ITA TUNNELLING AWARDS 2019

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

Mexico

Presented by : Jorge Antonio Pereyra Vargas

ITA TUNNELLING AWARDS 2019

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

ITA TUNNELLING AWARDS 2019

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.

ITA TUNNELLING AWARDS 2019

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.

ITA TUNNELLING AWARDS 2019

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.

ITA TUNNELLING AWARDS 2019

Client

SCT
SECRETARÍA DE COMUNICACIONES Y TRANSPORTES

Contractor

ICA

COTRISA

Engineer

SENER

Supervisor

Dirac
INGENIEROS CONSULTORES

Main suppliers

HERRENKNECHT
Tunnelling Systems

mtc
Maidl Tunnelconsultants

ITA TUNNELLING AWARDS 2019

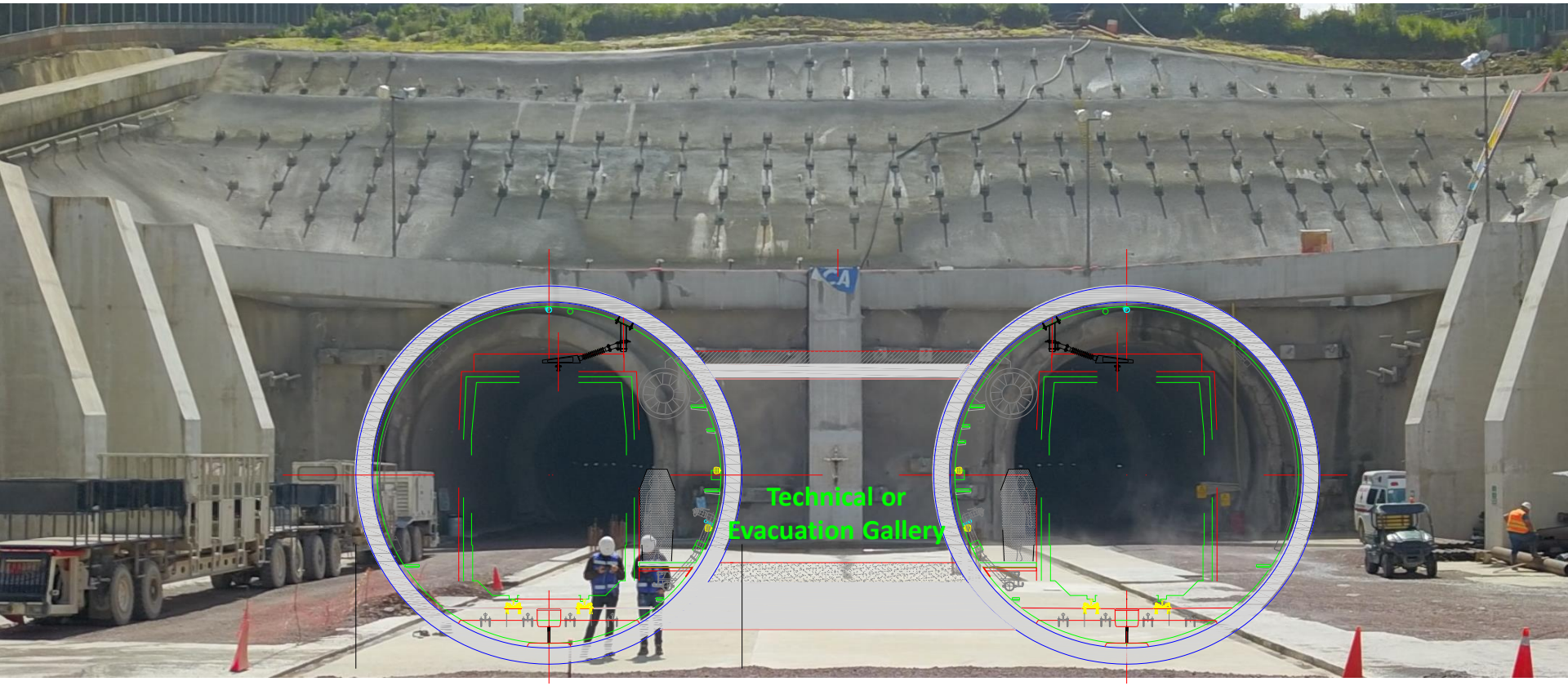
Tunnel characteristics

- 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

ITA TUNNELLING AWARDS 2019

Geometrical section of twin tunnels



ITA TUNNELLING AWARDS 2019

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

ITA TUNNELLING AWARDS 2019

Geological profile - Ground and groundwater conditions out of typical EPB operation ranges

PORTAL TOLUCA

Height differential between portals 150 m

Overburden between 15 to 130 m

Up to 70 m of water column

4%

PORTAL MÉXICO

TBM

Mixed face

Very soft to moderatly hard rocks

Soft to modera tly hard rocks

Hard to modera tly hard rocks

Soft to hard rocks

Soft to moderatly hard rocks

4,7 km

ITA TUNNELLING AWARDS 2019

Ground types

Sound Andesite

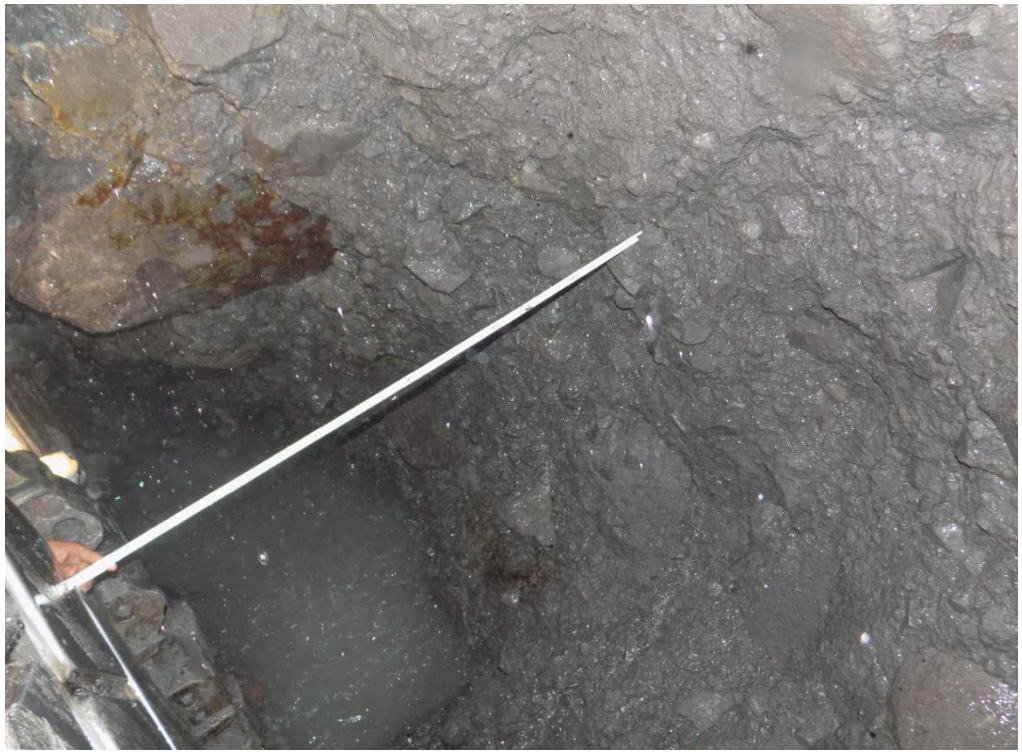
Oxidized Andesite

Fractured Andesite

ITA TUNNELLING AWARDS 2019

Ground types

Breccia



Breccia with blocks

ITA TUNNELLING AWARDS 2019

Ground types

Tuffs

ITA TUNNELLING AWARDS 2019

Face conditions

Mixed face

ITA TUNNELLING AWARDS 2019

Face conditions

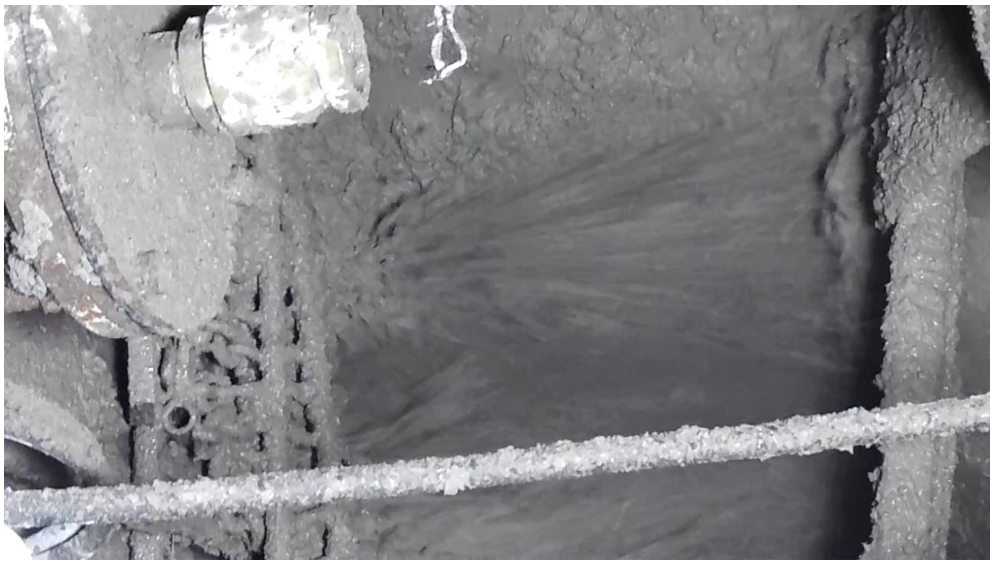
Boulders

Open rock fractures for tens of meters

Loosening of blocks

ITA TUNNELLING AWARDS 2019

High groundwater flows and groundwater pressures



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

ITA TUNNELLING AWARDS 2019

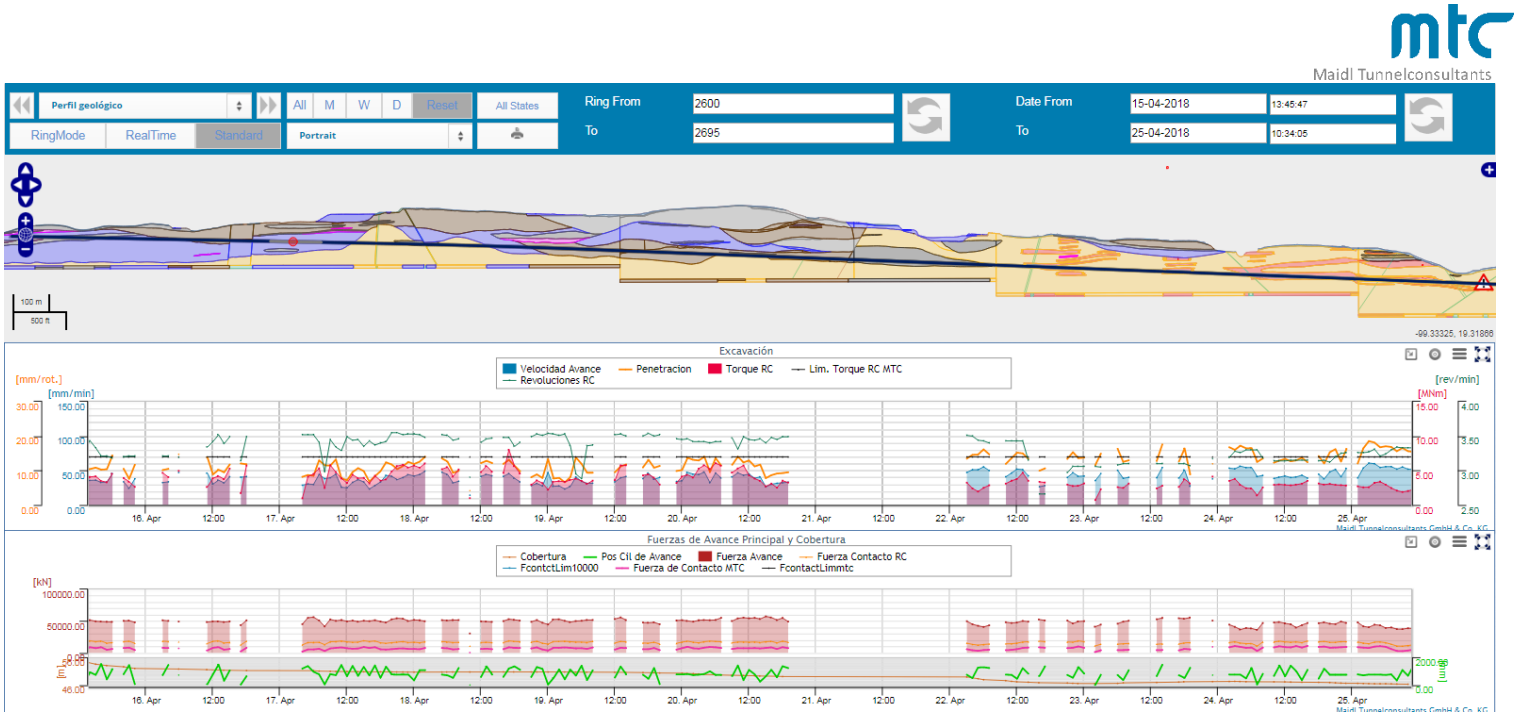
Team work

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

ITA TUNNELLING AWARDS 2019

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



ITA TUNNELLING AWARDS 2019

Cutter head inspection

Planning of the stop points for inspection of cutter head

ITA TUNNELLING AWARDS 2019

Cutter head inspection

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

Water flows up to 5.5 m^3/min

ITA TUNNELLING AWARDS 2019

ITA TUNNELLING AWARDS 2019

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

ITA TUNNELLING AWARDS 2019

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

ITA AITES Miami, USA 18th November 2019 Jorge Antonio Pereyra Vargas