

Metro Systems



coba
GROUP

ENGINEERING AND ENVIRONMENTAL CONSULTANTS

PRESENTATION

COBA is a multinational and multidisciplinary group of Engineering and Environmental Consultants, founded in 1962.

The Group provides engineering consultancy services ranging from basic and planning studies, technical, environmental and economic feasibility studies, design and construction design as well as project management and works supervision, to operation follow-up and behaviour monitoring.

The Group has offices/subsidiaries in three continents and experience in more than fifty countries and encompasses several companies in accordance with functional specializations or geographical areas.

The competences acquired along the last six decades, together with the state-of-the-art employee expertise, the stability of its permanent staff and the comprehensive international experience allow to find out the best solutions for the full satisfaction of public and private Clients' needs and expectations.

During its existence, the Group has participated together with public authorities or private developers, in the feasibility of multidimensional projects, some of them being structuring projects and with major impacts on the improvement of peoples' life conditions in the several countries where it worked.

At present, the Group has a wide number of competences and technical areas that allow the composition of multidisciplinary teams who share knowledge and experiences in the execution of projects.

METRO SYSTEMS / MASS TRANSIT SYSTEMS

COBA's capacity in the Metro Systems has been developed since the late 80's with the purpose to participate in the development program implemented by the Portuguese Authorities to improve, rehabilitate and upgrade the Portuguese public transportation systems.

This sector has had continuous activity since then, at first in Portugal and subsequently expanding to foreign countries, namely Spain, Algeria, Ireland and Brazil.

Over these 30 years of continuous activity, in some cases in association with the largest international companies in the railway sector, COBA participated in the most important metro infrastructures in Portugal, including, the Lisbon Metro, the Oporto Light Rail System and the Coimbra Bus Rapid Transit System. COBA's experience also covers BRT's (Bus Rapid Transit) in Brazil and the Dublin Metro Northern Line.

Nowadays, COBA provides engineering and design for different parts and components of track and permanent infrastructures, including railways, high-speed railways, light metros, subways, freight and passenger stations, maintenance

FIELDS OF ACTIVITY

HYDRAULIC UNDERTAKINGS

Concrete, Earth-fill and Rock-fill Dams. Weirs and Reservoirs Water Conveyance Systems. Hydraulic Structures.

POWER GENERATION AND TRANSMISSION

Hydroelectric Power Plants. Photovoltaic power plants and wind farms. Small Hydropower Plants. Power Plants Rehabilitation and Modernization. Substations High Voltage Transmission Lines. Cooling Water Systems for Thermoelectric Plants.

WATER SUPPLY AND WASTEWATER SYSTEMS

Catchment, Transport and Distribution of Potable Water. Water Treatment Plants. Drainage Systems. Wastewater Treatment Stations. Pumping Stations.

AGRICULTURES AND RURAL DEVELOPMENT

Irrigation and Drainage Systems. Rural Roads. Production Systems. Mapping and Basic Information.

TRANSPORTATION INFRASTRUCTURES

Roads and highways. Railways. Passenger and Freight Railway Stations. Metro and Light Rail. Airports. Bridges and other engineering structures.

ENVIRONMENT

Environmental Impact Assessment. Environmental Management, Monitoring and Auditing. Pollution Control. Landscaping. Land Management. Recovery of Degraded Areas. Waste Landfills.

GEOTECHNICAL STRUCTURES

Tunnels and Caverns. Slopes in Fill and Cut Section. Special Foundations Breakwaters. Embankment Works.

MARITIME AND FLUVIAL WORKS

Wharfs. River Training. Quay Rehabilitation. Flood and Flow Control.

MINING INDUSTRY

Environmental Studies. Design of Tailings Dams and Related Structures. Safety Assessment of Tailings Dams. Design Review of Tailings Dam Closure. Operations Maintenance and Monitoring Manual for Tailings Dams. Risk Analysis. Mine Closure Plan. Training.

BUILDINGS

Residential and Services Buildings. Industrial Buildings. Steel and Mixed Industrial Structures. Rehabilitation and Restoration of Ancient Buildings.

CARTOGRAPHY AND CADASTRE

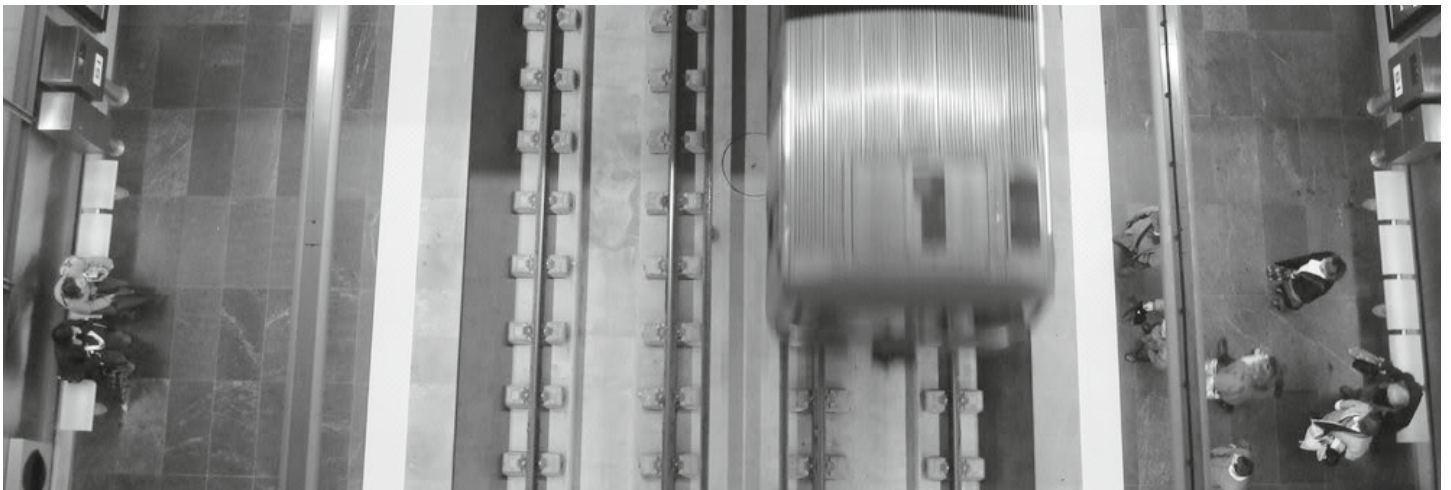
Geographic Information Systems (GIS). Digital Cartography. Thematic Cartography. Thematic Cadastres. Land Acquisition.

SAFETY CONTROL AND REHABILITATION

Expertise, Monitoring. Inspection and Reinforcement of Dams and Transportation Infrastructures. Works Instrumentation. Project Maintenance and Operation.

PROJECT MANAGEMENT AND CONSTRUCTION SUPERVISION

Project Management. Cost Management. Site Supervision. Quality Assurance/Quality Control.



LISBON METRO. EXTENSION OF THE YELLOW AND GREEN LINES | PORTUGAL

LOT 2 - SANTOS / CAIS DO SODRÉ

Client: Metro Santos Sodr , ACE (Mota-Engil Engenharia e Constru  o + SpieBagtignolles International, Portugal Branch Office)

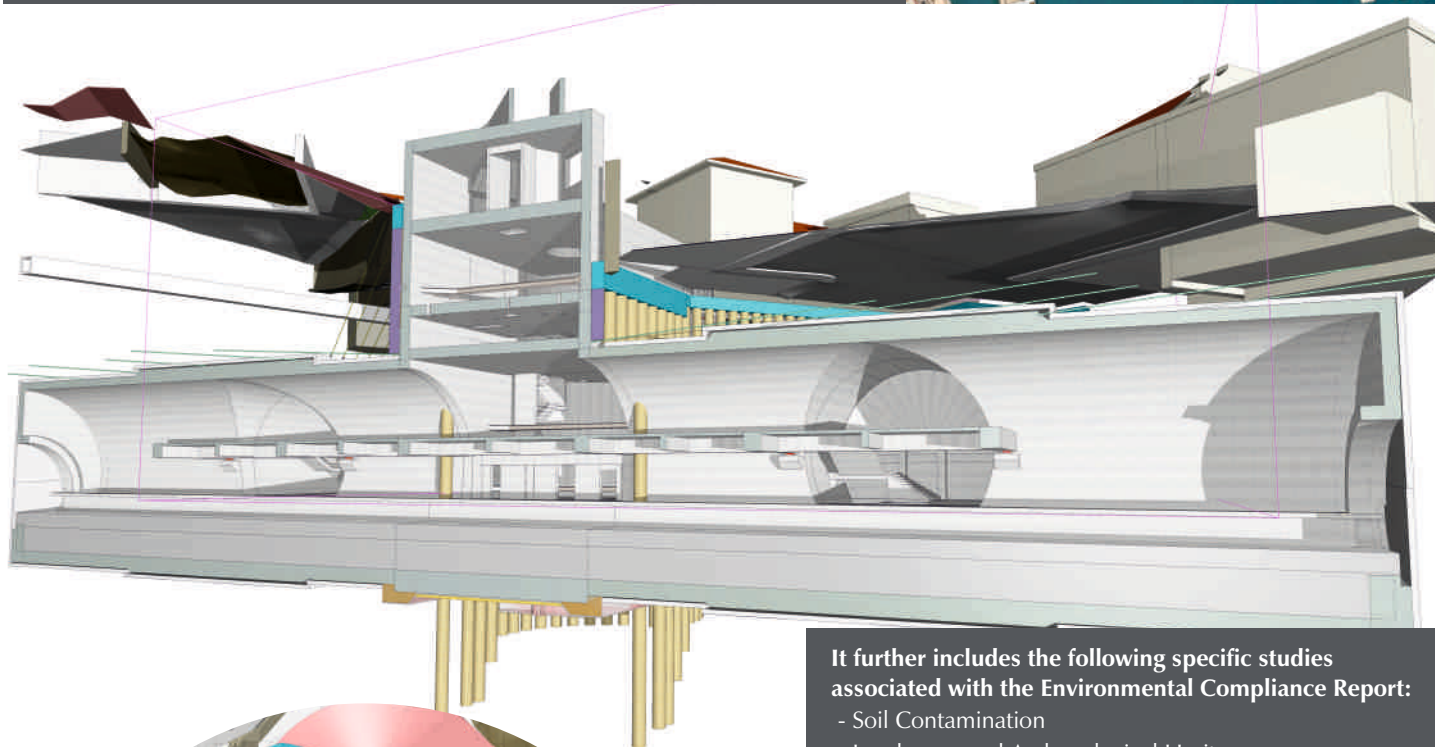
Owner: Metropolitano de Lisboa, EPE

Preliminary Design, Detailed Design, Environmental Compliance Report, Technical Assistance: 2021/2023

The project consists in the preparation of the Preliminary Design, Detailed Design, Environmental Compliance Report and Technical Assistance for the Design & Build Contract of Lot 2 - Extension of the Yellow and Green Lines - Rato / Cais do Sodr  - Execution of the Carcase Work between the Santos Station and the Cais do Sodr  Terminal, PK 1 + 319.729 to PK 1 + 984.273.

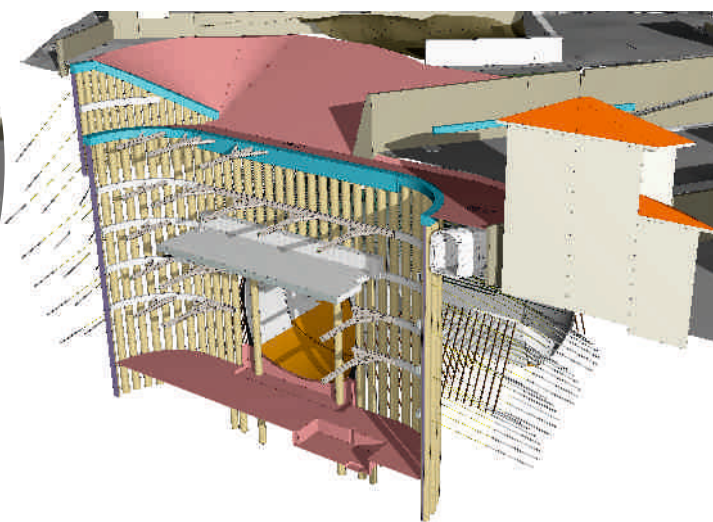
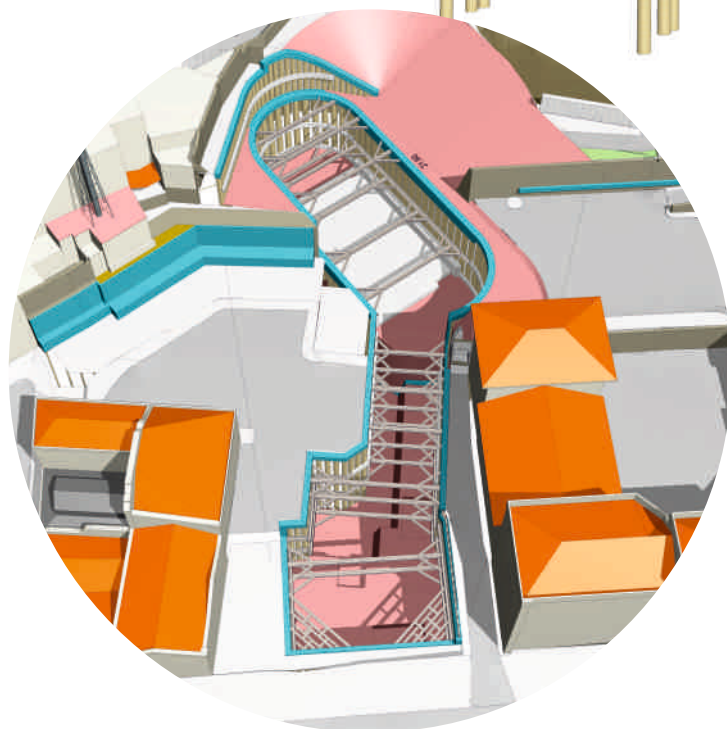
The project encompasses the following works:

- Santos Station (new)
- Tunnel between the Santos Station and the Cais do Sodr  Terminal
- Ventilation Shaft PV218
- New West Atrium of the Cais do Sodr  Station (existing)
- Special Integration Works in the Cais do Sodr  Terminal (existing)
- Special Underpinning Works of the Buildings located on Av. Dom Carlos I, 42-44
- Utilities, Traffic Detours, Diversions of the Cascais - Lisbon Railway Lines (operated by Infraestruturas de Portugal) and Diversions of the Tramway Lines (operated by CARRIS)



It further includes the following specific studies associated with the Environmental Compliance Report:

- Soil Contamination
- Landscape and Archaeological Heritage
- Noise and Vibration
- Hydrogeological Studies
- Traffic Microsimulation Studies

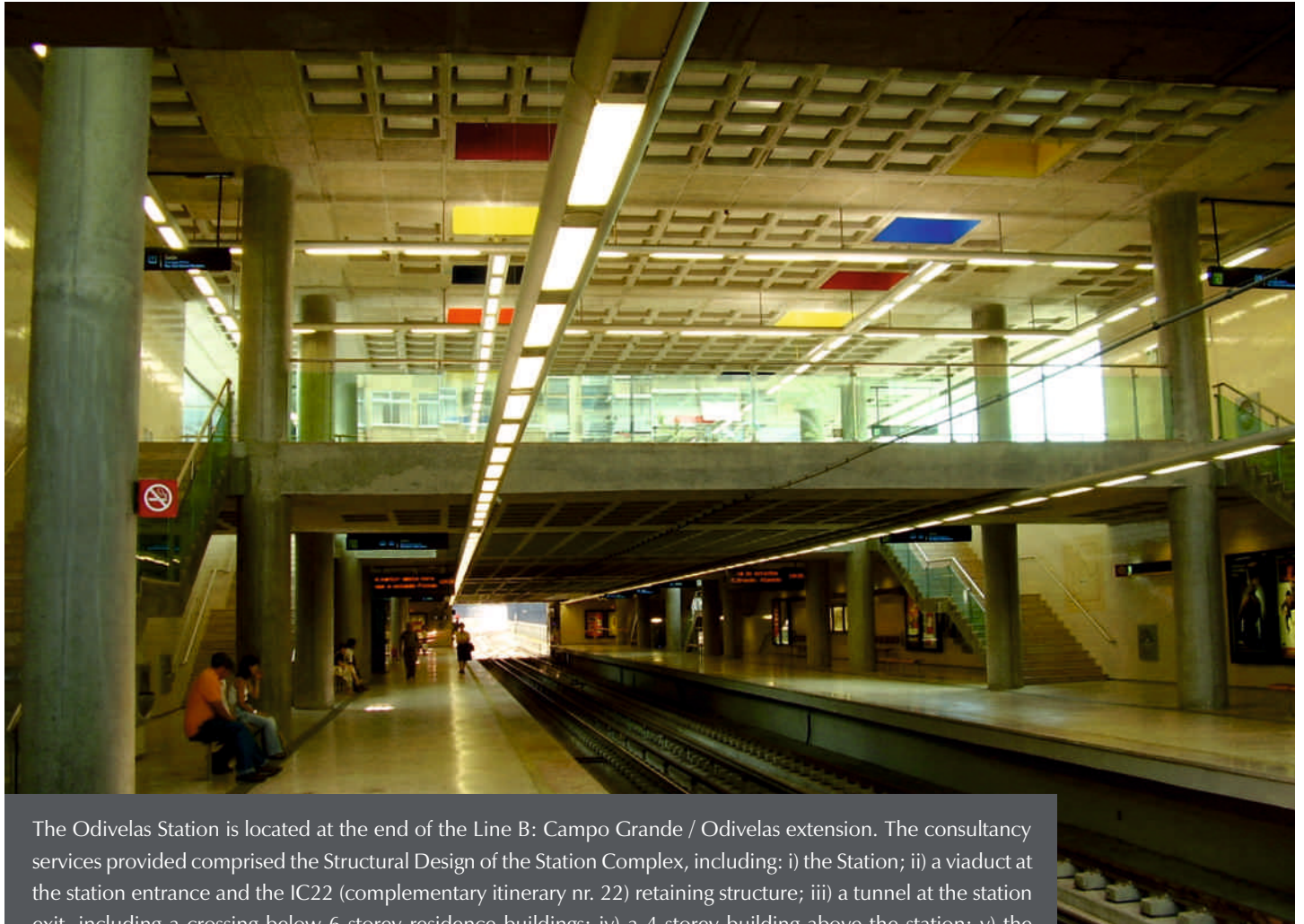


LISBON METRO. ODIVELAS STATION | PORTUGAL

Client/Owner: FERCONSULT / Metropolitano de Lisboa, S.A.

Final Design: 2000 / 2001

Technical Assistance: 2001 / 2003



The Odivelas Station is located at the end of the Line B: Campo Grande / Odivelas extension. The consultancy services provided comprised the Structural Design of the Station Complex, including: i) the Station; ii) a viaduct at the station entrance and the IC22 (complementary itinerary nr. 22) retaining structure; iii) a tunnel at the station exit, including a crossing below 6-storey residence buildings; iv) a 4-storey building above the station; v) the deviation of infrastructures, in particular a large diameter sewer located between the station and IC22.

The designed structures comprise, besides current construction types and materials, soil treatment by jet grouting and a construction method specifically designed for construction below buildings that includes load transfer.





LISBON METRO | PORTUGAL

COBA's intervention, within the strengthening of the interfered buildings, was included in the general set of design activities associated to the works. There was a close interface with the tunnel design and construction, which defined the constraints and parameters for the reinforcement designs. We are therefore before a situation where, besides the construction movement occurred at the surface, a physical interference was verified.

The building was strengthened with a new transfer structure at basement level designed to displace its weight to new piling laid outside the tunnel.

“The building was strengthened with a new transfer structure ”

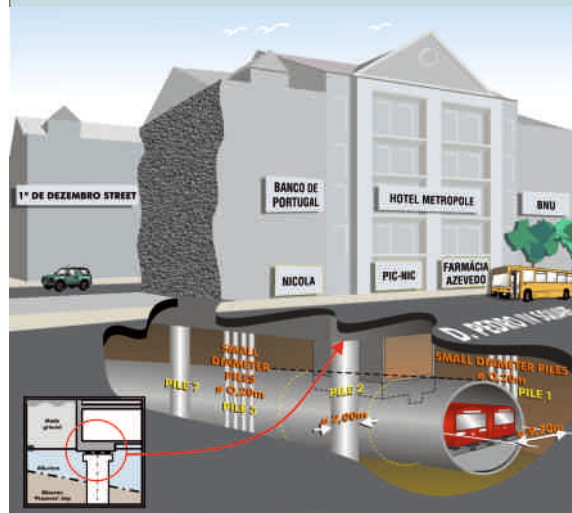


NICOLA/PIC-NIC/BNU BUILDING | PORTUGAL

Client/Owner: BPC-CBPO-AGROMAN-SOMAGUE-PROFABRIL-ACER, ACE / Metropolitano de Lisboa, S.A.

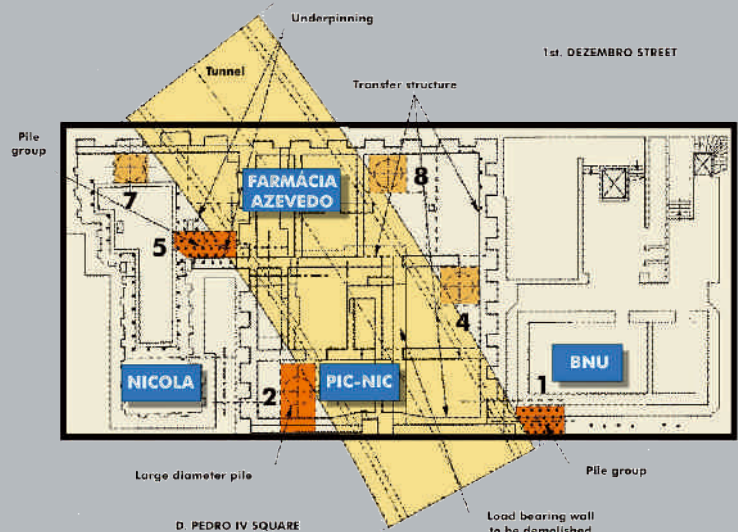
Final Design and Technical Assistance: 1994 / 1996

Within the scope of the construction of Lines "C" Rossio - Cais do Sodré and "A" Restauradores - Terreiro do Paço, included in the Lisbon Metro Expansion Plan in the historical city centre, tunnels were constructed with recourse to a "TMB", interfering with buildings located above the metro alignment, with special reference made to the Nicola / Pic-Nic / BNU building. This building is located at D. Pedro V Square, and its original construction date remotes to 1837 - 1845, therefore being part of the national heritage stand.



The principal activities developed by cobra comprised the following:

- general demolition and excavation;
- pile construction;
- construction of the reinforcement structure, including demolition of wall fends, so as to allow for beam and slab construction;
- demolition of existing walls between the basement and the ground-floor;
- load transfer to new foundations by means of hydraulic systems incorporating flat jacks, including instrumentation;
- removal of the physical interference at basement level, comprising the foundation slab, walls and central nucleus;
- monitoring during the tbm passing, followed by final adjustment by reactivating of the hydraulic system.



OPORTO LIGHT RAILWAY SYSTEM | PORTUGAL

Client/Owner: Metro do Porto, S.A.

Tender Design: 1996

Studies carried out in Association

The Oporto Light Railway System comprises 4 railway lines (Stº Ovídeo/Hospital de S. João; Campanhã/Srª da Hora/Matosinhos; Campanhã/Srª da Hora/Póvoa and Campanhã/Srª da Hora/Trofa), with a total extension of approximately 68 km, of which 50 km make use of existing railway tracks which are to be reviewed and adapted to accommodate the new means of transport. Includes the construction of 12 underground and 50 surface railway stations.



"12 underground
and 50 surface
railway stations"

BOLHÃO UNDERGROUND STATION - OPORTO METRO

Client/Owner: TRANSMETRO, ACE / Metro do Porto, S.A.

Final Design: 2001

Technical Assistance: 2001 / 2004

This is an underground station basically composed of: a main cavern where the railway platform is located; a transversal gallery for the access to the mezzanine at the platform level; an access shaft; operational rooms; an access shaft and emergency exit to Camélias Park; a connection tunnel to the main cavern.

The access shafts are delimited by a retaining structure comprising a secant pile cut off wall that confines the area to be excavated. The Fernandes Tomás shaft has an approximate total length of 44 m, an inner width of about 11 m and a depth of some 26 m. The Alexandre Braga shaft has an identical total length and an inner width of about 9 m.

In geological terms, the Bolhão Station is located in an area including fill materials, alluvial soils and granite saprolites, which can reach a total thickness of about 13 m.

COMBATENTES UNDERGROUND STATION - OPORTO METRO

Client/Owner: TRANSMETRO, ACE / Metro do Porto, S.A.

Final Design: 2001

Technical Assistance: 2001 / 2004

The Combatentes underground station is located at the Line S of the Oporto Light Metro, and develops over a plaza close the junction of Rua da Alegria with the Av. Dos Combatentes da Grande Guerra, nearby a BP gas station. This Station is located on a plain area with low population rate. The underground station is basically composed of: main shaft; main cavern where is the railway platform and transversal gallery.

The access shafts are delimited by a retaining structure comprising a secant pile cut off wall that confines the area to be excavated. The main shaft has an approximate total length of 35 m and an inner width of about 21 m. The bottom slab is located at variable levels, with its deepest point at level (120,7). To reach that depth it was necessary to carry out an excavation of approximately 27 m.

In geological terms, the Combatentes Station is located in an area including fill materials and granite saprolites, which can reach a total thickness of about 7 m.



COBA participated in:

Preliminary Studies of the entire project: 1998 / 1999

Trofa Line

Sections 1, 2 and 3 with an extension of 14 km

Preliminary Study, Final Design and Technical Assistance: 2001 / 2009

Line between Fonte do Cuco and Trofa, with an extension of 22 km and 12 railway stations.

Preliminary Study: 2001 / 2004

Line D - Yellow - Extension of Line "S" to the South (1st and 2nd Sections)

Alteration of the Line D alignment between Santo Ovídeo and Vila d'Este II, including the Feasibility Study of the Connections to Line G with an extension of 5869 m, including a Workshop and Maintenance Building at Vila d'Este and 5 (five) stations (Quinta do Cedro, Laborim, Santos Silva Hospital and Vila d'Este I and Vila d'Este II). Feasibility Study and Preliminary Study.

Extension of Line "S" to the South (1st Section) with 900 m, including 2 (two) stations (D. João II and Stº Ovídeo). Feasibility Study, Final Design and Technical Assistance.

Line G - Orange. Casa da Música - Laborim, between the Gaia Shopping Centre and Laborim, with a length of 2 km, including the "Jardim" railway station. Preliminary Study: 2003 / 2009

STº OVÍDEO SURFACE STATION – OPORTO METRO

Client/ Owner: Metro do Porto, S.A.

Tender Design: 1996

Studies undertaken in association

This is a rail and road structure integrated in the section of Line D (Yellow) of the Oporto Metro, between the D. João II and Stº Ovídio Stations, located at Av. da República in the city of Vila Nova de Gaia.

This project included the design of the new Stº Ovídio road tunnel, built under the existing St Ovídio Underpass.

This project, despite being a relatively short intervention in spatial terms, is characterised by remarkable constructive and analytical complexities. First, due to the different structural designs adapted to various constraints, which originated about 10 different sections in the Underpass and Station, each with an average length of about 30 m, in addition to the high roofs that had to be accommodated.

On the other hand, the very nature and location of the works - in a densely developed urban environment - very often resulted in construction restrictions, deadlocks, the need to analyse alternative solutions for temporary structures, traffic diversions and a rather complex network of utilities. Permanent technical assistance covering almost all technical specialities was thus required, which led to the need to allocate multidisciplinary teams from COBA for about two years.

This project covers an area of 54,902 m² and required 11,139 m³ of concrete, 1,488 tons of A500 NR steel and 786 piles.



DUBLIN METRO.

CONNECTION BETWEEN THE DUBLIN AIRPORT AND THE CITY CENTRE | IRELAND

Client/Owner: Celtic Metro Group (Barclays Private Equity, Obrascone Huarte Lain, Mitsui, Soares da Costa, Iridium Concesiones de Infraestructuras S.A., CAF e MTR) / Rail Procurement Agency" (RPA)

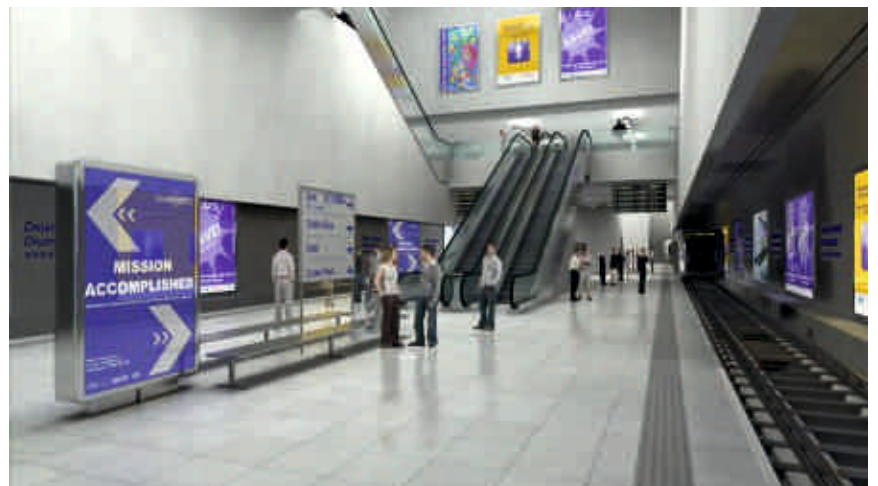
Basic Design for a Design-and-Build Tender: 2009

The Irish Government launched a design-build-operate tender for the Dublin Metro Northern Line, approximately 18 km long, which connects the Dublin Airport to the city centre (Saint Stephen Green).

COBA was responsible for the geotechnical and structural studies of the 8 underground stations constructed under "cut-and-cover", have a maximum depth of approximately 30 m. The solutions studies were strongly constrained by the geological and geotechnical conditions of the soil and land occupation aspects. Emphasis is placed on the significant number of buildings, the interaction with traffic deviation, the underground infrastructures, the weak strength and deformability of occurring formations and the water level near the surface.



"COBA was responsible for the geotechnical and structural studies of the 8 underground stations"



MONDEGO LIGHT METRO | PORTUGAL

Client: Sociedade Metro do Mondego, S.A.

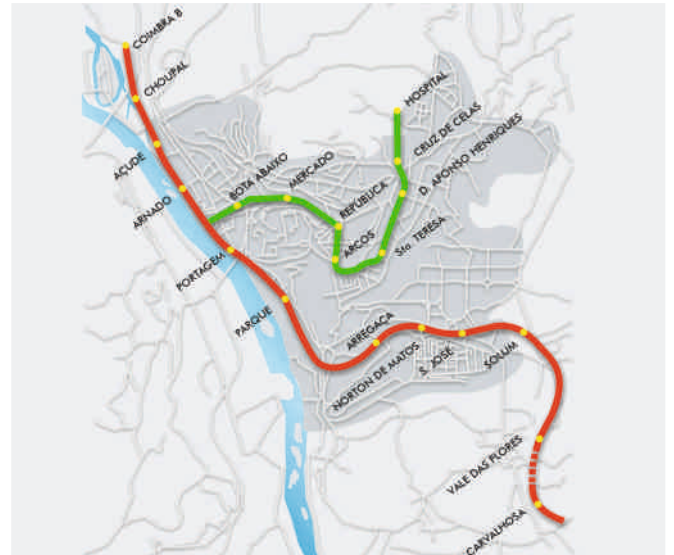
Feasibility and Economic Study and Preliminary Design: 1999 / 2000

The study envisaged the improvement of collective transport supply over the entire area to be covered – Coimbra, Miranda do Corvo and Lousã – including the area of the Lousã railway branch as well as the Coimbra Railway Station B and the main sites of attraction of Coimbra, namely the Hospital Universitário, Polo Universitário 1 (University in the high zone of the city) and the downtown of Coimbra, that constitute the base networks of the Mondego Light Metro.

The study presents and justifies the selection of a joint solution for the base network, including:

- The accurate definition of the alignment,
- The exact location of the stations, terminals, intermodal centres, interfaces with other means of transport and the stationary installations for exploitation and assistance to users;
- Restructuring of the road and railway collective transport system in the area to be served by the new mean of transport;
- The conditions of insertion in the existing road network or planned for short and mean terms;
- The management of traffic and parking spaces in view of the modifications to be made to the existing traffic systems.

“The study presents and justifies the selection of a joint solution for the base network”



TRANSBRASIL BRT (Bus Rapid Transit) CORRIDOR | BRAZIL

Client/Owner: Rio de Janeiro City Hall

Basic Design: 2011 / 2013

Detailed Design and Technical Assistance: 2015 / 2018

The implementation of the **TRANSBRASIL BRT Corridor** (Bus Rapid Transit) comprises an exclusive bus corridor between the Rio de Janeiro city centre (Santos Dumont Airport) and Deodoro, in the north, along the Brazil Avenue.

It is approximately 32 km long and includes 4 terminals and 29 stations. The overall and local traffic system and adjacent to the exclusive bus lane will be adjusted, and the new road infrastructure will consist of four sections, as shown below.

The BRT corridor falls within the structuring and streamlining the existing bus public transport system in Rio de Janeiro. In articulation with other similar corridors, it comprises an innovative, environmentally friendly and highly efficient public transport system that operates on segregated tracks, transporting the quality of rail transport to road transport.

The BRT system has revealed great efficiency in high traffic corridors in various cities throughout the world.



Studies included:

- Topography and Geotechnical Surveys & Testing;
- Geological and Geotechnical Studies;
- Road studies: alignment, geometry, hydrology, drainage and current engineering structures, earthworks, pavements, signalling & road safety equipment;
- Bridges and Pedestrian Crossings;
- Stations' and Terminals' Architecture;
- Urbanization, Landscaping & Urban Furniture;
- Relocation of Utilities;
- Expropriations.



 JULY | 2023



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