OFITECO

URBAN TUNNEL MONITORING

2022

CONTENTS

Safety Assessment and Risk Management

Tunneldata

Main References

SAFETY ASSESSMENT AND RISK MANAGEMENT

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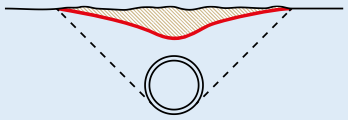
Importance of Monitoring

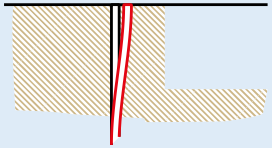
- **Integral part of any construction project**, with a particular importance in **underground construction**
- **Key risk mitigation measure:** control of the construction process and protection of existing assets
- **Not an end by itself:** updated **structural health information and verification of the design assumptions**
- **Better distribution of available resources,** cost-effective risk management approach

Main purpose: transform data into information and knowledge

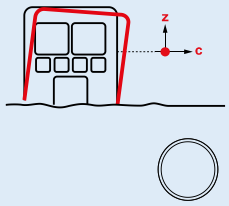
GROUND SETTLEMENT



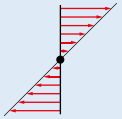
IN-DEPTH DEFORMATION



BUILDING DEFORMATIONS

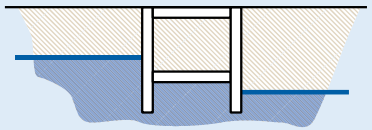


LOAD & STRESS



VIBRATIONS

WATER LEVEL



TBM OPERATION & PROGRESS OF WORKS

MONITORING

ACQUISITION REPORTING

ANALYSIS

INFORMATION
- UNDERSTAND THE RISK
- SUPPORT DECISION-MAKING
- PERMISSION TO TUNNEL

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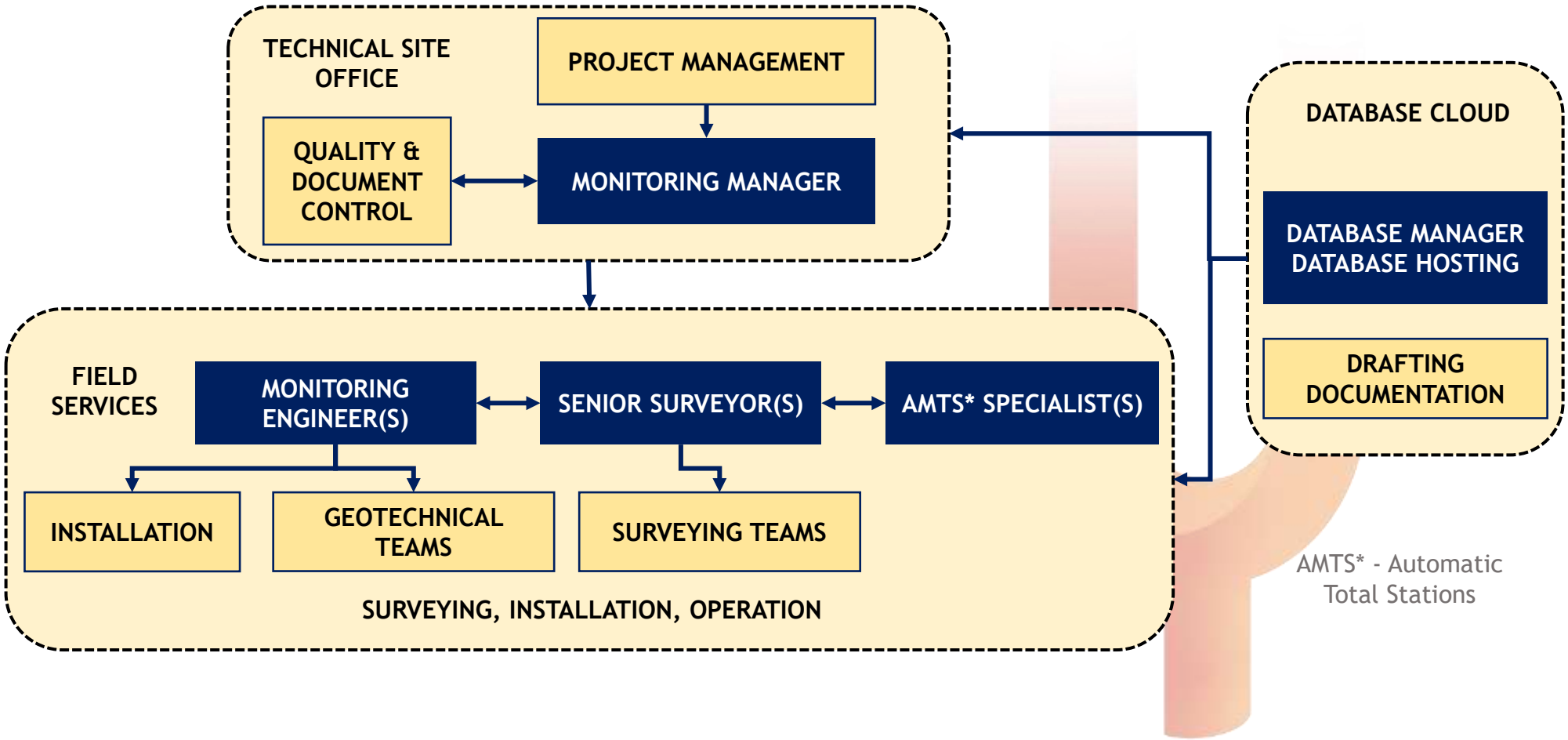
Integrated team offering a comprehensive service



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Ofiteco provides turnkey-style solutions in tunnel monitoring

- Full technical compliance, with **proven, state-of-the-art solutions**
- Operational and economical **risk** managed by Ofiteco
- Cost-effective, **streamlined process**, integrating analysis of reference design, selection of devices and manufacturers, installation, analysis and maintenance
- **Single interface** for all monitoring-related data; tool for informed, real time decision making
- Engineering **analysis and evaluation** incorporated in all stages

Our monitoring database solution, **TUNNELDATA**, is the core system supporting the technical functions.

TUNNELDATA

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TUNNELDATA: MONITORING INFORMATION MANAGEMENT SYSTEM

A **comprehensive management system** of monitoring and survey data combined with information on the construction progress and existing assets is a necessary tool for **safety and risk management** as well as **to assess the performance of the works** compared to the design assumptions.

For that purpose OFITECO developed **TUNNELDATA**, a web-based common data environment platform (CDE).

- In-house developed tool, adapted to daily I&M needs, **fully customisable** and unique for each project
- Not just software: **implementation of monitoring knowledge**
- Cloud-based **web platform**, with synchronized **real-time** data acquisition and processing
- Graphical **GIS interface** with access to all layers of information and custom **SCADA** displays

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TUNNELDATA: MONITORING INFORMATION MANAGEMENT SYSTEM

Manual data

Automated data

Progress of works information

TBM Parameters

CLOUD SERVICE

Hosting & DB

Administrator

Config & Data reduction

Different user profiles with different privileges

USER SERVICES

Web Interface

Reports

Alarms

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GIS Interface

- GIS Navigation Tools (Pan, zoom…).
- Filter by sensors, sensor information.
- Layers organisation: map, ortophoto.
- Thresholds, current active alerts.
- Contour plots

Different charts

GIS functionalities

GIS Interface – Progress of works

- Specific interface for work progress.
- Real-time communication with **TBM**-control systems, acquiring parameters and information.
- Cut-and-Cover excavation (manual entry).
- Conventional methods (manual entry).

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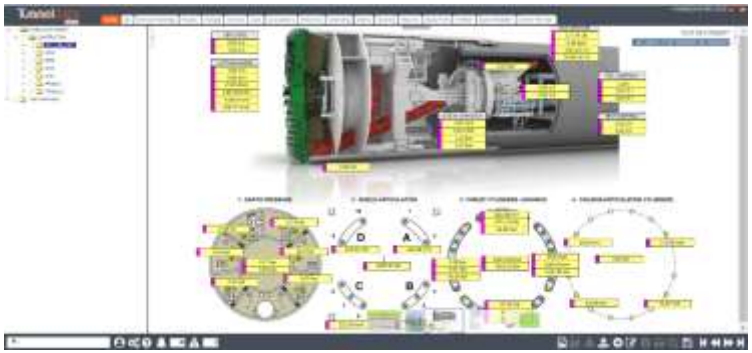
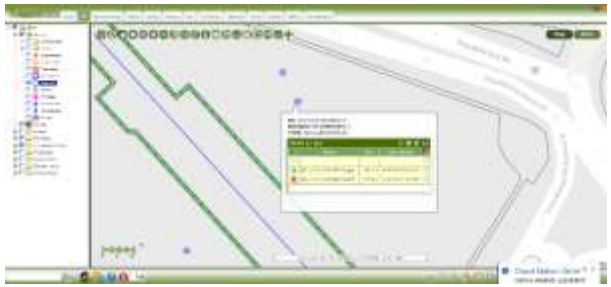
TUNNELDATA: MONITORING INFORMATION MANAGEMENT SYSTEM

- SCADA



- Selectable from GIS or menus
- Customizable
- TBM-specific SCADAS

- Repository of information



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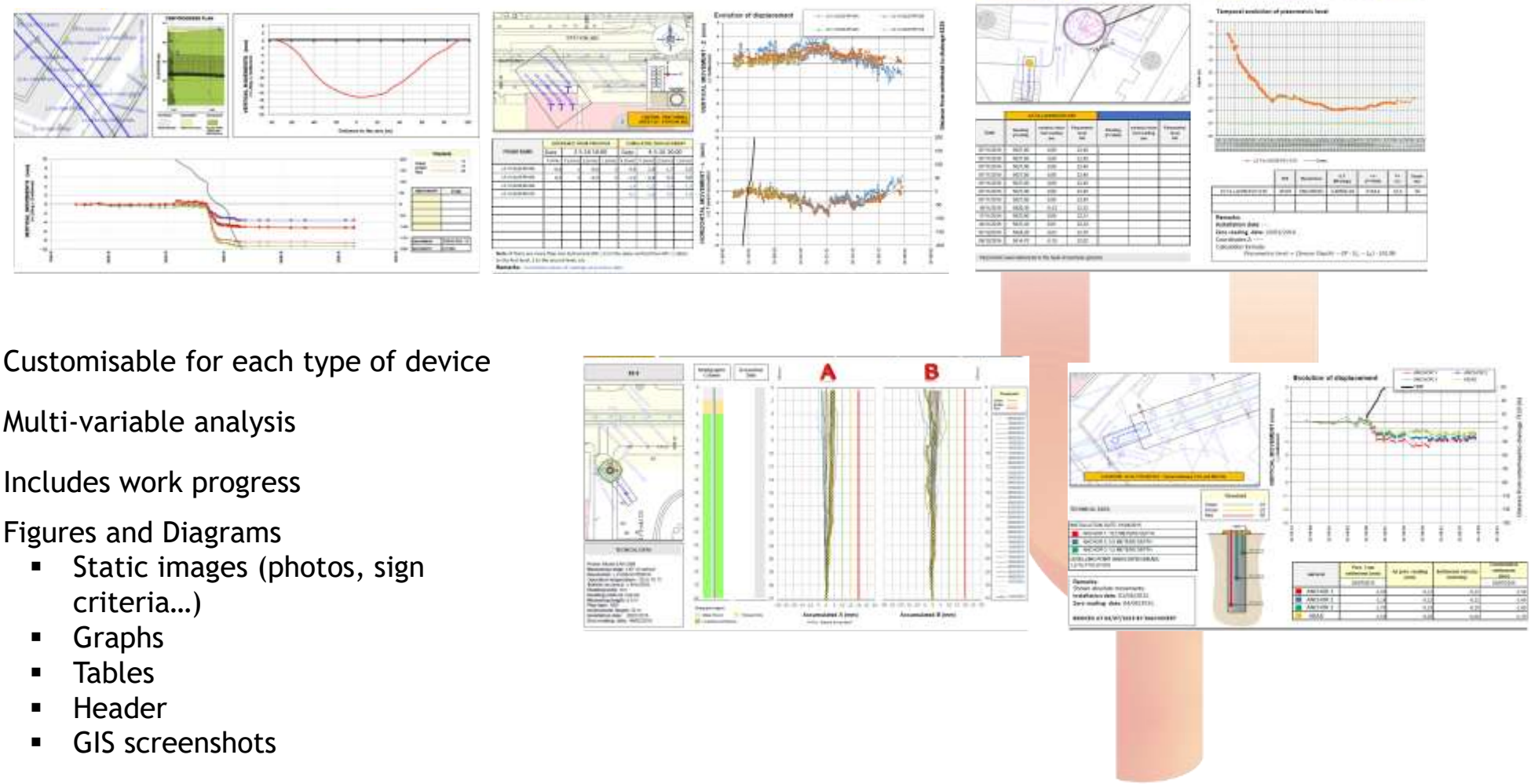
- Customisable Reports



- Customisable for each type of device
- Multi-variable analysis
- Includes work progress
- Figures and Diagrams
  - Static images (photos, sign criteria…)
  - Graphs
  - Tables
  - Header
  - GIS screenshots

MAIN REFERENCES

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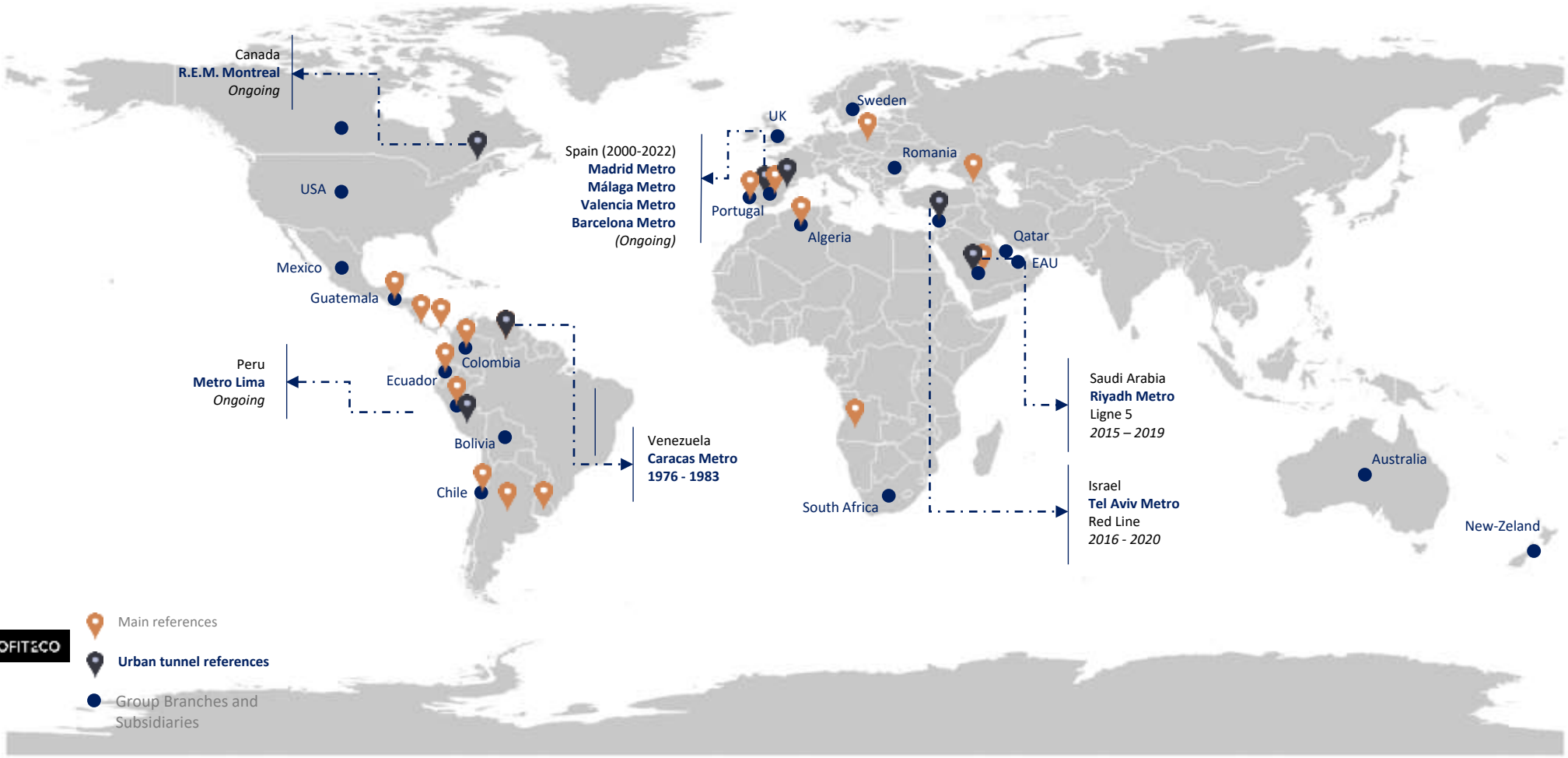
MAIN REFERENCES | Urban Tunnel Monitoring

In the tunnels and underground works sector, OFITECO is present in North America, South America, Europe, Australia, Africa and the Middle East.



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BARCELONA METRO- LINE 9. WORKS MONITORING-COMPLETION OF TUNNEL AND STATIONS

TUNNEL MONITORING AND SURVEILLANCE

Barcelona, Spain

IFERCAT

2022 - Ongoing

Monitoring of the tunnel and the stations, as well as the buildings and structures in the surroundings of the works, through the installation and monitoring of the instrumentation defined in the Monitoring Plan. The expected duration for these works is 90 months, with the start-up of the tunnel boring machine in the spring of 2022.

Scope of works:

- Real time monitoring
- Ongoing tracking of the instruments installed, adjusting the frequency to the monitoring needs of the construction at any given moment
- Installation of new monitoring instrumentation
- Attendance to the periodic monitoring meetings
- Modeling BIM
- Monitoring Database systems
- Total TBM tunnel length: 4,200 m
- 11 Stations

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RÉSEAU EXPRESS METROPOLITAIN (REM)
GEOTECHNICAL MONITORING OF THE TUNNEL UNDER THE PIERRE ELLIOTT TRUDEAU INTERNATIONAL AIRPORT
TUNNEL MONITORING AND SURVEILLANCE

Montreal, Canada

NouvLR

2019 - Ongoing

Main figures:

- Total TBM tunnel length: 3,063 m.
- Total Cut-and-Cover tunnel length: 110 m.
- Number of stations: 2 (all underground)
- Number of shafts: 2
- Number of TBMs: 1

Scope of works:

- Supplying and Installation of the instruments provided for in the instrumental monitoring plan.
- Real time monitoring
- Ongoing tracking of the instruments installed, adjusting the frequency to the monitoring needs of the construction at any given moment.
- Preparation of construction tracking reports.
- Attendance to the periodic monitoring meetings.
- Monitoring Database systems, including geotechnical sensors, surveying, TBM progress and GIS capabilities.

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LINE 2 AND FAUCETT AVE. – GAMBETTA AVE. BRANCH. LIMA & CALLAO METRO
STAGE 2: INSURGENTES STATION – PORT TERMINAL OF CALLAO
TUNNEL MONITORING AND SURVEILLANCE

Lima, Peru

M2 Lima Consortium

2019 - Ongoing

Main figures:

- Total tunnel length: 4,078 m.
- Number of stations: 4 (underground)
- Number of shafts: 4
- Number of TBMs: 1

Scope of works:

- Definition and elaboration of installation procedures.
- Supplying and Installation of the instruments provided for in the instrumental monitoring plan.
- Real time monitoring
- Ongoing tracking of the instruments installed, adjusting the frequency to the monitoring needs of the construction at any given moment.
- Preparation of construction tracking reports.
- Attendance to the periodic monitoring meetings.
- Monitoring Database systems, including geotechnical sensors, surveying, TBM progress and GIS capabilities.

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MÁLAGA METRO – LINES 1 & 2
SECTIONS: RENFE – GUADALMEDINA / GUADALMEDINA - ATARAZANAS
MONITORING AND SURVEILLANCE

Málaga, Spain

JV ACCIONA CONSTRUCCIÓN, S.A. – SANDO, S.A.

2018-2020

Metro de Málaga is performing an extension plan over the existing subway (opened up in 2014), which will add 3 extra kilometers and 6 new stations, summing up a total 14.8 km and 23 stations to the current network.

Currently, there are two new sections under construction, by a cut-and-cover method, and will have 3 underground levels, in order to allow both Lines 1 and 2 to reach the historical city center:

- Section RENFE – Guadalmedina: this section has a total 713 meters, and includes 1 new station and a shunting siding.
- Section Guadalmedina – Atarazanas: this section has a total 295 meters, with 1 new station, and a crossing under the Guadalmedina riverbed.

Scope of works:

- Drawing up of an specific monitoring plan for the project.
- Installation of the monitoring devices listed in the monitoring plan,
- Reading campaigns of the monitoring system, adapting its frequency to the control needed.
- Drawing up of the monitoring reports.

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TEL AVIV METRO - RED LINE - EASTERN SECTION
TUNNEL MONITORING AND SURVEILLANCE

Tel Aviv, Israel

JV China Civil & Danya Cebus

2016 - 2020

The eastern segment includes the construction of **three underground stations** (Aharonovitz, Ben Gurion, and Em Hamoshavot), **two 3.5-kilometer parallel tunnels** (digging using TBM machines) from the depot portal to the Ben Gurion station, from the Shenkar portal to two connecting passageways west of the Geha Junction, and another **370-meter connecting tunnel** from the Shenkar portal to the Em Hamoshavot station (using the NATM method)

Scope of works:

- Detailed monitoring plan and method of statement
- Supply, installation and maintenance of the geotechnical monitoring devices.
- Supply of database and reporting system, including licenses, support and service for the software.

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RIYADH METRO - LINE 5 (GREEN LINE)
TUNNEL MONITORING AND SURVEILLANCE

Riyadh, Saudi Arabia

Fast Consortium LLC

2015 - 2019

Main figures: Riyadh Metro – Line 5 (Green Line)

- Total length: 13,000 m (all underground)
- Number of stations: 11 (all underground)
- Number of TBMs: 2

Scope of works:

- Preparation of a plan for instrumental monitoring and control specific to the project.
- Supplying and Installation of the instruments provided for in the instrumental monitoring plan.
- Real time monitoring
- Ongoing tracking of the instruments installed, adjusting the frequency to the monitoring needs of the construction at any given moment.
- Preparation of construction tracking reports.
- Attendance to the periodic monitoring meetings.
- Monitoring Database systems, including geotechnical sensors, surveying, TBM progress and GIS capabilities.

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MALAGA METRO – LINE 2
SECTION: HEROES DE SOSTOA – MARTÍN CARPENA
TUNNEL MONITORING AND SURVEILLANCE

Malaga, Spain

METRO MALAGA JV

2006 - 2010

Scope of works:

- Drawing up of a specific monitoring plan for the project.
- Installation of the monitoring devices listed in the monitoring plan,
- Reading campaigns of the monitoring system, adapting its frequency to the control needed.
- Drawing up of the monitoring reports.

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MADRID METRO – LINE 7 EXTENSION
SECTION 1: LAS MUSAS – M-40 HIGHWAY
TUNNEL MONITORING AND SURVEILLANCE

Madrid, Spain

SACYR

2005 - 2007

Main figures: Madrid Metro – Line 7 (Section 1)

- Total length: **1,300 m** (all underground)
- Number of stations: **2** (all underground)

Scope of works:

- Preparation of a plan for instrumental monitoring and control specific to the project
- Monitoring data and report management system, maintenance and control
- Supplying and installation of the instruments provided for in the instrumental monitoring plan.
- Ongoing tracking of the instruments installed, adjusting the frequency to the monitoring needs of the construction at any given moment.
- Preparation of construction tracking reports
- Attendance to periodic monitoring meetings
- Noise and vibration control during construction

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MADRID METRO – LINE 7 EXTENSION
SECTION 2: AUTOVÍA M-40 - COSLADA
TUNNEL MONITORING AND SURVEILLANCE

Madrid, Spain

DRAGADOS

2005 - 2006

Main figures: Madrid Metro – Line 7 (Section 2)

- Total length: **2,110 m** (all underground)
- Number of stations: **2** (all underground)

Scope of works:

- Preparation of a plan for instrumental monitoring and control specific to the project
- Monitoring data and report management system, maintenance and control
- Supplying and installation of the instruments provided for in the instrumental monitoring plan.
- Ongoing tracking of the instruments installed, adjusting the frequency to the monitoring needs of the construction at any given moment.
- Preparation of construction tracking reports
- Attendance to periodic monitoring meetings
- Noise and vibration control during construction

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MADRID METRO – LINE 7 EXTENSION
SECTION 3: COSLADA – SAN FERNANDO
TUNNEL MONITORING AND SURVEILLANCE

Madrid, Spain

DRAGADOS

2005 - 2007

Main figures: Madrid Metro – Line 7 (Section 3)

- Total length: **4,870 m** (all underground)
- Number of stations: **6** (all underground)

Scope of works :

- Preparation of a plan for instrumental monitoring and control specific to the project
- Monitoring data and report management system, maintenance and control
- Supplying and installation of the instruments provided for in the instrumental monitoring plan.
- Ongoing tracking of the instruments installed, adjusting the frequency to the monitoring needs of the construction at any given moment.
- Preparation of construction tracking reports
- Attendance to periodic monitoring meetings
- Noise and vibration control during construction

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THANK YOU

Any question?

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