BARTEC SYSCOM

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Case study - Monitoring of a bridge in Portugal

Vibration monitoring of A7 viaduto bridge in Portugal

Abstract

The A7 viaduto, close to the city of Vila Pouca de Aguiar, is a bridge located in the North of Portugal belonging to the A7 highway.

The national department for the improvement of hydraulic performance of Portugal has recently approved the construction of a 5 km tunnel, in order to make a communication between two dams of the region. Since the tunnel will be located very close to the bridge, the main construction company (Iberdrola) has requested the monitoring of the bridge (pillar and structure) before and during the excavation of the tunnel.

The company Alava Ingenieros SA has been selected for the vibration monitoring analysis. The solution composed by three MR3000C devices and the SCS cloud software is chosen for the monitoring. The devices are installed during January 2018.

The monitoring will last one to two years, depending on the work progress inside the tunnel.

Monitoring Summary

Project:	A7 viaduto
Location:	Close to Vila Pouca de Aguiar, in the north of Portugal
Objective:	Vibration monitoring of the bridge before and during the excavation of a new tunnel
Duration:	1-2 years
Device type:	MR3000C with internal triaxial velocity meter and embedded 3G module
Installation:	January 2018
Power input:	Solar panel connected to a battery
Data analysis:	SCS (https://scs.bartec-syscom.com)
Output:	Comparison with Portuguese norm NP 2074: Protection of structures subjected to vibrations.

Monitoring configuration

The map in Figure 2 shows the location of the MR3000C instruments on the bridge and the expected location of the new tunnel.

The MR3000C used for the structural vibration monitoring of the bridge have all the following characteristics:

- Internal triaxial velocity meter;
- Embedded 3G module for internet connection;
- Vertical mounting.

The pictures in Figure 3 show the location of the installed instruments, in the most critical zones of the bridge: MR1 is on the external part of the bridge deck (Figure 3a), MR2 is on a pillar (Figure 3b) and MR3 is on the bridge abutment (Figure 3c).

The instruments are connected to a solar panel with a battery, which is able to guarantee at least 10 days of continuous monitoring to the three instruments without sun (Figure 3d).

The acquisition settings are:

- **Event recording**: a different trigger threshold is defined for each instrument. This level is applied to the three axes (X, Y, Z).
  - MR1: 15 mm/s
  - MR2: 3 mm/s
  - MR3: 2 mm/s

  At MR1, installed on the bridge deck, it is expected to have larger velocity values compared to MR2 and MR3, due to the highway traffic and the position close to the middle of the first bridge span.
- **Background recording**: the velocity peaks of the three axes and of the vector sum are periodically saved every minute.

All the data recorded by the instruments are automatically sent to the SCS cloud software (https://scs.bartec-syscom.com) for easy remote assess and data management.

Figure 1. The A7 viaduto bridge, in the north part of Portugal.

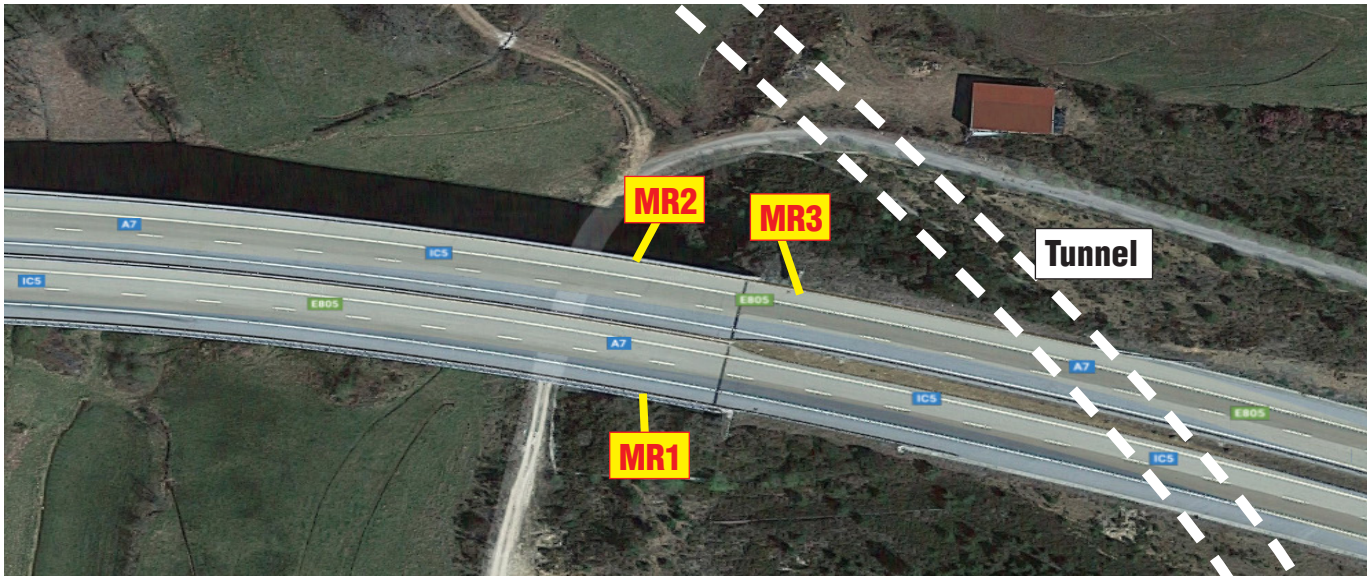

Figure 2. Map of the bridge and the future tunnel, with the MR3000C devices.

Figure 3. Instruments installed for the vibration monitoring of the A7 viaduto: a) MR1 on the external side of the bridge deck; b) MR2 on a pillar; c) M3 on the bridge abutment; d) solar panel and battery for the power supply of the MR3000C devices.

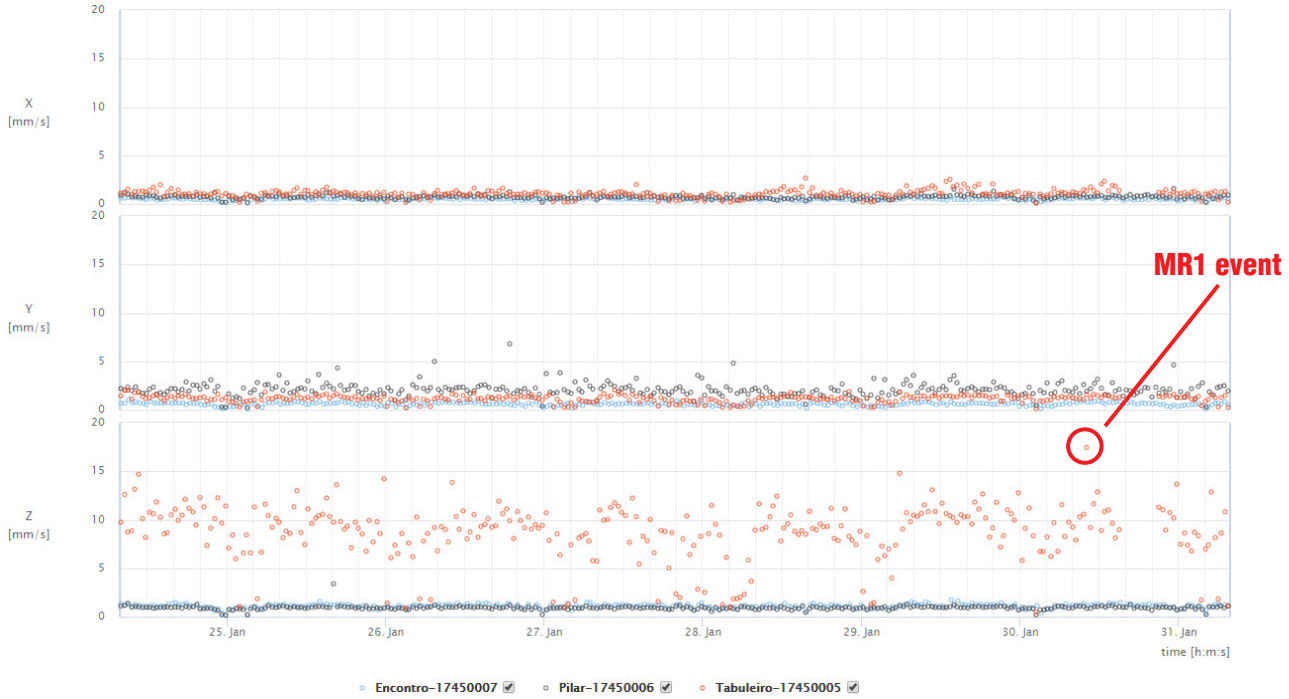

Figure 4. Background data: velocity peaks registered during the last week of January 2018.

Data analysis with SCS cloud software

The background files of the last week of January 2018 are showed in Figure 4. As expected, due to the highway traffic, the Z-components of MR1 has values significantly higher compared to the others, and one event is created (Peak Particle Velocity PPV is exceeding the trigger level set at 15 mm/s in the recorder).

When an event is created, it is immediately transferred to the SCS, which automatically generates a PDF report in near real-time with:

- time histories of the three axes and of the vector sum;
- FFT of the three axes;
- comparison with the Portuguese norm NP 2074.

The unique event of MR1 during the week is evaluated in Figure 5, where the comparison of the peaks with the NP 2074 norm is shown. The Z-peak exceeds the reference curves. For this reason, further analyses on the structure will determine if the structure could be damaged or if the trigger threshold could be increased in this point.

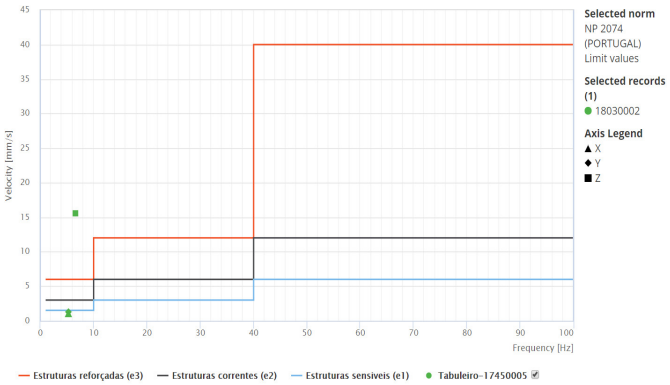

Figure 5. Comparison of MR1 event during the last week of January 2018 with the norm NP 2074. The three curves defined by the norm are chosen for the comparison.

Conclusions

The MR3000C devices from Bartec Syscom are installed for the vibration monitoring of the A7 viaduto in the north of Portugal, before and during the construction of a tunnel.

The MR3000C instruments are chosen because of the high reliability and embedded communication capabilities. By means of the internal 3G module, they automatically send data to the SCS, which analyses the data and sends in near real-time a PDF report with the time histories, the FFT and the graph comparison with the Portuguese norm NP 2074.

The MR3000C units are completely autonomous and independent, resulting in a very easy monitoring management, making the devices suitable for any kind of vibration monitoring projects.

Special thanks to Alava Ingenieros SA who allowed us to write this case study.

About BARTEC SYSCOM

SYSCOM Instruments SA is a subsidiary of BARTEC GROUP, a multinational manufacturer of industrial safety equipment. SYSCOM Instruments SA is a leading provider of vibration and seismic monitoring equipment for civil engineering and safety related markets, especially for NPP and LNG plants. SYSCOM Instruments SA reputation rests on the reliability of its products, coming from a meticulous control of every design and production aspects.

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