

## PROJECT DOSSIER

# GOLD LINE – DOHA METRO



## PROJECT OVERVIEW

Project	Gold Line - Doha Metro
Location	Doha, Qatar
Client	Qatar Railways Company (Qatar Rail)
Contractor	Aktor, L&T, Yapi Merkezi, STFA and Al Jaber JV
Consultants	Atkins
Duration	2014 - 2017

Gold Line Metro Project is part of Qatar Integrated Rail Project which is the key infrastructure project of Qatar National Vision 2030. Doha Metro will be one of the most advanced rail transit systems in the world when Phase I becomes operational by the end of 2019.

The east-west Gold (Historic) Line is the largest line of the project and extends from Ras Bu Aboud in the east crosses

Msheireb Major Station and reaches Sport City in the west (near Aspire Zone). It consists of twin tunnels of approximate length of 16 km, with ten underground stations namely Ras Bu Abboud, Qatar National Museum, Souq Waqif, Bin Mahmoud, Al Sadd, Joaan, Al Sudan, Al Waab, Sport City and Al Aziziyah.

Six TBMs were deployed to carry out ~ 32 km of tunneling at an average depth of 20 m below ground. 24 no. cross passages and one Emergency Exit have also been constructed in the project.



## Monitoring solution

The purpose of the instrumentation and monitoring was to ensure that the construction and excavation works proceed safely with monitoring of ground settlements and deformations, groundwater/ dewatering, shoring/piling works and of the structures within zone of influence of deep excavations and TBM/NATM tunnel alignments during construction period.

### Turnkey services

Encardio-rite was awarded the complete monitoring works on turn-key basis. Scope of works included:

- Supply of geotechnical, groundwater and geodetic instruments
- Installation of all geotechnical, groundwater and geodetic instruments
- Online monitoring of critical parameters and areas
- Manual monitoring of geotechnical instruments
- Surveying
- Processing and uploading of geotechnical and surveying data to the central monitoring database
- Daily & weekly reporting with evaluation & interpretations
- Maintenance & calibration of instrumentation
- Pre and post construction survey of buildings, infrastructure and utilities within ZOI of deep excavations and TBM/NATM tunnel alignments

## INSTRUMENT USED

- **Surface settlement point:** Installed around deep excavations like station boxes, station entrances, shafts, above TBM tunnel alignments, cross passage excavations, buried utilities like pipe line, cables etc. within ZOI to monitor ground settlement using precise leveling method
- **Inclinometer:** Installed in deep excavation shoring systems (piles and diaphragm walls) and around deep excavations like station boxes & shafts to monitor lateral deformations
- **Automatic water level recorders and vw piezometers:** Installed around deep excavations like stations and shafts, adjacent to TBM bored tunnels to monitor change in groundwater pressure and level due to construction activities
- **Standpipe piezometer:** To monitor water level/drawdown during construction
- **Crack meter:** Installed on existing critical cracks in buildings within ZOI of the works for monitoring their behavior during construction
- **Load cells:** Strain gage type centre hole load cells were installed to measure load on anchors supporting the D-walls at underground stations
- **Multi point borehole extensometers:** Installed above bored tunnel alignments to monitor subsurface ground settlement at anchor depths using digital depth micro meter. Reference plate at the head of the MPBX were also surveyed using precise levelling methods
- **Pressure cells & strain gages:** NATM pressure cells and strain gages were installed in NATM station passageways and tunnel cross passages to measure load on linings and deformation of steel ribs and support frames
- **Tilt meter:** Tilt plates were installed on structures within ZOI. These were measured using portable tilt meter and readout units to assess change in tilt of structures



- **Building settlement points:** Installed on buildings within the ZOI to monitor settlement of buildings using precise levelling method
- **Road prism targets:** Road prisms were installed on roads, with moving traffic, above NATM tunnelling and were monitored by Automatic Total Stations
- **Vibration monitoring device:** To monitor peak particle velocity (PPV in mm/sec) of the ground near structures (within ZOI) to assess the vibrations caused due to TBM tunneling/piling activities



## ACCOMPLISHMENT

Online monitoring was done for geotechnical sensors that were critical using advanced automatic dataloggers and data acquisition systems.

Monitored data (automatic as well as manual) was available online through our web based data management system to the Contractor, Client as well as the Consultant on their desktops. Monitoring reports were also submitted combined for geotechnical and geodetic monitoring data on daily and weekly basis. Monitoring reports included interpretations of variations observed in instrument data with respect to the construction progress in the respective area.

Following activities important for successful execution of the project were also performed by Encardio-rite:

- Prepared comprehensive method statements of the monitoring and surveying works
- Field monitoring technicians verified monitoring data at site itself before sending for processing. This facilitated prompt update on monitoring database
- Alerted JV immediately about any abrupt data change and the possible causes as noted by the field monitoring technicians
- Worked out most suitable location of instruments on buildings and structures
- Provided daily & weekly reporting with evaluation & interpretations
- Survey teams proactively replaced damaged survey targets on their own to ensure uninterrupted monitoring
- Participated in Weekly Monitoring Reviews with the Main Contractor's team.
- Planned installations & monitoring frequency of installed instruments based on stages of construction
- Liaised with site construction teams to carry out installation and monitoring in a timely manner and to remove any obstruction to the above activities



Main contractor ALYSJ JV appreciated Encardio-rite's major contribution in achieving the 1.1 million active measurements in January 2017.