



INTERNATIONAL CONFERENCE MEG 2014

27-28 November 2014. Rome. Italy

ALGIERS SUBWAY LINE 1 - EXTENSION A PLACE EMIR ABDELKADER - PLACE DES MARTYRS

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CENOR OFFICES





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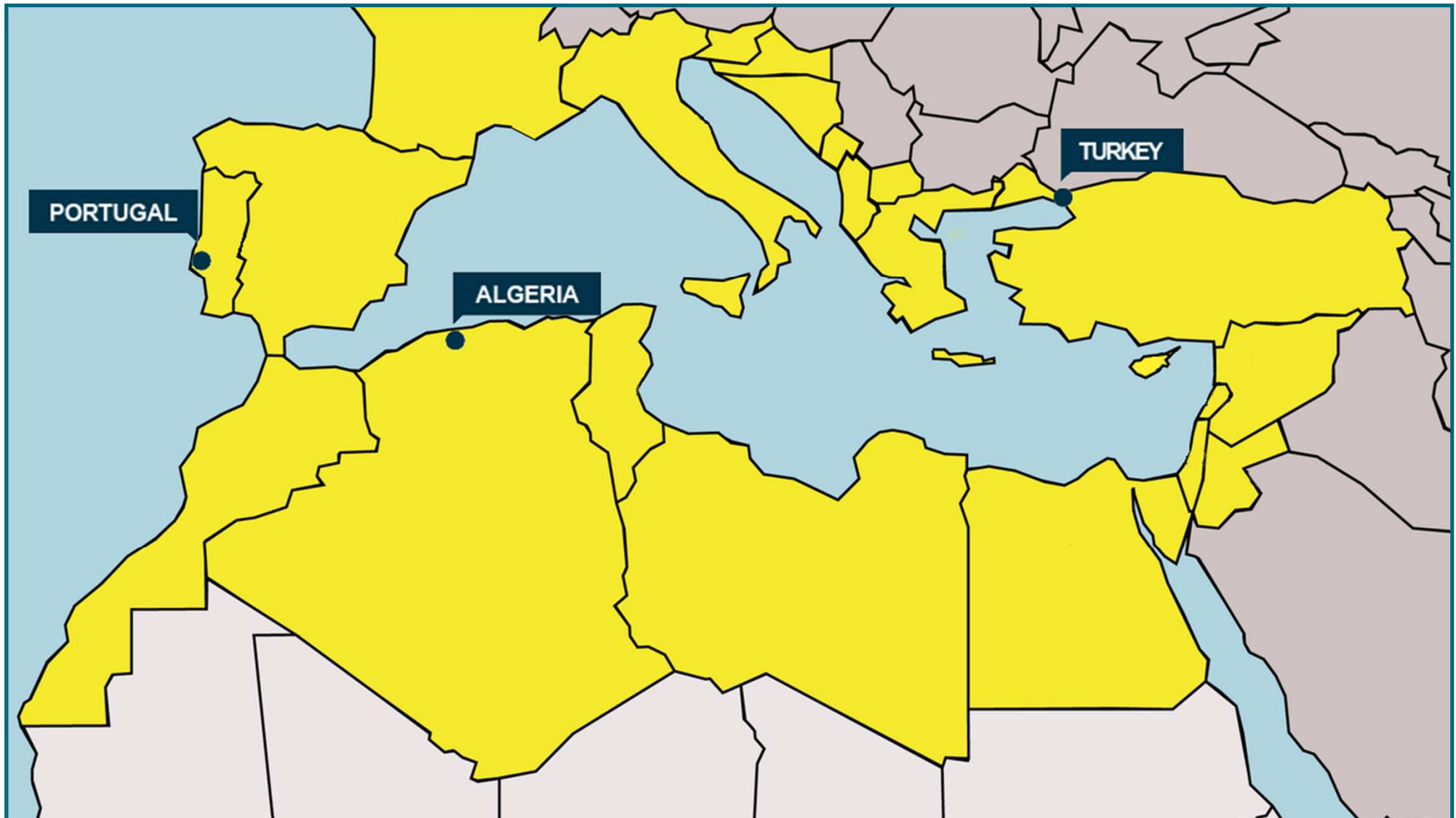




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INTRODUCTION

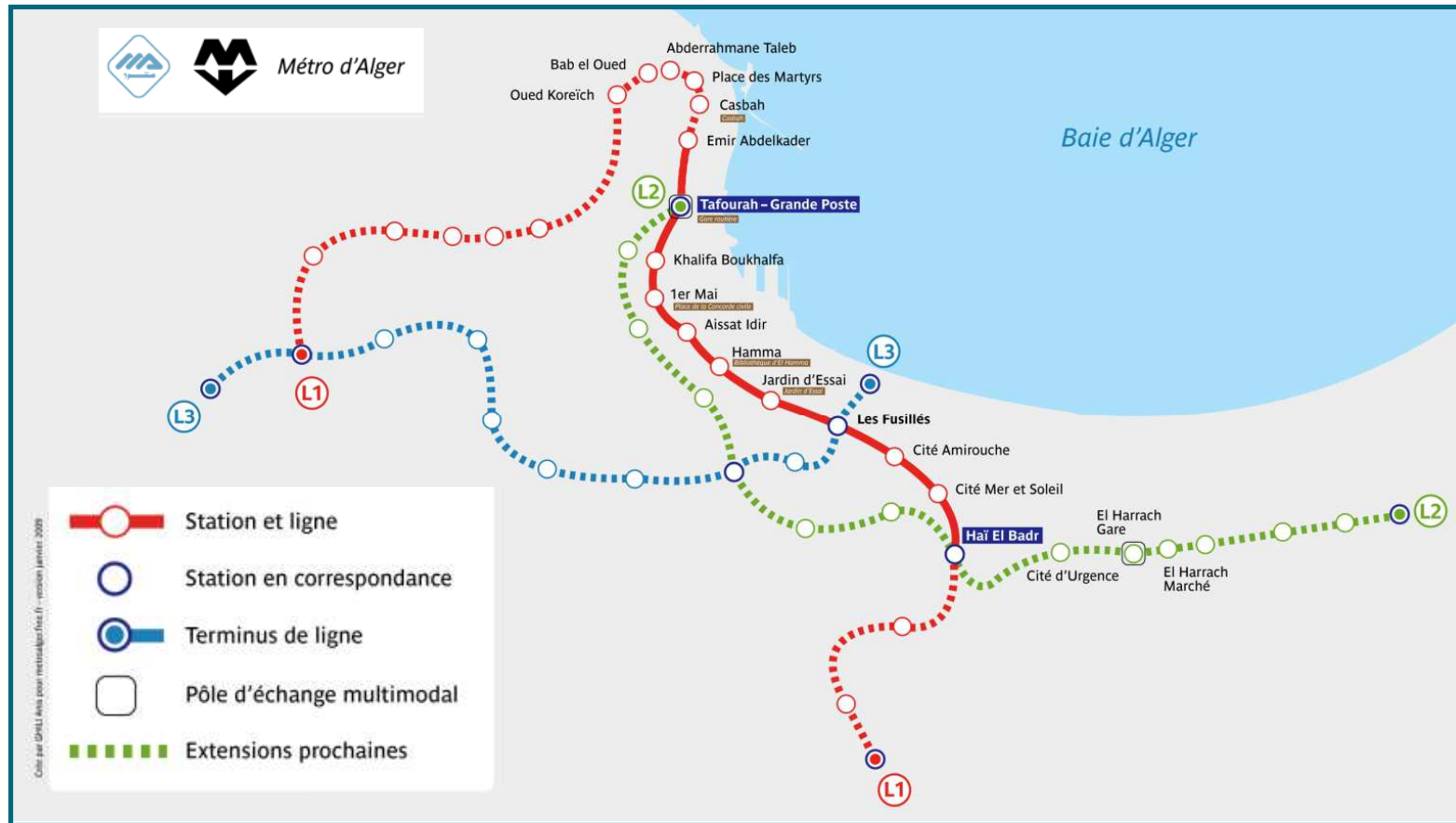


INTRODUCTION

- With a population currently estimated over three million, the city of Algiers is undergoing great development, resulting in strong infrastructural investments; to be a competitive and attractive city is fundamental to have good infrastructures
- One of the most emblematic works is the subway system, an almost unique achievement in this region, being the first city in the Maghreb and the second in the African continent, after Cairo, to receive such an infrastructure
- Currently, and after a long wait, part of this immense undertaking is already in use, corresponding to a stretch of 8.5 km long that connects Haï el Badr Station in the eastern part of the city, to Tafourah Station, located next to the Grande Poste office in Algiers
- An important number of additional stretches is currently either in construction or in design phase



INTRODUCTION



LINE 1 - EXTENSION A

Owner: **ENTERPRISE METRO D'ALGER (EMA)**

Contractor: **GROUPEMENT METRO D'ALGER CENTRE (GMAC)**

ANDRADE GUTIERREZ + TEIXEIRA DUARTE + GESI-TP + ZAGOPE

Preliminary studies: **ENSITRANS**

Final design: **CENOR**

Supervision: **DESSAU**



GENERAL CHARACTERISTICS OF THE PROJECT



GENERAL CHARACTERISTICS OF THE PROJECT

- Lot 1 of the Extension A of the Line 1 of Algiers Subway, located in the heart and historical center of Algiers, is currently under construction
- The works are almost fully developed underground, comprising the execution of a tunnel with a length of around 1450 m, two underground stations and their respective accesses to the surface and three ventilation shafts



GENERAL CHARACTERISTICS OF THE PROJECT



- Total extension of 1750 m (fully excavated underground)
- 2 Stations and its respective accesses (Place des Martyrs and Ali Boumendjel)
- 3 Ventilation shafts (PV1, PV2 and PV3)



GEOLOGICAL AND GEOTECHNICAL CONDITIONS

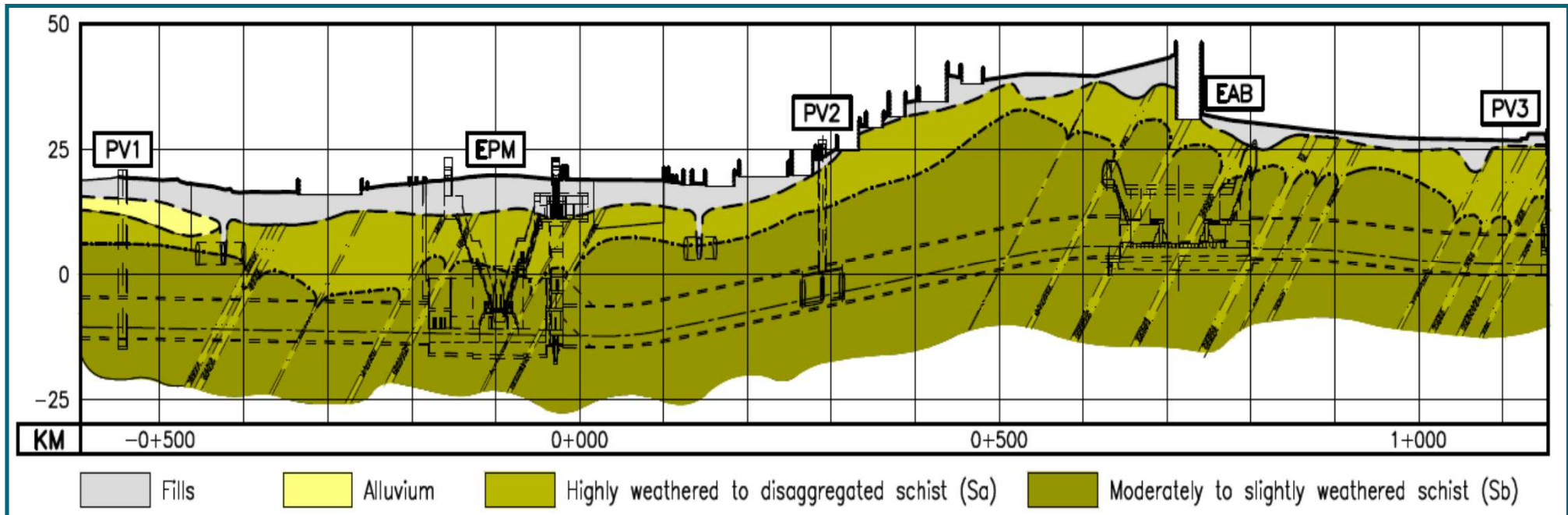


GEOLOGICAL AND GEOTECHNICAL CONDITIONS

- The tunnel is situated in a zone of soft and relatively plane morphology and it spreads out along the Mediterranean coastline
- The soil is essentially constituted by sericitic schist. In the Place des Martyrs area, an alluvial layer and landfills were identified with a significant thickness, generally about 7 m



GEOLOGICAL AND GEOTECHNICAL CONDITIONS



- Most of the underground works were interested with rock class moderately to slightly weathered schist
- Stations: low overburden depths, interesting highly weathered to disaggregated schist
- Groundwater level located on the base of the fill layers; in-depth water percolation on the most fractured zones of the rock mass



PLACE DES MARTYRS STATION



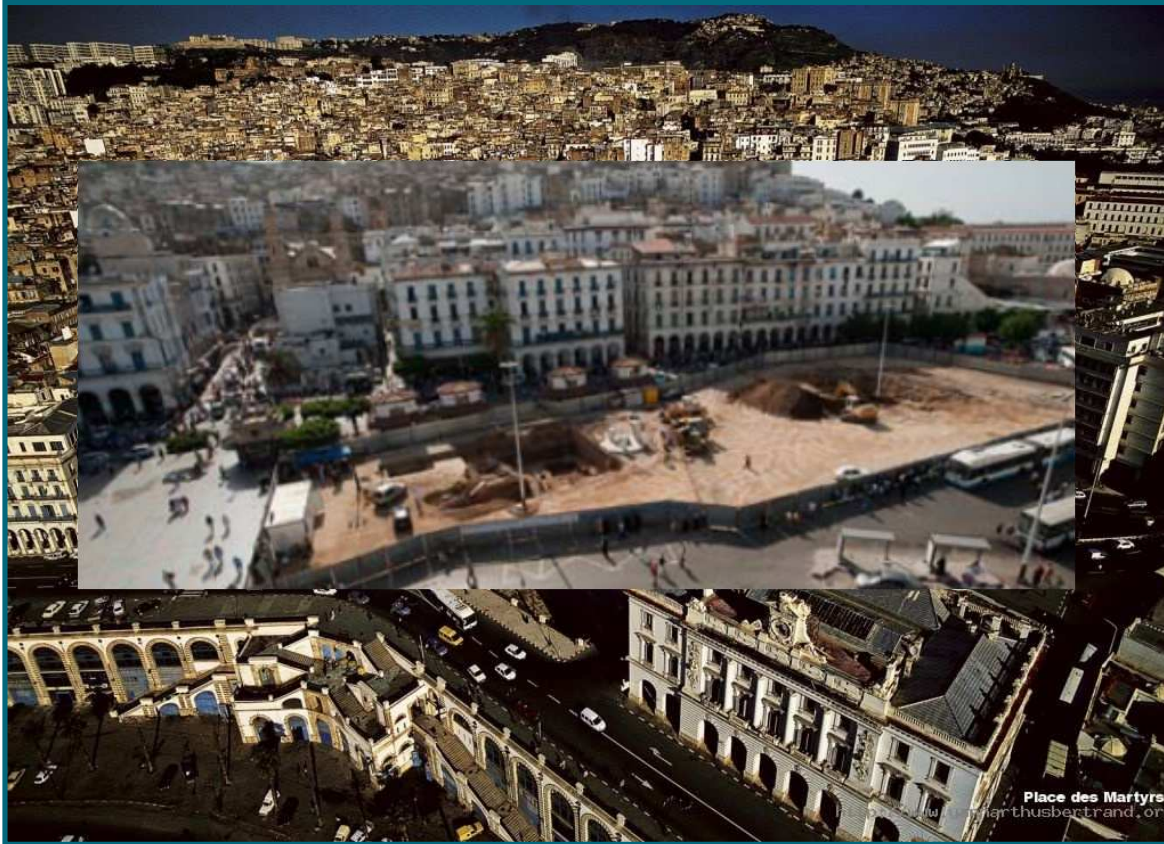
MAIN CONSTRAINTS

- City with an extremely rich patrimonial and historical value (Word Heritage, UNESCO, 1991)
- Dense surface occupation
- Buildings in advanced state of decay, due to their old age and to the lack of conservation measures, but also to the frequent earthquakes that afflict the region





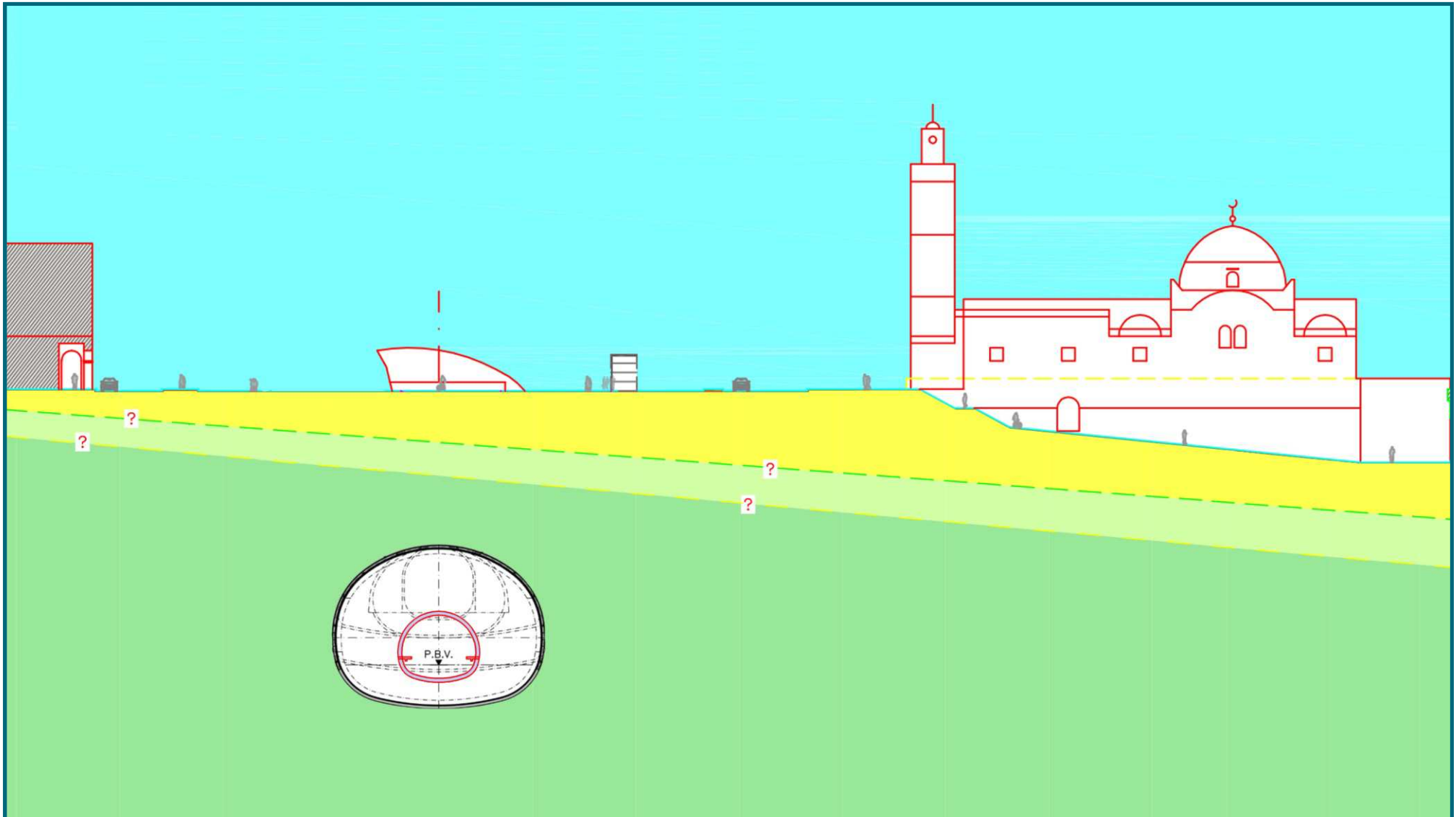
MAIN CONSTRAINTS



Highly important archaeological findings located in the whole square area rendered the initial excavation method impracticable and led to the development of an alternative method consisting of an underground excavation



MAIN CONSTRAINTS



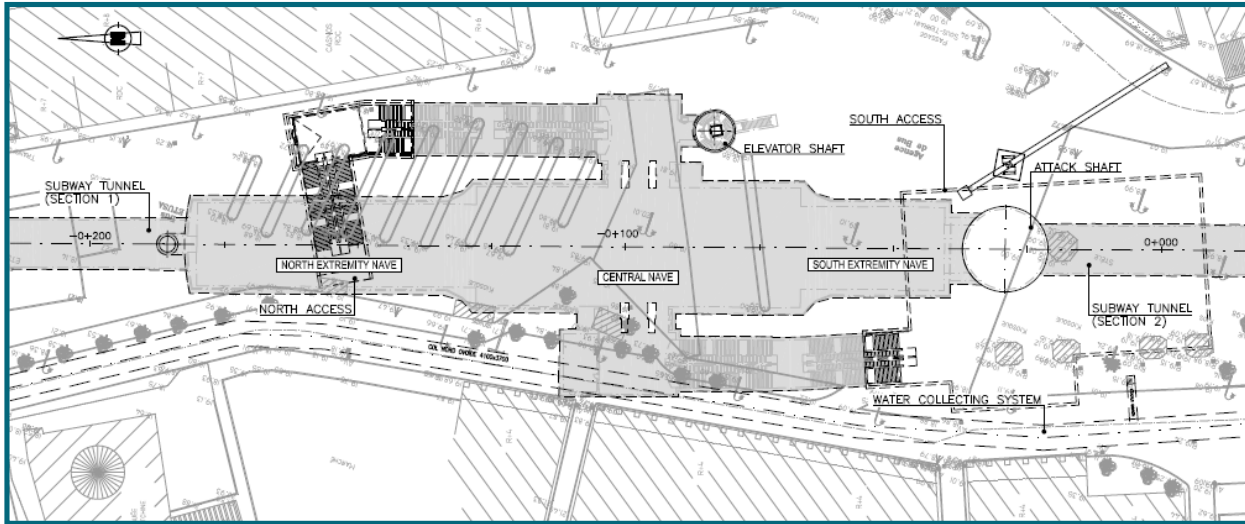


DESCRIPTION OF THE STATION

- The Place des Martyrs Station is located at a square with the same name, in the central area of the city, at the base of the Kasbah and near Algiers' harbour
- It concerns a gallery with unusual large dimensions, with a maximum span of 26 m and a height of 19 m, corresponding to an excavation cross section of 397 m² and a length of 144 m
- In order to fulfil the expectation that this station will become emblematic of all subway project, not only for its location but also because it will receive a museum that will integrate all the important archaeological findings discovered at the site



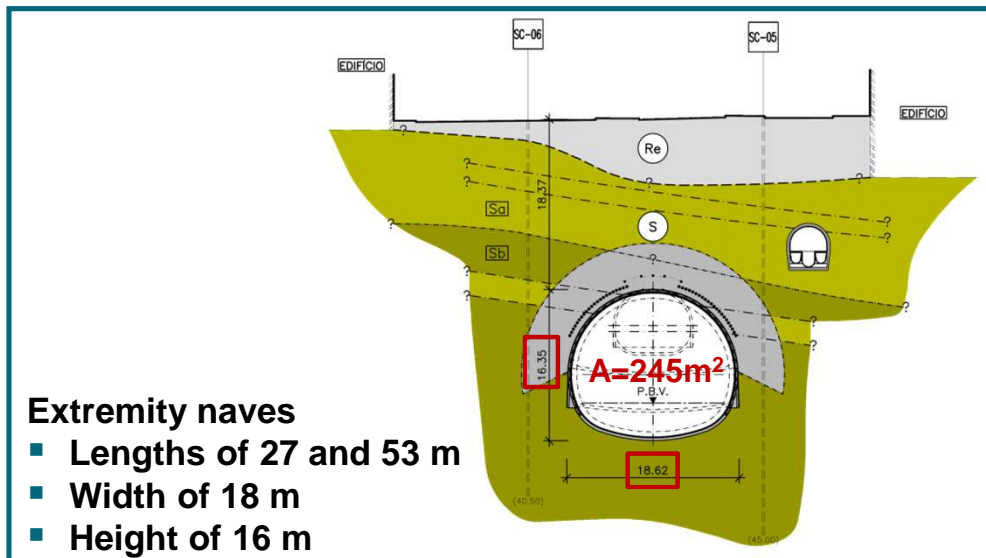
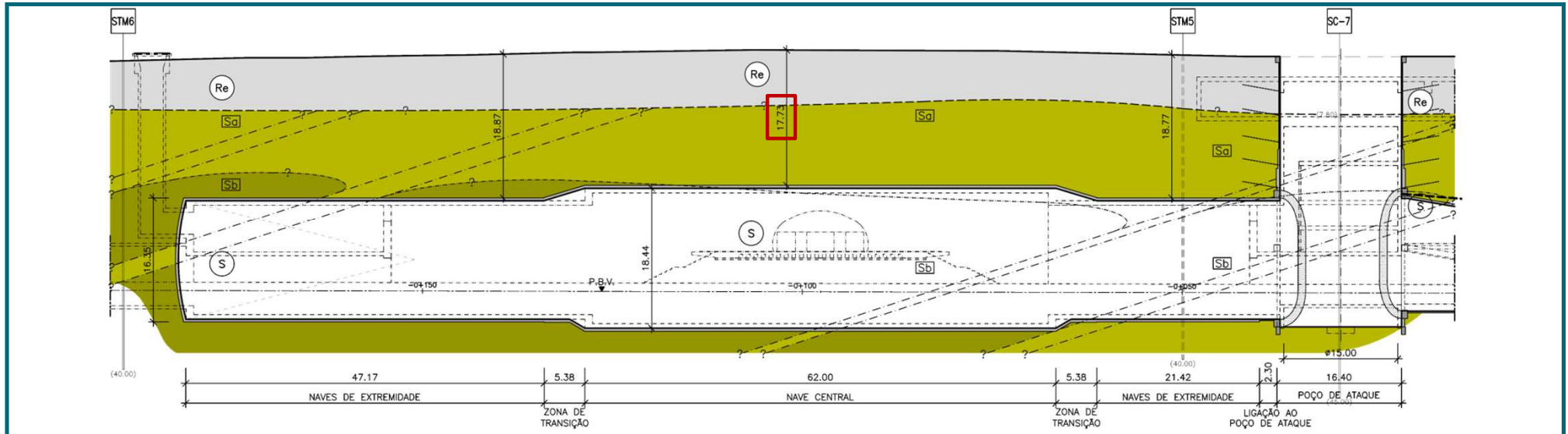
DESCRIPTION OF THE STATION



- 3 main bodies with a total extension of 144 m
- $\phi=15$ m shaft for the station's attack and equipment facility
- 2 galleries for the surface accesses

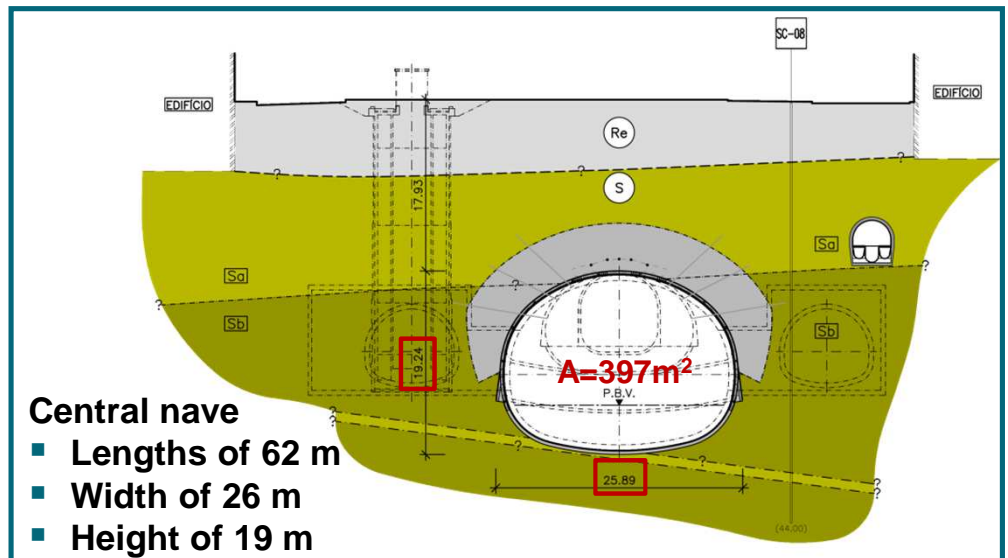


DESCRIPTION OF THE STATION



Extremity naves

- Lengths of 27 and 53 m
- Width of 18 m
- Height of 16 m

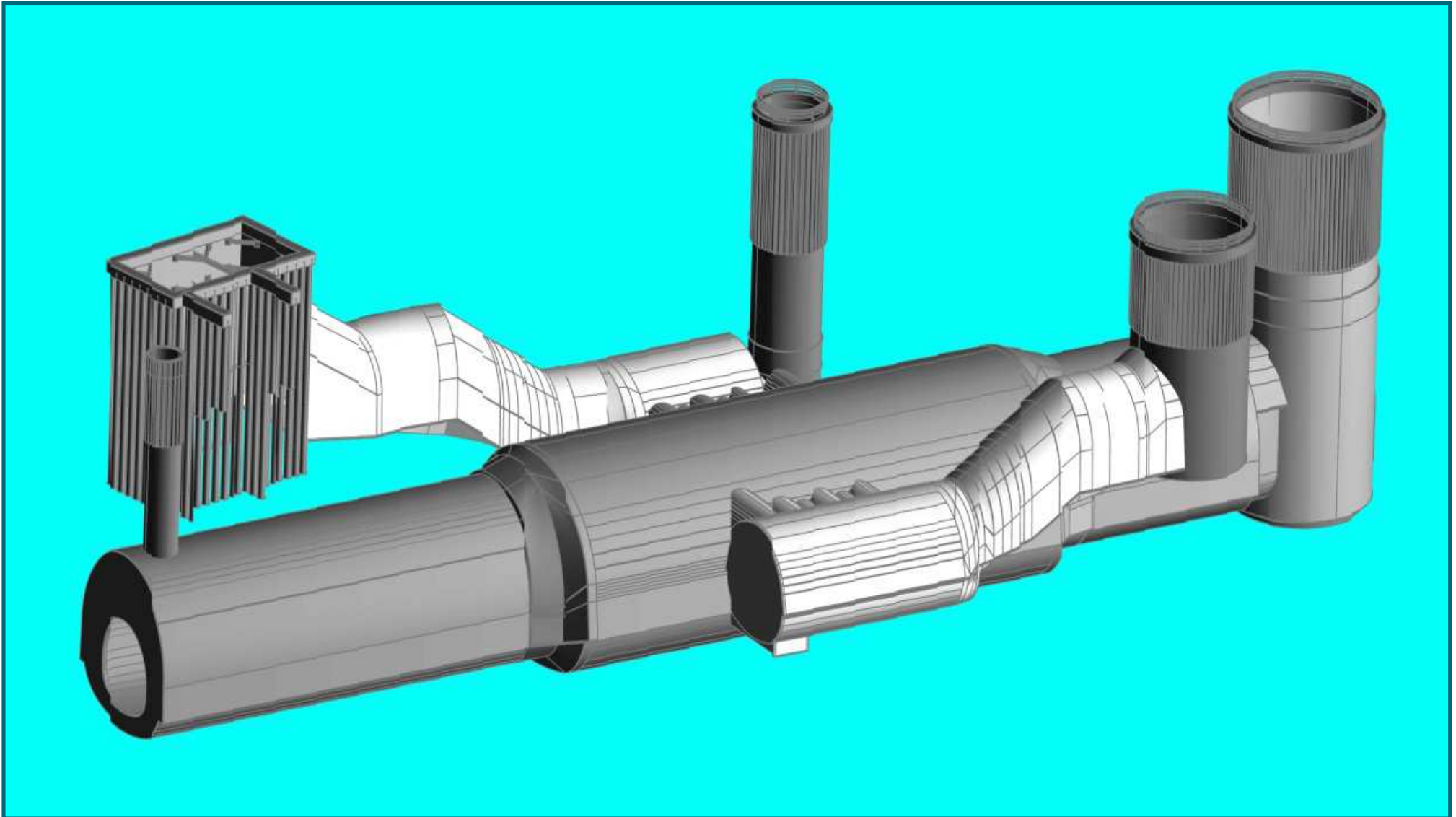


Central nave

- Lengths of 62 m
- Width of 26 m
- Height of 19 m



DESCRIPTION OF THE STATION



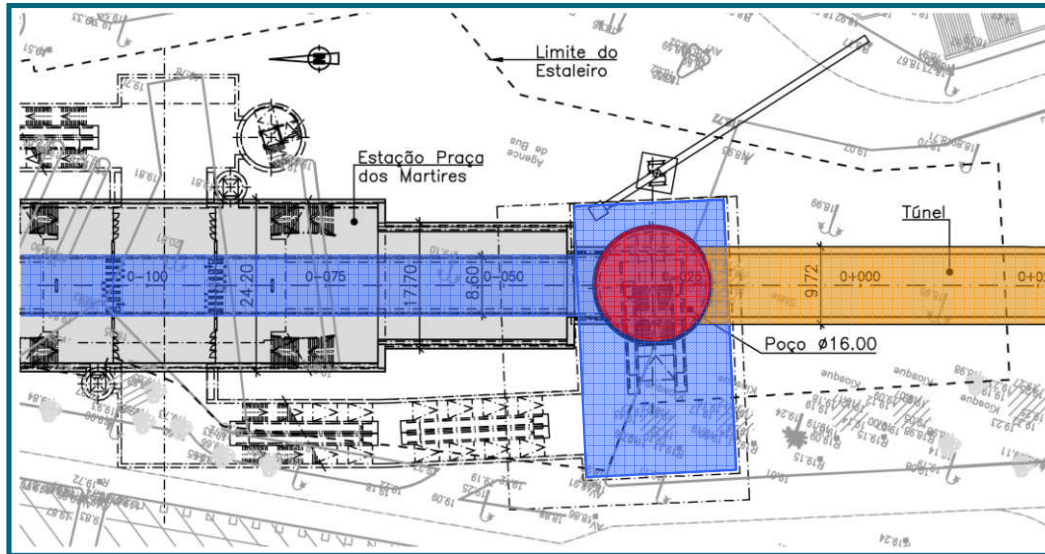


CENTRAL NAVE

- Prior to the beginning of the enlargement of this gallery, a treatment of the rock mass located around the upper part of the section was performed, mainly concerning the rock massif overburden constituted of weathered and fractured schist
- This treatment consisted of radial cement grouting aiming to create a 5 m aureole of treated rock mass beyond the final excavation contour
- In the case of the central nave, considering its dimensions, the excavation was conceived with a excavation sequence contemplating a central gallery, two lateral enlargements for the materialisation of the upper half section and two levels of benches



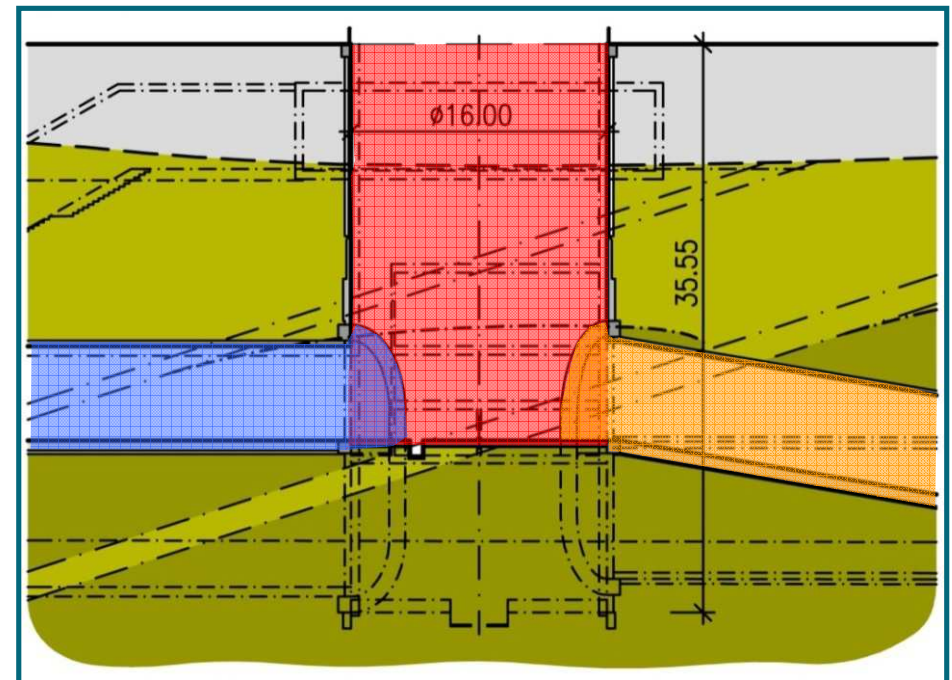
CENTRAL NAVE



A small rectangular area in which a hotel dating from the French colonial period had once stood, whose basements had eliminated all archaeological remains, permitted the creation of an attack front through the execution of a shaft

Attack Shaft

- Typical sequential excavation method
- Inside diameter of 15 m
- Depth of 35 m



Station's attack

- Exploratory gallery in the station's section at the level of its vault

Tunnel

- Downward attack tunnel which will have its section lowered afterwards in order to be included in the final section of the subway tunnel



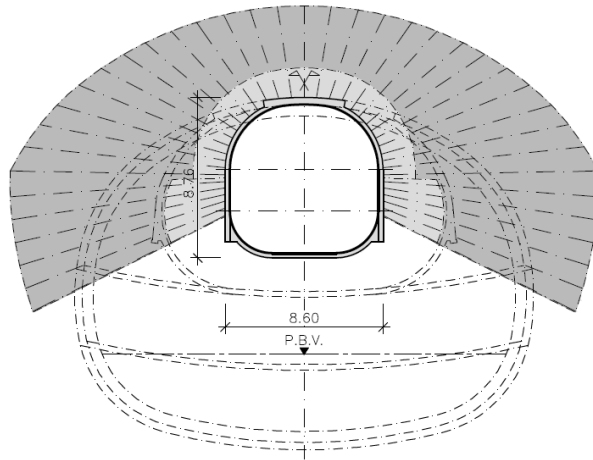
CENTRAL NAVE

ATTACK SHAFT

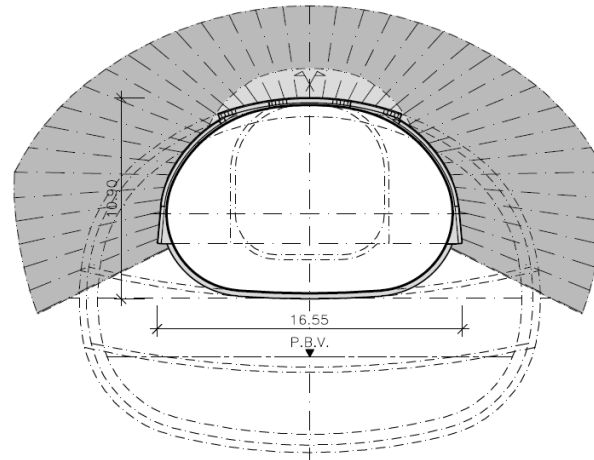




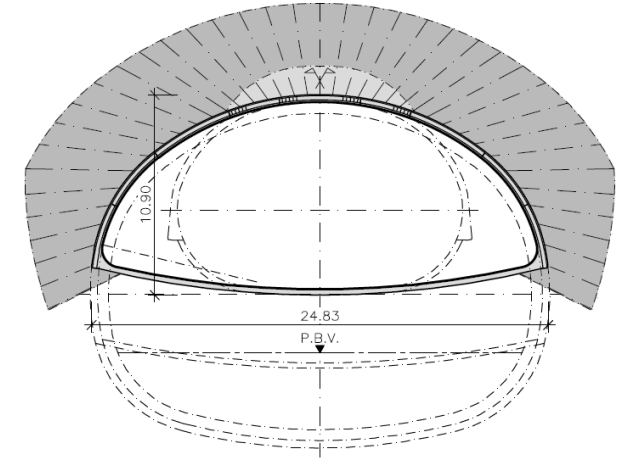
CENTRAL NAVE



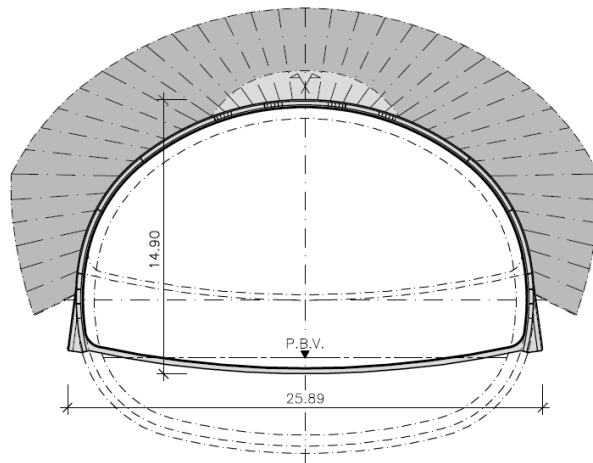
Exploratory gallery



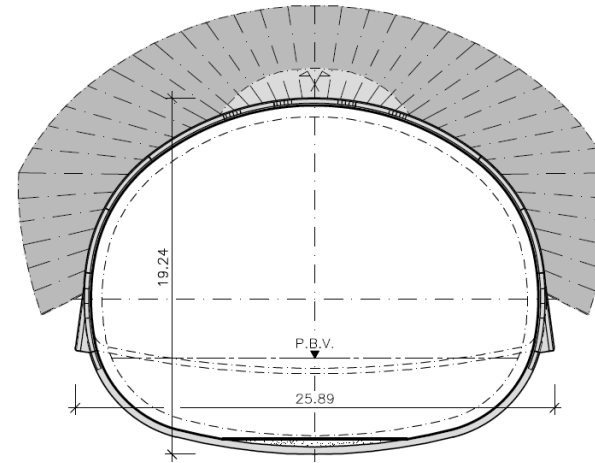
First enlargement



Second enlargement



First bench



Second bench



CONSTRUCTION SEQUENCE

EXCAVATION-PHASE I





CONSTRUCTION SEQUENCE

EXCAVATION-PHASE II





CONSTRUCTION SEQUENCE

EXCAVATION-PHASE III





CONSTRUCTION SEQUENCE

EXCAVATION-PHASE IV





CONSTRUCTION SEQUENCE

EXCAVATION-PHASE V





CONSTRUCTION SEQUENCE

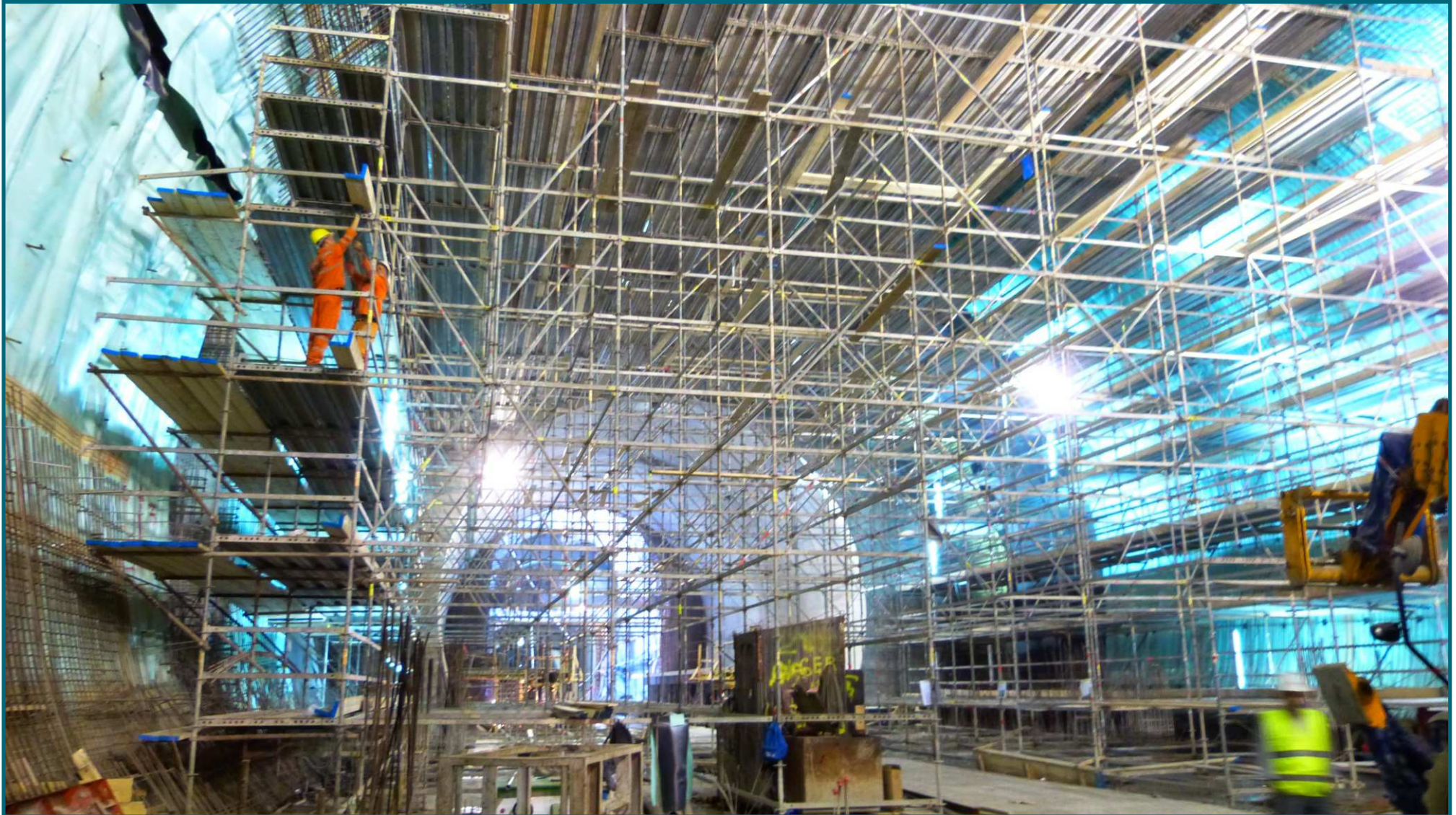
STEEL WORK





CONSTRUCTION SEQUENCE

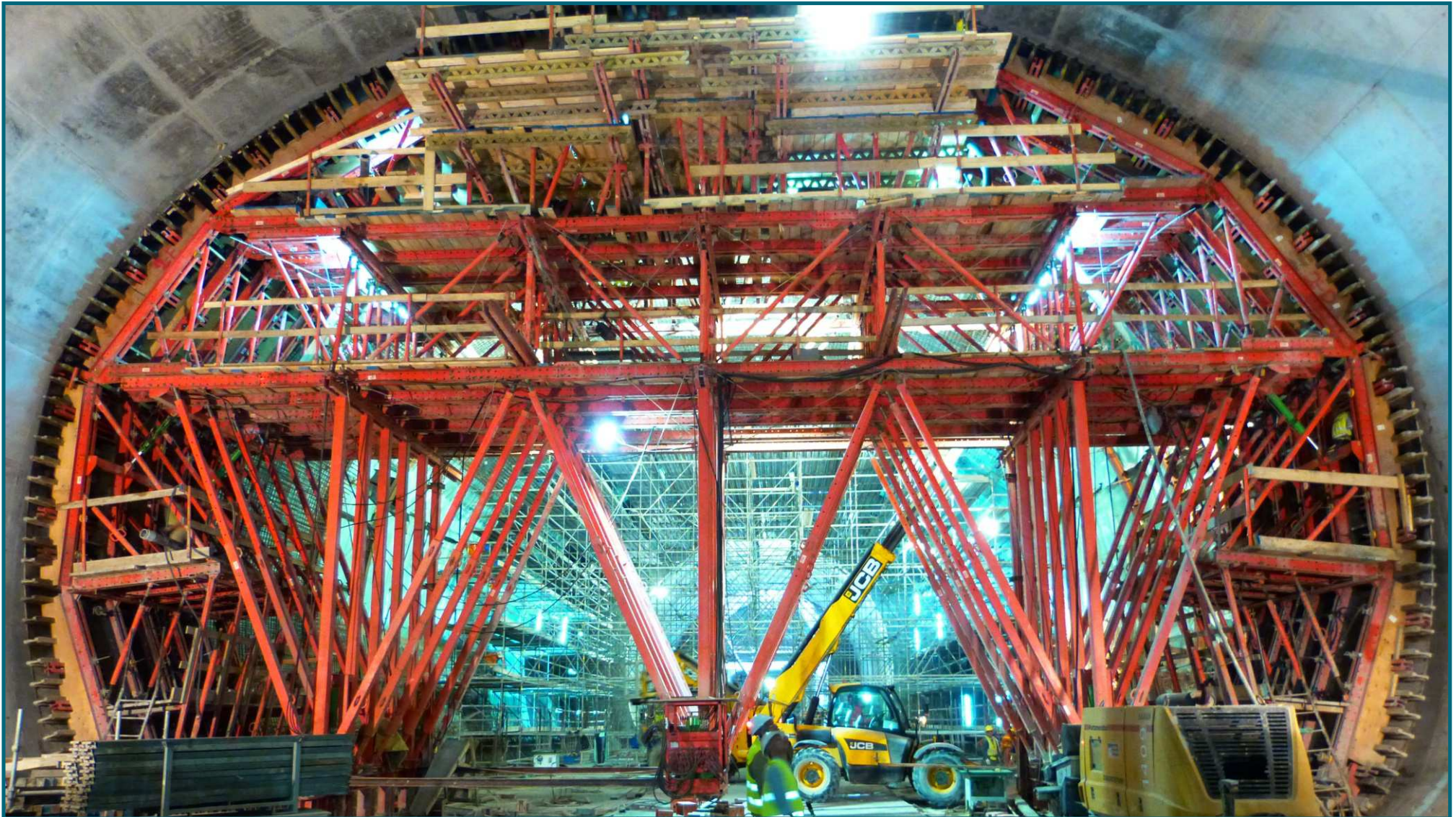
IMPERMEABILISATION





CONSTRUCTION SEQUENCE

CONCRETE





FINAL REMARKS



FINAL REMARKS

- Development of underground metro solutions in cities is unavoidable with the progressive influx of people that is expected in the future
- Execution of an underground station of unusual large dimensions, like Place des Martyrs Station, in a delicate urban environment, executed in difficult geological-geotechnical conditions and with a low overburden in weak materials is a challenging work of engineering that originate some uncommon solutions
- These solutions were made possible by a close interaction with the owner and the contractor, which also enabled their adaptation to the real conditions and constraints at the site