

APPENDIX: CHAPTER 11 – NOISE AND VIBRATION

APPENDIX 11.1: GLOSSARY OF ACOUSTIC TERMINOLOGY

L _{Aeq}	is the equivalent continuous sound level. It is a type of average and is used to describe a fluctuating noise in terms of a single noise level over the sample period. It is typically used as a descriptor for ambient noise.
L _{AFmax}	is the instantaneous maximum sound level measured during the sample period.
L _{AFmin}	is the instantaneous minimum sound level measured during the sample period.
L _{A10}	is the sound level that is exceeded for 10% of the sample period. It is typically used as a descriptor for traffic noise.
L _{A90}	is the sound level that is exceeded for 90% of the sample period. It is typically used as a descriptor for background noise.
SEL	is the A weighted equivalent sound level (L _{Ax}) which, when maintained for one second, contains the same quantity of sound energy as the actual time varying level of one noise event.
A-weighting	The "A" suffix denotes the fact that the sound levels have been "A-weighted" in order to account for the non-linear nature of human hearing. All sound levels in this report are expressed in terms of decibels (dB) relative to 2x10 ⁵ Pa.
PPV	Peak Particle Velocity is a measure of the velocity of vibration displacement in terms of millimetres per second (mm/s).
VDV	is an evaluation of human exposure to vibration in buildings. It defines a relationship that yields a consistent assessment of continuous, intermittent, occasional and impulsive vibration and correlates well with subjective response. It is defined as follows:

"Vibration dose value (VDV) is an assessment of the effect of building vibration on the people within. The VDV is the fourth root of the integral of the fourth power of acceleration after it has been frequency-weighted (as defined in BS6472: 2008). The frequency-weighted acceleration is measured in m/s² and the time period

over which the VDV is measured is in seconds. This yields VDV's in $m/s^{1.75}$.

APPENDIX 11.2: DERIVATION OF CONSTRUCTION NOISE & VIBRATION CRITERIA

A11.2 Criteria for Assessing Construction Noise & Vibration

There is no published statutory Irish guidance relating to the maximum permissible noise level that may be generated during the construction phase of a project. Local authorities normally control construction activities by imposing limits on the hours of operation and consider noise limits at their discretion. However, there are several publications commonly used in Ireland to set appropriate construction noise criteria. Each of these is discussed in the following paragraphs.

Please note that the majority of the construction activity in relation to the proposed development is expected to occur during normal site working hours, i.e. full days on Mondays to Fridays and half days on Saturdays.

A11.2.1 Noise

A11.2.1.1 National Roads Authority Guidelines

The National Roads Authority publication *Guidelines for the Treatment of Noise and Vibration in National Road Schemes* contains information on the permissible construction noise levels for various hours of operation. The noise level limits are outlined in Table A11.1.

Table A11.1: Maximum Permissible Noise Levels at the Facade of Dwellings during Construction

Date	Noise Levels (dB re. 2×10^{-5} Pa)	
	$L_{Aeq}(1hr)$	L_{Amax}
Monday to Friday 07:00 to 18:00hrs	70	80
Monday to Friday 18:00 to 22:00hrs	60*	65*
Saturdays 08:00 to 16:30hrs	65	75
Sundays & Bank Holidays 08:00 to 16:30hrs	60*	65*

Note * Construction activity at these times, other than that required for emergency works, will normally require the explicit permission of the relevant local authority.

A11.2.1.2 BS 5228-1:2009+A1:2014

Potential noise impacts during the construction phase of a project are often assessed in accordance with *British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise*. This British Standard sets out a methodology for predicting noise levels arising from a wide variety of construction and related activities and contains tables of sound power levels generated by a wide variety of mobile and fixed plant equipment.

Noise levels generated by the site operations and experienced at local receptors will depend upon a number of variables, the most significant of which are:

- the amount of noise generated by plant and equipment being used at the development site, generally expressed as a sound power level;
- the periods of operation of the plant at the development site, known as the "on-time";
- the distance between the noise source and the receptor, known as the "stand-off";
- the attenuation due to ground absorption or barrier screening effects; and
- reflections of noise due to the presence of hard vertical faces such as walls.

BS 5228-1:2009+A1:2014 gives several examples of acceptable limits for construction or demolition noise, the most simplistic being based upon the exceedence of fixed noise limits. For example paragraph E.2 states:

"Noise from construction and demolition sites should not exceed the level at which conversation in the nearest building would be difficult with the windows shut."

Paragraph E.2 goes on to state:

"Noise levels, between say 07.00 and 19.00 hours, outside the nearest window of the occupied room closest to the site boundary should not exceed:

- *70 decibels (dBA) in rural, suburban areas away from main road traffic and industrial noise;*
- *75 decibels (dBA) in urban areas near main roads in heavy industrial areas".*

Note that a typical planning condition in relation to noise as issued by Dublin City Council would be as follows:

During the construction and demolition phases, the proposed development shall comply with British Standard 5228 – Noise control on construction and open sites Part 1. Code of practice for basic information and procedures for noise control.

The typical condition references a superseded standard. The current standard, as referenced in our review, has been used to inform that assessment approach for

construction noise in line with Dublin City Council practice.

For residential properties it is considered appropriate to adopt the 65dB(A) criterion.

A11.2.1.3 Health Technical Memorandum

In addition to the information detailed previously there is specific guidance on appropriate noise levels within hospitals contained within the UK's National Health Service document *Health Technical Memorandum 08-01: Acoustics*. The recommended internal noise levels due to external noise sources within various areas of a hospital are listed in Table A11.2 below.

Table A11.2: Internal Noise Criteria for Clinical Areas

Room Type	Example	Criteria for noise intrusion from external sources (dB)
Ward – single person	Single-bed wards, recovery rooms, on-call rooms etc	40 L _{Aeq,1hr} daytime 35 L _{Aeq,1hr} night 45 L _{Amax,f} night
Ward – multi-bed	Multi-bed wards and recovery areas	45 L _{Aeq,1hr} daytime 35 L _{Aeq,1hr} night 45 L _{Amax,f} night
Operating Theatres	Operating Theatres	40 L _{Aeq,1hr} 50 L _{Amax,f}
Small Office Areas	Consulting rooms, private offices etc	40 L _{Aeq,1hr}

However, the values above are recommended to be applied to the noise intrusion from long terms sources of external noise. The issue of construction noise is discussed only briefly in HTM 08-01 where it is recommended that each project will have different requirements and that a strategy should be prepared to control noise and vibration impacts in accordance with the guidance in *BS 5228-1:2009+A1:2014* and *BS 5228-2:2009+A1:2014*. No criteria are presented for construction noise impacts on existing Clinical areas.

Based on the above discussion it is recommended that noise intrusion due to construction in the nearby Hospital Buildings is limited to 45dB L_{Aeq,1hr} during the daytime period.

A11.2.1.4 Summary

Based on the information discussed above it is considered appropriate to adopt the external noise criteria listed below in Table A11.3 at 1m from the façade of all sensitive locations.

Table A11.3: Summary of Construction Noise Limits at Residential Dwellings

Period over which criterion applies		Noise Impact Criterion ($L_{Aeq,1hr}$)
Monday to Friday	Day: 07:00 to 19:00	65 dB
	Evening: 19:00 to 22:00	55 dB*
	Night: 22:00 to 07:00	The higher of 45 dB or the ambient level*
Saturday: Day: 08:00 to 16:30 (work outside these hours will not be permitted)		65 dB
Sundays and Bank Holidays*: Day: 08:00 to 16:30 (work outside these hours will not be permitted)		60 dB*

Note * Construction activity at these times, other than that required for emergency works, will require the explicit permission of the relevant local authority.

In addition, an internal noise limit of 45dB $L_{Aeq,1hr}$ will be adopted for construction noise intrusion in all Hospital and Clinical Buildings.

A11.2.2 Vibration

Guidance relevant to acceptable vibration within buildings is contained in the following documents:

- BS 7385-2:1993 *Evaluation and Measurement for Vibration in Buildings. Guide to Damage Levels from Groundborne Vibration*;
- BS 5228-2:2009+A1:2014 – *Code Of Practice for Noise and Vibration Control on Construction and Open Sites – Part 2: Vibration*, and;
- DIN 4150-3 (1999-02) *Structural vibration - Effects of vibration on structures*

A11.2.2.1 Building Damage

BS 7385-2:1993 states that there should typically be no cosmetic damage if transient vibration does not exceed 15mm/s at low frequencies rising to 20mm/s at 15 Hz and 50mm/s at 40 Hz and above. These guidelines relate to relatively modern buildings and should be reduced to 50% or less for more critical buildings.

BS 5228-2:2009+A1:2014 recommends that, for soundly constructed residential property and similar structures that are generally in good repair, a threshold for minor or cosmetic (i.e. non-structural) damage should be taken as a peak particle velocity of 15 mm/s for transient vibration at frequencies below 15 Hz and 20 mm/s at frequencies above than 15 Hz. Below these vibration magnitudes minor damage is unlikely, although where there is existing damage these limits may be reduced by up to 50%. In addition, where continuous

vibration is such that resonances are excited within structures the limits discussed above may need to be reduced by 50%.

The German Standard *DIN 4150-3* states that for short term vibrations in buildings the values in Table A11.4 should apply depending on the building type.

Table A11.4: Allowable Vibration during Construction Phase for Sensitive Buildings

Property Type	Allowable vibration (in terms of peak particle velocity) at the closest part of sensitive property to the source of vibration, at a frequency of		
	Less than 10Hz	10 to 50Hz	50 to 100Hz (and above)
Commercial, Industrial or similar	20 mm/s	20-40 mm/s	40-50 mm/s
Dwellings or similar	5 mm/s	5-15 mm/s	15-20 mm/s
Particularly Sensitive	3 mm/s	3-8 mm/s	8-10 mm/s

A11.2.2.2 Underground Services

Generally underground structures are less susceptible to damage due to vibration. Notwithstanding this, *BS 5228-2:2009+A1:2014* recommends that in the absence of specific criteria from the statutory undertakers the following criteria should be applied to underground services:

- Maximum P.P.V for intermittent or transient vibrations – 30mm/s, and;
- Maximum P.P.V for continuous vibrations – 15mm/s.

These criteria should be reduced by 30% in the case where elderly or dilapidated brick sewers are encountered.

A11.2.2.2 Clinical Services

Due to the proximity of the development to existing Hospital and Clinical Services it is also considered appropriate to make reference to the UK Department of Health document *Health Technical Memorandum 08-01: Acoustics*. This document recommends a conservative approach for assessing the vibration impact on Clinical areas using frequency weighted acceleration. The frequency weighting, *Wg*, as described in *BS 6841:1987 Guide to Measurement and Evaluation of Human Exposure to Whole-Body Mechanical Vibration and Repeated Shock* should be used.

The maximum frequency weighted accelerations for both continuous and intermittent sources should not exceed the values in Table A11.5 in order to avoid adverse comment.

Table A11.5: Allowable Vibration during Construction Phase for Clinical Buildings

Location	Frequency weighted acceleration
Operating theatres, precision laboratories, audiometric testing booths	0.005 m/s ²
Wards	0.01 m/s ²
General Laboratories, treatment areas	0.02 m/s ²
Offices, Consulting Rooms	0.04 m/s ²

APPENDIX 11.3: CONSTRUCTION NOISE & VIBRATION MITIGATION MEASURES

A11.3 Construction Noise & Vibration Mitigation

A11.3.1 Liaison with the Neighbours

The Contractor should be proactive in engaging with the occupants of neighbouring properties and should notify them of any works forecast to generate appreciable levels of noise, explaining the nature and duration of the works.

A designated noise liaison should be appointed by the contractor for the duration of the construction works. This person should log any issues and follow up in a prompt fashion.

A11.3.2 Noise & Vibration Monitoring

The following ongoing noise monitoring programme is recommended for the site in relation to demolition and construction activities.

Noise Monitoring Terminals, number and locations to be agreed, to be installed with the following specifications (or similar approved):

- Logging of two concurrent periods, e.g. 15-minute & hourly;
- Daily CIC automated calibrations;
- E-mail alert on threshold exceedance;
- E-mail alert on low battery and low memory;
- Remote access to measured data, and;
- Live display of noise levels.

Vibration monitoring stations should continually log vibration levels using the Peak Particle Velocity parameter (PPV, mm/s) in the X, Y and Z directions, in accordance with *BS ISO 4866: 2010: Mechanical vibration and shock – Vibration of fixed structures – Guidelines for the measurement of vibrations and evaluation of their effects on structures*.

The mounting of the transducer to the vibrating structure will need to comply with *BS ISO 5348: 1998: Mechanical vibration and shock – Mechanical mounting of accelerometers*. In summary, the following ideal mounting conditions apply:

- The transducer and its mountings should be as rigid as possible;
- The mounting surfaces should be as clean and flat as possible;
- Simple symmetric mountings are best, and;
- The mass of the mounting should be small in comparison to that of the structure

under test.

The monitoring equipment should be set to monitor vibration in 5 minute periods. Noise and vibration data should be downloaded and reviewed on a fortnightly basis.

In addition, it is recommended that spot check noise & vibration measurements are conducted on a monthly basis. These spot checks can be organized to coincide with works that have potential to generate high levels of noise or vibration on site in order to confirm the potential extent of impact.

A monthly Noise & Vibration Monitoring Report should be prepared by the contractor. Reports should identify any exceedances above nominal limit values and attempts to clarify the causes etc. Where remedial measures are required and identifiable these should also be clearly stated.

A11.3.3 Noise Control Audits

It is recommended that noise control audits be conducted at regular intervals throughout the demolition/construction programme. In the first instance, it is recommended that such audits take place on a monthly basis. This is subject to review, however, and the frequency of audits may be increased if deemed necessary.

The purpose of the audits will be to ensure that all appropriate steps are being taken to control construction noise emissions. To this end, consideration should be given to issues such as the following (note that this list is not intended to be exhaustive):

- Hours of operation being correctly observed;
- Opportunities for noise control "at source";
- Optimum siting of plant items;
- Plant items being left to run unnecessarily;
- Correct use of proprietary noise control measures;
- Materials handling;
- Poor maintenance, and;
- Correct use of screening provided and opportunities for provision of additional screening.

A11.3.4 Hours of Work

Construction activity will mostly take place during daytime hours Monday to Friday and a half day on Saturdays. In the event of it being deemed necessary to undertake works outside these, it will be necessary to obtain prior written approval from Dublin City Council. Such approval would typically only be granted on submission of details of the activity accompanied by an assessment of potential noise impact.

Consideration should be given to the scheduling of activities in a manner that reflects the location of the site and the nature of neighbouring properties. Each potentially noisy event/activity should be considered on its individual merits and scheduled according to its noise level, proximity to sensitive locations and possible options for noise control.

Depending on the noise emission levels experienced and associated noise impact, the contractor should be flexible and able to conduct certain works at hours which reflect periods when the neighbouring properties have lower sensitivities to noise.

A11.3.5 Selection of Quiet Plant

Careful consideration must be given to the noise emission levels of plant items when they are being considered for use on the site. This practice is recommended in relation to sites with static plant such as compressors and generators. It is recommended that these units be supplied with manufacturers' proprietary acoustic enclosures where possible. The potential for any item of plant to generate noise will be assessed prior to the item being brought onto the site. The least noisy item should be selected wherever possible. Should a particular item of plant already on the site be found to generate high noise levels, the first action should be to identify whether or not said item can be replaced with a quieter alternative.

A11.3.6 Control of Noise Sources

If the use of low noise plant or replacing a noisy item of plant are not viable or practicable options, consideration should be given to noise control "at source". This refers to the modification of an item of plant or the application of improved sound reduction methods, often in consultation with the supplier. For example, resonance effects in panel work or cover plates can be reduced through stiffening or application of damping compounds; rattling and grinding noises can often be controlled by fixing resilient materials in between the surfaces in contact.

BS 5228-1:2009+A1:2014 states that *"as far as reasonably practicable sources of significant noise should be enclosed"*. In applying this guidance, constraints such as mobility, ventilation, access and safety must be taken into account. Items suitable for enclosure include pumps and generators. Demountable enclosures that could be moved around site as necessary may also be used to screen operatives using hand tools such as angle grinders.

In practice, a balance may need to be struck between the use of all available techniques and the resulting costs of doing so. It is therefore proposed to adopt the concept of *"Best Available Techniques"*. Best Available Techniques is defined as follows in EC Directive 96/61:

"...the most effective and advanced stage in the development of an activity and its methods of operation which indicate the practical suitability of particular techniques for providing, in principle, the basis for emission limit values designed to prevent or eliminate or, where that is not practicable, generally to reduce an emission and its impact on the environment as a whole."

In this context *"best"* means *"the most effective in achieving a high general level of protection of the environment as a whole"*.

The expression *"available techniques"* means *"those techniques developed on a scale which allows implementation...., under economically and technically viable conditions, taking into consideration the costs and advantages, whether or not the techniques are used or produced within the State, as long as they are reasonably accessible to the operator carrying on the activity"*.

The term *"techniques"* includes *"both the technology used and the way in which the installation is designed, built, managed, maintained, operated and decommissioned"*.

In specifying or otherwise determining Best Available Techniques, consideration should be given to a specified list of considerations and also to *"the likely costs and advantages of measures"* as well as *"the principles of precaution and prevention"*.

Thus, the concept of Best Available Techniques requires a degree of balance between the attainment of environmental benefits and the likely cost implications. In the identification of Best Available Techniques, regard should be had to a wide range of factors, however,

emphasis should be given to *“practical suitability”* and the need *“to reduce an emission and its impact on the environment as a whole”*.

Proposed techniques should also be evaluated in light of their potential effect on occupational health and safety.

BS 5228-1:2009+A1:2014 makes a number of recommendations in relation to *“use and siting of equipment”*. These are relevant and hence are reproduced below. These recommendations should be implemented on the site.

“Plant should always be used in accordance with manufacturers’ instructions. Care should be taken to site equipment away from noise-sensitive areas. Where possible, loading and unloading should also be carried out away from such areas.

Circumstances can arise when night-time working is unavoidable. Bearing in mind the special constraints under which such work has to be carried out, steps should be taken to minimise disturbance to occupants of nearby premises.

Machines such as cranes that may be in intermittent use should be shut down between work periods or should be throttled down to a minimum. Machines should not be left running unnecessarily, as this can be noisy and waste energy.

Plant known to emit noise strongly in one direction should, when possible, be orientated so that the noise is directed away from noise-sensitive areas. Attendant operators of the plant can also benefit from this acoustical phenomenon by sheltering, when possible, in the area with reduced noise levels.

Acoustic covers to engines should be kept closed when the engines are in use and idling. The use of compressors that have effective acoustic enclosures and are designed to operate when their access panels are closed is recommended.

Materials should be lowered whenever practicable and should not be dropped. The surfaces on to which the materials are being moved could be covered by resilient material.”

We would also offer the following outline guidance in relation to specific considerations.

- For mobile plant items such as cranes, dump trucks, excavators and loaders,

the installation of an acoustic exhaust and/or maintaining enclosure panels closed during operation can reduce noise levels by up to 10dB. Mobile plant should be switched off when not in use and not left idling.

- For piling plant, noise reduction can be achieved by enclosing the driving system in an acoustic shroud. For steady continuous noise, such as that generated by diesel engines, it may be possible to reduce the noise emitted by fitting a more effective exhaust silencer system or utilising an acoustic canopy to replace the normal engine cover.
- For percussive tools such as pneumatic concrete breakers, rock drills and tools a number of noise control measures include fitting muffler or sound reducing equipment to the breaker 'tool' and ensuring any leaks in the air lines are sealed. Erect localised screens around breaker or drill bit when in operation in close proximity to noise sensitive boundaries.
- For concrete mixers, control measures should be employed during cleaning to ensure no impulsive hammering is undertaken at the mixer drum.
- For all materials handling ensure that materials are not dropped from excessive heights and drop chutes/dump trucks are lined with resilient materials.
- For compressors, generators and pumps, these can be surrounded by acoustic lagging or enclosed within acoustic enclosures providing air ventilation.
- Demountable enclosures can also be used to screen operatives using hand tools and may be moved around site as necessary.
- All items of plant should be subject to regular maintenance. Such maintenance can prevent unnecessary increases in plant noise and can serve to prolong the effectiveness of noise control measures.

A11.3.7 Screening

The use of screens can be effective in reducing the noise level at a receiver location and should be employed as a complementary measure to all other forms of noise control. The effectiveness of a noise screen will depend on the height and length of the screen and its position relative to both the source and receiver. The height and length of any screen should, where practicable, be such that there is no direct line of sight between the source and the receiver.

BS 5228-1:2009+A1:2014 states that on level sites the screen should be placed as close as possible to either the source or the receiver. The construction of the screen should be such that there are no gaps or openings at joints in the screen material. In most practical situations the effectiveness of the screen is limited by the sound transmission over the

barrier rather than the transmission through the barrier itself. Screens constructed of materials with a surface mass greater than 10kg/m² typically offer adequate sound insulation performance.

Annex B of BS 5228-1:2009+A1:2014 (Figures B1, B2 and B3) provide typical details for temporary and mobile acoustic screens, sheds and enclosures that can be constructed on site from standard materials. BS 5228-1:2009+A1:2014 Figure B2 is included here for information purposes.

Figure A11.1: Typical acoustic screen/shed detail

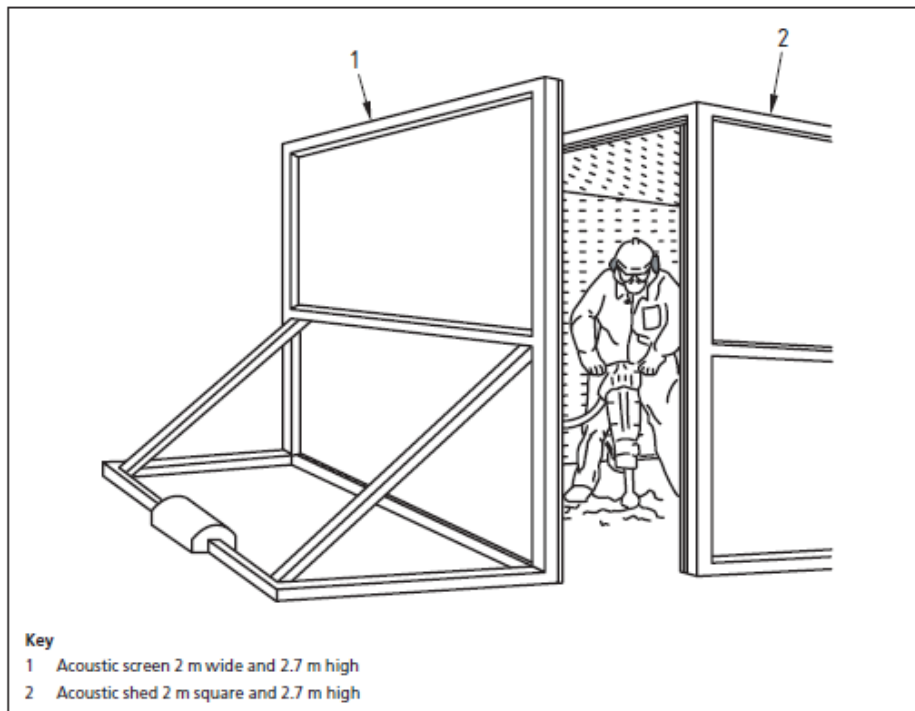


Table B.4 Measured sound reduction given by types of partial enclosure

Type of enclosure (see Figure B.3)	Reduction dB(A)		
	Facing the opening(s)	Sideways	Facing rear of shed
Open-sided shed lined with absorbent material; no screen	1	9	14
Open-sided shed lined with absorbent material; with reflecting screen in front	10	6	8
Open-sided shed lined with absorbent material; with absorbent screen in front	10	10	10

A11.3.8 Vibration

The vibration from construction activities will be limited to the values set out within Chapter 11 of the EIS. It should be noted that these limits are not absolute, but provide guidance as to magnitudes of vibration that are very unlikely to cause cosmetic damage. Magnitudes of vibration slightly greater than those in the table are normally unlikely to cause cosmetic damage, but construction work creating such magnitudes should proceed with caution.

Limit values have been provided for the following building types:

- Soundly constructed residential and commercial properties;
- Protected structures and sensitive buildings such as those with no or minimal foundations, and;
- Clinical buildings.
- It is understood that bored piling is to be used in this instance which is a piling method which generates relatively low levels of vibration. Notwithstanding this considerations should be given to the following methods to further mitigate the vibration levels,
- Minimise obstructions between the vibration source and the sensitive receiver, e.g. old basement floors, old foundations etc., which exacerbate the transmission of vibration;
- Reduce the resistance to bored piles by “mudding in”. This technique involves lubricating the borehole with a small amount of bentonite slurry.

A11.3.9 Piling

Piling is the construction activity which is most likely to cause disturbance. General guidance in relation to piling is outlined in the following paragraphs.

Piling programmes should be arranged so as to control the amount of disturbance in noise and vibration sensitive areas at times that are considered of greatest sensitivity. If piling works are in progress on a site at the same time as other works of construction or demolition that themselves may generate significant noise and vibration, the working programme should be phased so as to prevent unacceptable disturbance at any time.

During consultation the planner, developer, architect and engineer, as well as the local authority, should be made aware of the proposed method of working of the piling contractor. The piling contractor should in turn have evaluated any practicable and more acceptable alternatives that would economically achieve, in the given ground conditions, equivalent structural results.

It should be remembered that a decision regarding the type of pile to be used on a site will normally be governed by such criteria as loads to be carried, strata to be penetrated and the economics of the system, for example the time it will take to complete the installation and other associated operations such as soil removal. It may not be possible for technical reasons to replace a noisy process by one of the ‘quieter piling’ alternatives.

Even if it is possible, the adoption of a quieter method may prolong the piling operation; the net result being that the overall disturbance to the community will not necessarily be reduced.

On typical piling sites the major sources of noise are essentially mobile and the noise received at any control points will therefore vary from day to day as work proceeds. The duration of piling works is usually short in relation to the length of construction work as a whole, and the amount of time spent working near to noise sensitive areas can represent only a part of the piling period.

Noise reduction can be achieved by enclosing the driving system in an acoustic shroud. For steady continuous noise, such as that generated by diesel engines, it may be possible to reduce the noise emitted by fitting a more effective exhaust silencer system or utilising an acoustic canopy to replace the normal engine cover.

Screening by barriers and hoardings is less effective than total enclosure but can be a useful adjunct to other noise control measures. For maximum benefit, screens should be close either to the source of noise (as with stationary plant) or to the listener. Removal of a direct line of sight between source and listener can be advantageous both physically and psychologically. In certain types of piling works there will be ancillary mechanical plant and equipment that may be stationary, in which case, care should be taken in location, having due regard also for access routes. When appropriate, screens or enclosures should be provided for such equipment.

Contributions to the total site noise can also be anticipated from mobile ancillary equipment, such as handling cranes, dumpers, front end loaders etc. These machines may only have to work intermittently, and when safety permits, their engines should be switched off (or during short breaks from duty reduced to idling speed) when not in use.

All mechanical plant should be well maintained throughout the duration of the piling works. When a site is in a residential environment, lorries should not arrive at or depart from the site at times incontinent to residents.