

Kowloon Tong Station Interchange



Project nature:	Automatic Inclination Monitoring System
Project:	MTRC Contract 521 – Kowloon Tong Station Interchange
Client:	Maeda Corporation (Contractor)
Fugro company:	Fugro Geotechnical Services Ltd (Hong Kong)
Period:	2002
Project value:	n/a

At the time of this project, Kowloon Tong Station was the sole interchange point between two railway networks, and consequently one of the busiest stations on the Hong Kong rail system.

Forecasts of rapid growth in passenger numbers on completion of a railway extension project prompted the station owner MTRC to commission Maeda Corporation to implement extensive modification and renovation works, including an extension to the existing concourse.

The construction of the concourse extension involved extensive excavation works immediately adjacent to the existing station box. In order to ensure that construction activities would not cause disruption to railway operations, Maeda were required to closely monitor the behaviour of the existing structural diaphragm walls of the station box during excavation. Maeda commissioned Fugro Geotechnical Services Ltd to devise an instrumentation scheme to fulfil this objective.

The main requirement was to have a dedicated instrumentation system that could monitor any changes in the inclination of the diaphragm walls such that any movement trend could be detected as early as possible, to allow suitable remedial measures to be taken.

The system should allow readings to be made at intervals to suit the progress of the excavation activities (more readings are required as the excavation face gets closer to the diaphragm wall). In addition, the process of making the measurements should not be allowed to cause disruption to train services or the flow of passengers through the station, bearing in mind that the station is used by hundreds of thousands of passengers every day.

In order to measure the inclination of the diaphragm walls, Fugro installed a total of fifteen electrolytic (EL) tiltmeters, manufactured by Durham Geo Slope Indicator (Figure 2).

The EL tiltmeter consists of an electrolytic tilt sensor housed in a weatherproof enclosure. The tilt sensor is a precision bubble level that is sensed electrically as a resistance bridge. The bridge circuit outputs a voltage proportional to the tilt of the sensor.

In order to avoid the need for manual reading of the sensors, and to allow 24 hour monitoring without physical access to the site, automated data acquisition systems based around a datalogger and a GSM modem were installed at the concourse and platform levels of the station.



Figure 1 – Kowloon Tong Station – platform level

These allowed readings from the sensors installed on the diaphragm walls to be transmitted to a remote monitoring station via a GSM communications link, thus allowing data acquisition parameters (such as frequency of readings) to be configured and the latest readings to be downloaded from Fugro's office, with no need for staff to visit the site.

The GSM modem offered a reliable wireless solution, allowing Fugro to obtain readings that would be very impractical to obtain using conventional instrumentation and monitoring techniques.

The use of automated data acquisition systems offer many benefits compared with conventional manual monitoring techniques. Some of these are highlighted below:

- Increased safety for the personnel monitoring the instruments, as visits to site are significantly reduced.
- A continuous record of the instrument readings is available. The system keeps monitoring even when no work is being carried out on site, for example at night or on public holidays.
- Remote access gives immediate access to the latest readings and can thus provide early warning of problems
- Automated data acquisition systems such as the one described here are flexible and scaleable. It is simple to add additional sensors (which can be of a different type) to give a better picture of site conditions.

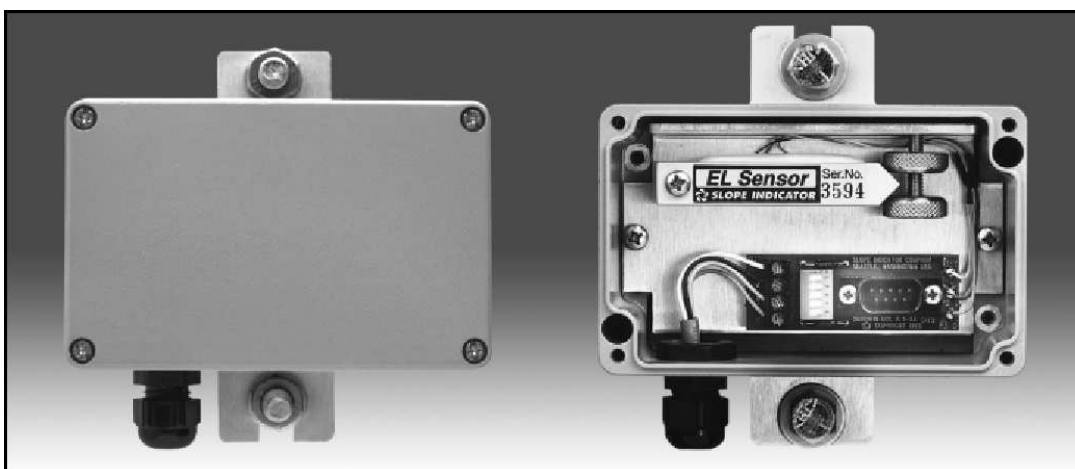


Figure 2 - EL Tiltmeter with cover in place and with cover removed for adjustment (photo: DGSi).