

BEDFORD HOUSE, 21A JOHN STREET, LONDON

Noise and Vibration Management Plan

Report 15392.NVMP.01

Prepared on 26 January 2017

For

Benesco Charity Ltd
8/10 Hallam Street
London
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1.0 INTRODUCTION

KP Acoustics has been commissioned by Benesco Charity Ltd, 8/10 Hallam Street, London, W1W 6NS, to compile a preliminary noise and vibration management plan for the project at Bedford House, 21A John Street, London.

This report presents all information gathered from relevant documentation and the steps which should be adopted regarding noise and vibration in order to maintain the amenity of all sensitive receivers adjacent to the site.

2.0 NOISE & VIBRATION ELEMENTS

2.1 Noise

The effects of noise on all neighbouring premises can be varied and complicated. In extreme cases they would be likely to include a sensation of loudness, potential interference with speech communication, disturbance of work or leisure and disturbance of sleep. A complicating factor is that, in any neighbourhood, some individuals will be more sensitive to noise than others.

In order to assess instantaneous noise levels at any time, the instantaneous A-weighted sound pressure level, L_{pA} can be used. This will give an indication of the loudness and degree of speech interference from noise.

The most commonly used descriptor, however, is the equivalent continuous A-weighted sound pressure level, $L_{Aeq,T}$. The time period involved should always be stated as the figure is a mathematical average of the all individual contributions of various sources during the reference period T. When assessing noise from individual events that may not always be present during a longer period L_{Aeq} , it can be useful to use a short reference period (e.g. 5min). As an alternative descriptor, the maximum sound pressure level, $L_{A(max)}$, or the one percentile level, L_{A01} , may be used.

With regards to noise levels, it is proposed that the absolute limit would be determined in accordance with BS5228-1:2009 and would be subject to an overall daytime noise limit of 75dB L_{Aeq} .

2.2 Vibration

The assessment of sensitivity to vibration at different times of the day is far more complex than sensitivity to noise. The sensitivity of the human frame to vibration varies according to the axis of vibration relative to the human body (e.g. x, y or z axis) and to the frequency of vibration. In general, except at very low frequencies, sensitivity is greater in the z axis (i.e. head to foot). When setting vibration control targets it is reasonable to assume that people will normally be sitting or standing during the day and lying down during the night.

With an impulsive source of vibration, it is usual to measure the peak value attained from the beginning to the end of a drive. It is also usual to measure in terms of peak particle velocity (P.P.V) if the risk of damage to the building is the primary concern and there is also

an interest in human reaction. If the concern is purely for human tolerance, then acceleration is the preferred parameter.

Vibrations, even of very low magnitude, may be perceptible to people and can interfere with the satisfactory conduct of certain delicate activities, e.g. operating theatres, use of very sensitive laboratory weighing equipment etc.

Nuisance from vibration is frequently associated with the assumption that, if vibrations can be felt, then damage is consequently inevitable; however, considerably greater levels of vibration are required to cause damage to buildings and structures than to be perceived by the human body.

Vibrations from site activities to the neighbourhood may therefore cause anxiety as well as annoyance and can disturb sleep, work or leisure activities. As with noise, in any neighbourhood, some individuals will be more sensitive to vibration than others.

3.0 CRITERIA FOR NOISE & VIBRATION

The following factors are typically used to assess the likelihood of disturbance caused by noise and vibration generating activities:

Site location

The relative location of a site in relation to noise or vibration sensitive receivers will be a determining factor. The closer a site is to sensitive premises, the higher the likelihood of complaints due to noise and vibration emanating from the site.

Ambient noise and vibration levels

From the environmental noise survey undertaken on site, as shown in time histories 15392.TH1-3, it is understood that the area is generally quiet with the main contribution being traffic noise from surrounding roads. This would indicate that there could be an increased likelihood of complaints due to the introduction of new noise sources.

However, the relationship between response and noise level difference may well be different. For example, a greater difference between the ambient noise level in the area and the new noise sources may be tolerated when it is known that the operations are of short duration. There is no known relationship between response and levels when comparing newly intruding and ambient vibrations.

Duration of site operations

In general, the longer the duration of all on-site operations, the more likely it is that noise or vibration from the site will potentially be an issue. In this respect, good public relations are very important. Local residents may be willing to accept a new status of noise and vibration if they know and understand the source and the duration of all operations. It is then important that site operations are carried out according to a stated schedule.

Hours of work

For any noise sensitive premises some periods of the day will be more sensitive than others. For example levels of noise that would be intruding within a dwelling during the day would not be an issue during the night. For dwellings, times of site operation outside normal weekday working hours will need special consideration.

Noise control targets for the evening period in such cases will need to be stricter than those for the daytime and, when noise limits are set, the evening limit may have to be as low as 10 dB(A) below the daytime limit. Very strict noise control targets should be applied to any site which is to operate at night.

Attitude to the site operator

It is well established that “one’s music is somebody else’s noise” and vice-versa. People's attitudes to noise are always influenced by their attitudes to the noise source itself.

Noise and vibration generated from a site will tend to be accepted more willingly by local residents if they consider that the site operator is adopting best practicable means to avoid unnecessary noise.

Noise and vibration characteristics

In many cases the particular identity of noise and vibration will affect people’s judgement and appreciation of the signal itself. For example, the presence of a high-amplitude impulsive noise, accompanied by a vibration sensation would render the overall assessment slightly more onerous as “penalties” would need to be employed. These would comprise weightings to signals (e.g. 5dB(A) to a highly tonal or intermittent noise source).

4.0 NOISE & VIBRATION MANAGEMENT PLAN

Deviation from approved method statements will be permitted only with prior approval from relevant parties. This will be facilitated by formal review before any deviation is undertaken.

Site Personnel

All operatives on site will be trained to ensure that noise minimisation and best practicable means (BPM) are implemented at all times. Works will be checked regularly by Site Engineers to ensure that BPM are being undertaken and where necessary corrective actions implemented.

Employees must show consideration to the sensitive receptors, including residential neighbours, and must not generate unnecessary noise when walking to and from the site, or when leaving and arriving at work.

General Noise and Vibration Control Measures

The Best Practicable Means (BPM) (as defined in Section 72 of the Control of Pollution Act 1974) will be used to reduce noise and vibration levels at all times. Where practicable

the control measures set out in BS 5228:2009 + A1:2014 Part 1, Section 8 will also be implemented.

Recommended noise and vibration control measures include:

- Choice of methodology/technique for operations (including site layout) will be considered in order to eliminate or reduce emissions at sensitive locations
- Fixed items of construction plant will be electrically powered in preference to diesel or petrol driven
- If any specialise fabrication is required, this will be undertaken off-site if possible
- Noisy plant will be kept as far away as possible from sensitive areas
- Each item of plant used will comply with the noise limits quoted in the relevant European Commission Directive 2000/14/EC/United Kingdom Statutory Instrument (SI) 2001/1701 [3] where reasonably available
- Equipment will be well-maintained and will be used in the mode of operation that minimises noise and shut down when not in use
- Vehicles shall not wait or queue on the public highway with engines running (unless the engine is required to power the operation of the vehicle e.g. concrete wagon)
- Where possible deliveries will be arranged on a just-in-time basis in order to prevent vehicles queuing outside site.
- All materials will be handled in a manner that minimises noise

5.0 NOISE ASSESSMENT

It is assumed that the separating wall between the building site and the adjacent buildings is comprised of a 300mm (min.) brick wall. This would be anticipated to provide an in-situ airborne sound insulation performance in the range 55-60dB, Dw.

Based on all sound pressure level figures provided in BS5228-1:2009 and in the absence of any manufacturer's noise emission levels, it is anticipated that site operations would generate levels within the range 90-95dB(A) internally. The party walls would be the main attenuating elements, therefore reducing the noise levels within the range 40-45dB(A). These figures have been calculated as a worst-case scenario, not taking into consideration the highly reverberant field within the source space (building site) and the acoustically absorptive residential environment (receiver space).

Please note that the above prediction is based solely on noise from typical site operations, unaffected from any other noise within the residential space (e.g. road traffic).

If noise disturbance is a persistent issue for neighbouring residences, under Example E4 BS 5228-1:2009+A1:2014 states:

“If the contractor has applied best practicable means to the provision of mitigation, i.e. all reasonable measures have been taken to reduce the noise levels, but levels are still such that widespread community disturbance or interference with activities or sleep is likely to occur, there are two further provisions that can be made if the construction activities are likely to continue for a significant period of time either continuously or sporadically. These are as follows:

- a) Noise insulation (NI). This is the provision of secondary glazing to the windows of affected habitable rooms. Additional ventilation provision might also be necessary to allow the windows to be kept closed whilst maintaining the appropriate number of air changes in the room. Secondary glazing increases attenuation and this can provide a significant improvement to the internal noise environment
- b) Temporary or permanent re-housing (TRH). Where construction noise levels are such that noise insulation will not provide sufficient attenuation to prevent disturbance or interference with activities or sleep, then the occupants can be temporarily re-housed away from the construction site. However, if the nature of the construction activities means that re-housing would be necessary for a significant extent of time, e.g. in excess of six months, then there might be advantages in offering permanent re-housing, i.e. the property would be purchased by the developer and the occupants would purchase another property elsewhere. The property would then remain vacant or be used by site personnel for the duration of the works, after which it can be re-sold.

Where, in spite of the mitigation measures applied and any Section 61 consent under the Control of Pollution Act 1974, noise levels at some properties are expected to exceed trigger levels for the periods defined below, a scheme for the installation of noise insulation or the reasonable costs thereof, or a scheme to facilitate temporary rehousing of occupants, as appropriate, will be implemented by the developer or promoter. The scheme will include provision for the notification of affected parties.”

Table E.2 of BS 5228-1:2009+A1:2014 provides example of time periods, averaging times and noise levels associated with the determination of eligibility for noise insulation and is represented below in Table 4.2 with the follow guidance for interpretation.

Examples of time periods, averaging times and noise levels associated with the determination of eligibility for noise insulation

Time	Relevant time period	Averaging time, T	Noise insulation trigger level dB $L_{Aeq,T}$ ^{A)}
Monday to Friday	07.00 – 08.00	1 h	70
	08.00 – 18.00	10 h	75
	18.00 – 19.00	1 h	70
	19.00 – 22.00	3 h	65
	22.00 – 07.00	1 h	55
Saturday	07.00 – 08.00	1 h	70
	08.00 – 13.00	5 h	75
	13.00 – 14.00	1 h	70
	14.00 – 22.00	3 h	65
	22.00 – 07.00	1 h	55
Sunday and Public Holidays	07.00 – 21.00	1 h	65
	21.00 – 07.00	1 h	55

^{A)} All noise levels are predicted or measured at a point 1 m in front of the most exposed of any windows and doors in any façade of any eligible dwelling.

Noise insulation, or the reasonable costs thereof, will be offered by the developer or promoter to owners, where applied for by owners or occupiers, subject to meeting the other requirements of the proposed scheme, where the construction of the development causes, or is expected to cause, a measured or predicted airborne construction noise level that exceeds either of the following at property lawfully occupied as a permanent dwelling:

- the noise insulation trigger levels presented in Table E.2 for the corresponding times of day;
- a noise level 5 dB or more above the existing pre-construction ambient noise level for the corresponding times of day; whichever is the higher; and for a period of 10 or more days of working in any 15 consecutive days or for a total number of days exceeding 40 in any 6 consecutive months.”

6.0 VIBRATION ASSESSMENT

This section presents an assessment of the potential risk regarding vibration generated by the construction works detailed in this document, and the associated adverse effects on the surrounding area.

Guidance Vibration Limits

Estimated vibration levels have been evaluated against guidance presented in relevant British Standards in order to assess the likelihood of both structural damage to neighbouring buildings and the human response of the occupants.

Building Damage

According to BS 7385 Part 2 for residential or light commercial buildings, the threshold for the onset of potential cosmetic damage (i.e. formation of hairline cracks on drywall surfaces or the growth of existing cracks in plaster or drywall surfaces) to buildings varies with frequency. This ranges from a PPV of 15 mm/s at 4Hz, rising to 20mm/s at 15 Hz, and to 50 mm/s at and above 40Hz for transient vibration. BS 7385: Part 2 also states that the probability of building damage tends towards zero at 12.5 mm/s peak component particle velocity.

Line (see Figure 6.1)	Type of Building	Peak component particle velocity in frequency range of predominant pulse	
		4Hz to 15Hz	15Hz and above
1	Reinforced or framed structures. Industrial and heavy commercial buildings	50mm/s at 4Hz and above	
2	Unreinforced or light framed structures. Residential or light commercial type buildings	15mm/s at 4Hz increasing to 20mm/s at 15Hz	20mm/s at 15Hz increasing to 50mm/s at 40Hz and above
Note 1: Values referred to are at the base of the building			
Note 2: For Line 2, at frequencies below 4Hz, a maximum displacement of 0.6mm (zero to peak) should not be exceeded			

Table 6.1: Transient Vibration Guide Values for Cosmetic Damage (from BS 7385: Part 2:1993)

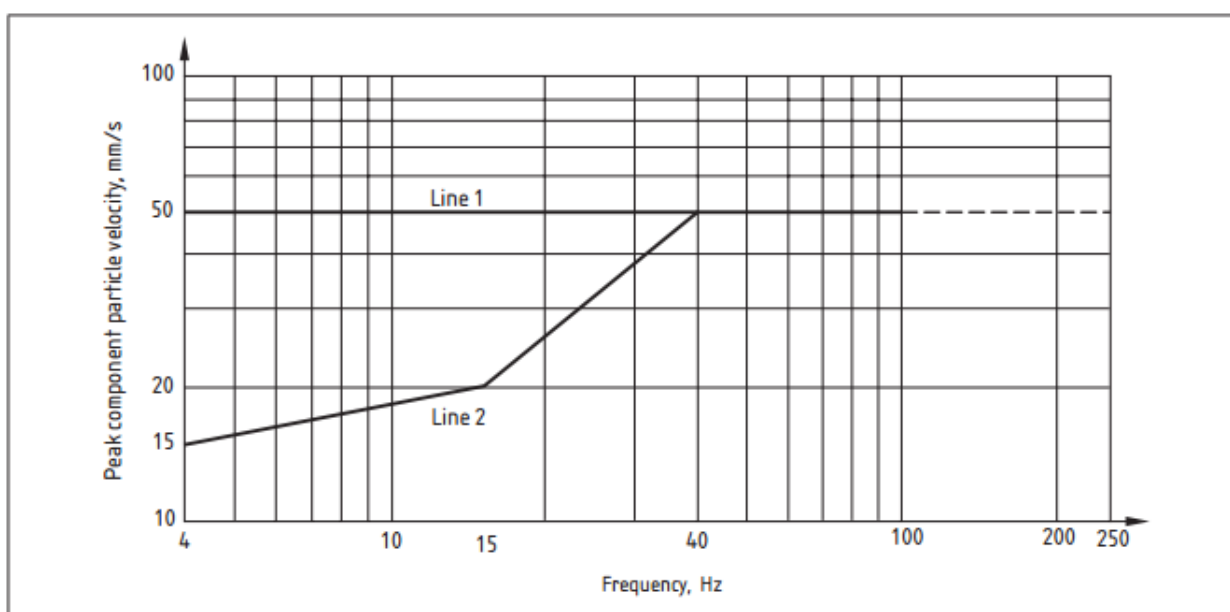


Figure 6.1: Summary of Damage Thresholds for Transient Vibration on Domestic Structures

Subjective Response

According to guidance provided in BS 5228 Part 2, the threshold of vibration perceptible to humans lies around 0.14 to 0.3 mm/s. The Standard also indicates that a PPVs of around 1 mm/s in residential environments, as a first estimate, are likely to cause complaints, but can be tolerable provided prior warning and explanation of the works is given to residents; whilst, vibration magnitudes of around 10 mm/s are likely to be intolerable for more than a very brief exposure to this level.

As in the case above, the nature of all machinery due to be used is not known. This makes the prediction of vibration levels at adjacent dwellings very difficult.

On consideration of the above, a two-stage criterion is recommended:

- 5 mm/s p.p.v. ‘soft’ limit; when exceeded, the contractor should temporarily halt works. Works should only be resumed after consultation with the local residents, and with extreme caution
- 10 mm/s p.p.v. ‘hard’ limit; when exceeded, the contractor should stop work. Works should only continue after a thorough structural examination of the adjacent property, subsequent consultation with the local residents, and then with extreme caution. Should significant damage be identified, alternative methods of land remediation operations should be adopted.

From previous experience on similar sites, it is unlikely that vibration would be an issue to local residents. A snapshot of vibration monitoring during continuous HGV movement at 5m from the road, is shown in Figure 6.2.

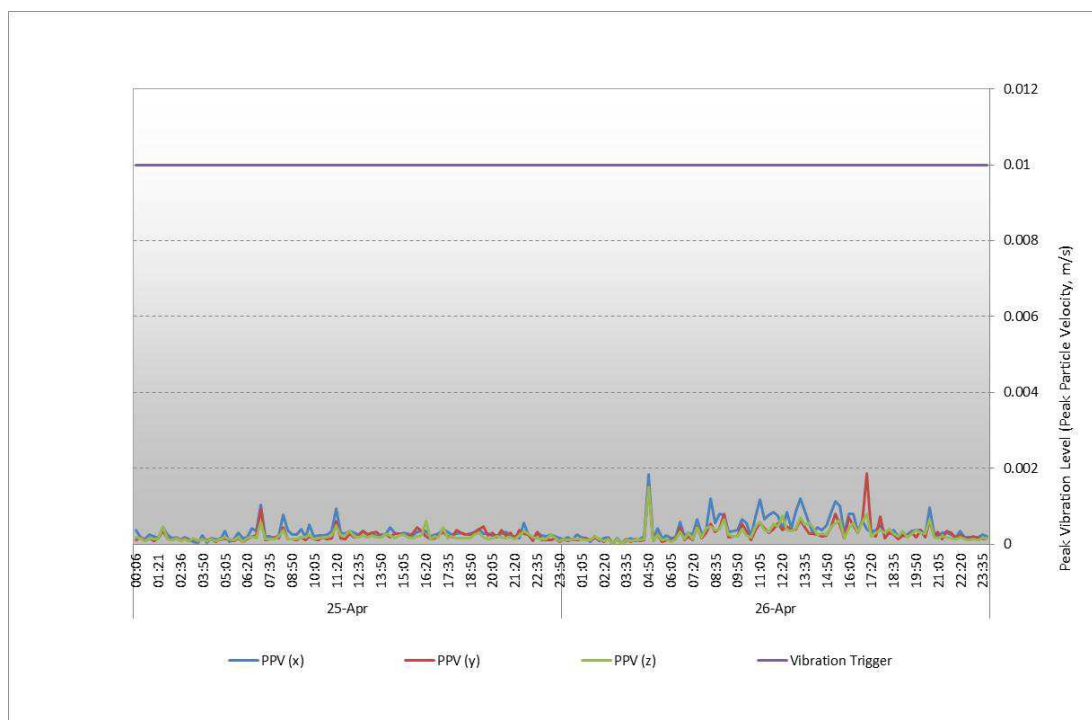


Figure 6.2: Results from vibration monitoring of HGV movements (similar scenario)

As can be seen from Figure 6.2, vibration levels are significantly lower than the limits set above, posing no threat to the local residents. Please note that this is for indicative purposes and would not reflect the predicted vibration levels in this project.

7.0 CONCLUSION

KP Acoustics has been commissioned to undertake a preliminary assessment of noise and vibration levels from all site operations at Bedford House, 21A John Street, London, in order to provide initial advice on the control of noise and vibration on site.

Information on good practice steps have been provided, while a realistic approach has been adopted regarding the maximum noise and vibration levels which should be met on site.

In order to predict specific noise levels to be experienced on site and at the nearest noise sensitive receivers, further information would be required, such as manufacturer noise emissions data for plant items operating on site. Initial predictions for noise and vibration however indicate that provided that the guidelines provided within this report are followed, any disturbance caused by noise or vibration will be minimised.

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Bedford House, 21A John Street, London
Environmental Noise Time History
5th January to 6th January 2017

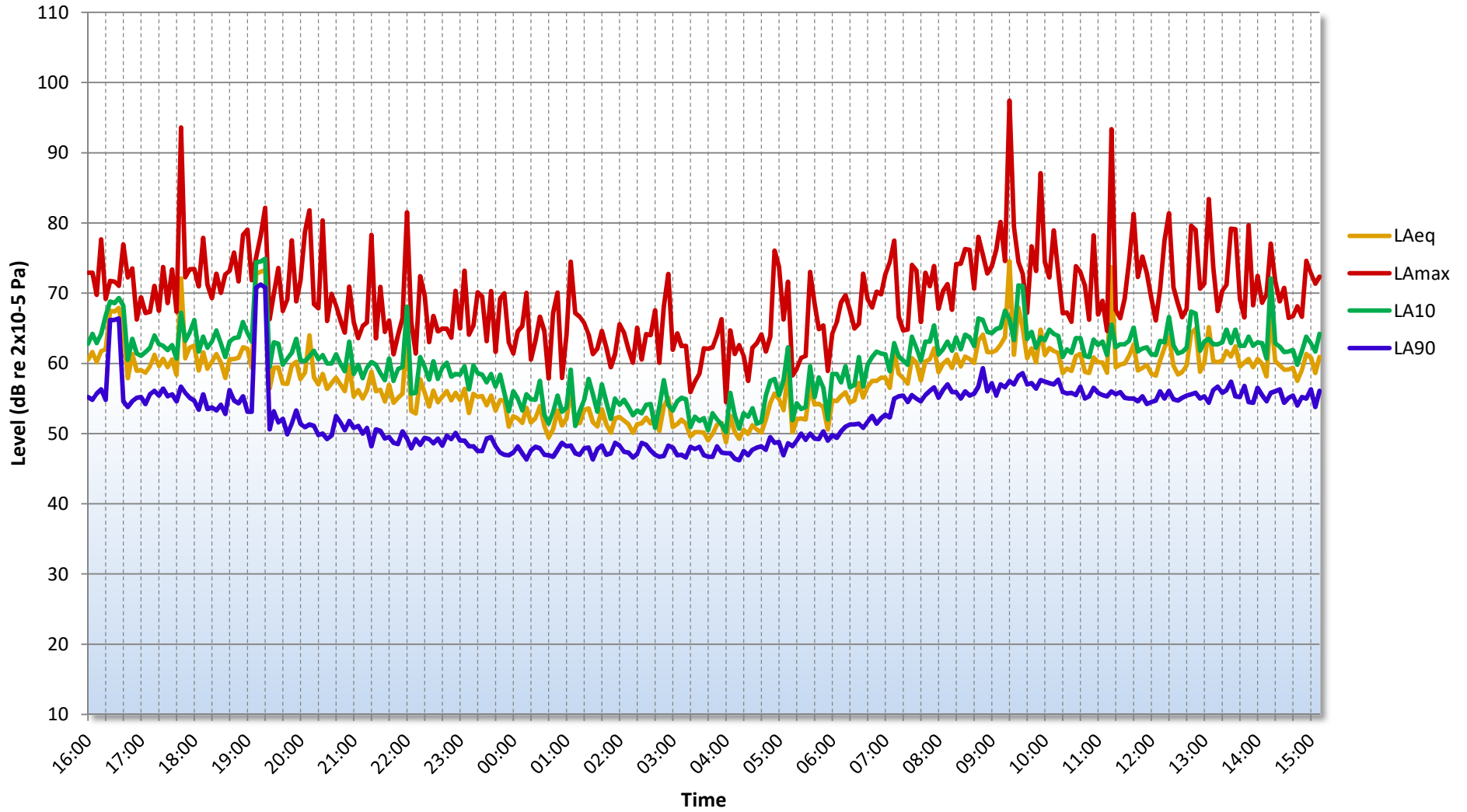


Figure 15392.TH1.Front

Bedford House, 21A John Street, London
Environmental Noise Time History
5th January to 6th January 2017

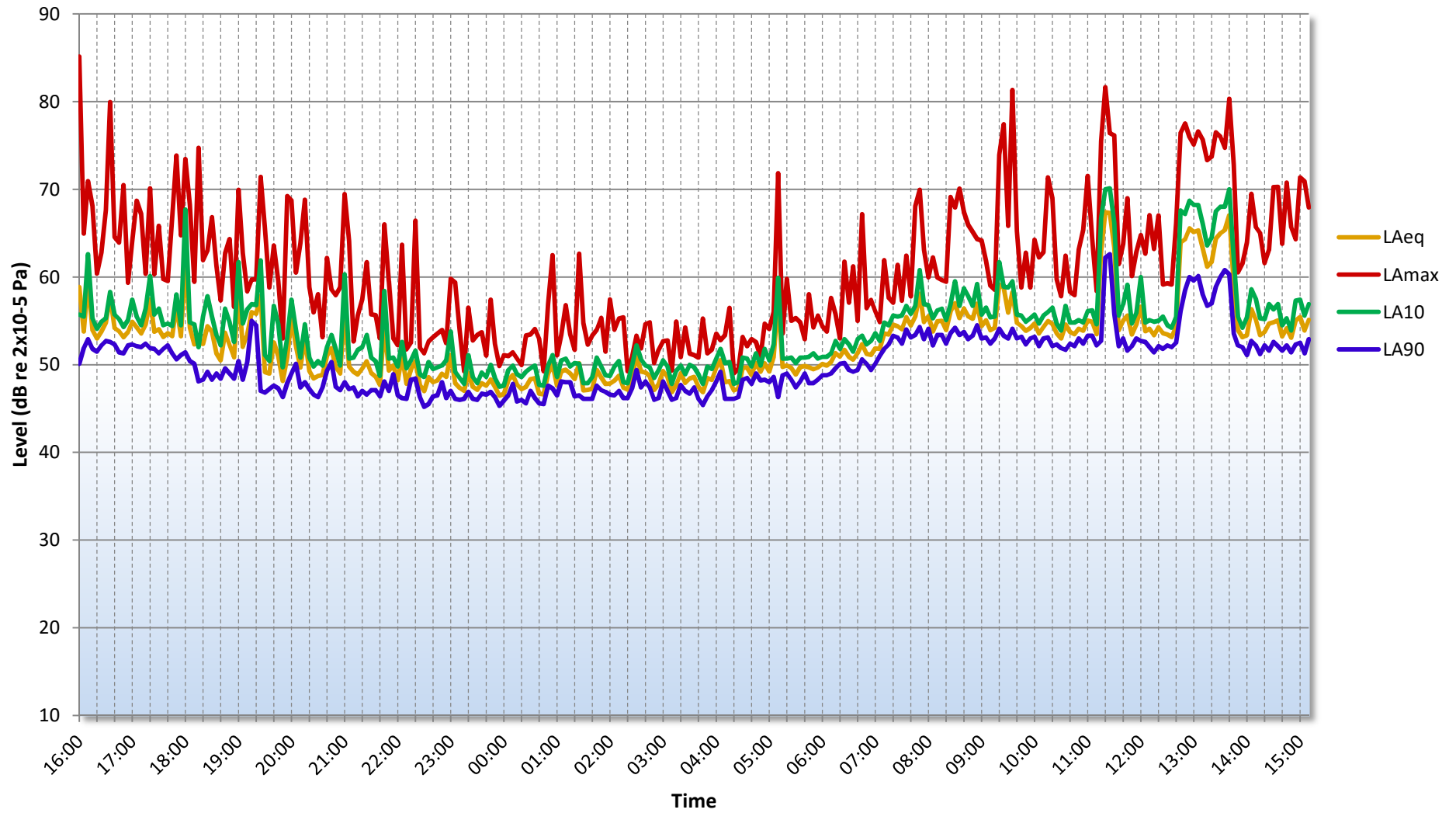


Figure 15392.TH2.Central Facades

Bedford House, 21A John Street, London
Environmental Noise Time History
5th January to 6th January 2017

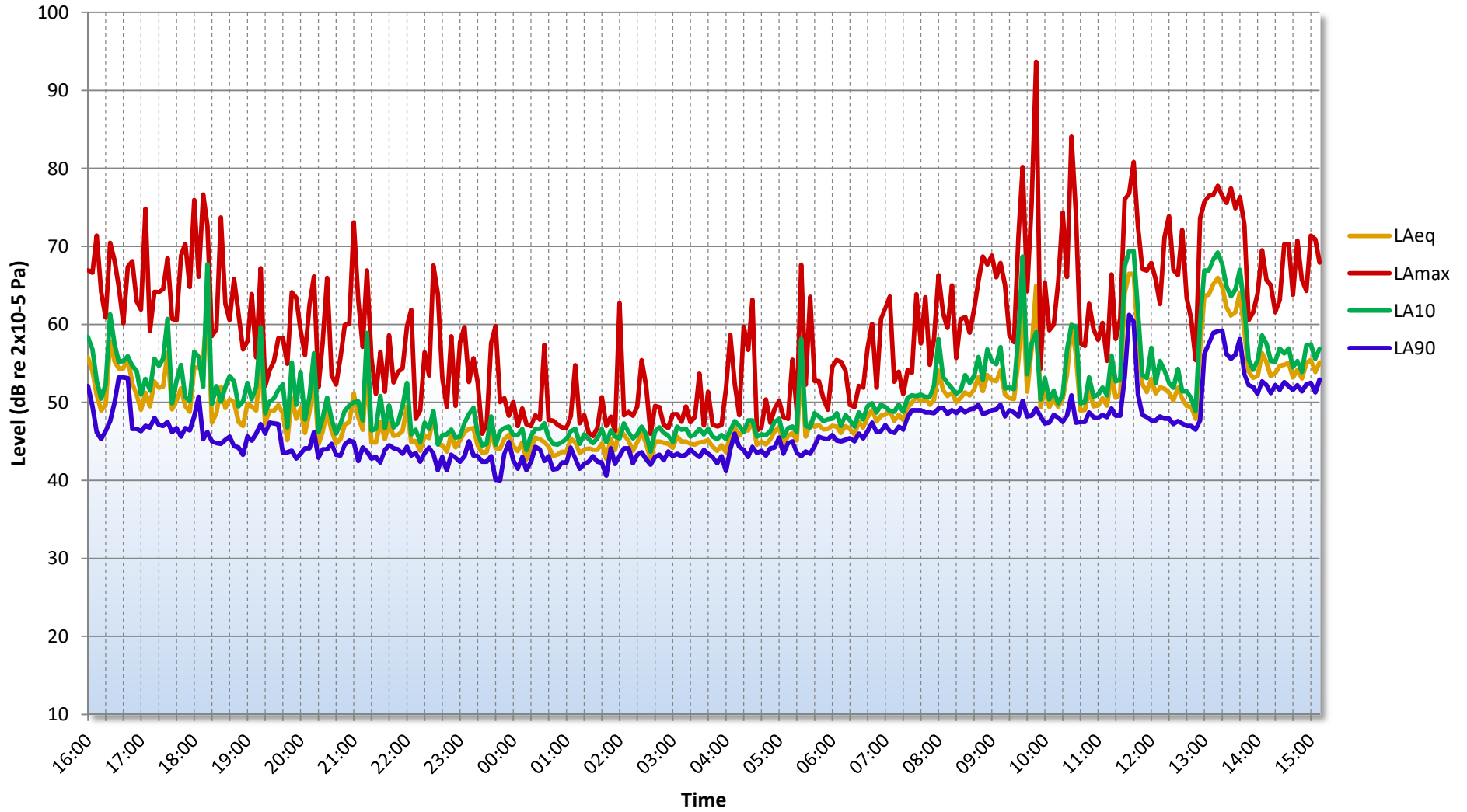


Figure 15392.TH3.Rear Facade

GENERAL ACOUSTIC TERMINOLOGY

Decibel scale - dB

In practice, when sound intensity or sound pressure is measured, a logarithmic scale is used in which the unit is the 'decibel', dB. This is derived from the human auditory system, where the dynamic range of human hearing is so large, in the order of 10^{13} units, that only a logarithmic scale is the sensible solution for displaying such a range.

Decibel scale, 'A' weighted - dB(A)

The human ear is less sensitive at frequency extremes, below 125Hz and above 16Khz. A sound level meter models the ears variable sensitivity to sound at different frequencies. This is achieved by building a filter into the Sound Level Meter with a similar frequency response to that of the ear, an A-weighted filter where the unit is dB(A).

L_{eq}

The sound from noise sources often fluctuates widely during a given period of time. An average value can be measured, the equivalent sound pressure level L_{eq} . The L_{eq} is the equivalent sound level which would deliver the same sound energy as the actual fluctuating sound measured in the same time period.

L_{10}

This is the level exceeded for no more than 10% of the time. This parameter is often used as a "not to exceed" criterion for noise.

L_{90}

This is the level exceeded for no more than 90% of the time. This parameter is often used as a descriptor of "background noise" for environmental impact studies.

L_{max}

This is the maximum sound pressure level that has been measured over a period.

Octave Bands

In order to completely determine the composition of a sound it is necessary to determine the sound level at each frequency individually. Usually, values are stated in octave bands. The audible frequency region is divided into 11 such octave bands whose centre frequencies are defined in accordance with international standards. These centre frequencies are: 16, 31.5, 63, 125, 250, 500, 1000, 2000, 4000, 8000 and 16000 Hertz.

Environmental noise terms are defined in BS7445, *Description and Measurement of Environmental Noise*.

APPLIED ACOUSTIC TERMINOLOGY

Addition of noise from several sources

Noise from different sound sources combines to produce a sound level higher than that from any individual source. Two equally intense sound sources operating together produce a sound level which is 3dB higher than a single source and 4 sources produce a 6dB higher sound level.

Attenuation by distance

Sound which propagates from a point source in free air attenuates by 6dB for each doubling of distance from the noise source. Sound energy from line sources (e.g. stream of cars) drops off by 3dB for each doubling of distance.

Subjective impression of noise

Hearing perception is highly individualised. Sensitivity to noise also depends on frequency content, time of occurrence, duration of sound and psychological factors such as emotion and expectations. The following table is a guide to explain increases or decreases in sound levels for many scenarios.

Change in sound level (dB)	Change in perceived loudness
1	Imperceptible
3	Just barely perceptible
6	Clearly noticeable
10	About twice as loud

Transmission path(s)

The transmission path is the path the sound takes from the source to the receiver. Where multiple paths exist in parallel, the reduction in each path should be calculated and summed at the receiving point. Outdoor barriers can block transmission paths, for example traffic noise. The effectiveness of barriers is dependent on factors such as its distance from the noise source and the receiver, its height and construction.

Ground-borne vibration

In addition to airborne noise levels caused by transportation, construction, and industrial sources there is also the generation of ground-borne vibration to consider. This can lead to structure-borne noise, perceptible vibration, or in rare cases, building damage.

Sound insulation - Absorption within porous materials

Upon encountering a porous material, sound energy is absorbed. Porous materials which are intended to absorb sound are known as absorbents, and usually absorb 50 to 90% of the energy and are frequency dependent. Some are designed to absorb low frequencies, some for high frequencies and more exotic designs being able to absorb very wide ranges of frequencies. The energy is converted into both mechanical movement and heat within the material; both the stiffness and mass of panels affect the sound insulation performance.