BARTEC SYSCOM

February 2021

Case study
Vibration monitoring during rail embankment piling work

Case study - Vibration monitoring during rail embankment piling work

Introduction

This case study presents the vibratory monitoring work required during the realization of a sheet pile curtain by piling. The embankment of SNCF tracks must be reinforced to ensure its stability by nailing technique. Structures and installations in a „sensitive state" are nearby and must benefit from vibration monitoring. The reference is based on the SNCF standard IN1226.

Figure 1. Pajot 2800 hammer used for piling

Figure 2. ROCK installed on a catenary pole

Project summary

Project:	Vibration monitoring during the construction of a sheet pile curtain for slope stabilization in Perdreauville (78), France
Contractor:	NGE FONDATIONS
Location:	Perdreauville (78), France
Objective:	Vibration monitoring of catenary poles, a bungalow, an electrical box and an aqueduc near the nailing zone of the embankment
Date:	Between February and June 2020, effective monitoring period of approximately 1 month.
Instrumentation:	7 ROCK devices with triaxial speed sensor and 6 months autonomy on internal battery
Data handling:	SCS (*https://scs.bartec-syscom.com*) cloud software with notifications per SMS and Email for threshold exceedance
Reference:	Conformity to the SNCF IN1226 standard, table C for powerful mechanical machines, vibrations not maintained (transient, repeated pulses)

Vibration monitoring device

The diagram below (Figure 3.) shows in yellow/red the layout of the 7 ROCK vibration monitoring devices, close to the SNCF tracks. Sensitive structures are also indicated in the plan below.

- C1 to C4 on catenary poles
- Bungalow
- Electrical box
- Acqueduc

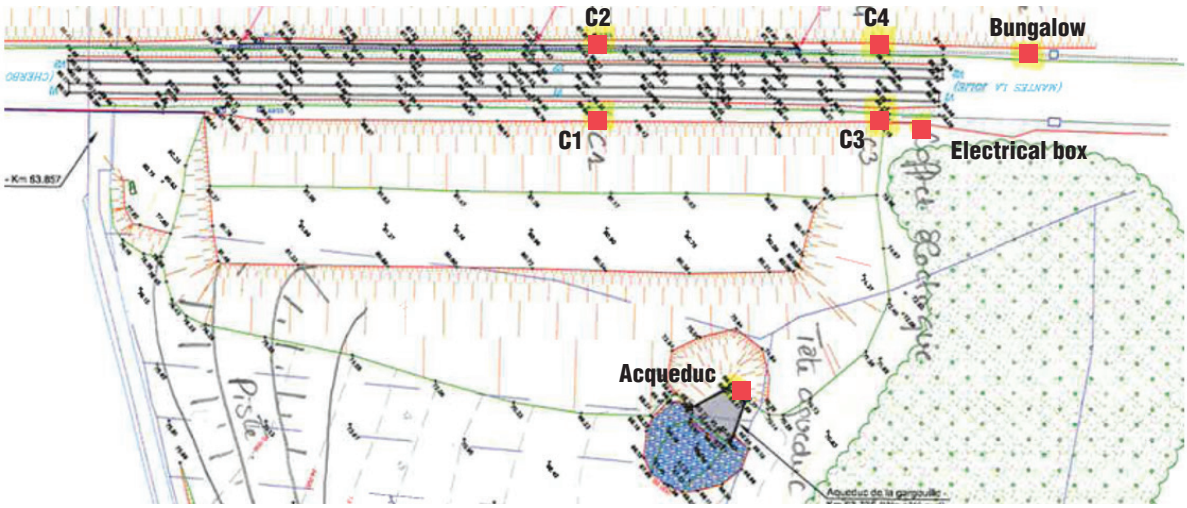

Figure 3. On-site vibration monitoring devices

Case study - Vibration monitoring during rail embankment piling work

BARTEC SYSCOM

Vibrations during piling work

In this case, Table C of the IN1226 for thresholds for powerful mechanical equipment within 30 m of the installations, for vibrations not maintained for hammers is applied (Figure 6.).
As the Pajot 2800 hammer used for sheet pile driving generates vibrations whose dominant frequencies are normally between 15 Hz and 25 Hz, the particle velocities of thresholds between 10 Hz and 30 Hz are selected, namely: 15 mm/s for the 4 devices on catenary poles and 9 mm/s for the remaining beacons on structures considered as sensitive.
2 thresholds are set accordingly on each beacon, namely an acquisition threshold and an alarm threshold not to be exceeded. Notifications are automatically sent directly by Email with PDF report and by SMS to the stakeholders.
If the vibration threshold is exceeded, the strike rates / frequencies must be adapted.

Figure 4. Stand-alone ROCK beacon, typical installation without cables

Figure 5. ROCK beacon close to the electrical box

Tableau C	Seuils* pour vibrations NON ENTRETENUES (transitoires, à impulsions répétées)				
Ouvrages et installations	Déplacements	Vitesses particulaire en mm/s			
	F < 5 Hz	5 ≤ **F** < 10 Hz	10 ≤ **F** < 30 Hz	30 ≤ **F** < 100 Hz	**F** ≥ 100 Hz
État jugé résistant (1)	**interdit ****	**8**	**12**	**15**	**20**
État jugé sensible (2)***	**interdit ****	**6**	**9**	**12**	**15**
État jugé très sensible (3)****	**interdit ****	**4**	**6**	**9**	**12**
Plateforme et poteau caténaire	interdit **	8	15	20	30

Figure 6. Table C of the IN1226, frequencies and amplitudes considered between 10 and 30 Hz.

Normative outcome evaluation

Example of time signal recording during piling with frequency transform (FFT) and comparison of the 2 levels, state considered as sensitive and catenary pole, of the IN1226.

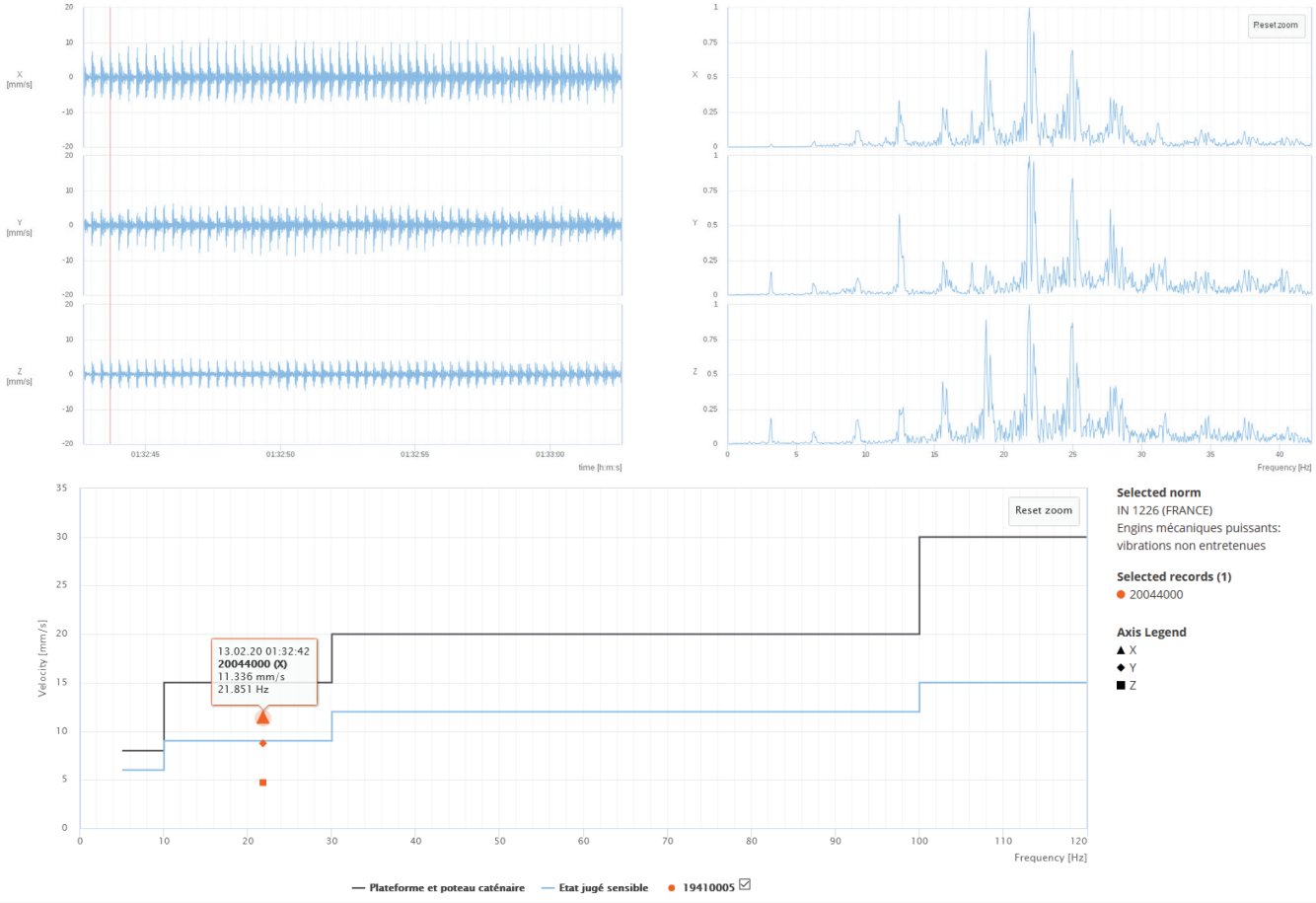

Figure 7. Time signal of an event, 3 orthogonal axes, with the Fourier transform. The dominant frequency spectrum is well around the 15-30 Hz range. Graphical comparison with the IN1226 directly with the Syscom Cloud Software.

Instrumentation

ROCK beacons are particularly adapted to this kind of vibration measurements, in difficult environments, without necessarily access to a stable power supply. In this case, power cables are difficult to deploy on site and the ROCK-SCS measurement solution is perfectly suited by allowing measurements with remote data access and a 6 months autonomy on internal battery. The software solution allows for very fast and extremely easy to set up notifications.

Main characteristics of ROCK devices:

- 6 months autonomy on internal battery, easy installation without the need for cables
- complete vibration monitoring solution with the SCS cloud software
- highly sensitive triaxial internal speed sensor with a measuring range of 135 mm/s (5.3 in/s)
- Beacon with integrated 4G LTE modem for remote monitoring and compact, rugged aluminum housing

Figure 8. Syscom ROCK beacon

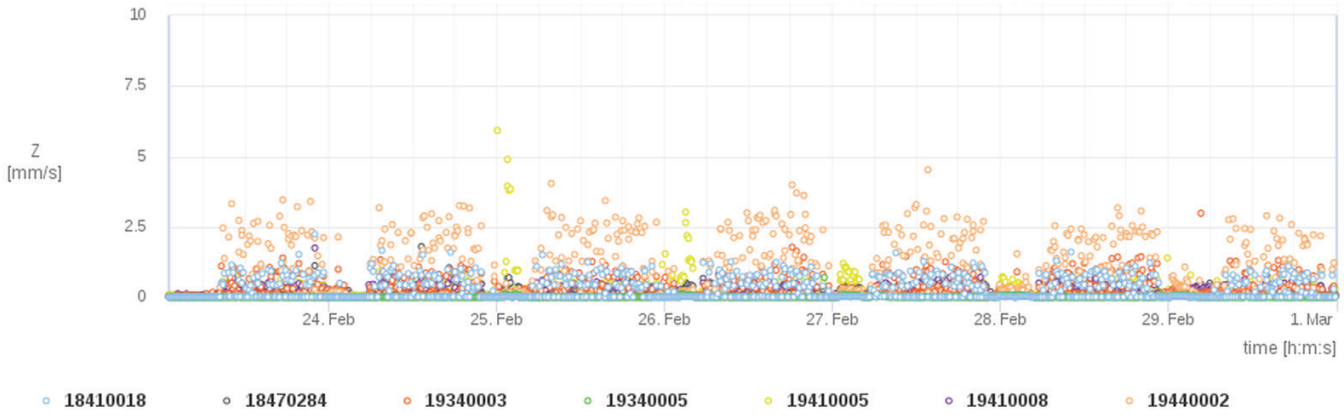

Figure 9. Weekly reading of the 7 beacons of the vertical measurement axis, no amplitude greater than 7mm/s, week in accordance with the IN1226.

Conclusion

The vibration monitoring made it possible to carry out the reinforcement work on the SNCF rail embankment and to guarantee its stability in an optimal way, by ensuring that the monitored structures were protected from vibrations of too great an amplitude. The vibration measurement solution was easy to operate and quickly installed, for monitoring that was carried out with great efficiency.

For more information about the study and the instruments, please contact AVNIR Energy or directly SYSCOM at the contact details below.

We are grateful to NGE FONDATIONS and AVNIR Energy for allowing us to write this case study.

https://www.ngefondations.fr/
https://www.avnir-energy.com/

About SYSCOM

SYSCOM Instruments SA is a subsidiary of BARTEC GROUP, a multinational company that manufactures industrial safety equipment. SYSCOM Instruments SA is a leading supplier of vibration and seismic monitoring equipment for the civil engineering and safety markets, in particular for nuclear power plants and LNG plants. The reputation of SYSCOM Instruments SA is based on the reliability of its products, resulting from a meticulous control of all aspects of design and production.

SYSCOM Instruments SA
SWITZERLAND

Rue de l'Industrie 21
1450 Sainte-Croix

T. +41 (0) 24 455 44 11

info@bartec-syscom.com
www.bartec-syscom.com