

Project Title

Line 9, Barcelona Metro, Barcelona, Spain

Barcelona Metro, Line 9, currently under construction, is a major expansion of this important city's public transport infrastructure. This 41km long US\$2.4B project includes 34km of tunnel, 43 stations and numerous interchanges with existing metro and high-speed rail lines as well as the airport.



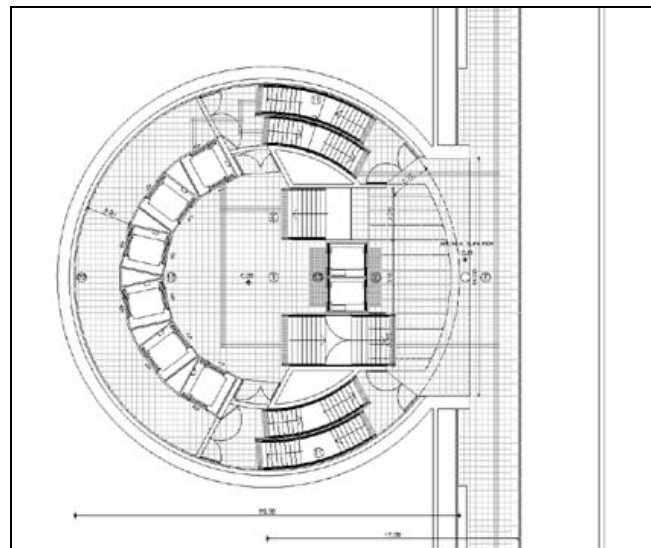
3D Representation of Stacked Track Station Configuration

Section IV of the project, at a cost US\$265M, is being constructed by a JV of Dragados/Nesco/ACS/Comsa y Sorigué and comprises a 4km section of soft ground tunnel, from Gorg Station to Segrera Station, and a second separate 5.5km section, from Zona Franca to Zona Universitaria, to be constructed using the same TBM.

The 10.9m Ø (internal) single bore twin track running tunnels are being constructed using a 12.06m Ø EPBM with 4MW of installed power. The tunnels are lined using a 400mm thick tapered ring made up of six 1.8m wide segments plus key. The tracks within tunnel are in a “stacked” configuration; a soffit/floor slab providing the support and fire separation between tracks. The geology along the Gorg - Segrera section comprises fluvial alluvium and Miocene,

with some granite. Cover varies from 8m as the tunnel passes beneath the Besós River to 45m through the Miocene ground.

In September 2004 there were severe problems with the operation of the EPBM, principally slow advance rates, poor alignment control, evidence of tool loss from the cutter-head and the formation of chimneys to surface with the associated loss in pressure at the face. As a consequence of these difficulties a temporary shaft was formed to investigate the condition of the cutter-head and facilitate repair as necessary. The investigation established that the cutter-head exhibited considerable damage (wear) from tracks 3.0m to 4.5m and would require extensive refurbishment.



Station configuration showing access shaft and in tunnel platforms

ICC was retained to undertake a detailed assessment of the damage and to identify, with appropriate justification, the probable cause of the damage and the likely timescale over which the damage occurred.