

Noise Measurement

Measuring noise in the Construction Industry

The construction industry is a major source of pollution, responsible for around 4% of particulate emissions, more water pollution incidents than any other industry, and thousands of noise complaints every year.

Construction sites produce a lot of noise, mainly from vehicles, heavy equipment and machinery, but also from people shouting and radios turned up too loud.

Excessive noise is not only annoying and distracting, but can lead to hearing loss, high blood pressure, sleep disturbance and extreme stress.

This article looks at some of the issues of noise levels in the construction industry and suggests some simple measures which can help site managers and construction companies to manage their noise levels.

There are two areas where noise has an impact and where companies are responsible.

The first of these is the impact of noise upon the surrounding environment from site operations. The second is the effect upon employees and site workers from the noise generated by these operations.

Although the sources of these noise levels is likely to be the same, the way in which they can be monitored and managed, as well as the regulatory authorities responsible for enforcement, is different.



Noise and the surrounding environment

Statutory requirements

The Environment Protection Act 1990 and the Control of Pollution Act 1974 set down the statutory position in respect of noise arising from construction site activity. The controls available to Local Authorities are contained in the Control of Pollution Act 1974.

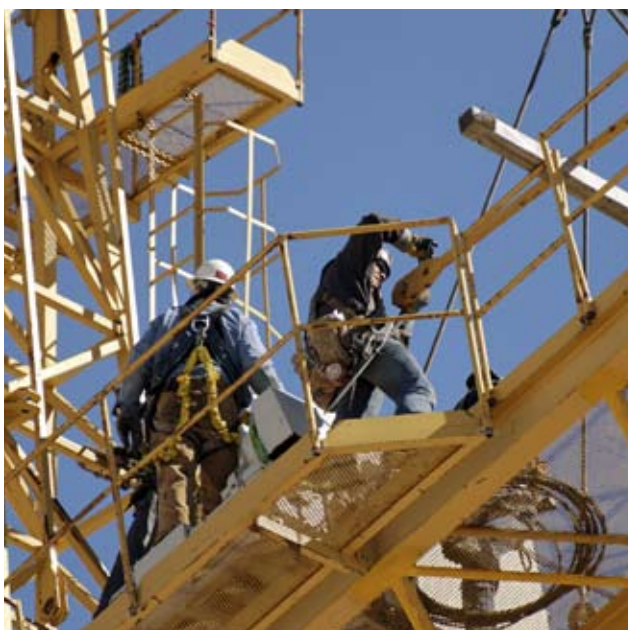
Section 60 of the Act allows Local Authorities to impose restrictions on building operations by way of a statutory notice. The notice can impose methods of working and "permitted working hours".

However, even where work is carried out within these "permitted working hours" the contractor is expected to adopt the "best practicable means" to ensure that noise from the site is kept to a minimum.

In addition, Section 61 of the Act allows the Local Authority to enter into a binding agreement with the developer and/or contractor to abide by the conditions of the agreement.

Conditions often include methods of work, including the use or otherwise of certain tools, also silencing and screening methods etc. Other conditions include noise and vibration monitoring, site contacts and information, training and supervision, but the most important aspect is undoubtedly the hours of work.

On certain projects where it would be impractical to impose the standard daytime "permitted working hours" as the majority of tasks could not be carried out during permitted hours for safety reasons, the number of conditions the Local Authority can impose is largely reduced to what is and is not "best practice".



Why noise good practice is important?

Excessive noise levels on site represent a major hazard to site workers and can annoy local residents.

Noise causes more off-site complaints than any other issue and can rapidly damage relations with those residents.

Some of the issues that may arise include:

» Noise travels in all directions from a construction noise source, and will bend around and over walls and buildings. It will also reflect back from solid surfaces. Some plant and activities generate more noise in one direction than others, so careful positioning of the equipment can pay dividends.

» Various types of control on noise levels from construction sites can be imposed when noise starts to cause a nuisance. These controls can affect a construction programme by limiting the length of time during which noisy activities are allowed and influencing the construction method. Failing to meet noise constraints can result in fines.

» If the local environmental health officer considers the noise excessive, a notice to control noise levels or even an injunction to stop work may be served. Some contractors have faced considerable difficulties when their noise control measures have not proved satisfactory to the local authority and have been the subject of statutory powers.

» In some cases residents have taken out civil action against contractors on urban projects. Contractors are recommended to manage noise in a pro-active way rather than wait for complaints to be made.

» It is not only loud noises that cause complaint, but also antisocial activity and irregular or tonal noises such as reversing warnings.

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» Other reasons for complaint include shouting, bad language, radios and out-of-hours deliveries.

» On some projects there are agreements on the hours during which noisy working is allowed. On other projects working hours may be restricted by a limit on the average noise allowed to be generated over a given period. In these cases, if the noise exceeds the limit set then the working period must be reduced.

“A housing contractor was fined £1000 by magistrates following complaints by local residents about a noisy housing site where work started at 6.30 each morning.”

Where does the noise come from?

On a building site the worst noise comes from contractors' plant and mostly from machines used for demolition, piling and excavation. Noise from concrete mixing is often also an issue.

Hammering, cutting metal/paving slabs and drilling are also noisy activities, not only in new buildings but also when extending occupied buildings, as the noise can be transmitted through the structure to rooms remote from the noise source.

Complaints are also occasionally received about excessive noise from radios on site. The nuisance caused by noise depends on the sort of noise as well as how loud it is.



Intermittent noise is usually more disturbing than continuous noise, and a high frequency noise is more worrying than a low frequency one. The high-pitched noise of sawing, for instance, is more troubling than equally loud noise from an excavator.

How loud is it?

Sound pressure in weighted decibels dB(A)	Situation
140	Peak action level, immediate irreversible damage Jet at 30 m
130	Threshold of pain Pneumatic breaker (unsilenced) at 1 m
120	Pneumatic digger 600 hp scraper at 2 m
110	Rock drill Diesel hammer driving sheet steel at 10 m
100	Scrabbling 7 hp road roller on concrete at 10 m
95	Concrete pouring
85	Second action level (Control of Noise at Work Regulations 2005) Drilling/grinding concrete
80	First action level (Control of Noise at Work Regulations 2005)-Scaffold dismantling at 10 m 8 hp diesel hoist at 10 m
70	5 hp power float at 7m
60	Typical office
50	Living room

Liaising with the community

Community liaison is the key to increasing community tolerance to noise. If you inform the local community and residents of what you will be doing on site and for how long, they may accept higher noise levels.

Discuss with them in advance what aspects of noisy working is most annoying and see if there are any remedies that will not affect your programme.

Consider agreeing to a shutdown at particularly sensitive times, for example halt noisy works at lunchtimes to appease restaurant- and pub-owners. Through good relations, the potential for complaints or civil claims in the long term may be reduced. It is especially important to avoid unexpected early starts in the morning.

Measurement and Monitoring

The need to measure and monitor noise levels is an essential part of site operations regardless of any mitigation measures that have been put in place.

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Where measurements are required, site operators, contractors and companies should ensure that those measurements meet the demands of the local authority otherwise there is potential for dispute over the relevance and accuracy of any measurements made.

There are several points to consider when making noise measurements.

The noise measurement equipment

In general, noise measurements can be made using a hand held or tripod mounted sound level meter. However, there are many different kinds of sound level meter, varying in price from around £30 to over £3000.

A simple instrument may require less training to operate, but might not give the measurement parameters needed.

An expensive instrument may provide the data required, but the level of training and understanding needed to use it could turn it into an expensive book end.

The British Standard BS5228 "Noise and Vibration Control on Construction and Open Sites": Part 1:1997 has some requirements for a sound level meter and these are that it meets at least BS EN 60804 Type 2.

(Note that BS EN 60804 has been superseded by BS EN 61672-1:2003 which uses the word Class rather than Type ie Class 2 = Type 2)

What this means in reality is that the sound level meter must be Type 2 or Class 2 and that it must be able to measure $L_{Aeq,t}$ (which may be written as L_{eq}) which is the average noise level over a period of time.

The sound level meter should also be able to measure the highest level and this will be recorded as the L_{max} or Maximum Hold.

Sound level meters are generally not weatherproof and if measurements need to be made over longer periods of time, an outdoor measurement kit would be recommended.

Calibration

As with any noise measurement equipment, the sound level meter must be calibrated before and after each use to check that it is measuring correctly using an acoustic calibrator.

"the calibration of all noise measurement equipment using an acoustic calibrator is a very important part of making measurements"

In addition to this, the sound level meter and acoustic calibrator must be subject to annual calibration by the manufacturer and a certificate of calibration shall be available with the equipment for the purpose of inspection.

Location of measurements

A suitable number of noise monitoring locations shall be established at the site boundary and agreed with the local authority. The microphone shall be situated in a free-field location, approximately 1.2 to 1.5 metres above local site level.

Measurements shall be made in accordance with good acoustical practice, care being taken to avoid the effects of local acoustic screening and acoustic reflections.

The calibration level and battery level of the sound level meter shall be recorded at the beginning and end of each monitoring session.



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When measurements are made

Adequate background noise levels shall be obtained at all monitoring locations prior to the commencement of construction works.

What this means is that before any works start, you should measure the noise level to check a reference level.

Noise measurements should be made out to assess the activity with the highest potential noise impact.

Checklist

There are a number of things that can be done to minimise the impact of site operations and a quick checklist is shown below.

- » Change the working method to use equipment or modes of operation that produce less noise.
- » Reduce the need for noisy assembly practices, eg fabricate off site.
- » Keep noisy plant as far away as possible from public areas.
- » Adopt working hours to restrict noisy activities to certain periods of the day.
- » Arrange delivery times to suit the area - daytime for residential areas, perhaps night time for inner-city areas.
- » Route construction vehicles to take account of the need to reduce noise and vibration and keep access roads well maintained.
- » Minimise the drop height into hoppers, lorries or other



plant (reducing the drop height by a factor of 10 reduces noise by about 10 dB).

- » Consider using rubber linings on tippers in very sensitive sites.



Health & Safety

All of the points covered above are aimed at the impact of noise from sites on the surrounding environment and community.

However, the risk of these noise levels to employees working on site should also be considered. As they will be much closer to the sources of the noise, the levels that they are exposed to will be higher.

Statutory requirements

The 2005 Control of Noise at Work Regulations which is enforced by the Health & Safety Executive (HSE) defines the limits of noise levels to which employees can be exposed over a working day.

The Control of Noise at Work Regulations 2005 came into force on 6 April 2006. The new regulations implement the European Union's Physical Agents (Noise) Directive within Great Britain.

The new regulations bring significant changes to the actions which were required by employers and employees under the previous Noise at Work Regulations 1989.

Employers now have extra responsibilities, and noise exposures and level limits are lower.

The Regulations cover not only the obviously noisy industrial

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premises and construction sites, but virtually all work places with few exceptions, including work places where the risk of the noise may not be immediately obvious.

So they apply for example, to motorcycle couriers, and to call centre workers who are exposed to noise (including speech) through headphones. The regulations also cover the self-employed, as employers and employees.

Under these Regulations, employers are required to:

- » Assesses the risks to employees from noise at work
- » Take action to reduce the noise exposure that produces those risks
- » Provide employees with hearing protection if the noise exposure cannot be reduced by other action
- » Ensure that the legal limits on noise exposure are not exceeded
- » Provide employees with information, instruction and training on the risk of hearing damage
- » Carry out health surveillance for employees where there is a risk to their health

Action levels and limit values

The regulations require specific action to be taken at defined action values.

The limits set out in the regulations consider both a workers average exposure often referred to in dB(A) or 'A' weighting and maximum noise (peak sound pressure) in dB(C) or 'C' weighting which is a measure of peak, impact or explosive noises.

After preventative steps have been taken to control the noise at source, hearing protection is often the only way to reduce worker exposure, but it should not be used as an alternative to controlling noise at source.

The noise exposure action values are:

Lower exposure action values:
Daily or weekly exposure of 80dB
Peak sound pressure of 135dB

Upper exposure action values:
Daily or weekly exposure of 85dB
Peak sound pressure of 137dB

Level of noise not to be exceeded:
Daily or weekly exposure of 87dB
Peak sound pressure of 140dB

These exposure limit values take account of any reduction in exposure provided by hearing protection.

What does this mean?

» 80-85dB – An employer should provide employees with hearing protectors if they ask for them, between the lower and upper exposure action values. A worker can not be forced to wear hearing protection between these levels, it's not the law.

» 85dB and above, an employer must provide employees with hearing protectors and ensure they are worn properly e.g conduct spot checks etc.

» Identify and clearly mark 'Zone's' where wearing hearing protection is compulsory.

» Provide employees with training and information on how to use and care for the hearing protectors.

» Ensure hearing protectors are properly used and maintained e.g check seals are undamaged etc.

An employer under the control of noise at work regulations 2005 has many responsibilities with regards to the use of hearing protection and managing noise in general.

The employee however does have a responsibility to wear hearing protection in defined zones, which exceed the upper exposure level, where a company has provided hearing protection, defined and clearly marked where it should be worn and trained its employees in their use and maintenance.

An employee who regularly fails to use hearing protection in these circumstances could not deem the company to be at fault and would normally be subject to the company's disciplinary procedure.



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Where does the noise come from?

The sources of noise are the same as previously discussed, that being plant, machines used for demolition, piling and excavation and concrete mixing.

Hammering, cutting metal/paving slabs and drilling are also noisy activities as well as radios which are often turned up to be louder than the activities going on around them.

Measurement and Monitoring

The measurement of the noise exposure of employees is similar to that previously discussed but the aim is to assess the amount of noise that an employee is subject to.

It must be clear that the aim is not to measure the noise level from individual pieces of equipment or plant, but to put the sound level meter or noise dosimeter next to the ear of the employee.

How this is done depends upon the activities that the employees are undertaking.

For many activities where there is a defined work place or where the employee is using a hand held tool or equipment, using a sound level meter is appropriate.



The person making the measurement can stand next to the employee and take the noise levels.

However, there are many situations where using a hand held Sound Level Meter is not possible for both practical and safety reasons.

For example, assessing the noise exposure of fork lift truck drivers or employees with complex working patterns would be problematic using a sound level meter and this is where a noise dosimeter becomes the ideal measurement tool.



The noise measurement equipment

The requirements for a sound level meter that is to be used for Health & Safety measurement is slightly different to those for site noise measurements.

The specifications are given by the Noise at Work Regulations as are as follows:

- » Your sound level meter should meet at least Class 2 of BS EN 61672-1:2003 (the current instrumentation standard for sound level meters), or at least Type 2 of BS EN 60804:2001 (the former standard).
- » Your dosimeter should meet the requirements of BS EN 61252:1997.
- » Your calibrator should meet at least Class 2 of BS EN 60942:2003.

Calibration

Exactly the same procedures apply to the calibration of any noise measurement equipment that is used for Health & Safety as for Environmental noise measurements.

Calibration before and after each measurement is essential and the equipment must be calibrated regularly by the manufacturer.

Putting this all together

Sound Level Meter

If you put the requirements for the Health & Safety and the Site noise measurement together and look for an instrument that meets the latest BS EN 61672-1:2003 standard it will be able to meet both of these requirements.

Check that the sound level meter can measure:

- » Integrated Sound Level (L_{eq} , L_{Aeq} or $L_{Aeq,t}$)
- » Peak Sound Pressure (L_{CPeak})
- » Maximum Sound Level (L_{max} , L_{AFmax} or L_{ASmax})

Acoustic Calibrator

- » The acoustic calibrator should meet at least Class 2 of BS EN 60942:2003.

Noise Dosemeter

- » A Noise Dosemeter should meet the requirements of BS EN 61252:1997.

References

1. Control of Noise at Work Regulations 2005
<http://www.hse.gov.uk/noise/regulations.htm>
2. BS5228 "Noise and Vibration Control on Construction and Open Sites": Part 1:1997"
3. The Environment Protection Act 1990
4. Control of Pollution Act 1974

Further Reading & Information

Cirrus Article 3 - Choosing noise measurement equipment for Noise at Work

The Cirrus doseBadge Personal Noise Dosemeter

The Cirrus CR:260A Series of Sound Level Meters

The Cirrus CR:800C Series of Sound Level Meters

The Cirrus Safety Officer's Noise Measurement Kits

The Cirrus Acoustic Calibrators

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