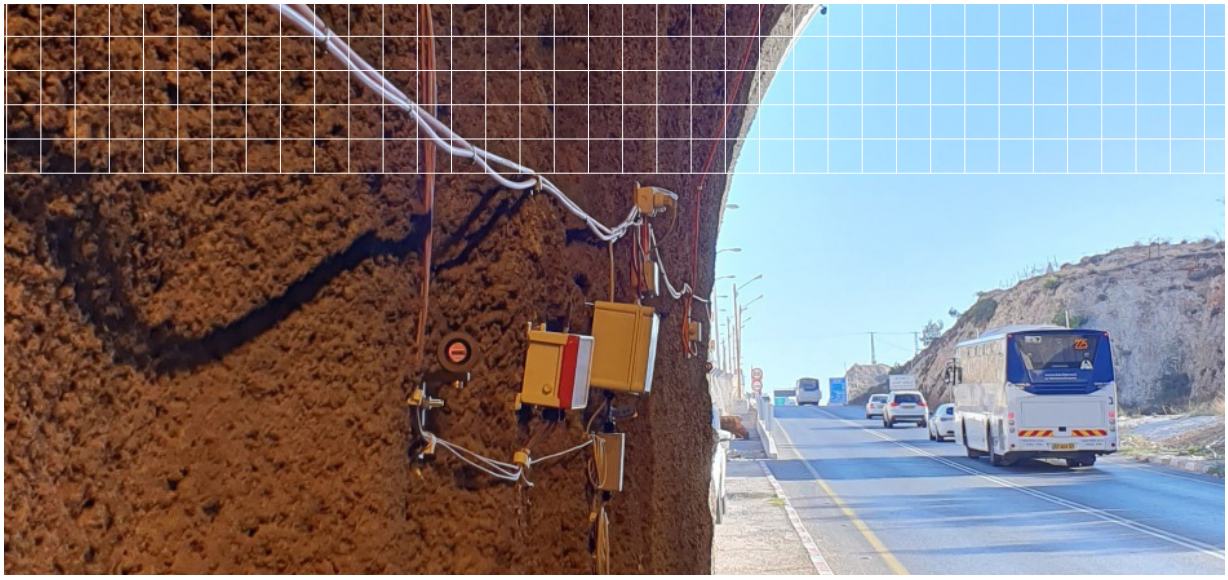
SYSCOM Instruments



Tunnel monitoring, Israel

Case study

January 2020

Monitoring of an existing tunnel next to a new tunnel excavation in Israel

Abstract

A new tunnel on road 60 between Gush Etzion and Jerusalem is under excavation using blasting techniques and heavy machinery. An existing tunnel located next to the new tunnel should remain in operation to road traffic during blasting and is therefore fully instrumented. The vibration monitoring has to be executed before, during and after each blast activities and the monitoring devices used must be compliant to DIN 45669-1 standard. The automatic vibration monitoring data have to be shared online and in near real-time according to DIN 4150-3 standard.

MR3000C devices connected to the SCS (Syscom Cloud Software) are installed to perform the vibration monitoring under the responsability of Syscom partner in Israel, Medidot-Advanced Monitoring Technologies Ltd.

Other geotechnical instrumentations are part of the complete tunnel monitoring, among them are total stations, displacement rods, stress cells and a 3D laser scanner.

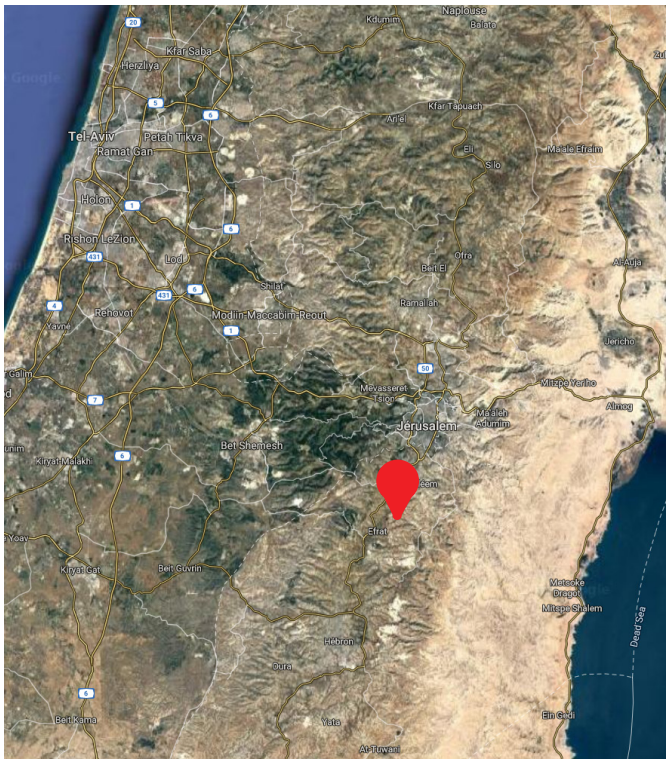


Figure 1. Location of the new tunnel in Israel.

Monitoring Summary

Project:	New tunnel digging using blasting techniques and heavy machinery
Contractor:	Shikun & Binui Group
Location:	Road 60, between Gush Etzion and Jerusalem
Objective:	Automatic vibration data acquistion and transfer to a post-processing software in order to comply with DIN 4150-3 and ensure no impact on existing traffic road during monitoring
Date:	From November 2019 lasting several months
Device type:	9 MR3000C with internal triaxial velocity sensor & embedded 4G modem: 4 on the ceiling & 5 on tunnel wall
Data analysis:	SCS (scs.syscom-instruments.com) with E-mail notification and automated PDF reporting (event & background)
Output:	Compliance with German norm DIN 4150-3

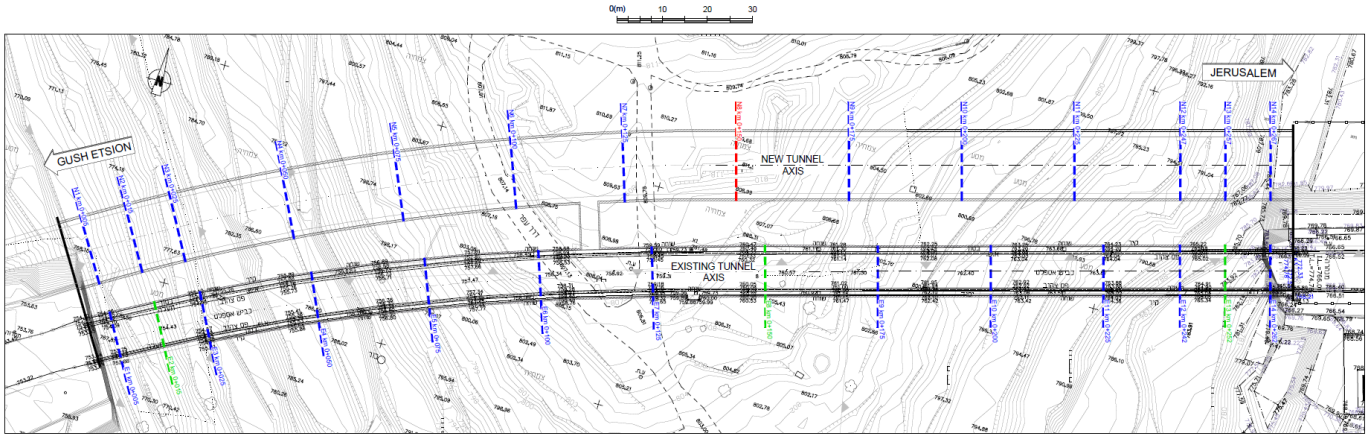


Figure 2. Location of monitoring sections, top view. Standard blue sections, special red section on new tunnel, special green sections on existing tunnel.

Vibration monitoring only on existing tunnel.

Tunnel head monitoring

In order to get relevant data along the work, the MR3000C devices have to be moved several times following the tunnel head, re-setting their location with the excavation advance every 10 meters, as defined by blue tunnel sections according to Figure 2.

The location of the geophones are therefore always located next to the head work as designed in Figure 3 related to Position i and Position i+1.

VS1 to VS5 labels refer to vertical wall mount MR3000C while VC1 to VC4 labels refer to ceiling mount MR3000C.

The below photos illustrate the very good installation and coupling between the rock and the instruments in order to guarantee a perfect transmission of the blast and machinery induced vibrations without unwanted interferences. This is fundamental to ensure genuine data without alterations of signals amplitudes and no amortization or amplifications of signals frequency spectrums.

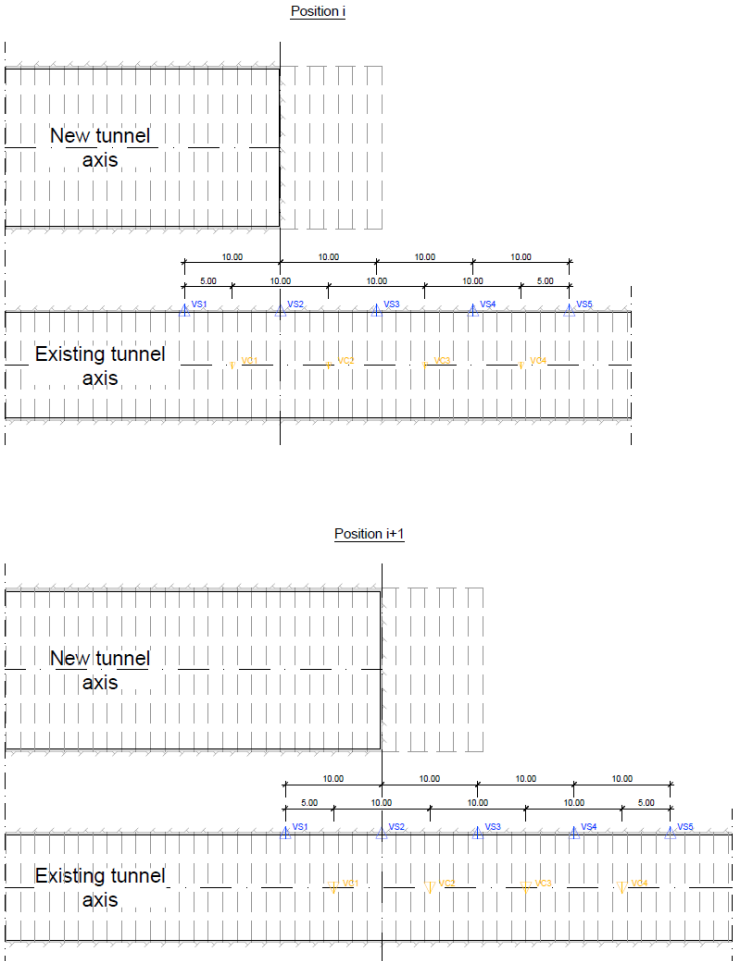


Figure 3. Location of the geophones following the tunnel head.

a)

b)

c)

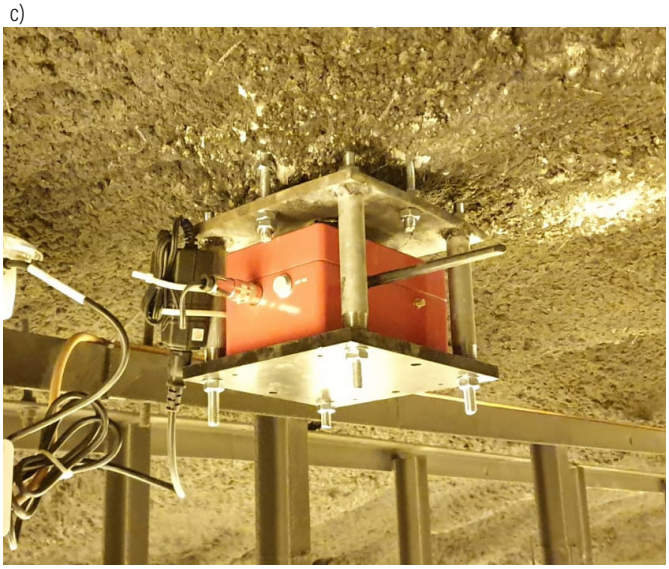


Figure 4. Different installations of MR3000C devices: a) with protective plastic housing, b) wall mount and c) ceiling mount.

Near real time notifications with Syscom Cloud Software (SCS)

A specific project objective is to have data uploaded and shared online to stakeholders. Thanks to the SCS, this task is fully automated with each MR3000C transferring their recordings directly to the cloud, then processed for an event or a periodic based reporting and generating E-mail and/or SMS alarms in case of DIN 4150-3 exceedance with very limited warning latence (sub-minute range).

The following screens are representative of a continuous monitoring of data points during the entire project life. On Figure 5 the background plot, as named in the SCS, is very suitable for long term monitoring giving very easy data interpretation about the average vibration level on site.

Figure 6 representing a graph with peak velocity amplitudes versus dominant frequencies. As clearly highlighted, these signals give genuine information related to the tunnel structure natural frequencies. That could be further processed and analyzed using several techniques related to experimental modal analysis, SHM (Structural Health Monitoring) or also using FEM models for computational comparisons.

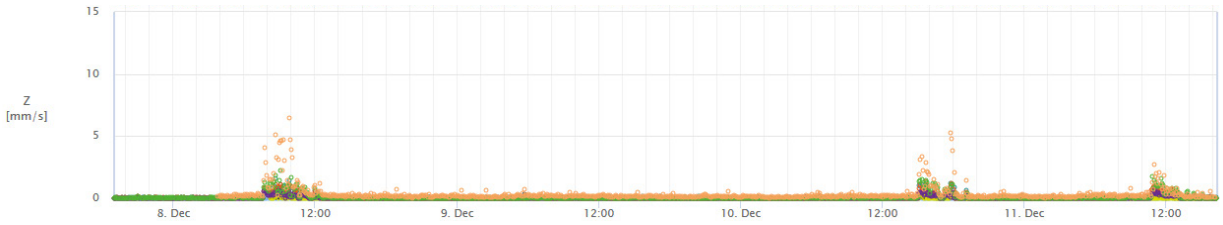


Figure 5. Z axis plot related to a 4 days background monitoring.

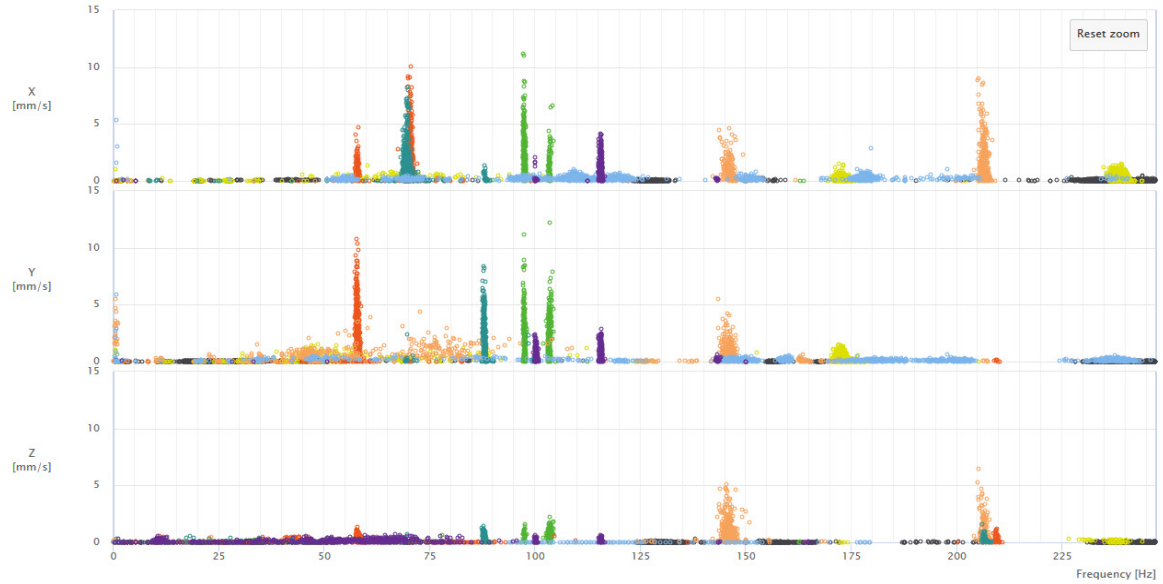


Figure 6. Peak (mm/s) vs Freq (Hz) 3-axis plot during 1 week monitoring for 9 MR3000C devices.

Conclusion

Automatic data acquisition in near real time with quick and reliable notifications processed using Syscom MR3000C devices and SCS cloud processing solution is a very effective monitoring combo. This solution ensures a safe and reliable monitoring of the blasting activities, providing no impact on existing traffic on road 60. It is fully compliant to contractor expectations and widely used geophones based standard DIN 45669-1 (instrument wise) and DIN 4150-3 (structure wise).

Do not hesitate to contact directly Syscom for more information about structural vibration monitoring and sharing best practices.

Special thanks to MSI Tech who allowed us to write this case study. (http://www.msitech.co.il)

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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