

Instrumentation and monitoring solutions

Soil / Structure / Environment



Sixense Group



Sixense is a group offering global excellence in solutions encompassing activities in the following fields:

- ▶ engineering, monitoring, software and digitalisation,
- ▶ infrastructure projects, soil and the environment.

Our solutions are offered throughout the lifecycle of the infrastructure (design, construction and operation), to understand, analyse, anticipate and optimise our clients' investments.

Sixense's mission is to help designers, builders, contracting authorities and operators to optimise the management of their construction sites and assets.

Sixense innovates, develops and adapts the best technologies and software available to offer reliable and optimal solutions, incorporating its expertise in inspection, instrumentation and monitoring, 2D/3D mapping, laboratory technologies, engineering and consulting.



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OBJECTIVE: TO HELP YOU MANAGE THE RISKS INVOLVED WITH YOUR CONSTRUCTION PROJECTS AND YOUR ASSETS ONCE IN OPERATION

Construction

Throughout the world, there is a growing awareness of risks and a rise in standards in terms of prevention and sustainable development. Commissioning authorities, project managers, infrastructure operators and construction companies must anticipate and contain risks, so they can make safe decisions while optimising costs and schedules.

Operation

For many asset managers, optimisation of maintenance tasks and extending the lifespan of assets have become key factors requiring innovative tools and methods such as those offered by Sixense.

Data collection and analysis

Our instrumentation and monitoring solutions allow us to help you manage the risks associated with your assets. Our measurements can be enhanced with pre-analysis and presentation of data for engineers, and by expert engineering missions to provide maintenance or repair recommendations.

Our instrumentation and monitoring technologies

Soil / Structure / Environment

Whether for one-off manual measuring or very large-scale monitoring with thousands of sensors connected in real time, we are continually integrating the most relevant technological innovations in the construction field.



MONITORING DURING THE CONSTRUCTION PHASE OR IN CLOSE PROXIMITY TO WORK SITES

We offer solutions specifically tailored to enhance safety and optimise risk management during civil engineering construction projects. Our services encompass a wide range of technologies, both automatic and manual: geotechnical sensors, innovative automatic topography and satellite monitoring solutions.

During the construction of new tunnels or underground infrastructure, we can monitor deformation, the hydrogeology of the site, geotechnical parameters, acoustics and vibration. We can also measure convergence and pressures in the ground, carry out geophysical investigations, and provide operational parameters for tunnel boring machines in real time.

All these readings feed into our overall service comprising the design of the monitoring system, the choice and provision of instruments best adapted for the project, the installation and configuration of the system and its maintenance during the monitoring phase and subsequently the management and presentation of all data in real time.

Our measurements also allow monitoring of the behaviour of existing structures, whether above or below ground, when work is being carried out in close proximity.



MONITORING OPERATIONAL INFRASTRUCTURE

Our range of sensors, acquisition systems and software allows infrastructure designers and managers to monitor a structure or asset.

Sixense's added value lies in its capacity to install or take over running of all types of sensor and to obtain high-quality data. Measurements are then processed to provide useful indicators and overviews to the various stakeholders. Our systems have been deployed around the world to study and monitor bridges, dams and other complex structures. Our experience allows us to operate in difficult conditions, proposing resilient instrumentation for operation at sea, in extreme environments, or in zones with risk of explosion.



GEOTECHNICAL, STRUCTURAL AND ENVIRONMENTAL SENSORS

- ▶ Geotechnical instrumentation + inclinometers + extensometers + total pressure sensors + seismographs,
- ▶ Hydrological instrumentation + flow meters + water level, piezometers + pore pressure cells + sonar,
- ▶ Structural sensors + strain gauges + crackmeters + inclinometers + liquid level sensors + flat jack + pressure cells + corrosion scale + accelerometers + geophones + differential GPS + temperature + displacement sensors,
- ▶ Environmental monitoring: air, water, noise, vibration, dust, meteorology,
- ▶ Meteorological + temperature + relative humidity + wind speed and direction + dew point + rainfall + lightning + pyranometer + visibility sensors.



Environmental impact

The solutions offered by SIXENSE naturally take into account environmental issues, which are now a key feature of any major project that sets out to be sustainable.

Special monitoring solutions, notably for noise, vibration and air quality are thus combined with consultancy, expertise and forecasting to allow you to better anticipate and thereby reduce your impact.

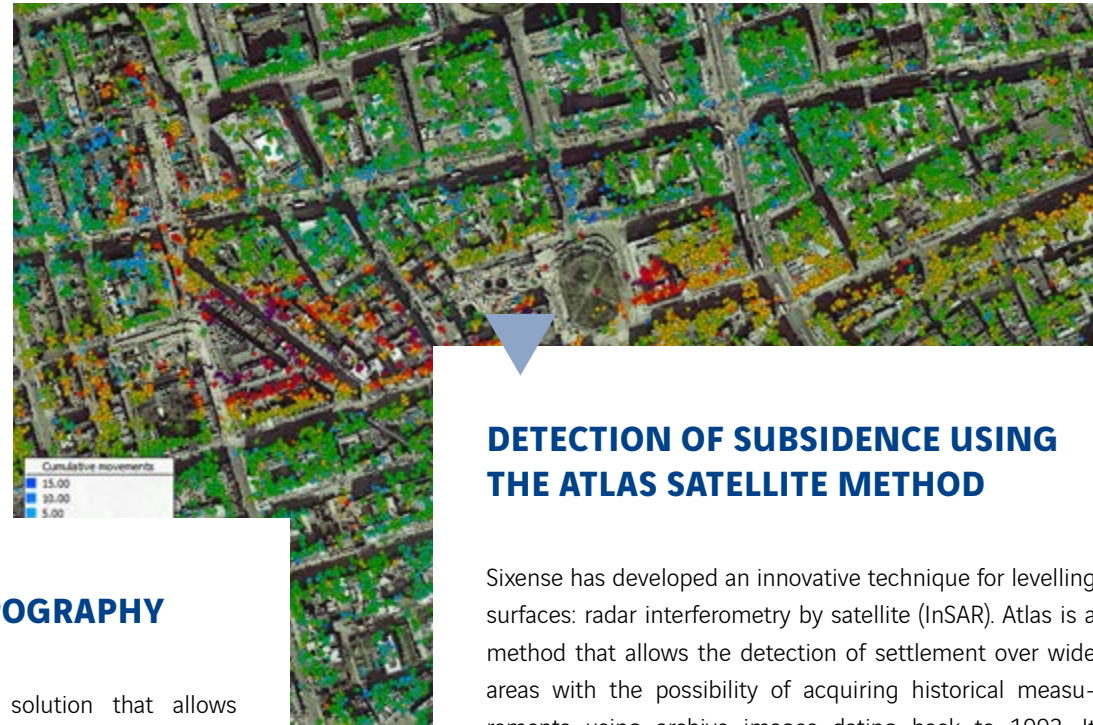


AUTOMATIC TOPOGRAPHY

An innovative geodesic solution that allows automatic real time monitoring of structures and surfaces. Our Cyclops and Centaur systems measure movements remotely in 3D to an accuracy better than 1 mm.

Our applications offer the possibility of grouping theodolites in an unstable environment while guaranteeing nominal precision.

Our experience and continual research has resulted in a quality of data that provides a higher degree of reliability and precision, and allows us to be called upon to upgrade third-party installations.



DETECTION OF SUBSIDENCE USING THE ATLAS SATELLITE METHOD

Sixense has developed an innovative technique for levelling surfaces: radar interferometry by satellite (InSAR). Atlas is a method that allows the detection of settlement over wide areas with the possibility of acquiring historical measurements using archive images dating back to 1992. It is possible to combine this method with automatic and manual levelling measurements to optimise the detection of risks, control costs, and inform stakeholders.

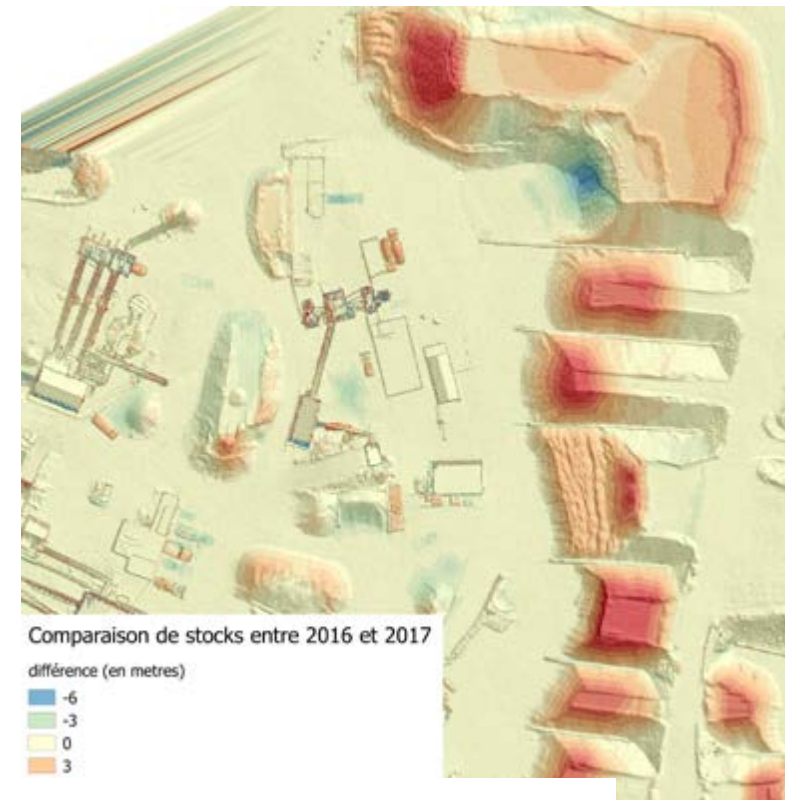


MONITORING STRUCTURES WITH CABLES AND PRESTRESSED COMPONENTS

Sixense has the expertise, tools and specific methods to examine and monitor structures with cables and prestressed components:

- ▶ Acoustic monitoring in real time to detect ruptures in wires due to corrosion or fatigue,
- ▶ Ultrasound detection of corroded anchorages in stay cables,
- ▶ Measurement of residual prestress in concrete structures,
- ▶ Checking tension in prestress bars,
- ▶ Locating cavities and white paste inside external prestressing cables,

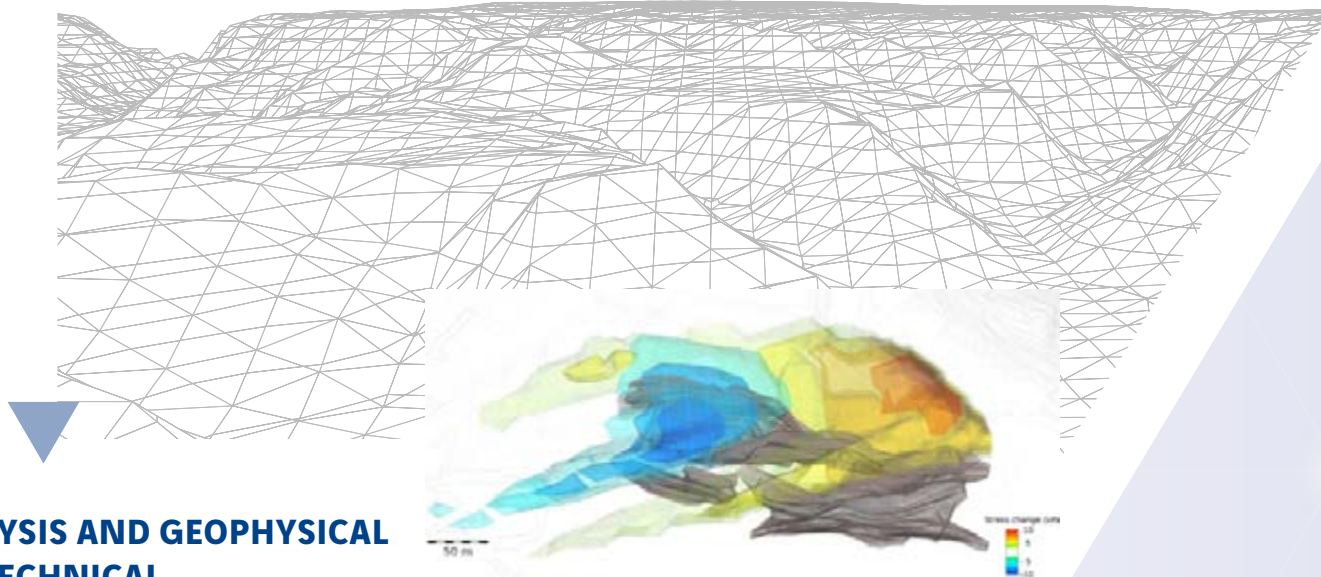
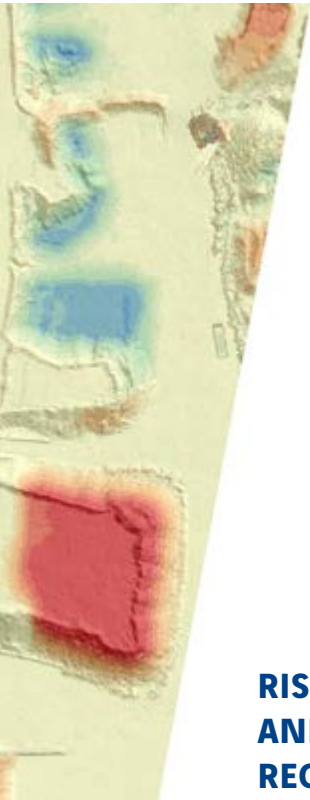
These solutions provide key information for the management of cabled structures such as cable-stayed and suspension bridges, and for prestressed concrete structures.



MONITORING GROUND DEFORMATION BY 3D MAPPING

Depending on the size of the area to be monitored, we offer solutions using a 3D deformation map, LIDAR and photogrammetric methods, with vectors adapted to the construction project. Measurements can be taken from the ground, by helicopter or drone.

Large scale (1-10km): LIDAR technology, accuracy of 5-10 cm.
Medium scale (subsidence of an embankment, for example): photogrammetry technology, accuracy of 3-5 cm.



RISK ANALYSIS AND GEOPHYSICAL AND GEOTECHNICAL RECONNAISSANCE

Our geophysicists are specialists in techniques for studying the sub-surface and use a range of methods adapted to the specifics of each investigation terrain. Combined with powerful analytical software, and detailed interpretation, these data-gathering techniques enable us to give reliable recommendations and advice.

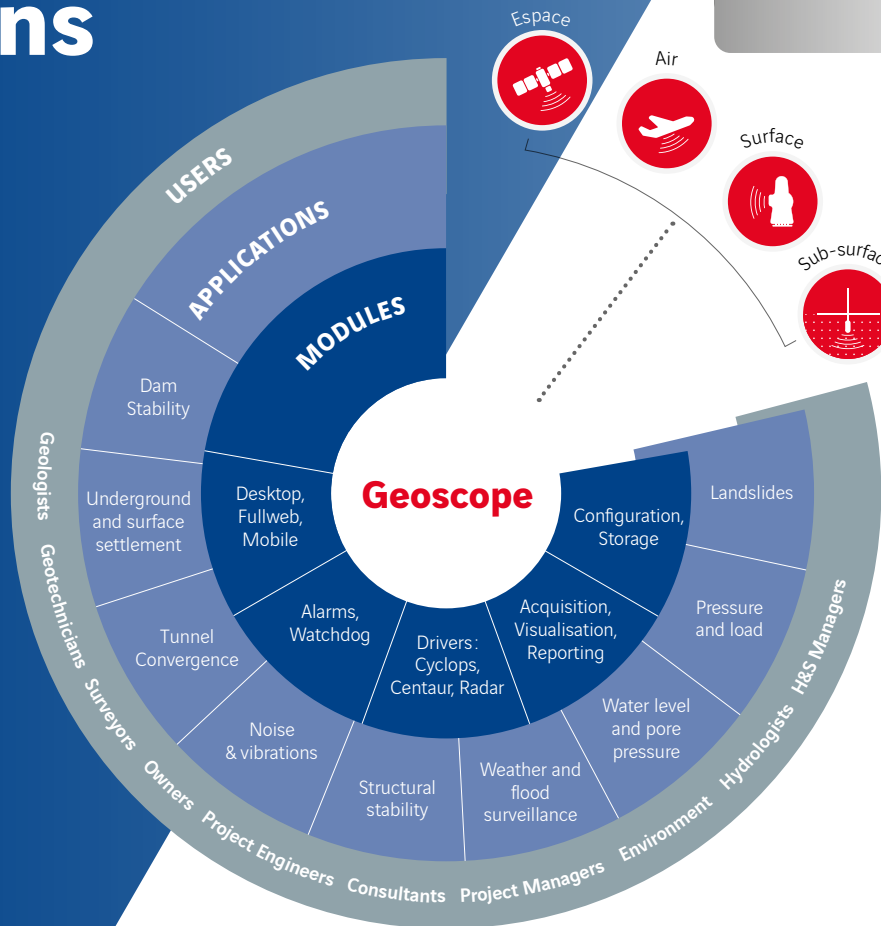
Our techniques include:

Electric Cylinder® & Cyljet®, electrical, seismic, radar, electromagnetic, magnetic, and gravimetric measurement.

Sourceless Seismic method

The application of the latest innovations in terms of predictive calculation using seismic noise means we can carry out rapid and non-invasive measurement programmes, with unrivalled quality of interpretation and diagnosis.

Our software solutions



Geoscope

RISK MITIGATION

Geoscope is a software tool that allows real-time management of data from your work site and the environment. It is a decision-making aid that enables you to anticipate and manage geotechnical, environmental and structural risks, allowing you to integrate data of all types derived from various sources and in several formats, notably provided by third-party services.

Geoscope provides real-time data monitoring using a powerful, multitasking data processing engine. It can handle all type of data source (sensors, dataloggers, acoustic, theodolite, etc.) and provide visualisations and rapid calculations for both simple and complex structures.

ScanPrint

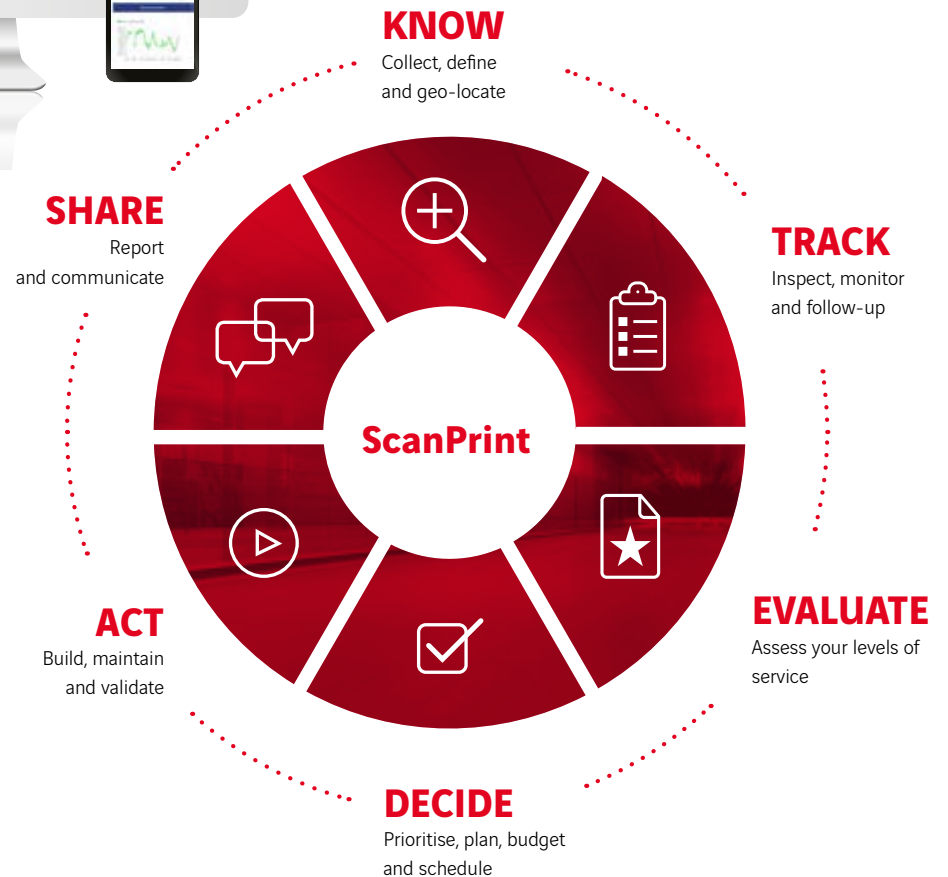
ASSET MANAGEMENT

ScanPrint is a personalised platform to manage all data pertaining to an infrastructure asset: management, surveillance and maintenance of infrastructure, and equipment.

The data and indicators generated by our instruments are integrated into ScanPrint via the software's Structural Health Management (SHM) module, along with the other visual surveillance or automatised data. The operator has direct access to indicators from ScanPrint SHM, which can then be shared with other service providers and stakeholders.

This module allows you to:

- ▶ Monitor and acknowledge alert messages and threshold exceedances,
- ▶ Monitor and analyse detected incidents,
- ▶ Schedule, carry out and monitor system maintenance and manual reading of sensors,
- ▶ Pre-analyse data to help with decision making,
- ▶ Give service providers access to data.



Analysis and engineering



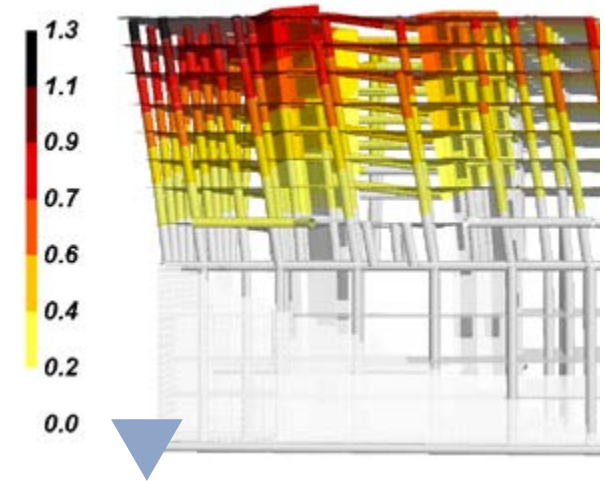


HELP WITH USING INSTRUMENTATION

Sixense offers a service to help with the operation, pre-analysis and presentation of data destined for management and engineering companies.

- ▶ Routine checks for correct instrumentation functionality,
- ▶ Regulation of the data acquisition system and use of filters,
- ▶ Monitoring and management of system functionality and behavioural alarms,
- ▶ Trend searches and setting of base thresholds,
- ▶ Expert analysis of topographical and geotechnical data,
- ▶ Expert analysis of acoustic data:
 - classification of acoustic incidents,
 - localisation of disconnected wires,
- ▶ Expert analysis of vibration data:
 - characterisation modes of propagation,
 - identification of behavioural anomalies or damage,
 - tension calculation in stay cables.
- ▶ Reports automatised or sent following exceptional incidents.

These services set out to provide data that is useable by civil engineering specialists in charge of the evaluation and management of work sites or structures.



ENGINEERING

Sixense offers applied engineering services for the analysis and interpretation of monitoring data.

Our experts will advise you and help you to:

- ▶ Understand the measured phenomena,
- ▶ Assess the significance of any detected anomalies,
- ▶ Advise on the need for intervention,
- ▶ Define actions to be taken.

Our applied solutions

URBAN WORKS MONITORING

STRUCTURAL MONITORING

BRIDGE MONITORING

URBAN EXCAVATION MONITORING

LANDSLIDE MONITORING

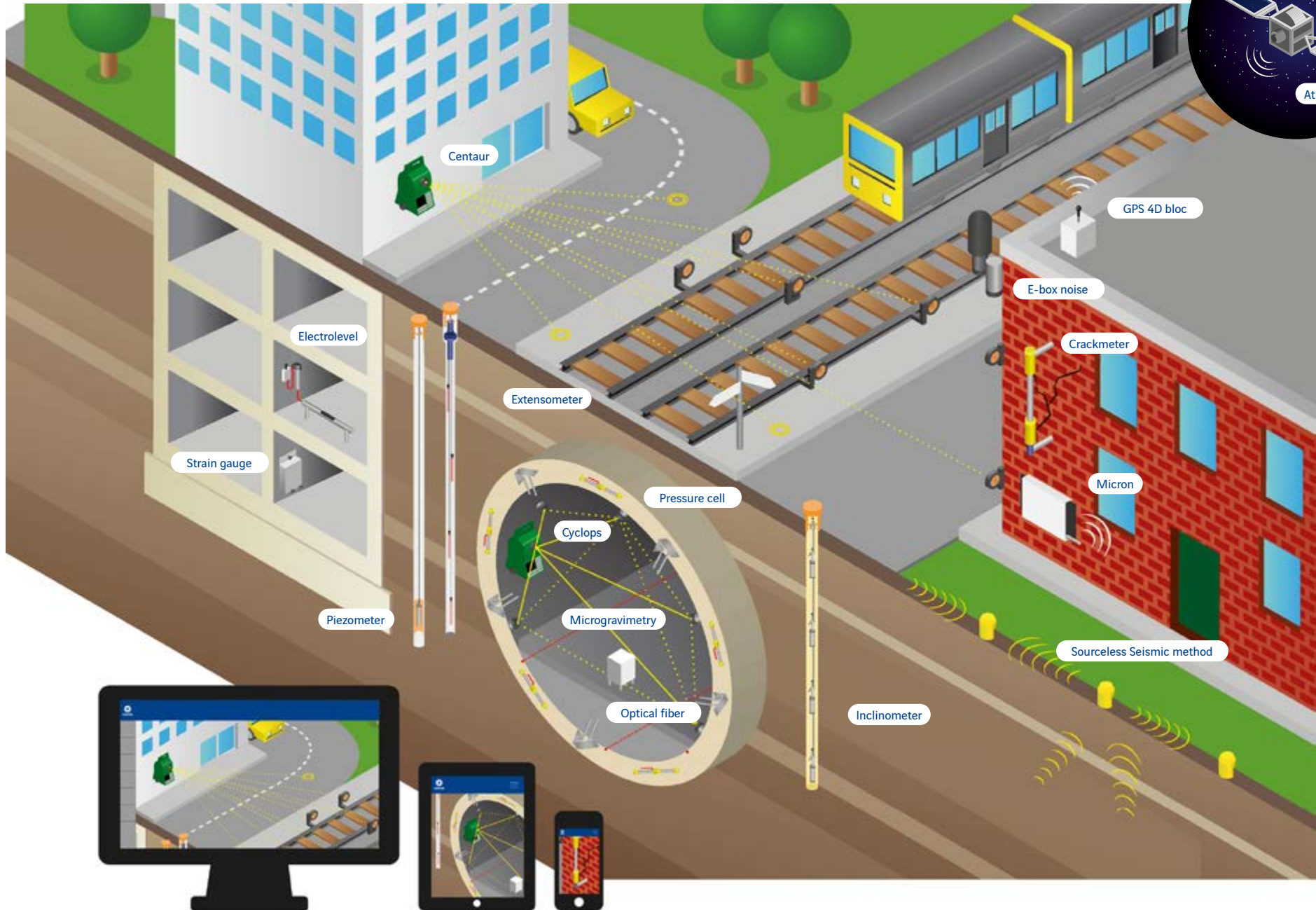
DAM MONITORING

INFRASTRUCTURE NETWORK MONITORING

MONITORING BURIED PIPES

MINE MONITORING

URBAN WORKS MONITORING



STRUCTURAL MONITORING



MONITORING BRIDGES



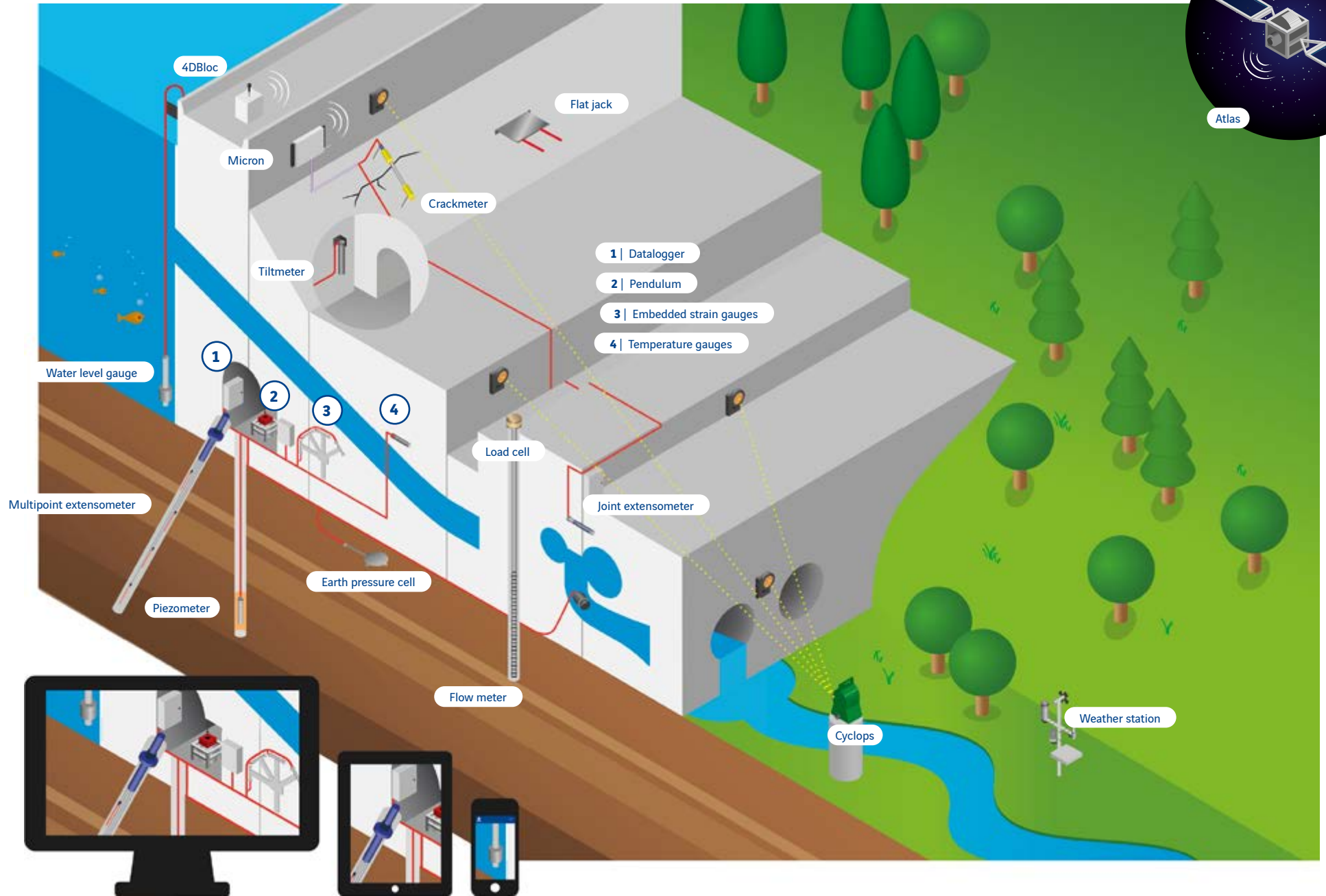
URBAN EXCAVATION MONITORING



LANDSLIDE MONITORING



DAM MONITORING



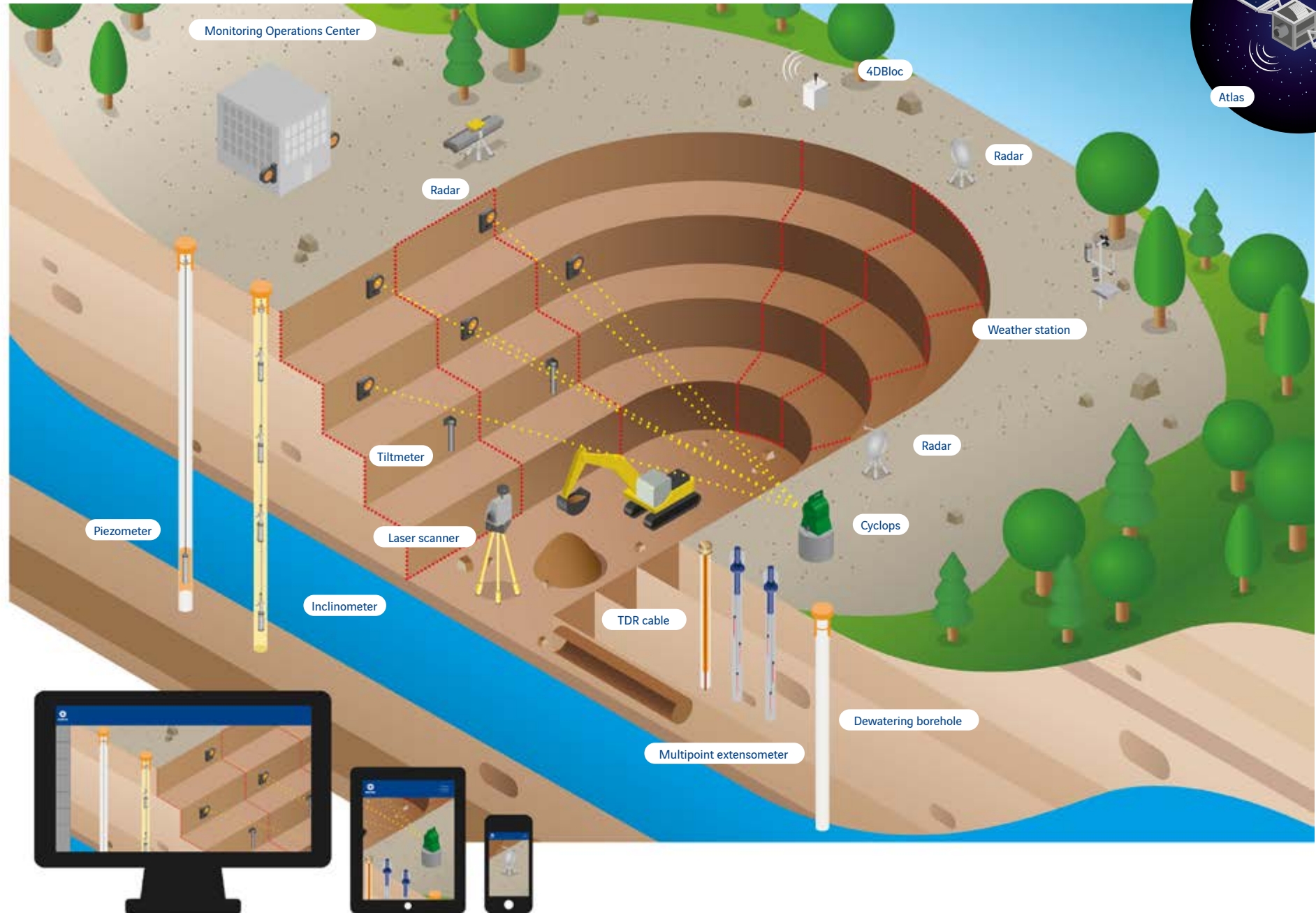
INFRASTRUCTURE NETWORK MONITORING



MONITORING BURIED PIPES



MINE MONITORING



References



TUNNELS & METROS

Noord-Zuidlijn, Amsterdam, NL
Crossrail, London, UK
Alaskan Way, Seattle, USA
Rennes Metro, France
Guadalajara Metro, Mexico
City Rail Link, Auckland, New-Zealand
Grand Paris Express, France

RAILWAYS & MOTORWAYS

LGV Sud Atlantique Europe, France
Trans Jamaican Motorway, Jamaica
Maliakos Kleidi, Greece
Olympia Odos, Greece
Microtunnelling under railways, France

STAY-CABLE, SUSPENSION AND OTHER BRIDGES

Ohio River Bridge, USA
Rio-Antirrio, Greece
Millau Viaduct, France
Bay Chai, Vietnam
Russki Island Bridge, Russia

Bosphorus Bridge, Turkey
Lysefjord, Norway
Second Severn Crossing, UK
Korabelny, Petrovsky Bridge, Russia

Chek Lap kok viaduct, China

DAMS

Plavinas, Latvia
Paso Piedras, Argentina
Saint Guérin, France
Boadella, Spain
High Grand Falls, Kenya
La Villita, Mexico
Malpaso, Mexico

HARBOURS & AIRPORTS

Port of Barcelona, Spain
Arsenal de Brest, France
Freeport Harbour, USA
Port of Marseille Fos, France

Abu Dhabi International Airport, UAE
New Mexico Airport, Mexico
Heathrow Express, UK



BUILDINGS & STADIUMS

Couvent des Jacobins, France
 Palace of Versailles, France
 Smithsonian Institute, USA
 British Museum, UK
 The Shard of Glass, UK
 King's Cross station, UK
 Louvre, France
 National French Library, France
 New Hospital Princesse Grace, Monaco

Vancouver stadium, Canada
 Parc des Princes stadium, France

ENVIRONMENT

Thames Tideway, UK
 E.ON thermal power plants, France
 Gamesa and Nordex windfarms, France
 Lafarge cement plants and quarries
 Tour Odéon, Monaco

LANDSLIDES

4 hill sides, Hong Kong
 Koudiat Acerdoune, Algeria
 Atatürk dam, Turkey
 Roquebillière, France

ENERGY & NUCLEAR

ANDRA underground laboratory, France
 Mont Terri underground laboratory, CH
 Salle Curan windfarms, France
 Chinon Air Coolers, France
 MAEVA model, France
 B211 Building, Sellafield, UK
 Dong Siri platform, Denmark
 N'Kossa offshore platform, Congo

MINES & INDUSTRY

Open pit diamant mine, Botswana
 Laser Megajoule, France
 ELI Superlaser, Hungary



Testimonials

« Since 2001, L'ANDRA and Sixense (formerly Soldata) have been developing an IT system able of managing more than 10,000 sensors distributed around the underground laboratory, the piezometric network, and environmental stations on the surface. The Sixense group has demonstrated its capacity to provide advice and optimal solutions, and to ensure the reliability of its measurement systems. Also shown is the expertise for the development and long-term maintenance of instrumentation systems and examination databases. »

Philippe Tabani,

R&D Engineer, data acquisition and instrumentation, Andra

« The Rio-Antirrio bridge was built in a seismic zone. The real-time monitoring system installed by Sixense allows us to analyse a large volume of data to have an overall vision of the structure and to benefit from automatic alerts immediately after a tremor. The great advantage of the system is that we improved safety, and for us, safety is of paramount importance. »

Aris Stathopoulos,

*Structural Maintenance Manager Gefyra SA/ VINCI Concessions,
Rio-Antirrio Bridge, Greece*

« As an important team member on the Alaskan Way Bored Tunnel Team, Sixense has provided unparalleled technical support, innovative solutions to complex challenges and an unwavering "can-do" attitude. »

David Sowers,

David Sowers - Deputy Program Director - WSDOT (Washington State Department of Transportation)

« I would like to personally thank Sixense and specifically the team which has, over several years supported the delivery of Crossrail. Sixense's contribution through the main C704 contract, through earlier contracts within our supply chain, and through your continued support with the satellite interferometry has proved invaluable.

As we approach the opening of Crossrail, one of the unseen successes of the project has been our ability to deliver the underground spaces without any appreciable settlement impact to the infrastructure above. This has represented one of the greatest delivery risks and we are indebted to Sixense for your skills, experience and professionalism in supporting our project. »

Simon Wright OBE,

Chief Executive, CROSSRAIL



sixense

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