move SOLUTIONS

Proactive **Bridge** Monitoring

The complete solution for **Static SHM, Dynamic SHM** and **Geo-environmental monitoring**

Piers • Cable stays • Abutments • Joints • Decks • Piers • Cable stays • Abutments • Joints • Decks • Piers • Cable stays • Abutments • Joints • Decks • Piers

Modal analysis

Operational Modal Analysis (OMA), Frequencies and Modal Shapes

Oscillation and vibration peaks

Frequency, Amplitude, Acceleration, and Dynamic Displacement

Deck Deformation

Deck static deflection, dynamic displacement, strain, and temperature changes

Span stability

Vertical and Lateral Displacements, Inclination, Strain, and Temperature distribution

Joint behaviour

Vertical and Horizontal Displacements, Rotations, and Temperature

www.movesolutions.it

✔ Enhance safety ✔ Increase productivity ✔ Improve decision-making

Smart Bridge Monitoring with Dynamic and Static Wireless IoT Sensors

SINGLE CHANNEL NODE + LOAD CELLS

Stay cables monitoring

Monitor the tension in the stay cables and supports of a bridge to ensure it is structurally sound.

ACCELEROMETER SHM

Stay cables frequencies

Monitor the tension and frequencies of the stay cables of a bridge to ensure it can safely support the weight of vehicles and pedestrians.

TRIAXIAL TILTMETER

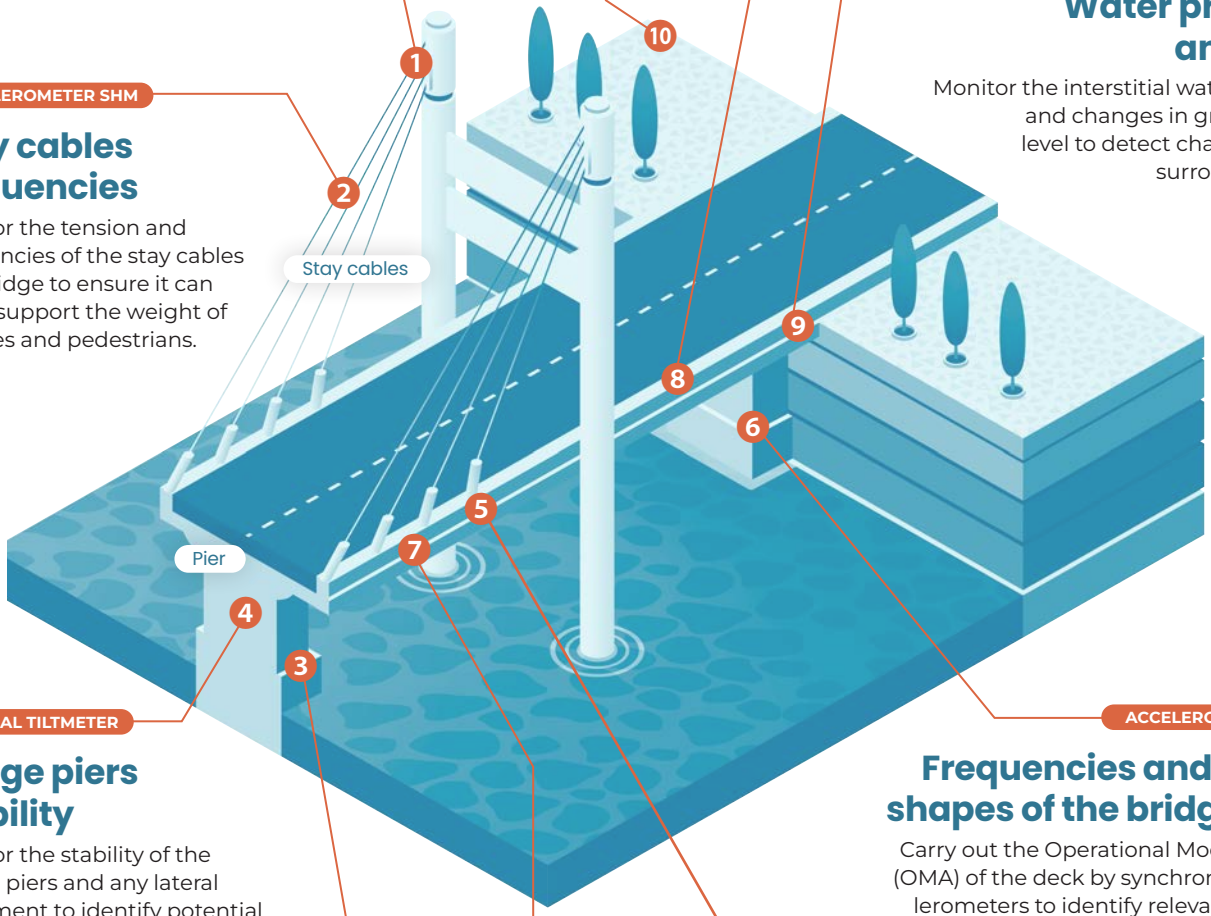
Bridge piers stability

Monitor the stability of the bridge piers and any lateral movement to identify potential structural problems.

DECK - DYNAMIC DISPLACEMENT SENSOR

Dynamic Displacement

Measure vibrations to increase safety and to comply with state regulations on structural monitoring, respecting the required threshold levels and sampling methods.



TRIAXIAL TILTMETER

Static Deflection

Analyse the deflection of the decks during static load tests to monitor the evolution of rotations over time.

SINGLE CHANNEL NODE + CRACKMETER

Bridge joint monitoring

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

SINGLE CHANNEL NODE + PIEZOMETER

Water pressure and level

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

ACCELEROMETER SHM

Frequencies and modal shapes of the bridge deck

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

SINGLE CHANNEL NODE + STRAIN GAUGES

Deformation monitoring

Monitor the deformation of deck, beam, and other structural elements to ensure the longevity of the structure.

Wireless sensors for bridge monitoring

• Piers • Cable stays • Abutments • Joints • Decks

2 6

ACCELEROMETER SHM

It measures acceleration (*mg*) and frequency (*Hz*) on three axes, and it can be synchronised to other **accelerometers SHM** for **Modal Analysis**.

3

DECK DYNAMIC DISPLACEMENT SENSOR

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

4 7

TRIAXIAL TILTMETER

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

1 5 8 9

SINGLE CHANNEL NODE

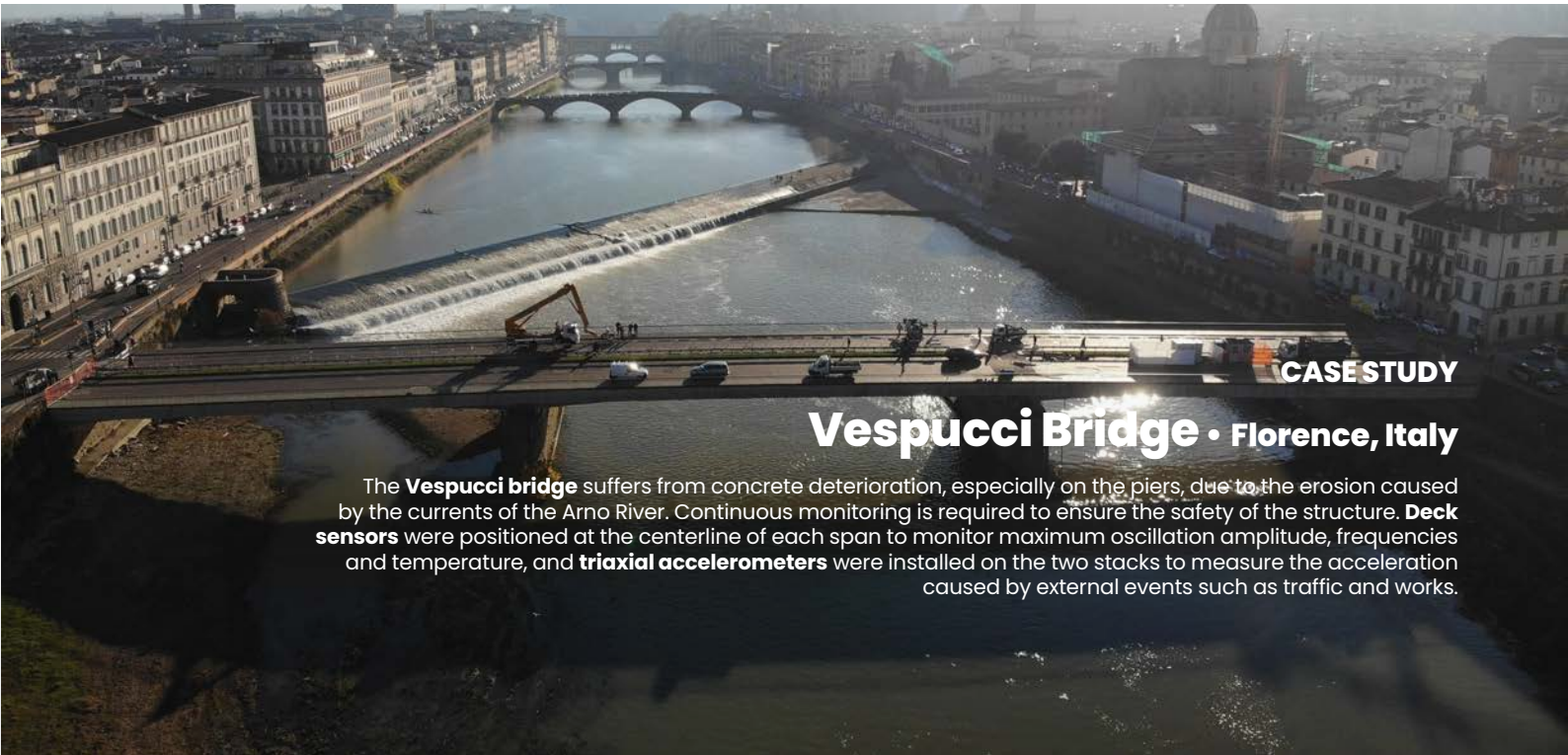
It makes **geotechnical and environmental probes** suited for wireless communication, sending alarms when a certain **activation threshold** is exceeded.

10

GATEWAY PRO

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

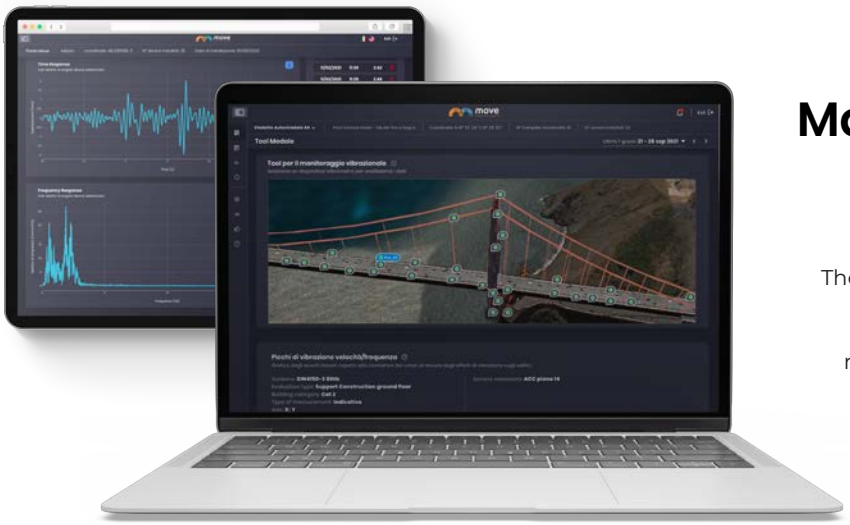
All our sensors are **battery powered** and they also measure **temperature**.



CASE STUDY

Vespucci Bridge • Florence, Italy

The **Vespucci bridge** suffers from concrete deterioration, especially on the piers, due to the erosion caused by the currents of the Arno River. Continuous monitoring is required to ensure the safety of the structure. **Deck sensors** were positioned at the centerline of each span to monitor maximum oscillation amplitude, frequencies and temperature, and **triaxial accelerometers** were installed on the two stacks to measure the acceleration caused by external events such as traffic and works.

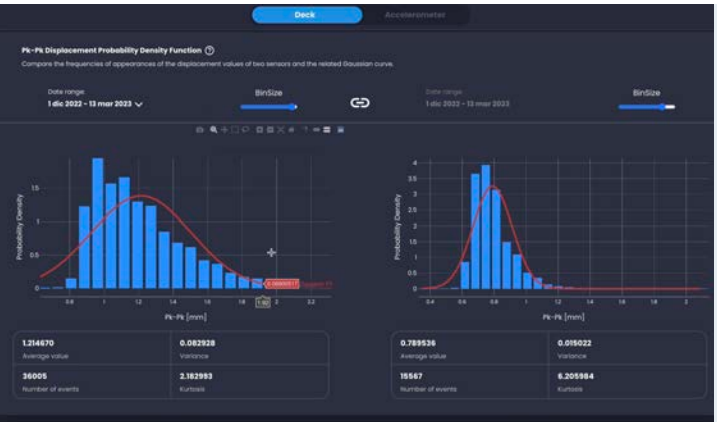


IoT Data Management
Make decisions based on clear information

The **Move Cloud 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.

Modal Frequency Tracking

Modal Frequencies Tracking is able to automatically monitor the variations of the vibrational modes over time. From the accelerometric or displacement data, it is possible to extrapolate the daily frequencies and modal shapes using the **FDD (Frequency Domain Decomposition)** technique.



Pk-Pk Displacement Probabilty Density

The histogram highlights the statistical distribution of **peak-to-peak displacement** values, in the selected time interval. In this way, it is possible to understand which is the average displacement of the structure and which is the uncommon one. An index of dispersion of the distribution with respect to its mean value is also provided.

Modal Frequency Clustering

Modal Frequency Clustering (MFC) displays similar modal frequency clusters in a structure.

Several statistics are provided such as the mean, standard deviation, and percentage change from the mean value of each cluster.

Learn more about all the tools of the **Move Cloud Platform**
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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.

Threshold setting

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

Static SHM

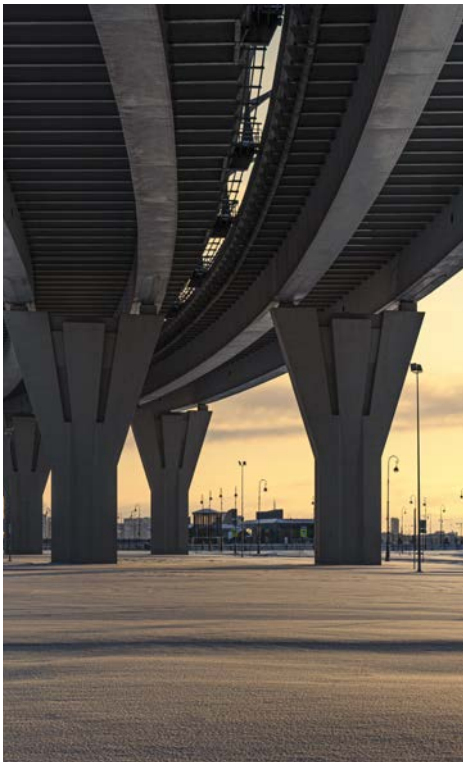
Static structural health monitoring measures slow-varying parameters over a long period of time, such as inclination, rotation, static displacement, and crack monitoring. This type of analysis is appropriate for structures that are subject to gradual load changes.

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.

Geo-environmental

Geo-environmental monitoring refers to the process of monitoring environmental factors that can impact the stability of a site, such as soil movement, groundwater levels, and changes in the soil's chemical composition.



SMART BRIDGE MONITORING

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