Construction of two parallel tunnels of the Mexico city – Toluca suburban railway

Mexico

Presented by: Jorge Antonio Pereyra Vargas
The Mexico City - Toluca interurban railway, will be a modern transport system, that will connect safely and efficiently Toluca valley and the western area of Mexico city, and will address the problems of connectivity and traffic congestion that occurs between these two urban areas.
The Mexico - Toluca Interurban Railway Project is located at approximately 3000m above sea level. It has a total extension of 57.7 km and 6 stations. It will connect the Toluca Valley metropolitan zone with the west zone of Mexico City with connections to metro line L1 and the futures lines L9 and L12.
Benefits to the metropolitan region of Mexico City

Providing a mass public transport system serving 230 thousand passengers per day, with direct service to work centers and recreations centers.

It will promote the use of non-motorized transportation and sustainable mobility with a CO₂ reduction of 27,827 ton / year. Equivalent to the oxygen produced by 225 hectares of forest.

Decrease in vehicular traffic to the benefit of 3.5 million inhabitants.
Benefits to the metropolitan region of Mexico city

57.87 km of travel in 39 min. It will reduce the transfer time in 90 minutes round trip improving quality of life of commuters.

Decrease in accidents. Approximately 400 road accidents per year can be avoided on the Mexico City-Toluca highway.

Savings for travel times, estimated at 4,400 million pesos.

Decrease in vehicle operating expenses, estimated figure at 1,800 million pesos.
Client

SCT
SECRETARÍA DE COMUNICACIONES Y TRANSPORTES

Contractor

ICA

Main suppliers

Maidl Tunnelconsultants

Engineer

SENER

Supervisor

Dirac®

Supervisor

HERRENKNECHT
Tunnelling Systems

Maidl Tunnelconsultants

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Tunnel characteristics

- Tunnels: 2
- Tunnel length Toluca – México: 4,762 m
- Tunnel length México – Toluca: 4,741 m
- Maximum slope: 4.0%
- Minimum radius of curvature: 1500 m
- Maximum overburden: 136 m
- Minimum overburden: 15 m
- Inside diameter with liner: 7.50 m
- Outside diameter excavation: 8.57 m
Geometrical section of twin tunnels
Machines

Two Multi-mode EPB Shield

Manufacturer: Herrenknecht
Origin Country: Germany
Excavation diameter: 8.57 m
Length TBM: 12.00 m
Total length with back up: 135.00 m
Total weight (TBM+Backup): 1,667 Ton
Maximum thrust: 84,235 KN
Installed electric power: 5,200 kVA
Turn of cut wheel: 0 a 4.2 rpm
Geological profile - Ground and groundwater conditions out of typical EPB operation ranges

- Height differential between portals 150 m
- Overburden between 15 to 130 m
- Up to 70 m of water column
- Mixed face
  - Very soft to moderately hard rocks
- Soft to moderately hard rocks
- Hard to moderately hard rocks
- Soft to hard rocks
- Soft to moderately hard rocks
- 4,7 km
- 4%
Ground types

Sound Andesite

Oxidized Andesite

Fractured Andesite

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Ground types

Tuffs
Face conditions

Mixed face
Face conditions

Boulders
Open rock fractures for tens of meters
Loosening of blocks

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High groundwater flows and groundwater pressures

Up to 5 bar crown pressure in the excavation chamber with a controlled plug in the screw
Team work

The awareness of difficulties, motivated the Contractor’s team to maximize the potential of digitalization in TBM tunneling, monitoring the TBM operation and the ground conditions in real-time providing the same level of information and fluid communication between all the labor and management levels of the project.
Digital tools – Tunnelling 4.0

Real-time monitoring and adjustment of the operating parameters of the TBM, associated with the geological model and objective values for analysis and decision making; it has been enhanced with the use of digital tools.
Cutter head inspection

Planning of the stop points for inspection of cutter head
Cutter head inspection

Measures adopted to decrease the amount of groundwater flow into the chamber

Water flows up to 5.5 m³/min
The Mexico City-Toluca railway twin tunnel construction proved that EPB shield tunnelling is possible in such a heterogeneous ground with high groundwater pressures between 4 and 7 bar at the crown

Average EPB shield performance in closed mode
300 m/month
The construction of the Mexico City-Toluca railway tunnels has set a new benchmark in effectiveness and cost-savings in tunnelling, enabling timely termination of the tunnels for this key infrastructure in Mexico.