ARCHITA
Innovative multidimensional mobile mapping system

Italy

Presented by: Ricardo Ferraro, Head of Survey Department ETS S.r.l.
CHALLENGE

ensuring sustainable transport, safety and security
by improving the infrastructure management system
ARCHITA

is a multidimensional mobile mapping system with linked and integrated equipment of survey and position sensor installed on a vehicle. A large set of information (geometry, status, structural condition) are obtained in a single passage and integrated in one output environment for the maintenance, design and the management of infrastructure.
Benefits

**ARCHITA** guarantees a simultaneous and integrated survey of geometry and condition of infrastructure, gathering all the information required for the assessment, the maintenance and the management of infrastructure (all-in-one solution).

We can design the future infrastructure management through time with a clear, objective and repeatable system which supports the engineering judgement.

**Benefits**

- **reliable digital data**
Benefits

ARCHITA guarantees acquisition velocity of 15-30 km/h on average with minimal impact on rail/road traffic, reducing the time on the in-situ activities and increasing the safety for men at work and users.

ARCHITA allows to know the as-built of the infrastructure and plan the mitigation measures for the non-compliances.

ARCHITA allows to check the consistency of the construction works with respect to the design.

reliable digital data
increase safety and security

Miami, USA 18th November 2019
Ricardo Ferraro, Head of Survey Department
Benefits

ARCHITA produces back-office optimization and cost efficiency. Short disruption for railway and reduced traffic jam for roads (on-field activity reduced of 60%) and guarantees of reduced costs compared to standard solution with equivalent output.

Reduced time for decision-making phase of the clients to plan activities and carry out cost analysis, focusing on the most critical and strategic line (small scale). Fast and reliable output to support design solutions and works strategy (large scale).

- Cost efficiency
- Increase safety and security
- Reliable digital data
Benefits

ARCHITA consists of several technical equipment integrated into a single vehicle. This makes available an integrated DB useful to create an innovative IT environment for infrastructure maintenance, design and management.

Defects mapping with IA support and virtual inspection of the tunnel.

New workflow for infrastructure design from set of digital data acquired.

Innovative approach for infrastructure management through a set of objective and reliable digital data.

- Reliable digital data
- Increase safety and security
- Cost efficiency
- Innovation
ARCHITA:
RAIL CONFIGURATION
Technological solution made up of integrated and engineered survey instruments:
- Operating speed: 15-30 km/h
- Output: Acquisition of Actual State of the work through different data (point cloud, high resolution images, lidograms and e thermograms)
Laser scanner, thermal and digital cameras, Innovative Light solution

<table>
<thead>
<tr>
<th>SURVEY SENSORS</th>
<th>POSITIONING SENSORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 8 digital cameras with 2046 x 2046 resolution</td>
<td>No. 2 GPS antennas</td>
</tr>
<tr>
<td>No. 2 profilers Z+F 9012 in class 1 (2 mln p.p.s.)</td>
<td>No. 1 IMU inertial platform</td>
</tr>
<tr>
<td>No. 4 thermal imaging cameras</td>
<td>No. 1 optical odometer</td>
</tr>
</tbody>
</table>

Miami, USA 18th November 2019
Laser scanner, linear cameras, LED light system

<table>
<thead>
<tr>
<th>SURVEY SENSORS</th>
<th>POSITIONING SENSORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 3 hight speed linear cameras, 18432 pixel</td>
<td>No. 1 GPS antenna</td>
</tr>
<tr>
<td>No. 1 profiler Z+F 9012 in class 1 (1 million p.p.s.)</td>
<td>No. 1 IMU inertial platform</td>
</tr>
<tr>
<td>No. 16 LED lighting system on steel structure</td>
<td>No. 1 rotary encoder</td>
</tr>
</tbody>
</table>

Miami, USA 18th November 2019

Ricardo Ferraro, Head of Survey Department
Ballast, lining and pavement georadar systems

**SRS – Safe Rail System**
- n. 3 antennas of 400 MHz

**STREAM**
- n. 1 antenna of 600 MHz

**Ris Hi Pave**
- No. 1 antenna of 2 GHz coupled with No. 1 antenna of 400/900 MHz
ARCHITA - equipment integration
Geometric survey as a drawing start

Point cloud to 3D CAD model

Point cloud to surface model

Miami, USA 18th November 2019
Automatic rail extraction and clearance analysis
Non-destructive testing

georadar scanning to determine the ballast thickness, the geotechnical context and possible presence of cavities

georadar scanning to determinate the lining thickness, the additional layers beyond the lining and water phenomena
Evidence of defects detection

point cloud synchronization with thermal images

HD image from linear camera

Today we can do semi-automatic detection simultaneously with the first AI applications
Tomorrow we will achieve them thanks to the support of AI
Result of defects detection

We are able to represent the tunnel current state in different ways as:
- technical drawings and reports
- defect extension index
- Virtual Reality inspection.

All data allow to undertake engineering studies to plan maintenance activities and carry out statistical studies to assess and manage the risk along the line.
Retro BIM

A structured workflow allows to enhance all the integrated information from ARCHITA survey to obtaining all the necessary output:

- Set of data obtained from ARCHITA and destructive investigations
- Diagnostic analysis to know the conservation status of the structures
- Digitalization of the tunnel geometries (modelling of railway tracks, tunnel lining, progressive sections, etc.)
- Current State Analysis and automatic clearance analysis for shape adjustment
- Geotechnical and structural analysis employing the surfaces and the solids from the digitalized model
ARCHITA - Outputs integration

- Point cloud
- Thermal image
- HD image
- Ballast/tunnel lining radar scanning
- 3D CAD model
- IFC model
Virtual Reality Inspection

The VR inspection is aimed to verify the current state of the tunnel and allows to obtain objective geometric data and visual information for all the parties.

The VR inspection is also aimed as an innovative approach for the infrastructure management by verifying the survey results of the investigation phase and the construction work performed by all the parties.
Machine Learning

The defects mapping, the management of big data and the predictive maintenance require the implementation of machine learning to support the engineering of the future.

Our R&D department is involved in the development of Artificial Intelligence for these applications. Moreover, our large database and the accuracy of the instrumentation allow a proper “feeding” of the system.

An example of first machine learning test results.
ARCHITA

Companies’ Stakeholder

Contractors: Micos SpA (Construction Company), Sveco SpA (Construction Company), ITALFERR SpA (Italian Design Infrastructure Company), Roma Metropolitane srl (Rome Underground Design Company), FS International (Italian Railways Group)

Owners: RFI SpA (National Railways Authority), ANAS SpA (National Road Authority), Autostrada Brescia Verona Vicenza Padova SpA (Highway Authority)

Suppliers: Leica Geosystems HEXAGON Group (Manufacturer), ADTS srl (Manufacturer)

Research Institute: Bruno Kessler Fondation

International Conference: «Smart Underground Space & Infrastructures» SUS 2019, WTC2020 (coming 2020)
Thank you