SYSCOM Instruments

REM vibration monitoring, Montréal, Canada

Case study

April 2019

Monitoring of the REM in Montréal with MR3000 & ROCK devices during 5 years

Abstract

The Réseau express métropolitain (REM) is a major public transit project under construction across the Greater Montréal. It is the largest public transit project undertaken in Québec in the last fifty years and will be doubling the length of the current metro network. It will have 26 stations and 67 km of new tracks (Figure 1.), in order to move around the city in a much easier way and to avoid traffic congestions. The new line will also link the city center to the Montréal-Trudeau airport in about 20 minutes and its completion is expected around 2023.

NouvLR is the consortium in charge of the construction works for the REM and will have to comply with the vibration threshold guidelines given by the FTA (Federal Transit Administration).

Geophysics GPR (Syscom local partner) is in charge of the complete vibration surveillance during the whole project duration. MR3000 & ROCK devices (Figure 2.) were selected to perform the monitoring due to their best in class specifications and near real-time monitoring capabilities. Linked to the Syscom Cloud Software (SCS) for data processing and automated reporting, this proven solution provide the best return on investment for such major projects.

Monitoring Summary

Project:	REM, Montréal (Canada)
Sector:	The whole line
Objective:	Vibration monitoring of buildings, existing metro lines, sensitive structures surrounding the construction sites in order to comply with FTA guidelines
Duration:	Minimum 5 years
Device type:	MR3000C, MR3000BLA & ROCK
Devices installed:	>80
Output:	Data transferred to SCS (Syscom Cloud Software) for near real-time data processing, alarming, automated reporting and easy data sharing when an alarm level is exceeded.

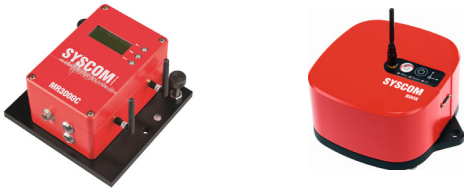

Figure 2. Syscom MR3000C & ROCK vibration monitoring devices

Key Facts - Réseau express métropolitain (REM)	
City:	Montréal (Canada)
Nbr of line:	1
New railway length:	67 km
New stations:	26
Initial fleet:	240 cars
Automatization:	100% electric and automated light metro
Start-up:	From 2021 until 2023
Budget:	~ 6.3 billion CAD (~4.3 billion EUR)

Figure 1. Map of existing metro lines with the new REM line highlighted in green

Monitoring configuration

The MR3000C, MR3000BLA & ROCK used for the structural vibration monitoring have the following specifications:

- High sensitive internal triaxial velocity meter, class 1 according to DIN45669-1;
- Embedded 3G or 4G modem for internet connection through mobile network;
- Vertical or horizontal installation, depending on the location;
- SCS compatibility for automated data processing.

MR3000C is widely used and specifically designed for construction site monitoring and during tunneling work. MR3000BLA is most suited for blast induced vibration monitoring, when air pressure is of concern. ROCK devices are an ideal solution when power supply is not available due to its extended autonomy of up to 6 months on sole internal batteries.

Federal Transit Administration (FTA) vibration guidelines

A very clear objective for the REM during construction work is to avoid or minimize impacts on local residents through the implementation of appropriate measures.

In this regard, the two tables in Figure 3. show the acceptable vibration thresholds during construction of the REM for buildings protection and in the operating phase, when the trains are running.

During operations, the thresholds are relevant for more than 70 vibration events per day.

Seuils de vibration de construction pour la protection des bâtiments (FTA)

Type de bâtiment	Seuils de vibration	
	mm/seconde	VdB
Béton armé, acier ou bois (sans plâtre)	12,7	102
Béton ou maçonnerie (sans plâtre)	7,6	98
Bâtiments en bois et maçonnerie	5,1	94
Bâtiments sensibles aux dommages par vibration	3,1	90

Seuils de vibrations en exploitation (FTA)

Type de bâtiment	Seuils de vibration Pour plus de 70 événements de vibrations par jour	
	mm/seconde	VdB
Catégorie 1 – Haute sensibilité	0,045	65
Catégorie 2 – Résidentiel	0,101	72
Catégorie 3 – Institutionnel	0,143	75
Studio d'enregistrement	0,045	65
Auditorium et salle de théâtre	0,101	72

Figure 3. FTA threshold limits

Figure 4. MR3000C monitoring station Edouard-Montpetit

Station Edouard-Montpetit monitoring

Sixteen measuring points are located around station Edouard-Montpetit, where several sensitive infrastructures are located, such as:

- Tunnel under Mont-Royal
- Metro line (blue line)
- Sensitive laboratories
- Housing

Refer to Figure 4. for some pictures of the Edouard-Montpetit construction work timeline.

Measuring modes and real data set

In order to fully comply with the guidelines, a 24/7 permanent monitoring is put in place. Two measuring modes are used:

- Trigger based - when a pre-defined vibration amplitude is exceeded, the system records data and potentially raises alarms;
- Background based - continuous monitoring of the peak amplitudes (X,Y, Z), of the Vector Sum and of the dominant frequency during consecutive periods of 30 seconds.

The trigger mode allows extended event post-processing analysis at high sampling rate. The background recording gives a quick overview of the vibrations on-site over a long period of time. This also guarantees that the monitoring is active 100% of the time when visualizing the whole timeline in the SCS.

Refer to Figure 5 and 6 for Trigger and Background examples.

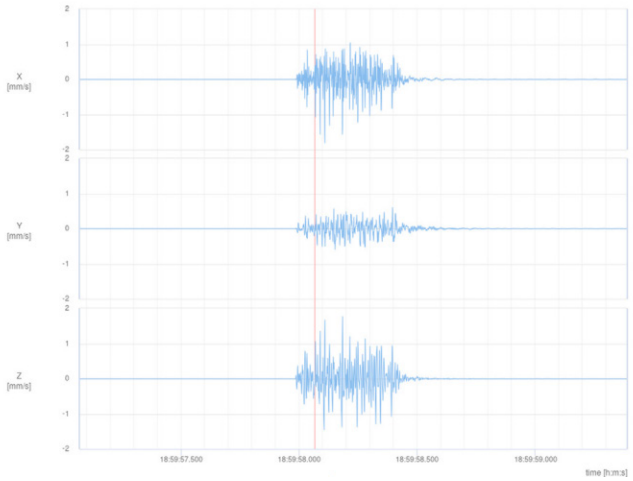

Figure 5. MR3000C triggered recording

Figure 6. Background recording with 8 MR3000C devices on 1 site

Conclusion

Monitoring the vibrations induced by the construction of the REM is a key factor in minimizing and mitigating their impacts on the environment. Thanks to Syscom devices and Geophysics GPR know-how, the vibration monitoring solution put in place for the REM will give NouvLR reliable real-time information and consequently allow them to remain fully compliant to the FTA guidelines.

Special thanks to Geophysics GPR who allowed us to write this case study.

GEOPHYSICS GPR INTERNATIONAL INC.

About Syscom

SYSCOM Instruments is part of Terra Insights platform of trusted monitoring technology brands. Terra Insights is the industry's first, end-to-end sensor to cloud data delivery platform that supports proactive, risk-informed decision making and monitoring. 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.

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