BARTEC SYSCOM

Case study Zurich train station Vibration monitoring

Vibration monitoring of train station and surrounding buildings in Zurich using SYSCOM MR3000C instruments

Abstract

The buildings surrounding the construction site for the renovation of the Central Station of Zurich must be continuously monitored, to ensure that the vibration values do not exceed the limit thresholds defined by the Swiss norm SN 640312a. For this reason, 4 MR3000C monitoring devices have been installed in different locations, in order to record the vibration and to automatically send notifications in case of exceedance of the limit threshold.

Summary

City:	Zurich, Switzerland
Customer:	Porr Suisse AG
Monitoring company:	Ziegler Consultants
Objective:	Vibration monitoring during construction works
Locations:	Zurich Central Station and surrounding buildings in Europaallee
Recorders:	4 MR3000C
Sensors:	Internal velocity sensors
Survey duration:	2 years

Figure 1. The construction site, with the train station on the left and the buildings on the right.

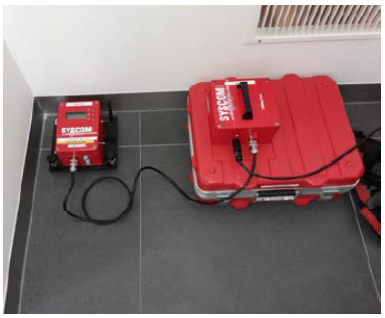
Monitoring plan

The Central Station of Zurich is the most important train station in Switzerland with a daily amount of about 400'000 passengers. The works to build a new shopping and business mall near the main station started in May 2015 and will last until May 2017. A monitoring system is installed in order to verify that the vibration levels in the buildings surrounding the working site, along Europaallee, do not exceed the maximum levels defined by the Swiss regulation SN 640312a for sensitive buildings and frequent vibration.
The site map is displayed in Figure 2. The four measurement points MP1-MP4 have been equipped with a MR3000C with:

- Internal triaxial velocity sensor, to have a compact solution for vibration monitoring according to the Swiss regulation;
- GPRS module, in order to send automatic notifications (alarms and State-Of-Health messages) both via e-mail and SMS, and to have a real-time display of the vibration level;
- External battery, in case of main power loss.

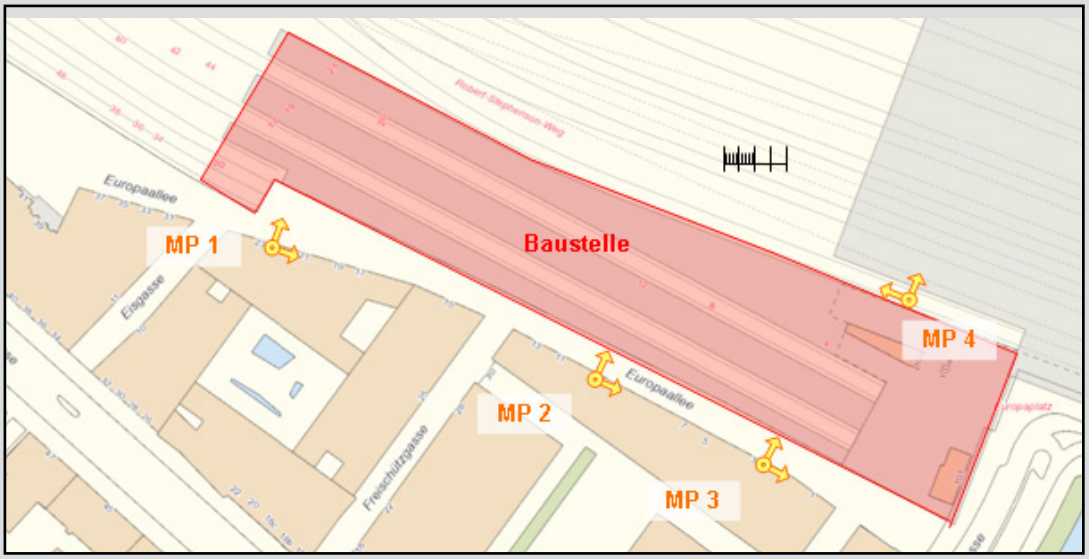
The MR3000C in the measuring points MP1, MP2 and MP3 are located inside different buildings while the MR3000C in position MP4 has been installed in the new underground train station, next to track 31 (see Figure 3).

a)



b)

Figure 3. MR3000C in MP1 (a) and MP4 (b).



NOTE: The red zone delimits the construction works between the train station and the buildings on Europaallee.

Monitoring points and threshold values

MP	Location	Trigger	Alarm 1	Alarm 2
MP1	Europaallee 23	0.5 mm/s	2 mm/s	4 mm/s
MP2	Europaallee 11	0.5 mm/s	2 mm/s	4 mm/s
MP3	Europaallee 3	0.5 mm/s	2 mm/s	4 mm/s
MP4	Train station, platform 31	1.0 mm/s	2 mm/s	4 mm/s

Notification actions

Level exceeded	Automatic action done by MR3000C
Trigger	Creation of an event
Alarm 1	SMS sent to a local operator
Alarm 2	SMS sent to a local operator and to the monitoring supervisors

NOTE: The actions are the same for all the MR3000C.

Figure 2. Overview of the monitoring project.

Data analysis

In Figure 4, the background values recorded at MP1 during two days in October 2015 shows the different vibration levels between day and night. The vibration are higher between 7:00 and 12:00 and from 13:00 to 16:00, corresponding to the working time period on site.

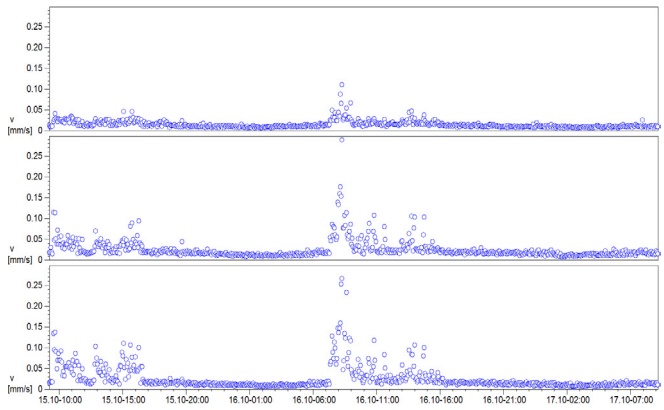


Figure 4. Background values recorded at MP1 between October 15th and 17th, displayed with EAW Light.

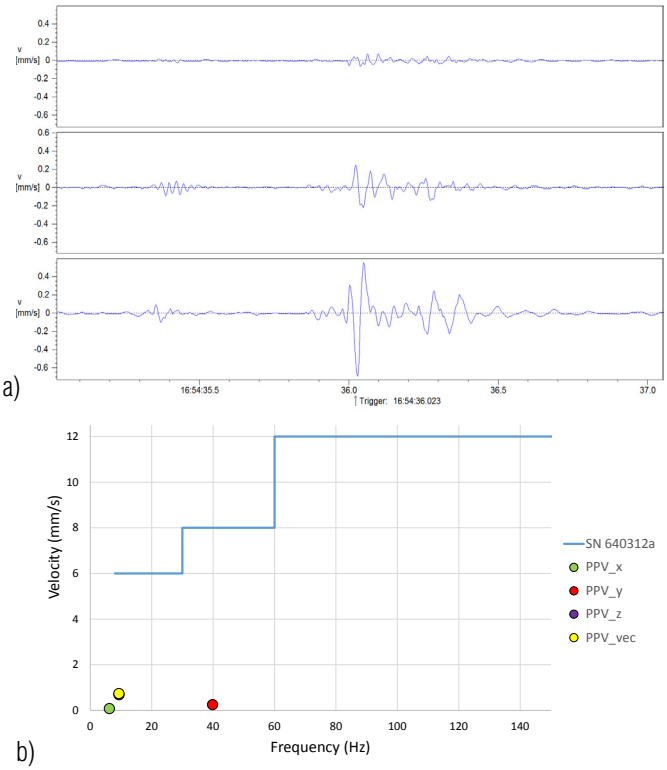


Figure 5. Event recorded in October 2015 on MP1: Time histories (a) and comparison with the Swiss norm SN 640312a (b).

In Figure 5, the most critical event recorded at MP1 during October 2015 is shown. For each event, the maximum velocity and frequency for the three axes and the vector (module of the three components) are saved. These values are called PPV (Peak Particle Velocity). As in most cases, the vertical component (z-axis) is the predominant one.

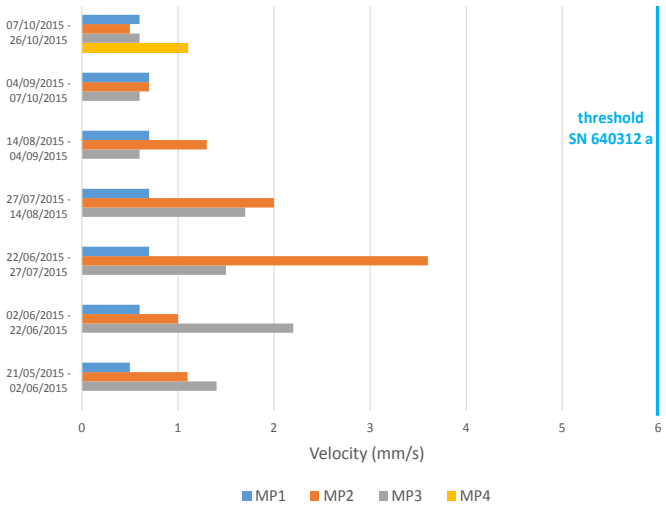


Figure 6. Maximum vibration values from May 2015 to October 2015.

The PPVs of the event are then compared with the limits defined by the Swiss regulation SN 640312a. In particular, the values are compared with the curve for “sensitive buildings“ and “frequent vibration“, since the monitoring is performed on commercial buildings and the works are realized every day from monday to friday.
In Figure 6, the maximum values saved in different periods between May 2015 and October 2015 are displayed. MP4 has been installed only at the beginning of October. Up to now, the vibration levels never reached 6 mm/s, critical threshold defined by the Swiss norm for the low frequencies.

Conclusions

Four MR3000C devices have been installed in the Central Station and in the surrounding buildings in order to monitor the vibration produced by the construction site, both for insurance purposes and for conformity to the regulations. The data are evaluated by the Swiss company Ziegler Consultants with a monthly reporting about vibration levels recorded during the construction works. In case the threshold limit will be exceeded, the intensity of vibration sources on site (like excavations, pneumatic drills, ...) will be immediately reduced.

Special thanks to Ziegler Consultants and Porr Suisse AG 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 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 reputation rests on the reliability of its products, coming from a meticulous control of every design and production aspect.

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