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5aNSa2. Permanent Vibration & Noise monitoring as a valuable tool to the construction industry

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The construction of large infrastructure in dense urban areas comes along with a number of environmental challenges. Roads, railways, subways and large building construction necessarily have a significant impact on residents, and on surrounding buildings as well. This is especially true when it comes to consider large projects duration which generally counts in months and even years. In this context, noise and vibration induced by the construction activities are major source of annoyance to the community and may also induce potential damages to the immediate surroundings. Both issues have thus to be properly monitored in order to reduce adverse effects on residents, help mitigate risks and prevent potential interruption of the construction site's activity which would increase the overall project costs. The proposed paper focuses on how available communication technologies provide an essential added value to noise and vibrations measurements. Operational conditions and project manager's requirements for system deployment will be reviewed on an illustrative project. Benefits to the different parties will be highlighted on the basis of this example where adequate measures could be taken in the right timing and kept the project running while minimizing its environmental & noise impact.

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INTRODUCTION

City urban planning involves a variety of situations where the impact of renovation work and/or construction of new building projects in the immediate vicinity of residential areas can’t be ignored. Pollution of various nature including noise & vibrations is perceived by the neighbouring residents as a growing source of annoyance, and it is a real challenge for both public authorities and big construction firms to manage keeping noise & vibration levels within acceptable limits during the different phases of the projects.

Apart from annoyance to the resident persons living at nearby distance from the renovation or construction work, another category of disturbance has to be considered too: this relates to the impact of noise & vibration on objects and/or sensitive instruments which are located in buildings impacted by such work. Discarding the possible negative impact of vibrations may prevent some production process to be operated with the requested accuracy, or cause significant damages, all the more dramatic that when possibly ruining unique pieces of art. The latter situation will be discussed with more details in the following sections.

TWO YEARS AT THE MUSEUM...

In 2010 the British Museum started construction work on the World Conservation and Exhibitions Centre. This important new building is intended to provide a special exhibitions gallery, state-of-the-art laboratories and conservation studios, facilities to house and preserve the Museum’s collection and services to support the Museum’s extensive loan program. Building work is due to complete in late 2013.

Thanks to more than 2 years of continuous noise & vibration monitoring an expert eye could be kept on the different collections which might have suffered from excess in disturbance levels generated by the nearby construction work. The applied preventive approach helped saving quite a number of pieces of art from possible damages due to the negative impact of vibration induced by the demolition/constructive work nearby.

WHY MONITORING NOISE & VIBRATION?

Demolition and construction work associated with the project is taking place in close proximity to the existing Museum buildings and other neighbouring properties. Many of the Museum’s galleries and stores are located in buildings adjacent to the site; thus construction work presents an on-going risk to the collection.

FIGURE 1. British Museum – historical building (left) and nearby World Conservation and Exhibitions Centre (right)
Bickerdike Allen Partners have been appointed by the Museum to advice on noise and vibration matters. Strict limitations have been set on the levels of vibration and noise that can be produced by the contractors in the site.

In addition to localized mitigation aimed at protecting the collection, a noise and vibration monitoring system designed by 01dB has been installed by Acoustic1 to measure levels of noise and vibration during the course of the project. The system ensures compliance with the predefined noise and vibration limits. It alerts nominated staff when these limits are exceeded to ensure action is taken. The Museum has implemented an internal procedure to respond to alerts.

**FIGURE 2.** Global view of the construction site when starting the project.  
**FIGURE 3.** Central Gallery of the Museum

**ALERT MANAGEMENT**

To make the whole system efficient, a special care has been put into the best possible definition of vibration thresholds adapted to the different rooms & galleries which were permanently monitored. This resulted into the definition of two levels of vibration limits:

- **First Action Level:** represents the level at which the Museum shall be advised that vibration levels are approaching the permissible limit. Depending on circumstances, decisions are taken over whether to continue with the present method of construction (or demolition) or adopt an alternative one.
- **Second Action Level:** represents the level at which the contractor shall be stopped to review with the Museum what further action should be taken.

The 01dB system allows the Museum to closely monitor vibration levels generated by site activity. In conjunction with the localized protection installed in galleries and store rooms, it gives the Museum a level of assurance that vibration limitations are being adhered to by contractors working in the site.
TEN GOOD REASONS FOR CHOOSING THIS APPROACH

Numerous advantages are linked with using the system developed & proposed by 01dB. Among them we can insist on a list of 10 which deserve special attention:

- Full compliance with noise and vibration standards on metrology for the deployed monitoring terminals
- Networkable monitoring terminals combining multiple communications (LAN, Wifi, 3G)
- Advanced trigger conditions combining several devices and on multiple indicators
- Alerts messages sent by email and SMS texts
- Noise and vibration data logging
- Time domain signal recording on noise and vibration terminals
- Data archiving on centralized server
- Internet remote access with secured authentication
- Advanced processing software tools and automatic reporting
- More than 15 years of experience in noise and vibration monitoring.

CONCLUSION

As it was expected, strong vibrations that could potentially affect priceless collections have been measured over more than 2 years of demolition and construction works. The monitoring system setup by 01dB and installed by Acoustic1 has generated crucial alert messages in real-time to the relevant personnel. Demolition / Construction works have effectively been suspended several times and contractors adopted suitable techniques to lessen the vibration levels generated by such work nearby the Museum. The 01dB system has played a key role to reject false alerts and ensure factual warnings are relayed whenever collections were at risk. After Le Louvre Museum in Paris, the 01dB system has demonstrated once again its great reliability.
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