemsolve pile settlement analysis programme to determine the ultimate skin friction capacities and end-bearing characteristics, with the pile head load/movement prediction achieved by combining the results in Cemset.

What was at first considered an extremely challenging task — to perform a static load test over water, with loading up to 20MN — was made significantly easier by the application of the bi-directional testing, Fugro claims. This method gave the bridge design team confidence in design values, with the knowledge that the piles met their specified settlement criteria.

Following the success of these foundation pile tests, Fugro specialists went on to complete three similar tests at the Komárom end of the bridge.

The O-cell method offers numerous advantages over traditional top-down loading arrangements for testing the foundation capacity of piles used for bridge piers. As the technology for drilled shafts or piles develops and larger loads are demanded from each foundation element, the need to verify these design capacities is increased.

The approach is particularly advantageous over water or in congested construction areas. It is not only applicable for preliminary expendable test piles, but also enables the integrity of working test piles to be restored and subsequently integrated into the structure as permanent piles.

The concrete stresses generated during loading are half those required in a traditional test where the load is applied at the pile head. The technique requires minimal surface equipment, making it significantly safer to deploy and enabling deployment at sites with restricted access or headroom.

The O-cell method is suitable for testing any size and capacity of drilled shaft or pile at land or marine sites. Typical test loads exceed 50MN, with more than 200MN achieved on a number of bridge projects. Fugro undertakes an estimated 400 O-cell tests a year around the world, citing safety and adaptability among the advantages, in addition to significant cost savings as the test load and pile dimensions increase