



## Toledo station, a multi-award-winning station of the underground network in Naples

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The multi-award-winning Toledo station on Metro line 1 in the Spanish quarter of Naples, Italy, has been described as one of the most impressive and beautiful in the world. In the 5 years since its opening the station has won many awards and helped Naples win the 2019 World Tunnelling Congress. The excavation of the station's unusually large platform access tunnel in unstable water-bearing soft rock and loose sand required a complex combination of cement-chemical grouting, ground freezing and extensive monitoring.

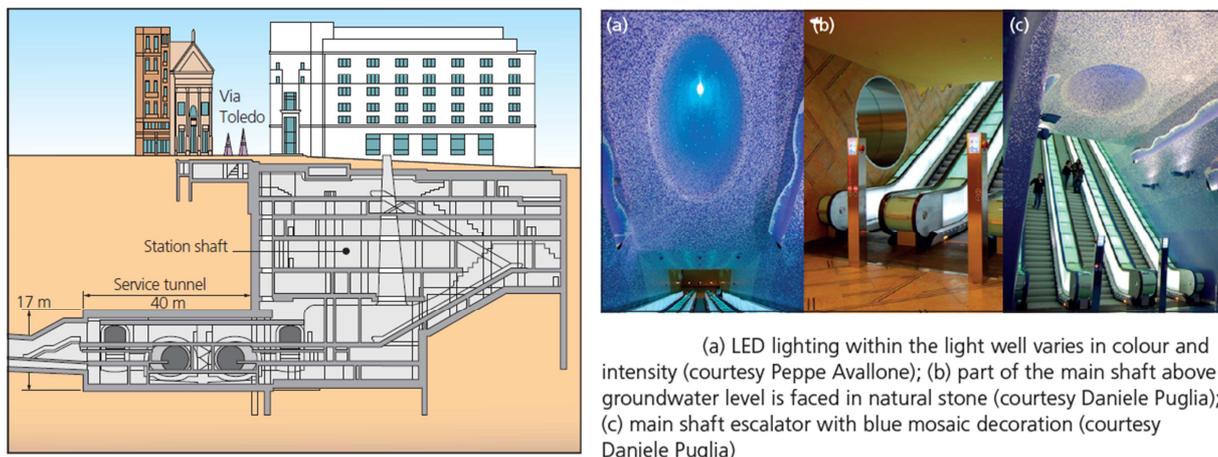


Figure 1: Section of the station with the service tunnel and some details of the beautiful interiors

The main part of the service tunnel was excavated in a soft rock formation (volcanic Yellow Tuff) with a minor part of the ceiling located in a loose volcanic silty sand (Pozzolana). The groundwater table was nearly horizontal and about 27 m above the tunnel invert.

To allow a safe and substantially dry excavation, a small drift tunnel about 10 m above the service tunnel was preliminary excavated in the sandy layer immediately above the groundwater table. This was initially used both to carry out grouting at the sides and invert of the service tunnel to be excavated in the soft rock and to create an end plug by way of jet-

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grouting in the sand. The drift tunnel was also used to install near-vertical freeze pipes needed for the ground freezing at the crown, which was partially located in the silty sand layer above

the soft rock Cement grouting was used to fill the larger cracks, followed by chemical grouting to fill the remaining smaller cracks. The drift tunnel was only 8 m below the foundations of an existing building and for these reasons careful survey was carried out to monitor building settlement.

**In addition to the technical aspects**, the station is characterised by valuable architectural elements with a play of colour and lighting that makes the facility unique. From the surface down to the tunnel platforms, the black of contemporary asphalt gives way to the ochre of Neapolitan Yellow Tuff and blue representing groundwater.

**Inside the station**, murals in stone mosaics and lenticular panels mimic the movement of the seas along the corridors that lead to the platforms. In addition, unearthed parts of the Aragonese city walls have been restored and incorporated in the new structures.

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