CASE STUDY

Structural monitoring of Asinelli and Garisenda Towers (Bologna)

Structural monitoring to investigate the conditions of the historical site.
SCOPE OF WORK

Structural and remote monitoring to inspect damages and variations

Structural monitoring allows to control masonry deformations and the variations in the stressing state of the supporting steel belts. The monitoring also inspects major damages, variations in the Towers’ declivity and trends in environmental parameters (i.e.: temperature, wind speed and direction).

The monuments in the centre of Bologna: Torre Garisenda and Torre degli Asinelli.
SERVICES

What we did to get to the end result

Once the scope is defined, studying what operations will have to be involved is the next step. For this project, expertise and resources came from Next Marine and Next Remote joining forces.

Structural monitoring

Installation and setup of remote sensors to control deformations and variations in the structure to preserve the historical site and the safety of visitors and nearby areas.

Acquisition, management and consultation of captured data on a restricted access portal

The Client can access captured data at any time, on a specifically developed portal with all the information sent by the sensors installed on the Towers. They’ve been sending data since 2011.

Real time monitoring

The collection, analysis and data transfer control via web provides a constant and accurate control of the monitored data in real time, with the most advanced analysis and control tools, such as land or Lidar Early Warning.
Check of eventual system damages

Ongoing monitoring also allows us to check possible system damages and fix them as soon as possible.
METHODOLOGIES

How we achieved the end result

Sixty-two transducers have been installed on the towers. The sensors send data on a preset and planned basis to data capture units installed by the Towers.

Data are then transmitted via GPRS and TCP/IP stack to a specific server, where they will be processed by a monitoring software. With this specific software, the Client can check figures detected over time on a restricted access platform. The software can also detect the sensors’ operational parameters, in order to get a correct diagnosis of possible issues.
OUR COMMITMENT

Quality, Health, Safety, Environment

We adopt QHSE Management Systems which embody all aspects of Quality Assurance, Competence Monitoring and Risk Assessment, as well as comprehensively addressing Health, Safety & Environmental issues.

Next is committed to always deliver products and services of a consistently high quality, aiming to meet and possibly exceed the Client’s requirements and expectations. The health and safety of employees and other persons involved are safeguarded, and proper regard is paid to the conservation of the environment.

NEXT QHSE Management Systems are fully in-house managed.
The assets involved in the project

As of today, the data capture system includes 22 motion sensors, 10 acoustic strain gauges, 14 inclinometers, 3 piezometers, 6 laser distance meters, 4 temperature sensors, 2 gonioanemometers and one meteo station.
Setting up one of the sensors.

Working on the top of the tower.

Evaluating the inclination of the tower.
## Sensors

<table>
<thead>
<tr>
<th>TORRE GARISENDA</th>
<th>TORRE ASINELLI</th>
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</thead>
<tbody>
<tr>
<td>9 Strain Transducers with invar wire placed on the masonry</td>
<td>8 Strain Transducers placed on the masonry</td>
</tr>
<tr>
<td>4 Strain Gauges placed on the supporting belts</td>
<td>5 Strain Transducers placed on the cracks</td>
</tr>
<tr>
<td>6 Biaxial Inclinometers</td>
<td>6 Strain Gauges placed on the supporting belts</td>
</tr>
<tr>
<td>3 Laser Distance Meters placed on the targets: Prendiparte Tower, Cupola of S. Maria della Vita, via S. Stefano 16</td>
<td>8 Biaxial Inclinometer</td>
</tr>
<tr>
<td>1 Goniometric Station</td>
<td>3 Laser Motion Sensors placed on the targets: Torre Prendiparte, Cupola of S. Maria della Vita, via S. Stefano 16</td>
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<tr>
<td>1 Meteo Station</td>
<td>1 Goniometric Station</td>
</tr>
<tr>
<td>2 Temperature Sensors</td>
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