

The all-in-one system for **Railway** Monitoring

The complete solution for Static SHM, Dynamic SHM and Geotechnical and Environmental monitoring

Track monitoring • Ballast void • Rail bridges • Subways • Track monitoring • Ballast void • Rail Bridges • Subways • Track monitoring • Ballast void • Rail Bridges • Subways • Track monitoring



Ballast void

Ballast conditions, settlement of the track, dynamic displacement and frequencies



Slope stability

Slope angle variations, groundwater level and weather conditions



Railway bridge

Oscillation and vibration peaks, modal analysis, deck deformation, span stability, joint behaviour



Railway tunnel

Convergence, longitudinal settlement, deformations and cracks

Smart Rail monitoring with Dynamic and Static Wireless IoT sensors



Twist monitoring

Monitor the expansion of the bridge joints to ensure that they expand and contract within acceptable limits.



TILT BEAM

Tunnel convergence

Monitor the convergence of the tunnel during its use phase to detect any changes in the walls over time and to prevent any long-term structural problems.

Tunne

ACCELEROMETER

Tilt.

Tilt.

TILTMETER

TILTMETER

Slope monitoring

Cant monitoring Monitor the angle at which the track is tilted to one side (cant) to optimize the performance of the track and rolling stock and ensure safe rides.

Install tiltmeters on a post in the ground

to monitor its inclination or subsidence

over time to identify possible instability.

Frequencies and modal shapes

Carry out the Operational Modal Analysis (OMA) of the deck by synchronizing accelerometers to identify relevant vibration modes and their evolution over time.



Bridge joint monitoring

Monitor the expansion of the bridge joints to ensure that they expand and contract within acceptable limits. Rail bridge

DDS - DYNAMIC DISPLACEMENT SENSOR

Ballast void monitoring

Monitor the voids or empty spaces between the ballast stones that support railway tracks to ensure the safety and stability of railway tracks.



Vertical settlement

Monitor the downward movement of the track and its supporting structures for early detection of uneven tracks.



Water pressure and level

Monitor the interstitial water pressure and changes in groundwater level to detect changes in the surrounding soil and potential hazards to the railway.



Wireless sensors for railway monitoring • Track monitoring • Ballast void • Rail Bridges • Subways



ACCELEROMETER

It measures acceleration (mg) and frequency (Hz) on three axes, and it can be synchronised to other Accelerometers SHM for modal analysis.



DDS DYNAMIC DISPLACEMENT SENSOR

It measures the dynamic amplitude of the displacement (mm) and the vibration frequency through an FFT algorithm.



It measures triaxial tilt changes, with a resolution of 0.000015° (0.00027 mm/m) and the option to be synchronized to other Tiltmeters.



It makes geotechnical and environmental probes suited for wireless communication, sending alarms when a certain activation threshold is exceeded.



It acts as an intermediary, using LORAWAN communication to collect data measured by the sensors and transmitting them to the IoT Platform where they can be processed and analyzed.



It consists of a series of Tiltmeters attached to a bar, which is then affixed to the structure to measure the degree of slope or tilt over a large area.

All our sensors are **battery powered** and they also measure **temperature**.

CASE STUDY Railway bridge • casella, Italy

Located on the Scrivia river, the bridge is about 160 meters long and is divided into 7 spans with lowered arches, in reinforced concrete. Move Solutions wireless SHM sensors were used to monitor the health of the structure; a **DDS** (Dynamic Displacement Sensor) was installed on the intrados of the arch and on the piles to record all the dynamic events caused by the passage of the train at high speeds, and a Tiltmeter was used to monitor the inclination of the structure.



The **Move Solutions IoT Platform** offers a single workspace to monitor and manage infrastructure project data. Automate the processing and diagnosis of data by receiving accurate and timely information about the health of a structure.

Cant along the tracks

The **Cant** is the transversal inclination of the railway expressed as the height difference in millimeters between two rails.

The cant is estimated using the angles provided by the **Tiltmeters** installed on the sleepers.





Twist along the tracks

The **Twist** is the difference between two transversal levels measured separately at a predefined distance.

To calculate twist it is necessary to process the data collected by two consecutive **Tiltmeters** on the sleepers.

Vertical settlement

The **Vertical settlement** graph shows the deformation profile of the track on the vertical plane.

Each point of the chart corresponds to the displacement values in millimeters provided by each sensor that forms the **Tilt beam** chain.



Learn more about all the tools of the Move Solutions IoT Platform www.movesolutions.it





Smart Structural Health Monitoring A comprehensive solution

Our Smart Structural Health Monitoring (SHM) system offers a complete solution that helps detect potential issues before they become critical, ensuring the safety and longevity of structures.



Wireless system

Avoid expensive and complex installations thanks to battery-powered, LoRaWAN-based and long-lasting devices.



Remote monitoring

View all sensor-collected data on our Cloud Platform, accessible from any computer at any time.



Configure sensors according to your needs to receive automated alerts of threshold breaches.

Static SHM

Static structural health monitoring measures slow-varying parameters over a long period of time, such as inclination, rotation, static displacement, and crack monitoring. This type of analysis is appropriate for structures that are subject to gradual load changes.

Dynamic SHM

Dynamic structural health monitoring is used to handle dynamic loading, such as frequencies, dynamic displacement, modal forms, vibrations and accelerations. This type of analysis is suitable for structures subject to fast impacts involving frequencies and vibrations.

Geotechnical & Environmental

The focus of geotechnical monitoring is on ground movement, settlement, slope stability, subsidence and any changes that may affect the stability of a structure. Environmental monitoring looks at factors like air quality, water level, soil contamination, wind speed and anything that can have an impact on the structure degradation.







SMART RAILWAY MONITORING

✓ Enhance safety ✓ Increase productivity ✓ Improve quality





www.movesolutions.it



- info@movesolutions.it
- **€** +39 338 263 9556
- Via Giovanni Battista Pirelli 11, 20124 Milano Italy
 Via Guglielmo Lippi Francesconi 1256/J 55100 Lucca Italy