

EASTERN EXPANSE

Construction for metro projects, with events such as the World Cup on the horizon, is driving the demand for tunnelling Qatar. Other cities in the Middle East are also investing in infrastructure development, growing the market for tunnelling across the region. Keren Falwell reports

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Keren joins the Tunnels and Tunnelling team as a contributing editor this year



INVESTMENT IN large infrastructure projects and strategies for economic diversification are driving demand for tunnelling in the Middle East.

From sewers to roads and rail systems, many big-budget projects are under way as governments aim to reduce economic dependency on oil and gas.

“These countries want to be regional hubs for industry and commerce, not just oil and gas, and to do that you have to have cities where people can live,” said Nick Chittenden, BASF’s regional manager – Middle East, Egypt and East Africa – for underground construction.

And, he points out, the pace of tunnelling development has been very fast, growing from the first tunnels built for the Dubai metro about 10 years ago.

This trend is illustrated by figures from business analyst Timetric. In 2013 the Middle Eastern tunnelling and drilling equipment market was the smallest regional market, accounting for 3.2 per cent of the global market and with a value of USD 528.4m. Saudi Arabia was the largest market, with a 47.7 per cent share, followed by the UAE, Qatar and Bahrain with 47.2 per cent, 2.9 per cent and 2.1 per cent respectively. However, the region is forecast to achieve a compound annual growth rate of 10.76 per cent in the period 2013-2018.

The Middle East’s importance to the tunnelling industry was recognised at this year’s World Tunnelling Congress in Croatia where the Qatar Tunnelling Society was accepted into the ITA and it was announced that the UAE will host the WTC in 2018. The annual Arabian Tunnelling Conference and Exhibition,



organised by the Society of Engineers – UAE in partnership with the ITA, has also become an established fixture on the industry calendar. This year's event will be held in Dubai from 23 to 25 November.

In Dubai, Expo 2020 has been motivation for a 15km extension to the metro's Red Line from Nakheel Harbour & Tower Station to the expo site. The winning consortium is due to be announced in January next year.

In Qatar, the 2022 Fifa World Cup and National Vision 2030, the country's economic and social development plan, are contributing to construction industry growth which, according to the Construction Intelligence Center, is expected to reach a record 13.28 per cent during the period 2014–2018.

A big part of that is the USD 43bn Qatar Rail Integrated Network, which includes the USD 36bn Doha Metro, the Long Distance Passenger and Freight Rail, and the Lusail Light Rail Transit.

The metro comprises three lines – Red, Green and Gold – which are being built simultaneously and by the start of the second quarter this year, 21 no. 7m-diameter EPBs from Herrenknecht had been commissioned to excavate the soft ground and rock underneath the Qatari capital.

So far four EPBMs are dedicated to the 11.3km of twin tunnelling required for the Red Line North and five for the 12.05km of the Red Line South, which is underground. Tunnelling will be at an average depth of 20m. This 40km line, which extends from Al Wakra in the south to Lusail in the north, will have 12 underground stations, five stations elevated at grade and a major transfer station at Msheireb.

A milestone was reached on the Red Line in April when, for the first time on the metro project, one TBM was lifted from one station site to another. Al Khor TBM, which had finished its first stretch, from Al Qassar station to Doha



Above: The Doha Metro is currently under construction

Below: Work on Doha's Gold line

Exhibition & Convention Center station, was conveyed back to Al Qassar for relaunching towards the north of Doha, to complete the tunnelling section between Al Qassar, Katara and Legtaifiya.

Two joint ventures have been selected as design and build contractors for the Red Line – one led by Impreglio, South Korea's SAK Engineering and Construction and Galfar Al Misnad; and the other led by Qatari Diar Vinci Construction, GS Engineering and Construction and Al Darwish Engineering.

The Green Line (Education Line), being built by the joint venture of Porr Bau GmbH, Saudi Binladin Group and Hamad Bin Khalid Contracting, extends from Msheireb Station in the east to Doha West International. Here, six EPBMs are working on the 16.6km, seven-station stretch between Msheireb and Education City, again at a 20m depth.

Six EPBs are also currently working on the 13.3km of tunnelling for the Gold Line, a contract awarded to the ALYSJ joint venture comprising Greece's AKTOR, the joint venture leader; India's Larsen and Toubro; Turkey's Yapi Merkezi and



Above: Work for new metro lines being built in Doha

Sezai Turkes Feyzi Akkaya Marine Construction (STFA); and Qatar's Al Jaber Engineering. Atkins is the lead designer. The Gold Line, which extends from Ras Bu Abboud Station in the east to Sport City in the west, will consist of 10 underground stations and work on all stations is under way.

Precast segments will provide the final lining for the Gold Line and the TBM tunnels will be connected to emergency escape passages excavated using NATM methods.

Omikron Kappa Consulting, which is providing detailed geotechnical – structural designs check and special consultancy and design services for the project's metro stations, tunnels and underground structures, says the Metro Gold line has been a unique and challenging project, not least because of the high specifications and exacting standards required. There have also been geotechnical challenges.

"The most significant geotechnical challenge is the fact that many stations are near the coast line, with karstic channels and features interconnected with sea water so it's of utmost importance to maintain safe drainage during excavation," says

Panayotis Kontothanassis of Omikron Kappa, adding that this has required extensive pumping and a special drainage system.

Excavating the stations has also had its challenges.

"In this case the pumped water coming from the excavated pits cannot be easily discharged to Doha's central sewage system so a special method of deep reinjection wells has been implemented," Kontothanassis says.

The project should also be considered within the context of a busy city, made even busier by the large number of construction projects being carried out at the same time.

"There are private projects, hotels, sport facilities, road and infrastructure



projects being built simultaneously. The fact that within five years' numerous flagship projects will be realised in Doha that would normally take 15-20 years is remarkable," Kontothanassis says.

"And not only are these projects considered landmark projects in the Gulf region, they are considered worldwide flagship projects."

All three lines of the Doha Metro will be completed by the end of 2019, well in advance of the 2022 Fifa World Cup, which is expected to attract 800,000 visitors to the country. A fourth route, the Blue Line, is scheduled to be completed by 2026 during phase two of the metro's development.

Another major project in the city, due to start in the third quarter, is the Inner Doha Re-sewerage Implementation Strategy (IDRIS), which will expand the overloaded existing system and cater for the anticipated rapid population growth. It has a completion date of the fourth quarter of 2019.

The scheme, which will serve an area of 680km², includes the construction of a 45km main trunk sewer and more than 70km of lateral interceptor sewers. The main trunk sewer will have internal diameters ranging from 3-4.5m, and depths of 20-55m.

In May, Qatar's Public Works Authority, Ashghal, awarded the first contracts under the scheme, the majority of which have gone to Qatari companies or joint ventures involving Qatari companies. The joint venture of Bouygues Qatar and UrbaCon Trading & Contracting has won two pieces of work – the USD 265m contract for construction of the three northern segments of the main trunk sewer in central Doha, and the USD 339m contract for construction of the southern segment of the main trunk sewer which terminates in the new Doha South sewage treatment works.

The USD 294m contract for construction of the central segment of the main trunk sewer has been awarded to IDRIS SHP Contractors, a joint venture of Hochtief Solutions Middle East Qatar together with Al Sraiya Strabag for Roads and Infrastructure, and Petroserv Ltd.

Two TBMs will be used to excavate this 14.7km section and after installation of the tunnel's outer ring, an inner lining of an HDPE membrane will be added to protect the concrete from the aggressive gases that build up in the system. In addition to the sewer tunnel, which will have a 4.5m diameter, shafts up to 45m deep will be built, some of which will serve as connectors to other



Above:
Construction work in Doha

IDRIS construction contracts.

"After the successful delivery of the BARWA Commercial Avenue project [mixed use development], we are very happy to strengthen our presence in the Middle East through this major project," says Nikolaus Graf von Matuschka, CEO of the Hochtief Solutions Executive Board.

However, while these large projects are progressing, Reuters reports that Qatar is rescheduling 15 per cent of its development works because of competition for labour, bureaucratic delays and rising costs. One casualty of this move is Sharq Crossing – one of the most ambitious engineering projects ever undertaken in the Middle East.

The Sharq Crossing was to be a 12km series of tunnels and bridges across Doha Bay, connecting Hamad International Airport, Katara Cultural Village and the Dafna/West Bay business district. Construction was to have started this year and be completed in time for the 2022 World Cup. While the project seems to be on hold, it does, however, remain part of the emirate's 2030 Vision.

In neighbouring United Arab Emirates, Society of Engineers – UAE president Essa Al Maidoor told the Arabian Tunnelling Conference and Exhibition in Abu Dhabi last December that tunnelling had an important role in the emirate's developing infrastructure.

"Abu Dhabi is witnessing a qualitative leap in infrastructure

projects...that contribute to enhancing the status of the emirate as a global city through higher sustainable levels of economic growth," he said.

Among the mega-projects in the emirates is the USD 1.6bn Strategic Tunnel Enhancement Programme (STEP), a huge wastewater network tunnel which is one of the longest gravity-driven wastewater tunnels in the world. The project will enable the Abu Dhabi Sewerage Services Company to increase its daily capacity of wastewater from 450,000m³ to 800,000m³, and reduce power and maintenance costs through the decommissioning of 34 existing pumping stations across the Abu Dhabi islands and mainland.

It involves the construction of a 41km-deep sewer tunnel which descends from 24m below ground level to a depth of 80m, and 43km of supply tunnels to transport the sewage to treatment plants. TBMs are creating the main tunnel, which has a casing of precast concrete sections, while the pipe jacking method is being used for the link sewers.

Elsewhere in the Middle East, metros are providing work, or potentially fertile contracts, for the tunnelling industry.

Tunnelling is also under way on the USD 22.5bn metro in the Saudi Arabian capital Riyadh. Here seven TBMs will excavate around 35km of tunnels for the 178km transport system. The tunnels for the six-line metro are around 30m below the city.

The design and construction contracts have been awarded to three consortiums – BACS (Blue and Green lines); ANM (Red line); and FAST (Orange, Yellow and Purple lines) – and the project is expected to be completed by 2018.

In Egypt, a joint venture led by Vinci Construction Grands Projets with Bouygues Travaux Publics, a subsidiary of Bouygues Construction, has won a USD 300m contract to build the extension of Line 3 of the Cairo metro.

The project comprises Phase 4 of the transport system, continuing on from Phase 2, and involves construction of a 5.15km tunnel and five underground stations on the east-west line between Haroun and El Nozha stations.

Vinci Construction Grands Projets and Bouygues Travaux Publics will work with Egyptian partners Orascom Construction and Arab Contractors to complete the project within a short design-build delivery deadline of 34 months.

The team will modify an EPBM used on the previous phase, to operate as a slurry pressure balance machine.

Also in Egypt, six tunnels are under construction to connect the eastern and western banks of the Suez Canal as part of the USD 8bn expansion of the waterway, funded by Egyptians buying investment certificates. President Abdel Fattah al-Sisi hopes the project, which involves widening the canal, will reinvestigate Egypt's economy and he has set the ambitious completion date of August this year.

Three tunnels – two road and one rail – will be built under both Port Said and Ismailia. The road tunnels will be 3.1km long and 10.8m in diameter, each with two 3.75m-wide lanes. They will reach a depth of 48m and have five ventilation shafts.

Herrenknecht TBMs are at work on the project and the EPC contract is being carried out by state-owned Arab Contractors Company and the private Orascom Construction Industries, which are working under the supervision of the Armed Forces Engineering Authority.

Work is also expected to start on the Oman Railway Network this year. The 2,135km system will link through to the UAE, as part of the GCC rail network, and stretch south to the border with Yemen. It will include 10 tunnels covering a total 4.7km and two of the tunnels will be 1.57km long. In May Oman Rail opened prequalification tenders for the line connecting Al-Buraimi with Al Duqm and Salalah.

On the other side of the Al Hajar mountains, work is under way on the UAE's section of the GCC rail network. This 1,200km project for Etihad Rail includes more than 10 tunnels.

There are many other projects on drawing boards to whet the tunnelling industry's appetite.

A metro is proposed for the Jordanian capital Amman as part of the city's 2025 Vision, while Kuwait City also has plans for a metro to help ease the worsening traffic congestion. The USD 7bn transport system will comprise four lines and 60km of the 171km will be underground. The project is part of a USD 25bn rail network linking Kuwait with its five partners in the Gulf Co-operation Council – Saudi Arabia, Qatar, Bahrain, Oman and the UAE.

Tehran's metro network is also earmarked for expansion and in Saudi Arabia bidding is expected to open later this year for construction of a metro rail system in the commercial hub of Jeddah, the country's second largest city.

The new system, which is due to start running in 2020, aims to boost Jeddah's infrastructure which is struggling to cope with the city's rapidly rising population. Currently 3.9 million people live in the city but this is expected to rise to 4.9 million by 2020 and 6.3 million in 2033.

BASF's Chittenden believes that although the pace of new tunnelling projects will eventually slow, activity will continue in the Middle East for the next 10-15 years, and much of that will be sustained by Saudi Arabia, which has plans for several new metros.

In the holy city of Mecca, which currently has no public transport system, a 188km metro network with 88 stations on four lanes will cater for the city's 1.6 million permanent population and the 9 million Haj and Umrah pilgrims who visit each year. Work on phase one will start next year and the network is due to open in 2019.

In Madinah, the three-line metro will comprise 71 stations and 92km of railway – around 25km underground. Before the system opens in 2020, engineers face the challenge of tunnelling through lava, as Madinah sits beside the Harrat Rahat lava plain, the largest volcanic field in Saudi Arabia.

Although the lower oil price may impact on future infrastructure spending, for those projects that do go ahead, tunnelling is now a viable option.

"Tunnelling is in a new phase in the Middle East," Chittenden says. "The raised profile is having a positive impact at government level and will now be considered more often as an option"