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THE GRANGE, WESTERGATE

NOISE & VIBRATION ASSESSMENT

Technical Report: R9414-1 Rev 0

Date: 24th March 2022

For: Smith Simmons & Partners
15 West Pallant
Chichester
PO19 1TB

24 Acoustics Document Control Sheet

Project Title: The Grange, Westergate – Noise and Vibration Assessment

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For and on behalf of 24 Acoustics Ltd				

Document Status and Approval Schedule

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0	Approved for issue	Josh Large	Stephen Gosling

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1.0 INTRODUCTION

1.1 24 Acoustics Ltd has been instructed by Smith Simmons and Partners to undertake an assessment of environmental noise and vibration at The Grange, Westergate, which is proposed for residential development. The assessment has included:

- Ambient noise and vibration monitoring on the proposed site;
- Assessment of the noise and vibration arising from the nearby railway.

1.2 This noise and vibration assessment is intended to discharge Condition 6 of the planning consent, AL/28/21/PL, which states:

> *The development shall not begin until a scheme for protecting the dwellings from noise and vibration from the railway line has been submitted to and been approved in writing by the Local Planning Authority. Any works which form part of the scheme approved by the Local Planning Authority shall be completed before any permitted dwelling is occupied and retained in perpetuity.*

1.3 An explanation of acoustical terms used in this report is provided in Appendix A. All sound pressure levels in this report are given in dB re: 20 µPa.

2.0 SITE DESCRIPTION

2.1 The site is located beside Lidsey Road in Westergate and lies adjacent to the railway line between Chichester and Barnham. The site comes under the jurisdiction of Arun District Council. A visual overview of the site is provided in Figure 1.

2.2 The site is located in a quiet residential area. It is currently used as a residence, with further residences to the east and west. The site is flat, with the railway line approximately 1 metre below site ground level. It is proposed to construct two dwellings on the site, both four-bedroom detached houses, with a garage proposed in between. Both dwellings will be approximately 70 m from the railway line. The proposed development is shown in Figure 2.

2.3 The railway line runs along the southern boundary of the site. Historic train data and observations made during site visits suggest that this is primarily a passenger train route, with the occasional freight train passing. The railway line is the primary source of noise on site, with distant road traffic noise from Lidsey Road at low levels.

3.0 CRITERIA

Planning Condition

3.1 Development at The Grange is subject to compliance with Condition 6 of the planning consent, AL/28/21/PL, which states

> *The development shall not begin until a scheme for protecting the dwellings from noise and vibration from the railway line has been submitted to and been approved in writing by the Local Planning Authority. Any works which form part of the scheme approved by the Local Planning Authority shall be completed before any permitted dwelling is occupied and retained in perpetuity.*

National Planning Policy Framework and Noise Policy Statement for England

3.2 The National Planning Policy Framework (NPPF) [Reference 1] states that planning policies and decisions should aim to:

- Prevent new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability
- Mitigate and reduce to a minimum, potential adverse impacts resulting from noise from new development and avoid noise giving rise to significant adverse impacts on health and quality of life.
- Identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.

3.3 The NPPF refers to the Noise Policy Statement for England (NPSE) [Reference 2] which is intended to apply to all forms of noise, including environmental noise, neighbour noise, and neighbourhood noise. The NPSE sets out the Government's long-term vision to 'promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development' which is supported by the following aims:

- Avoid significant adverse impacts on health and quality of life;
- Mitigate and minimise adverse impacts on health and quality of life;
- Where possible, contribute to the improvement of health and quality of life.

3.4 The NPSE defines the concept of a 'significant observed adverse effect level' (SOAEL) as 'the level above which significant adverse effects on health and quality of life occur'. The following guidance is provided within the NPSE:

> *"It is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times. It is acknowledged that further research is required to increase our understanding of what may constitute a significant adverse impact on health and quality of life from noise. However, not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available."*

3.5 In 2019 the Planning Practice Guidance (PPG) was updated [Reference 3]. This is written to support the NPPF with more specific planning guidance. The PPG reflects the NPSE and states that noise needs to be considered when new developments may create additional noise and when new developments would be sensitive to the prevailing acoustic environment. It also states that opportunities should be taken, where practicable, to achieve improvements to the acoustic environment. The PPG states that noise can over-ride other planning concerns but should not be considered in isolation from the other economic, social and environmental dimensions of the proposed development.

3.6 The PPG expands upon the concept of SOAEL (together with Lowest Observable Adverse Effect Level, LOAEL and No Observed Effect Level, NOEL) as introduced in the NPSE and provides a table of noise exposure hierarchy for use in noise assessments in the planning system. Table 1 is reproduced from the NPPG and summarises the noise exposure hierarchy, based on the likely average response.

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life	No Observed Adverse Effect	No specific measures required
Lowest Observable Adverse Effect Level (LOAEL)			
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/ or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level (SOAEL)			
Noticeable and disruptive	The noise causes a material change in behaviour and/ or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Noticeable and very disruptive	Extension and regular changes in behaviour and/ or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/ awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non auditory	Unacceptable Adverse Effect	Prevent

Table 1 - PPG Noise Exposure Hierarchy

3.7 In general terms it is considered that a noise level with an effect level which is lower than SOAEL is acceptable (providing the effect is mitigated to a minimum). There is currently, however, a major discontinuity between the above guidance and objective technical criteria for use in planning noise assessments. For this site it is considered that the appropriate (technical and objective) standards for use in assessing the noise is those of British Standard 8233:2014 [Reference 4]. This is described below.

Arun District Council - Noise

3.8 Section 6.5 of Sussex County's 'Planning Noise Advice Document' [Reference 5] states:

> *Design control measures should aim to meet the recommended standards set out in table 4 of BS 8233:2014 and regular night-time noise events such as scheduled aircraft or passing trains which can cause sleep disturbance shall be minimized and assessed as L_{Afmax}, as recommended in the WHO's Night Noise Guidelines for Europe (2009)*

British Standard 8233 and World Health Organisation Guidance

3.9 BS 8233:2014 provides design guidance for dwelling houses, flats and rooms in residential use and states that it is 'desirable' that internal noise levels in dwellings do not exceed 35 dB $L_{Aeq,16\ hour}$ in living rooms and bedrooms during the day, 40 dB $L_{Aeq,\ 16\text{-}hour}$ in dining rooms during the day and 30 dB $L_{Aeq,\ 8\text{-}hour}$ in bedrooms at night.

3.10 The World Health Organisation (WHO) [Reference 6] provides guidance on desirable internal noise levels to minimise the risk of sleep disturbance. The WHO 2000 guidelines suggest internal noise levels not exceeding 30 dB $L_{Aeq,\ 8\text{-}hour}$ or regularly exceeding 45 dB $L_{Amax,f}$ for 'a good night's sleep' (more than 10- 15 events per night).

3.11 The World Health Organisation also provides guidance on the relationship between annoyance and noise levels in external amenity areas (gardens, terraces, balconies etc.). It suggests that in order to prevent the majority of the population being moderately annoyed by noise the noise level in these areas should not exceed 50 dB $L_{Aeq,16\text{-}hour}$ between 07:00 and 23:00 and also defines 55 dB $L_{Aeq,\ 16\text{-}hour}$ as the onset of significant community annoyance. It should be noted that these values are aspirational and BS 8233:2014 refers to these levels as 'not achievable in all circumstances where development might be desirable'. In such situations development should be designed to achieve the lowest levels practicable in external amenity spaces but development should not be prohibited.

Noise Criteria Summary

3.12 Based upon the review of standards and guidance described above the following acoustic criteria has been adopted for use in this project:

- Noise levels internally with windows closed and alternative means of background ventilation provided should not exceed 35 dB $L_{Aeq,16\,hour}$ in living rooms and bedrooms during the day and 30 dB $L_{Aeq,\,8\,hour}$ and 45 dB $L_{Amax,f}$ (for 10 events or more) in bedrooms at night;
- Where internal noise criteria are not met with windows open, an alternative form of ventilation will be provided;
- Where feasible, noise levels in private rear gardens should be no greater than 55 dB $L_{Aeq,\,16\,hour}$ during the day. However, where this is not achievable, higher levels are considered acceptable, provided the scheme is designed to mitigate to the lowest level practicable.

Arun District Council - Vibration

3.13 Section 3.4 of Sussex County's 'Planning Noise Advice Document' advocates the use of BS 6472-1:2008 [Reference 7] for sites where vibration is a potential issue, stating that levels be no greater than 'low probability of adverse comment'.

British Standard BS 6472: 2008

3.14 The assessment of human response to vibration within buildings is currently guided by BS 6472. Where vibration occurs as a series of events, as in the case of train pass-bys, BS 6472 indicates that Vibration Dose Values (VDVs) should be used. Human response to vibration in buildings is assessed in terms of VDVs defined over daytime and night-time periods.

3.15 The human body is most sensitive to vibration in the vertical direction (head to foot). The standard defines values of VDV which are likely to cause varying degrees of adverse comment, and these are summarised in Table 2.

Place and Time	Vibration Dose Value, $m/s^{1.75}$		
	Low probability of adverse comment	Adverse comment possible	Adverse comment probable
Residential 16 hr day (07:00 to 23:00)	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential 8 hr night (23:00 to 07:00)	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

Table 2 - Vibration Dose Values and Subjective Response

4.0 NOISE AND VIBRATION MEASUREMENTS

Instrumentation

4.1 Noise and vibration levels were measured using the following equipment:

Svantek (Class 1) precision sound & vibration level meter	Type 958-A
Svantek tri-axial accelerometer	Type SV84
Brüel & Kjær acoustic calibrator	Type 4231

4.2 The instrumentation was powered by an external battery and stored in a weatherproof case. An outdoor microphone windshield was used.

4.3 The calibration of all instrumentation was verified before and after the tests and no significant signal variation occurred. Calibration of 24 Acoustics' equipment is traceable to National Standards.

Survey Conditions

4.4 The weather conditions during the background noise measurements were generally dry with wind speeds below 5 m/s.

4.5 During the surveying period, ground works took place along the site access road, with further construction works taking place at a nearby property. This data has been retained and presents a more robust worst-case prediction of external noise & vibration.

Noise Measurement Procedure

4.6 The noise measurement location used (shown in Figure 2) was chosen to establish how noise from the railway line affects the proposed site. Measurements were undertaken approximately 55 m from the railway line.

4.7 Noise measurements were undertaken at a height of approximately 1.7 metres, on the western boundary, in line of sight of the railway. There were no strong sources of noise at the measurement location.

4.8 The instrumentation was configured to record 1-minute measurements of the A-weighted statistical parameters including L_{Aeq}, L_{A90} and L_{Amax} (all measured on fast response). The survey was undertaken in general accordance with BS 7445: 1991 "Description and measurement of environmental noise Part 2 - Acquisition of data pertinent to land use [Reference 6]

Vibration Measurement Procedure

4.9 Measurements of VDVs (as defined in BS 6472) were taken in three axes of motion, defined as X (longitudinal), Y (lateral) and Z (vertical), all relative to the surroundings). The axes were orientated as follows:

x-axis - parallel to the railway line;
y-axis - perpendicular to the railway line;
z-axis – vertical.

4.10 Vibration measurements were undertaken at the same location as noise measurements, with the accelerometer placed on firm ground. BS 6472 recommends measuring vibration on the floor of the building being assessed, which was not possible in this case, as it is not yet built. Relevant multiplying factors and corrections were used to establish whether vibration is likely to have an effect on the end user.

5.0 NOISE AND VIBRATION SURVEY RESULTS

Noise

5.1 The measured noise levels (expressed as L_{Aeq} and L_{Amax}) are shown in Appendix B. The measured average (L_{eq}) data values have been combined to generate the overall 16-hour daytime and 8-hour night-time free field levels; these are shown in Table 3 below:

Date and Time	Daytime	Night	
	$L_{Aeq,\ 16\ hour}$	$L_{Aeq,\ 8\ hour}$	$L_{Amax,f}$ Typical
Tuesday 8th March	44.3*	43.3	66.4
Wednesday 9th March	50.2	42.9	62.9
Thursday 10th March	48.3	42.7	64.0
Friday 11th March	47.6*	-	-
Average	**48**	**43**	**64**

Table 3 - Daytime and night-time noise survey results

Vibration

5.2 Measured VDVs are shown in Appendix B and are summarised in Table 4 below:

Date	Period	Direction of Motion and Vibration Dose Value, $m.s^{-1.75}$		
		X	Y	Z
08/03/22	Day	0.0015	0.0053	0.0132
	Night	0.0018	0.0021	0.0090
09/03/22	Day	0.0025	0.0041	0.0219
	Night	0.0016	0.0016	0.0099
10/03/22	Day	0.0026	0.0033	0.0229
	Night	0.0016	0.0019	0.0096
11/03/22	Day	0.0014	0.0016	0.0082
Average	Day	0.0020	0.0036	0.0166
	Night	0.0018	0.0023	0.0113

Table 4 - Daytime and night-time vibration survey results

5.3 Table 4 shows that vibration is highest in the Z-direction (vertical). These measurements will be used for the vibration assessment, as they present a worst-case scenario.

6.0 NOISE ASSESSMENT

6.1 The new properties will be designed to not exceed noise levels of 35 dB $L_{Aeq, 16\,hour}$ during the day, 30 dB $L_{Aeq, 8\,hour}$ at night and 45 dB $L_{Amax, f}$ for regular events at night, inside habitable rooms (living rooms/bedrooms).

6.2 The assessment was undertaken based on drawings provided by Smith Simmons and Partners and include corrections for distance between the measurement location and proposed dwelling.

6.3 The rooms most significantly affected by rail noise in the proposed dwellings are on the southern façades, which are in line of sight of the railway. On the southern façade of each dwelling, there is a bedroom (Bedroom 4) and a living room at ground floor level, and a bedroom (Bedroom 2) at first floor level.

Glazing

6.4 The minimum acoustic requirements for the glazing, applicable to all habitable rooms throughout the development, are summarised in Table 5.

Description	Minimum SRI (dB) per Octave Band Centre Frequency (Hz)					
	125	250	500	1k	2k	4k
Glazing	24	20	25	35	38	35

Table 5 - Glazing performances

6.5 In making a comparison with the values in Table 5, it is important that the glazing figures used are the result of tests in accordance with ISO 10140, Part 2: 2010 and that the quoted minimum sound reduction specifications are met by the entire glazing system as a whole, including frames, seals, any insulated panels and not just the glass. The requirements also apply to any glazed doors to habitable rooms.

6.6 For guidance, the following glazing configuration would be capable of achieving the required values in Table 4:

- 4mm glass (12mm - 16mm cavity) 4mm glass – 31 dB R_w

Ventilators

6.7 The minimum acoustic requirements for ventilators, applicable to all habitable rooms throughout the development, are summarised in Table 6.

Description	Minimum SRI (dB) per Octave Band Centre Frequency (Hz)					
	125	**250**	**500**	**1k**	**2k**	**4k**
Ventilator	23	26	29	30	33	33

Table 6 - Ventilators – acoustic performance

6.8 In making a comparison with the specifications in Table 6, it is important that the figures used are the result of laboratory tests. The specific ventilation requirements (e.g. equivalent free area etc.) should be confirmed by others. The calculations assume one ventilator per habitable room. If multiple ventilators are required, this assessment should be revised.

6.9 For guidance, the required values states in Table 6 can be achieved using trickle ventilators with an overall performance of 32 dB $D_{n,e,w}$.

External Façade

6.10 Masonry external walls have been assumed in the calculations, achieving a minimum sound insulation performance of 52 dB R_w.

7.0 VIBRATION ASSESSMENT

7.1 As a worst-case screening tool, 24 Acoustics' experience indicates that buildings can amplify free field vertical VDV measurements, depending on the housing construction. This amplification can be up to twice the measured level at ground floor, and four times at first floor level. To provide a worst-case scenario, these multiplying factors have been applied to the daytime and night-time VDV values measured during the vibration survey.

7.2 The predicted daytime and night-time internal VDVs are summarised in Table 7. The probability of adverse comment is also presented for reference.

Location	Predicted Worst Case Internal VDV ($ms^{-1.75}$)			
	Daytime – Ground Floor (07:00 To 23:00 Hours)		Night-Time – First Floor (23:00 to 07:00 Hours)	
Internal floor	0.033	Low probability of adverse comment	0.045	Low probability of adverse comment

Table 7 - Predicted internal daytime and night-time VDVs

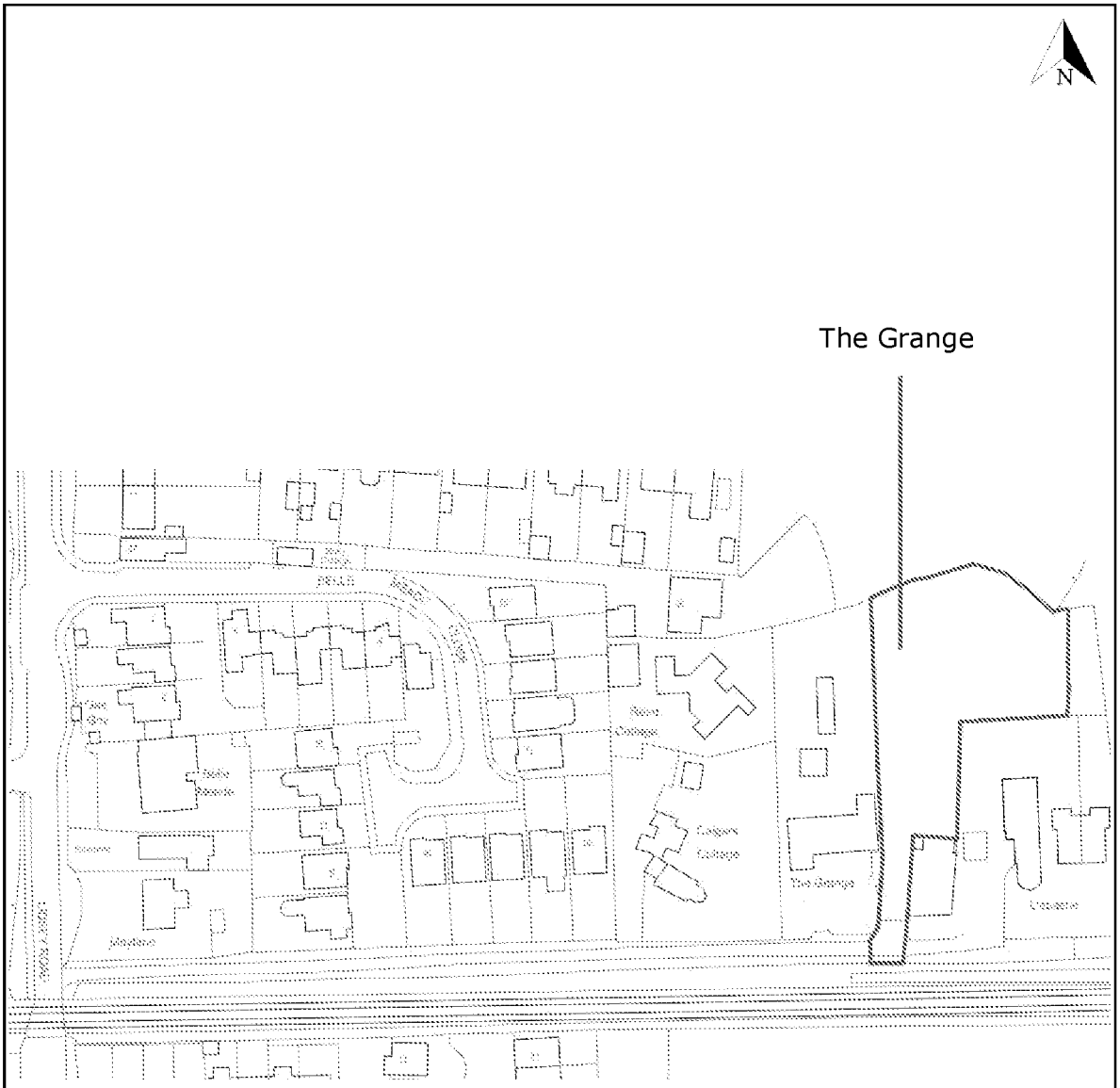
7.3 The values in Table 7 show that there is a low probability of adverse comment from groundborne vibration from the railway at the new development, hence no mitigation measures are required.

8.0 CONCLUSIONS

8.1 24 Acoustics Ltd has been instructed by Smith Simmons and Partners to undertake an assessment of environmental noise and vibration at The Grange, Westergate, in order to discharge Condition 6 of the planning consent, AL/28/21/PL, relating to noise and vibration from the nearby railway.

8.2 Recommendations for glazing and alternative means of ventilation have been provided, to ensure that noise within habitable rooms would comply with maximum internal levels of 35 dB L_{Aeq} during the daytime and 30 dB L_{Aeq} and 45 dB $L_{Amax,f}$ at night for regular events.

8.3 A worst-case vibration assessment has indicated that there is a low probability of adverse comment due to the ground borne vibration from the railway line, hence no mitigation measures are necessary.



Project: The Grange, Westergate	**Title:** Site Overview		24Acoustics
DWG No: Figure 1	**Scale:** N.T.S.	**Rev:** -	
Date: March 2022	**Drawn By:** JL	**Job No:** 9414	

Project: The Grange, Westergate	**Title:** Proposed layout and noise & vibration monitoring location	
DWG No: Figure 2	**Scale:** N.T.S.	**Rev:** -
Date: March 2022	**Drawn By:** JL	**Job No:** 9414

24Acoustics

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1. National Planning Policy Framework, Department for Communities and Local Government, 2019.

2. Noise Policy Statement for England, Defra, 2010.

3. Planning Practice Guidance, Department of Communities and Local Government, July 2019.

4. British Standards Institution. British Standard 8233: Sound Insulation and Noise Reduction for Buildings, 2014.

5. Planning Noise Advice Document: Sussex, March 2021.

6. World Health Organisation. Guidelines for Community Noise, 2000.

7. British Standards Institution. British Standard 6472: Guide to evaluation of human exposure to vibration in buildings, Part 1: Vibration source other than blasting, 2008.

APPENDIX A: ACOUSTIC TERMINOLOGY

Noise is defined as unwanted sound. The range of audible sound is from 0 to 140 dB. The frequency response of the ear is usually taken to be around 18 Hz (number of oscillations per second) to 18000 Hz. The ear does not respond equally to different frequencies at the same level. It is more sensitive in the mid-frequency range than the lower and higher frequencies and because of this, the low and high frequency components of a sound are reduced in important by applying a weighting (filtering) circuit to the noise measuring instrument. The weighting which is most widely used and which correlates best with subjective response to noise is the dBA weighting. This is an internationally accepted standard for noise measurements.

For variable sources, such as traffic, a difference of 3 dBA is just distinguishable. In addition, a doubling of traffic flow will increase the overall noise by 3 dBA. The 'loudness' of a noise is a purely subjective parameter, but it is generally accepted that an increase/ decrease of 10 dBA corresponds to a doubling/ halving in perceived loudness.

External noise levels are rarely steady, but rise and fall according to activities within an area. In attempt to produce a figure that relates this variable noise level to subjective response, a number of noise indices have been developed. These include:

i) The L_{Amax} noise level

This is the maximum noise level recorded over the measurement period.

ii) The L_{Aeq} noise level

This is "equivalent continuous A-weighted sound pressure level, in decibels" and is defined in British Standard BS 7445 as the " value of the A-weighted sound pressure level of a continuous, steady sound that, within a specified time internal, T, has the same mean square sound pressure as a sound under consideration whose level varies with time".

It is a unit commonly used to describe construction noise and noise from industrial premises and is the most suitable unit for the description of other forms of environmental noise. In more straightforward terms, it is a measure of energy within the varying noise.

iii) The L_{A10} noise level

This is the noise level that is exceeded for 10% of the measurement period and gives an indication of the noisier levels. It is a unit that has been used over many years for the measurement and assessment of road traffic noise.

iv) The L_{A90} noise level

This is the noise level that is exceeded for 90% of the measurement period and gives an indication of the noise level during the quieter periods. It is often referred to as the background noise level and is used in the assessment of disturbance from industrial noise.

APPENDIX B: ENVIRONMENTAL NOISE & VIBRATION LEVELS