Doha (Qatar)
RED LINE NORTH METRO RAILWAY

LINE 3 IS PART OF A MORE COMPREHENSIVE TRANSPORT PROJECT SCHEDULED TO BE INAUGURATED TO MARK QATAR 2022. MAPEI ALSO TOOK PART IN CONSTRUCTION WORKS

The 7th of May this year saw the official inauguration of the stretch of the Red Line Metro Railway running between the stations at Al Qassar and Al Wakra, bringing the number of stations to 13 of the 18 planned, for a total length of 40 km.

The infrastructure is part of a more comprehensive programme to mark the opening of the "Qatar 2022" world soccer championships, which should see 40 stations and four metro railway lines open to the public: Red Line, Gold Line, Green Line and Blue Line.

The aim is to complete the Red Line and a further two lines, the Green Line and the Gold Line, by 2020, while it will be 2026 before the Blue Line is opened.

The Red Line is considered to be one of the main pillars of Qatar's new integrated transport system. This comprehensive infrastructure project also included the construction of pedestrian walkways and cycle lanes, a significant innovation for a country where cars are the most used means of transport. The aim of the programme of investments in the infrastructures is to reduce the number of cars on the roads and, as a result, reduce their impact on the environment.

WATERPROOFING IN A COMPLEX SITUATION

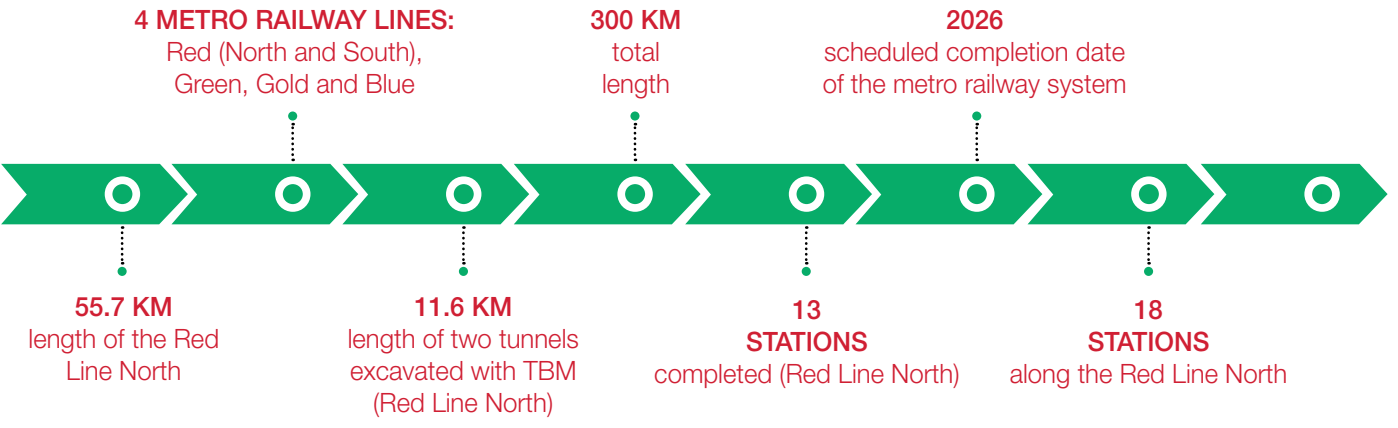
Also known as the Coast Line, the line consists of a stretch called the "Red Line North Underground", a project that included the excavation of two tunnels running parallel in both directions. The North stretch has seven stations and the volume of soil excavated to construct them amounted to 1,700,000 m^3. Mapei was involved in the project right from the design stage, especially regarding its underground waterproofing requirements. In fact, the tunnels are below the water line and, at their lowest point, reach a depth of 36-42 m. The water is contaminated and has a high

LEFT. A plan view of the future transport system in Doha.

saline level.
The tunnels where Mapei products were employed are in an urban area with a particularly high volume of traffic and a containment wall had to be built to support the ground to prevent subsidence before tunnelling work could commence.
The chosen waterproofing system included a double-layer of PVC membranes including MAPEPLAN TU S and MAPEPLAN PROTECTION.
MAPEPLAN TU S is a single layer waterproofing membrane with orange signal layer. MAPEPLAN PROTECTION is a homogeneous black membrane, used as protection layer of the MAPEPLAN PVC synthetic waterproofing membranes. MAPEPLAN TU S membrane was installed around the structure and divided into compartments measuring 150 - 200 m^2 with IDROSTOP PVC BEC ME 32T waterstops.
The waterstops also included a network of IDROSTOP MULTI 11 re-injectable hoses, which were used to seal and waterproof injections in construction joints. MICROCEM 8000 was chosen to reduce infiltrations into the various compartments, a micro-fine hydraulic binder with pozzolanic action for ground consolidation and waterproofing throughout injections into cementitious mixes.
For the anchor points a special waterproofing system had to be designed, and the solution was to form a collar of MAPEPLAN TU S membrane filled to one third its height with MAPEGEL UTT SYSTEM gel. This was then encapsulated in PLANIGROUT 300 ME PCT epoxy resin grout, which is used to form structural anchors (and distributed in Qatar by Mapei Doha).

CUTTING-EDGE TECHNOLOGY FOR UNDERGROUND WORKS

The Doha Metro Railway has proven to be a challenge from both a technical point of view and an architectural point of view.
Tunnelling operations were carried out by a full-section, 7.1 m diameter EPB (Earth Pressure Balanced) type TBM (Tunnel Boring Machine), specially designed to operate in areas with water under high pressure.
Mapei provided support for the contrac-



IN THE SPOTLIGHT

ADESILEX P10

High performance white cementitious adhesive, with no vertical slip and extended open time for glass, ceramic and marble mosaic. It is used for the interior and exterior bonding of normal or heavy weight mesh-backed or paper-faced glass, ceramic and marble mosaic on floors and walls.

tors when they were choosing the most suitable products for underground operations, which were specifically selected to guarantee excellent performance from the TBM cutting head, even under such challenging geological and hydrological conditions.

This is why POLYFOAMER FP and POLYFOAMER FP/LL liquid foaming agents were chosen, specifically developed to condition soil during mechanised tunnelling operations, along with MAPEDRILL M3 liquid synthetic polymer for water-based fluids to be employed in mechanized tunnelling and drilling.

CEMENTITIOUS COATINGS AND CERAMIC COVERINGS

The product chosen to create seamless flooring with a "terrazzo alla veneziana" effect in various areas of the stations (200,000 m^2), was ULTRATOP self-levelling mortar, which is used to create floors resistant to abrasion and wear caused by intense foot traffic.

The first step was to apply a coat of PRIMER SN with a smooth steel trowel. The still fresh surface was fully broadcast with QUARTZ 1.2 quartz sand in order to guarantee the perfect bonding of the next layer of ULTRATOP mortar.

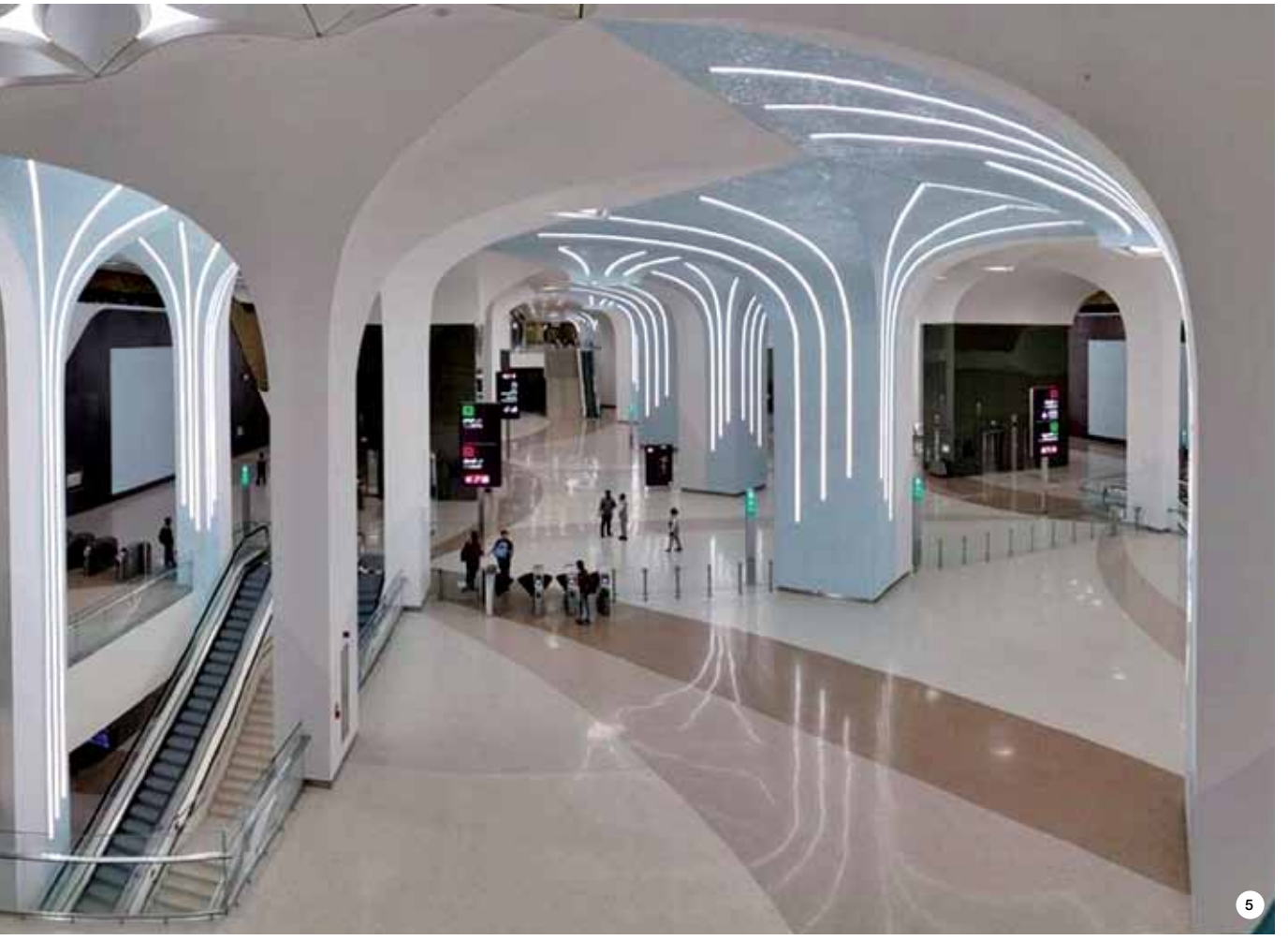
Metal profiles were installed to set the required aesthetic effect according to the lay-out of the project.

ULTRATOP, combined with the required aggregates or coloured glasses, was then applied at the required thickness. After several operations of grinding and polishing, surface pinholes, which inevitably came out after these treatments, were repaired with ULTRATOP STUCCO grout; the polishing operations were finally carried out until a smooth

PHOTO 1. A special waterproofing system was designed for the anchoring points consisting of MAPEPLAN TU S, MAPEGEL UTT SYSTEM and PLANIGROUT 300 ME PCT.

PHOTOS 2 AND 3. ADESILEX P10 mixed with ISOLASTIC was used to bond the hexagonal mosaic tiles supplied by Mosaico+ onto several surfaces, including the curved ones.

PHOTOS 4 AND 5. ULTRATOP was used to coat the floors in the stations with a "terrazzo alla veneziana" effect. The surface was then finished with MAPECRETE STAIN PROTECTION and MAPELUX LUCIDA.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and shining surface was obtained. MAPECRETE STAIN PROTECTION and MAPELUX LUCIDA were applied on the surface as a final finish.

Installation of a mixture of hexagonal, molten glass finish tiles on a 75,000 m^2 surface of the curved walls required a product that was up to the job. The mosaic tiles, in a pale blue colour with the Qatar Rail logo printed on them and with an opalescent finish, were made by Mosaico+ (a subsidiary of Mapei Group) exclusively for this project.

And for this part of the work, the product chosen was ADESILEX P10, a high-performance cementitious adhesive, with no vertical slip and extended open time. To improve its performance characteristics and deformability to the requirements of class S1 (deformable adhesive) according to EN 12004 standards, 50% of the mixing water for ADESILEX P10 adhesive was replaced with ISOLASTIC latex additive.

This bonding system also has the capacity to withstand vibrations generated by passing trains.

To grout the joints of the mosaic tiles in the prayer rooms and ablution rooms (5,000 m^2), the product chosen was ULTRACOLOR PLUS high-performance, antiefflorescence, quick-setting and drying polymer-modified mortar.

TECHNICAL DATA
Red Line North Underground, Doha metro system, Doha (Qatar)
Period of construction: 2014-2020
Period of the Mapei intervention: 2017-2018
Intervention by Mapei: supplying products for waterproofing, anchoring, laying cementitious coatings and bonding ceramic tiles and mosaics in the stations
Client: Qatar Railways Company
Main contractor: Salini Impregilo SpA
Cementitious coatings contractors: CMTC (Construction Material Trading Company), BMC, Fribel
Waterproofing contractors: CMTC-IAT, Ranesco
Mapei coordinators: Sameh Hanna, Mapei Doha LLC (Qatar), Giovanna Novella and Dario Casile, Mapei SpA (Italy)

MAPEI PRODUCTS
Waterproofing underground structures: Idrostop PVC BEC ME 32T*, Idrostop Multi 11, Mapeplan TU S, Mapeplan Protection, Mapeplan Injection valves, Microcem 8000, Planigrout 300 ME PCT*
Anchoring: Mapeplan TU S, Mapegel UTT System
Admixtures for TBM: Mapedrill M3, Polyfoamer FP, Polyfoamer FP/LL
Cementitious floors: Mapecrete Stain Protection, Primer SN, Quartz 1.2, Ultratop, Ultratop Stucco, Mapelux Lucida
Bonding and grouting ceramic tiles and mosaics: Adesilex P10, Isolastic, Ultracolor Plus

*These products are distributed on the Qatar market by Mapei Doha.

For further information see mapei.qa and mapei.com