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Left to the **Devices**

Web-based noise, vibration and air quality monitoring of major projects

This article provides information on web-based long-term unattended systems for monitoring noise, vibration and air quality. It is primarily focussed on the monitoring of major construction projects, but the principles apply equally to monitoring industrial sites for demonstrating compliance with planning conditions, permitting conditions or other limits.

Noise generated by construction activities can be significant and, for large projects, may last for lengthy periods over many years. This can therefore lead to considerable impacts on adjacent residential properties or other noise sensitive developments. The impacts may be greater still if the works must be carried out during the evening or night-time, when people are generally more sensitive to noise.

Vibration and dust

Many construction activities can also generate significant levels of vibration (e.g. some piling techniques, vibratory compaction, tunnelling etc.). Such vibration has the potential to cause damage to adjacent buildings, structures and third-party infrastructure, and cause disturbance to residents, or to affect vibration-sensitive equipment that may be present in the buildings.

Construction activities can also have a detrimental effect on air quality, particularly through the generation of dust and particulates.

Noise, vibration and air quality monitoring is increasingly required for major construction projects and may be undertaken for a variety of reasons, including:

- Establishing baseline noise, vibration and air quality levels
- Demonstrating compliance with set limits and contractual requirements
- Responding to, and identifying the cause of, complaints from members of the public
- Reporting on noise, vibration and air quality levels generated by the project
- Comparing actual noise, vibration and air quality levels against predicted impacts
- Demonstrating the application of Best Practicable Means (required under Section 61 of the Control of Pollution Act)
- Maintaining good relationships with local residents and businesses

Getting permissions

For major construction projects, there is often a requirement to obtain Prior Consent under Section 61 of the Control of Pollution Act. As part of obtaining such consent, it is usual to provide noise predictions of the works, and these predictions are then often used to set noise limits for the works. Any exceedance of the limits would then be a breach of the Consent. The Section 61 process also requires the Contractor to demonstrate that they will undertake the works using "Best Practicable Means". In other words, they will take all reasonable steps to minimise any noise impacts.

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In addition, many projects also have Noise Insulation and Temporary Rehousing criteria, whereby if noise trigger levels are exceeded for a set number of days, it is necessary to either provide noise insulation (typically secondary glazing and ventilation) or to re-house residents for the duration of the noisy works. >

Assessment and monitoring

Construction vibration may be assessed for its effect on buildings and/or residents within those buildings. The potential for building damage is generally assessed using Peak Particle Velocity (PPV) which is measured at the footing of the building. The effect of vibration on people residing within the building is more usually assessed using the Vibration Dose Value (VDV) which is assessed at the point of entry to the person, and is calculated from weighted acceleration and the length of exposure.

> "unattended noise, vibration and air quality monitoring is used on large construction projects to provide continuous monitoring"

Noise and air quality are generally measured externally to buildings.

Noise, vibration and air quality monitoring is generally undertaken either attended, or unattended. Attended monitoring can often provide a more detailed assessment, since an engineer is physically present with the monitor and can make a subjective assessment along with the objective measurements. This is particularly useful for noise measurements where the engineer can identify all significant noise sources and assess with Best Practicable Means is being implemented. However, attended monitoring is very labour intensive and measurements are only captured when the engineer is physically at site undertaking the measurements.

Unattended noise, vibration and air quality monitoring is therefore typically used on large construction projects to provide continuous monitoring for the duration of the project and enables a large number of locations to be monitored simultaneously and continuously. A well designed and user-friendly system can provide significant cost savings to the environmental monitoring elements of a project.

Modern systems

Many modern noise, vibration and air quality monitors have the ability to connect to the internet and to transmit monitoring data in real time to a central database. This data can then be viewed either live, or historically.

One of the main advantages of having live data is to ensure that noise limits are not breached. The limits can be entered into the monitoring system and "amber" and "red" alerts can be set. An amber alert can be used to provide a warning that the noise limit will be breached based on current operations. The amber alert can be sent by SMS and/or email to site operatives and supervisors who can then modify their works in real time to ensure that the noise limits are not breached. A red alert is sent once the noise limit has been breached and requires that all works must be stopped. Some systems will also forecast >

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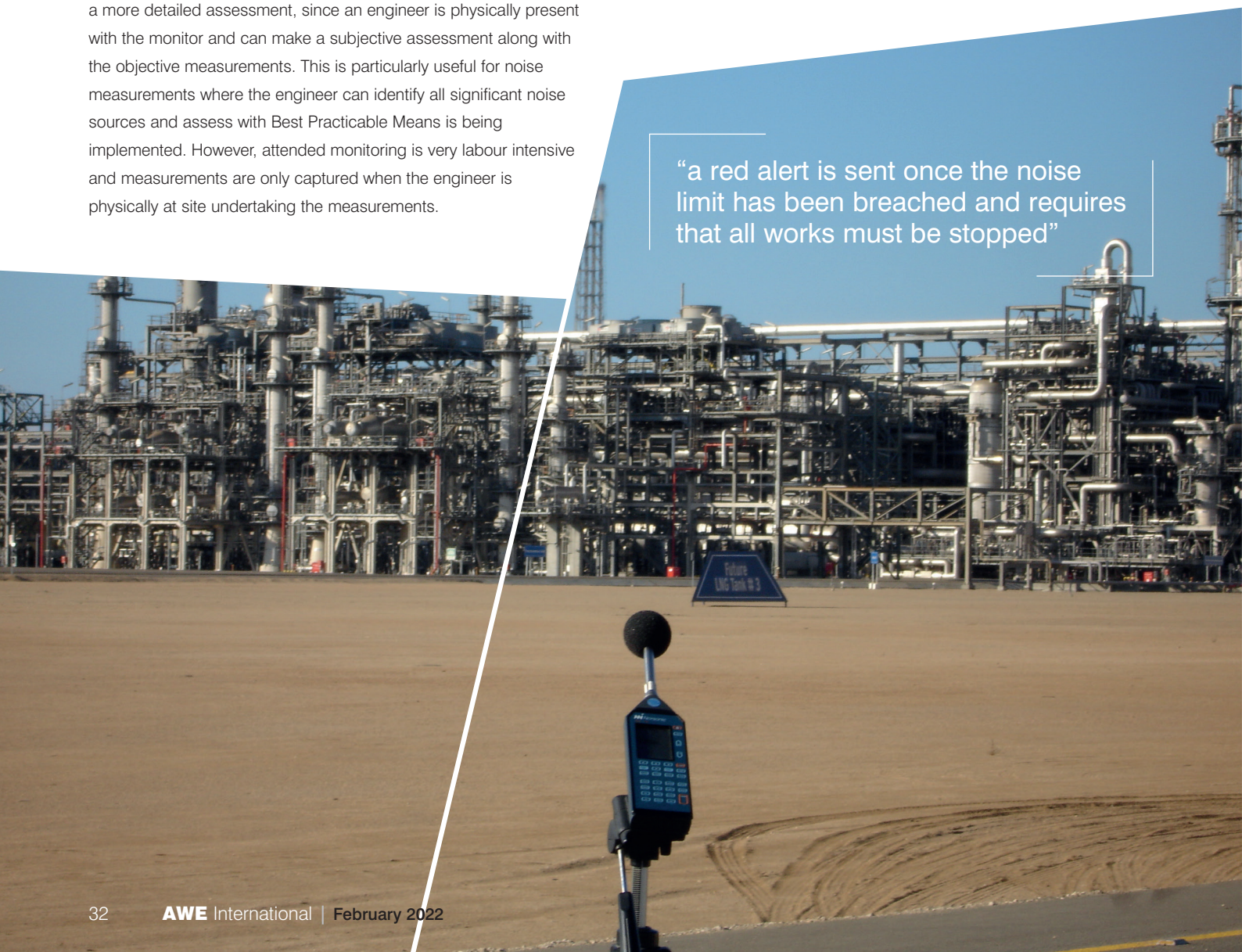

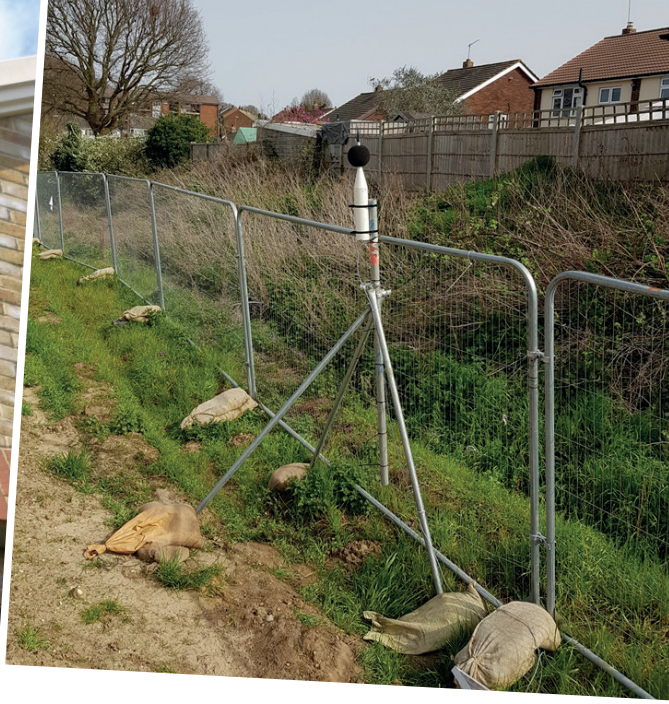

based on current noise levels and will provide time remaining at the current noise levels before a red exceedance. This allows site works to be managed in real time to ensure that noise limits are not breached.

Many systems allow noise, vibration, air quality, meteorological or other sensors to be connected. As all this data is stored in one database, it's possible to cross-correlate between the different sensors. For example, an alert can only be sent if the trigger level is exceeded at two or more monitors simultaneously. Or, an alert may be sent only if the wind speed is below a certain value. Dust alerts can be sent only when the wind is blowing in a certain direction.

> "many noise monitors have the ability to record audio, and this can be invaluable when investigating the cause of any exceedances"

Many monitoring systems are produced by equipment manufacturers and therefore only work with that manufacturer's monitors. However, there are also systems available which will work with equipment from a number of different manufacturers. This allows different monitoring equipment to be combined, particularly on large projects, where numerous monitors may be deployed and avoids the client/contractor having to access multiple web-based systems. It also allows the client/contractor to re-use monitoring equipment that they already own and add new equipment from a different manufacturer.

Many noise monitors also have the ability to record audio, and this can be invaluable when investigating the cause of any exceedances. It is possible to listen to the audio (historically) at the time when the exceedance occurred, and determine whether noise was generated by the site, or some other extraneous noise source.

Ease of use

The presentation of data and ease of use of these monitoring systems is critical to ensure that they become a useful tool in the management of the project. Many platforms have a "dashboard" view that is customisable and provides an overview of all monitors, or a selection of critical monitors. This is a very useful tool for the client to maintain an overview of operations.

It is usual to have varying levels of access depending on the requirements of individual users, including:

- Environmental Managers: Access to all data including summaries of any exceedances and the ability to modify user access
- Noise consultants: Access to all data and the ability to set noise limits. Ability to download detailed noise monitoring results for further analysis
- Project managers: Access to view data and summary of exceedances
- Local Authority: Access to view data
- Public: A public facing version of the website giving monitoring results or summary overview

The time and costs associated with reporting on monitoring results can be significantly reduced with the clever use of automated data analysis to process the raw monitoring data into the format required by the project. This includes averaging over the required time periods for the project and automatic reporting. Raw and/or processed data can also be exported for further analysis, as and when required.

Process management

One of the key elements of environmental monitoring is often the identification of periods when limits may be exceeded and providing justification for why such an exceedance occurred. This process can

easily be managed within the system. For example, a noise monitor may register an exceedance of a noise limit, and this will be highlighted by the monitoring system, which may also send an alert by SMS/Email. If audio recording is enabled on the noise monitor, the audio clip for the time of the exceedance can be listened to. If the exceedance is found to be attributable to a noise source other than construction, the exceedance can be manually discounted and a note added to show the cause of the exceedance.

> "the automation of various data processing and reporting activities can offer significant time/cost savings to the project"

Where the project is subject to Noise Insulation and Temporary Rehousing requirements, it is usual that these requirements are defined both in terms of level and also temporal requirements. i.e. the trigger level must be exceeded for a certain number of days/nights for a property to qualify. Typically this is 10 days out of any 15 consecutive days or 40 days in any 6-month period. Some systems can automatically track the number of exceedances and provide warnings should the temporal criteria get close to being exceeded. The automation of this element of the noise management can offer a significant cost/time saving compared to tracking exceedances manually.

Tracking and data

In addition to providing the monitoring results, systems can also track which individual instrument was located at which monitoring position, the date is was installed and the date it was removed or swapped. Calibration details for the instruments can be stored on the system, along with copies of the calibration certificates, allowing all relevant information to be accessed from a single portal.

Some systems also allow additional data to be stored, such as a database of Section 61 Consents to allow easy access to these documents.

In conclusion

Web-based noise, vibration and air quality monitoring systems can offer an invaluable tool for managing environmental monitoring requirements on large projects. They can be used to ensure compliance with Project, Contractual or Legal requirements and to manage environmental issues in real time. The automation of various data processing and reporting activities can offer significant time/cost savings to the project. ■

Author

David Nicholls is a Director of Addiscombe Environmental Consultants who specialise in providing noise, vibration and air quality support to construction projects, industrial sites, onshore and offshore oil and gas installations, planning and noise at work, through concept, design stage, construction and commissioning. He has worked as a noise consultant for 30 years and has particular experience in the construction, oil and gas, transportation, petrochemical and offshore sectors. He has appeared as an expert witness and has advised at government level. He has worked on some of the largest, most complex projects ever undertaken including Crossrail, HS2, Pearl GTL, Ivar Aasen and Nigeria LNG.

David is also a Director of Enbox Limited who provide web-based noise, vibration and air-quality monitoring solutions to the construction industry and other long-term monitoring requirements. Enbox specialises in providing compatibility with monitors from many different manufacturers and the Enbox system has been designed by users (consultants and operatives) rather than by equipment manufacturers or programmers, ensuring that is user-friendly and intuitive to use.