# Ma On Shan pile load tests

| | |
|---|---|
| Project nature: | Series of static pile load tests |
| Project: | KCRC ERE Contract TCC-300 (Shek Mun to Lee On) |
| Client: | Bauer Hong Kong Ltd (Foundation Sub-Contractor) |
| Fugro company: | Fugro Geotechnical Services Ltd (Hong Kong) |
| Period: | 2001 - 2002 |
| Project value: | approx € 400,000 |

The East Rail Extensions project was a major infrastructure project in Hong Kong undertaken by the Kowloon-Canton Railway Corporation (KCRC) between 2001 and 2004. It involved the construction of an 11.4km spur line with nine stations connecting Ma On Shan town centre to the main East Rail system at Tai Wai.

In order to minimise the land take and disruption to road traffic, the railway was designed to run above grade on viaducts. The viaducts are supported on concrete piers, which are in turn supported on concrete piles.

The foundation sub-contractor for the Shek Mun to Lee On section of the line, Bauer Hong Kong Ltd, commissioned Fugro Geotechnical Services Ltd to perform a series of static loading tests on selected piles.

Three piles were tested between October 2001 and May 2002. Pile diameters ranged from 1.2m to 1.5m, with lengths ranging from 40m to 73m. Working loads ranged from 3,800kN to 7,500kN. Test loads were applied in a number of cycles to a maximum of 200% of working load, and once achieved, the maximum load was held for 72 hours. Loads were applied using a computer controlled loading system.

The pile tests were notable for the fact that they took place in a very narrow congested site on the central reservation of the main road through Ma On Shan town centre. For one test, the top of the kentledge stack was only five meters away from an elevated pedestrian walkway, and the sides were less than a metre from live traffic.

Fugro were responsible for the planning and execution of the entire test, including the design and construction of the loading system, supply and installation of the instruments in the pile, performance of the test, and reporting of the results.

The loads on the test piles were applied by jacking against reaction provided by a concrete


*Pile load test in progress in Ma On Shan town centre*

kentledge stack. Computer control of the jacking system was used to ensure that the loads applied to the pile remained within close tolerances at all times.

Fugro's computer controlled jacking system works by continually monitoring the load measured by a load cell installed between the reaction system and the jack, and comparing the measured value with the desired value. Should the load drop below the desired value, the computer system will activate the pump to apply additional pressure to the jack until the correct load is reached once more.

This process of checking the measured load and adjusting the jacking pressure takes place several times per second, and allows much closer and accurate control of the loads than is easily achievable with manual control.

The piles were all instrumented in a similar manner, with forty to fifty (depending on pile length and ground conditions) vibrating wire strain gauges installed in layers at varying levels in the pile in order to monitor the shedding of load down the pile due to skin friction. Two rod extensometers were also installed in each pile to assess overall compression of the pile. Pile cap movements were monitored using linear potentiometers, backed up by conventional dial gauges.

During the concrete curing period between pile installation and load testing, the strain gauges in each pile were read every few hours by an automated datalogger system, and retrieved from Fugro's office using a GSM modem. Monitoring the strain gauges during the curing period provides information about the changes in the strain patterns in the pile caused by changes in the properties of the concrete and the surrounding soil as the concrete is curing.

This information, which is not normally acquired, is often very useful when subsequently evaluating the test results from the pile load test, especially for piles where the major proportion of the load is taken by friction.

All electronic instruments were connected into a data acquisition system consisting of a datalogger and computer. Readings were taken by the datalogger at intervals of a few seconds, and the information was passed to the computer where the readings could be observed in real time.

The use of computers to control the pile loading and to acquire the readings from the pile offers significant advantages in terms of reliability, accuracy and quality of data. The high level of automation means that staffing requirements are very low, as a single technician can both control the pile loading and take readings from all of the instruments on his own. There is also less scope for manipulation or misinterpretation of the results, as the entire test history may be determined from electronic records, with no transcription of readings from handwritten test sheets necessary.

*Computerised data acquisition and pile load control systems, and computer controlled pumping system*