Torrington Place Ltd and Whitbread Group Plc

Proposed Hotel Development
Brook House, 2-16 Torrington Place

Noise and Vibration
Impact Assessment
May 2013

alan saunders associates | acoustics

CONTENTS

List of Attachments

1. INTRODUCTION

It is proposed to convert and extend the existing six storey office building at Brook House, 2-16 Torrington Place, London to rooms for residential purposes.

Alan Saunders Associates has been commissioned by The Property Trust on behalf of Torrington Place Limited and Whitbread Group PLC to undertake an environmental noise survey in order to measure the prevailing background noise climate at the site and a vibration assessment in accordance with BS 6472: Part 1: 2008 *Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting*.

The background noise levels measured will establish the external plant noise emissions criteria requirements of Camden Council.

2. SURVEY PROCEDURE & EQUIPMENT

2.1 Environmental Noise Survey

An automated monitoring survey of the existing background noise levels was undertaken at the locations shown in the attached site plan, AS7236/SP1. Measurements of consecutive 5-minute L_{Aeq}, L_{Amax}, L_{A10} and L_{A90} sound pressure levels were taken between 12:30 hours on Thursday 8th November and 14:35 hours on Monday 12th November 2012.

The following equipment was used during the course of the survey:

- 1 no. Norsonic data logging sound level meter type 118;
- 1 no. Rion data logging sound level meter type NL52;
- 1 no. Norsonic sound level calibrator type 1253.

The calibration of the sound level meters was verified before and after use. No calibration drift was detected.

The weather during the survey was generally dry with low wind speeds, making the conditions suitable for the measurement of environmental noise.

Measurements were made generally in accordance with *ISO 1996-2:2007 Description, measurement and assessment of environmental noise Part 2- Determination of environmental noise levels*.

Please refer to Appendix A for details of the acoustic terminology used throughout this report.

2.2 Train Induced Vibration Survey

An automated vibration monitor (Vibrock Type v901) was installed in the basement plant room at the position shown on the attached Site Plan AS7236/SP1 to record vibration levels due to underground train movements between Thursday 8th November and Monday 12th November 2012.

The transducer was set to record vibration levels as acceleration in three perpendicular axes, from which Vibration Dose Values were determined for day and night-time periods following the procedures described in BS 6472: Part 1: 2008 Guide to e*valuation of human exposure to vibration in buildings: Vibration sources other than blasting*.

The measurement location was deemed to be the closest point to the LUL tunnel on a structure with good adhesion. On this basis, worst case results, with regard to levels across the site, would be obtained.

3. RESULTS

Figures AS7236/TH1-TH8 show the L_{Aeq}, L_{Amax}, L_{A10} and L_{A90} sound pressure levels as a time history at the measurement locations.

The noise climate on site is mainly determined by road traffic on Torrington Place and Tottenham Court Road.

3.1 Noise Levels

The average noise levels as measured at the monitoring locations are shown in Table 3.1 and 3.2. A façade correction has been applied to the data collected at both positions due to the microphone being located within close proximity of the façade.

Position 1		
Monitoring period, T	**Minimum $L_{A90,5mins}$, dB**	**Average $L_{Aeq,T}$, dB**
07:00 - 19:00 hours	50 (11/11/12 07:05)	68
19:00 - 23:00 hours	50 (11/11/12 21:35)	64
23:00 - 07:00 hours	49 (12/11/12 03.25)	60

Table 3.1 - Minimum background and average measured noise levels [dB ref. 20µPa]

Position 2		
Monitoring period, T	**Minimum $L_{A90,5mins}$, dB**	**Average $L_{Aeq,T}$, dB**
07:00 - 19:00 hours	52 (11/11/12 07:05)	72
19:00 - 23:00 hours	57 (11/11/12 21:35)	71
23:00 - 07:00 hours	51 (12/11/12 03:25)	69

Table 3.2 - Minimum background and average measured noise levels [dB ref. 20µPa]

Typical external night-time maximum events were in the range of $L_{Amax,fast}$ 86-96dB at Position 1 and $L_{Amax, fast}$ 80-86dB at Position 2. These are likely to have been due to road traffic in the surrounding area.

3.2 Vibration Survey

The maximum results of the vibration measurements during the survey period are shown in Table 3.3 in terms of vibration dose values (VDV) for day and night periods.

Daytime VDV_{day} ($m/s^{-1.75}$)	Night-time VDV_{night} ($m/s^{-1.75}$)
0.058	0.048

Table 3.3 – Maximum daytime and night-time VDV

4. DESIGN CRITERIA

The requirements of the Camden Council regarding plant noise are detailed within the Camden Council's Core Strategy 2010 and Development Management Policies 2010 (DP28).

Noise description and location of measurement	Period	Time	Noise level
Noise at 1 metre external to a sensitive façade	Day, evening and night	00:00-24:00	5dB(A) <L_{A90}
Noise that has a distinguishable discrete continuous note (whine, hiss, screech, hum) at 1 metre external to a sensitive facade	Day, evening and night	00:00-24:00	10dB(A) <L_{A90}
Noise that has distinct impulses (bangs, clicks, clatters, thumps) at 1 metre external to a sensitive façade	Day, evening and night	00:00-2400	10dB(A) <L_{A90}
Noise at 1 metre external to sensitive façade where L_{A90} >60dB	Day, evening and night	00:00-24:00	55dB(A) L_{Aeq}

Table 4.1 - London Borough of Camden's plant noise emissions criteria

The daytime, evening and night-time plant noise emissions criteria to be achieved at 1m from the nearest noise sensitive façade, based on non-tonal plant, are shown in Table 4.2.

Position	Daytime (07:00-19:00)	Evening (19:00-23:00)	Night-time (23:00-07:00)
Position 1	45dB	45dB	44dB
Position 2	47dB	52dB	46dB

Table 4.2 – Plant noise emissions criteria at nearest noise sensitive façade (dB ref. 20µPa)

4.1 National Planning Policy Framework

The National Planning Policy Framework (NPPF) was published in March 2012 and revoked all previous planning policy statements and guidance notes.

The document sets out the Government's planning policies and how these are expected to be applied. Paragraph 123 refers to noise impact:

123. Planning policies and decisions should aim to:

- *avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;*

- *mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions; recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established;*

and

- *identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.*

4.2 BS8233:1999 Sound insulation and noise reduction for buildings

The guidance in this document indicates 'good' and 'reasonable' noise levels for various activities within residential and commercial buildings.

The relevant sections of this standard are shown in the following table:

Criterion	Typical Situations	Design range $L_{Aeq,T}$ dB	
		Good	Reasonable
Reasonable resting/sleeping conditions	Living Rooms Bedrooms	30 30	40 35

Table 4.3 - Excerpt from BS8233: 1999 **[dB ref. 20µPa]**

This standard also states that individual noise events should not normally exceed 45 dB:$L_{Amax,fast}$ within bedrooms at night.

The Client's requirements are significantly more onerous than the noise levels set out in the table above. Compliance with the Client's specification will automatically result in lower noise levels than those stated in in Table 4.3.

5. VIBRATION EXPOSURE ASSESSMENT

BS6472: Part 1: 2008 *Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting* advises ranges of Vibration Dose Values [VDV] and the corresponding response of occupants of residential buildings during daytime and night-time periods. Table 5.1 shows the range of VDV corresponding to 'low probability of adverse comment'.

VDV, $m/s^{-1.75}$	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)
Horizontal and Vertical	0.2 – 0.4	0.1 – 0.2

Table 5.1 - BS6472:2008 'Low Probability of Adverse Comment'

The values recorded (Table 3.3) show that vibration levels at the site are comfortably below these ranges.

6. PREDICTED NOISE IMPACT

6.1 Proposed Plant

The following proposed external cooling plant has been confirmed by Applied Energy:

- 10 no. Mitsubishi heat pump units type PURY-EP250 (7th floor roof);
- 10 no. Mitsubishi heat pump units type PURY-EP250 (6th floor flat roof).

Highest noise levels generated by the Mitsubishi PURY-EP250 heat pump have been confirmed by the manufacturer as follows:

Frequency (Hz)	63	125	250	500	1000	2000	4000	8000	dB(A)
Lp @ 1m (standard mode)	72	65	62	57	54	50	47	40	60

Table 6.1 - Octave band sound pressure levels for Mitsubishi PURY-EP250 condensing unit in standard mode (dB ref. 20µPa)

The proposed location of the cooling plant is shown in attached site plan AS7236/SP1.

6.2 Predicted noise levels

Following an inspection of the site and its environs, the nearest noise sensitive residential receivers are thought to be situated at 22-24 Torrington Place with windows overlooking Torrington Place approximately 15m from the 6th floor plant area.

The condensing units at 6th and 7th floor levels will be surrounded by a weather louvred screen. Acoustic losses through the screen will be minimal and have been ignored within calculations. Line of sight screening provided by the roof edge has been included.

It should be noted that roof layout, dimensions and the location of the roof mounted plant have been taken from Axiom Architects drawings available at the time of writing.

The full calculation of noise emission is shown in Appendix B.

The following table summarises predicted noise levels at 1m from the nearest noise sensitive residential façade from all roof mounted cooling plant.

Predicted plant noise level at nearest residential receiver ($L_{Aeq,T}$)	**24-hour design criterion ($L_{Aeq,T}$)**
42 dB	44 dB

Table 6.2 - Predicted plant noise levels at nearest noise sensitive façade (dB ref. 20µPa)

The predicted levels are within the criteria set against Camden's Core Strategy 2010 and Development Management Policies 2010.

Predicted plant noise emissions have been checked outside the nearest window of Gordon Mansions on the north side of Torrington Place with the cumulative noise levels lower than those shown above.

All air handling and extract plant will be fitted with atmospheric acoustically specified silencers such that the cumulative plant noise level does not exceed the plant noise emissions criteria.

All plant having the potential to transmit vibration into the structure will be mounted on suitable manufacturer-selected isolation mounts in order to protect residential amenity.

Plant noise levels may be slightly higher outside the windows of the proposed guest bedrooms within this development, however, the Client's strict internal noise requirements mean that full mechanical ventilation will be provided and acoustically specified high performance glazing will be installed to ensure external noise intrusion from the ambient climate is controlled to their criteria. Hence, it is likely that windows would only ever be opened for cleaning and with windows closed the plant noise would be significantly lower than the 'good' levels stated in BS 8233: 1999 *Sound Insulation and noise reduction for buildings – Code of Practice*.

7. CONCLUSIONS

An environmental noise and vibration survey has been undertaken at the site at Brook House, 2-16 Torrington Place, London by Alan Saunders Associates between Thursday 8th November 2012 and 12th November 2012.

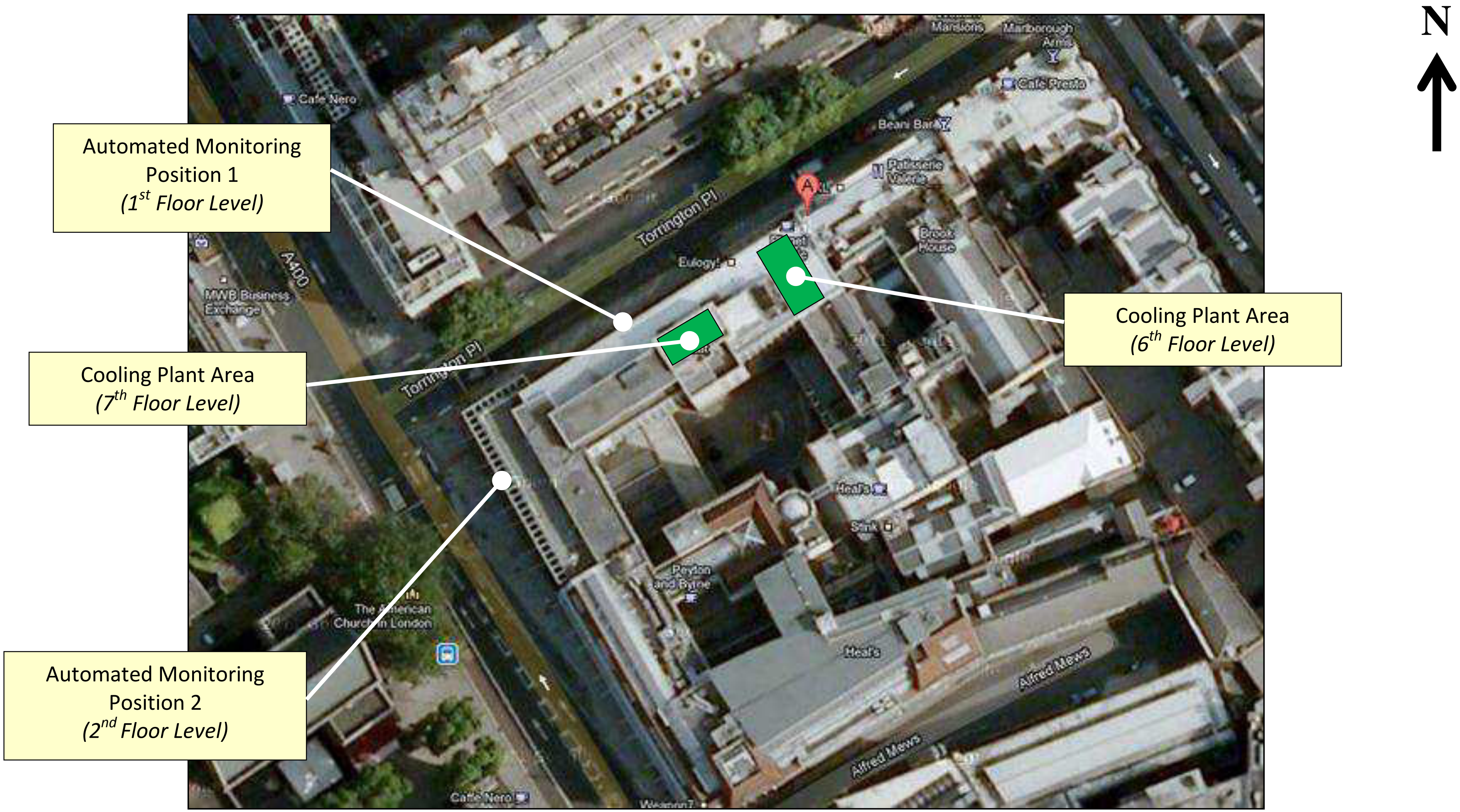
Measurements have been made to establish the existing background noise climate. This has enabled design criteria to be set for the control of external plant noise emissions to noise sensitive receivers, in accordance with the requirements of Camden Council.

Vibration measurements were analysed in accordance with BS 6472: Part 1: 2008 *Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting* in order to assess the impact of vibration on the development. The vibration levels recorded are below the range where there is 'low probability of adverse comment'.

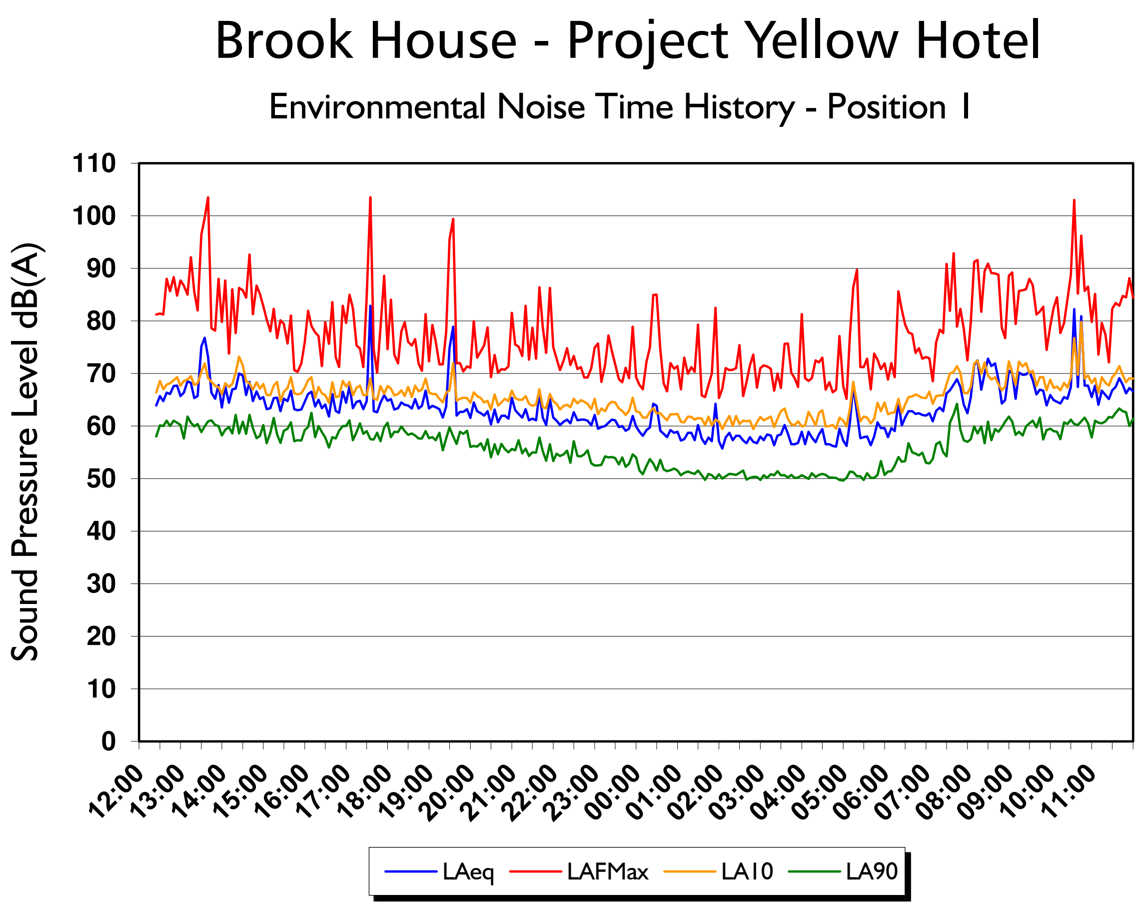
Data for the proposed cooling units have been used to predict the noise impact of the new plant on the nearest existing and proposed residences.

Compliance with the noise emission design criteria has been shown. No further mitigation measures are required for external plant noise emissions.

Daniel Saunders MIOA
ALAN SAUNDERS ASSOCIATES

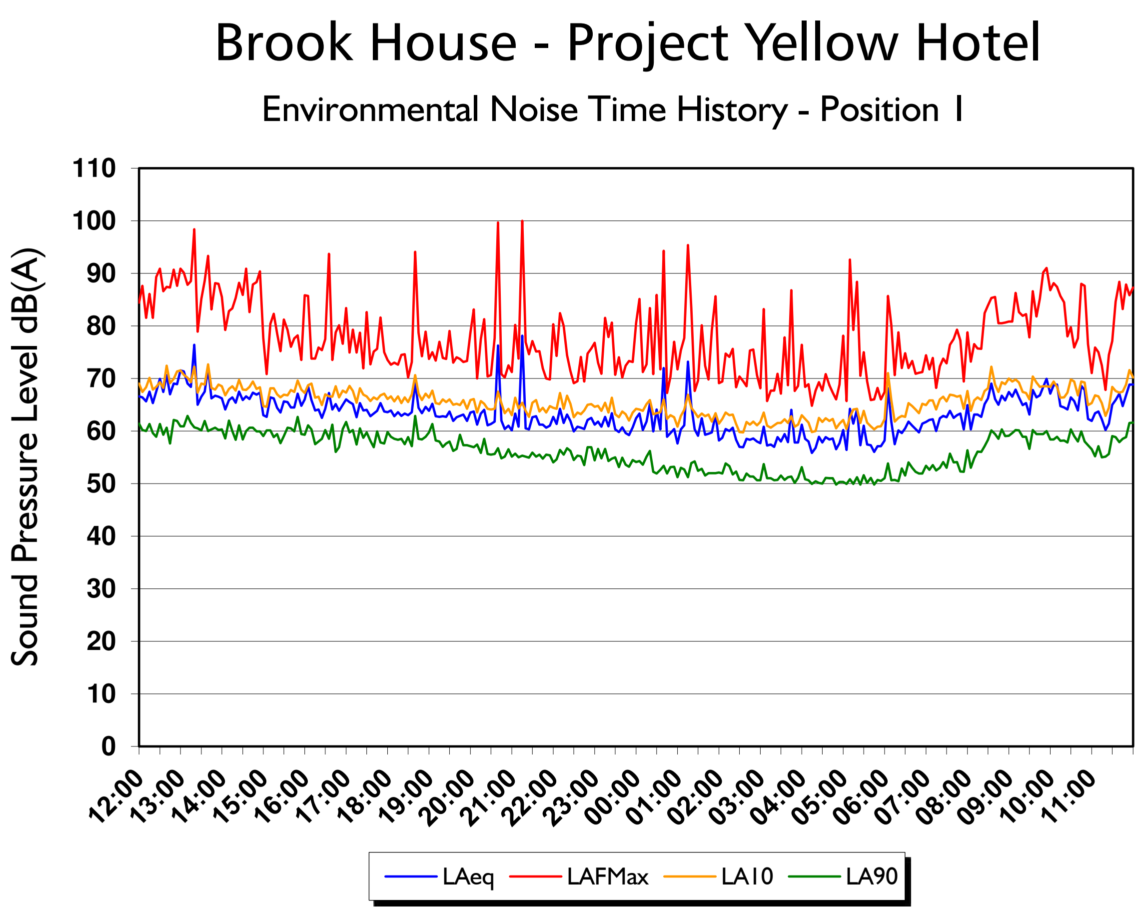


alan saunders associates | acoustics mail@alansaunders.com www.alansaunders.com T+44(0)1962 872130 F+44(0)1962 872131 westgate house romsey road winchester SO22 5BE	**Project:** Brook House, 2-16 Torrington Place, London	**Title:** Indicative Site Plan	**Figure:** AS7236/SP1	**Date:** 20th November 2012



Thursday 08 November to Friday 09 November 2012

Figure AS7236/TH1

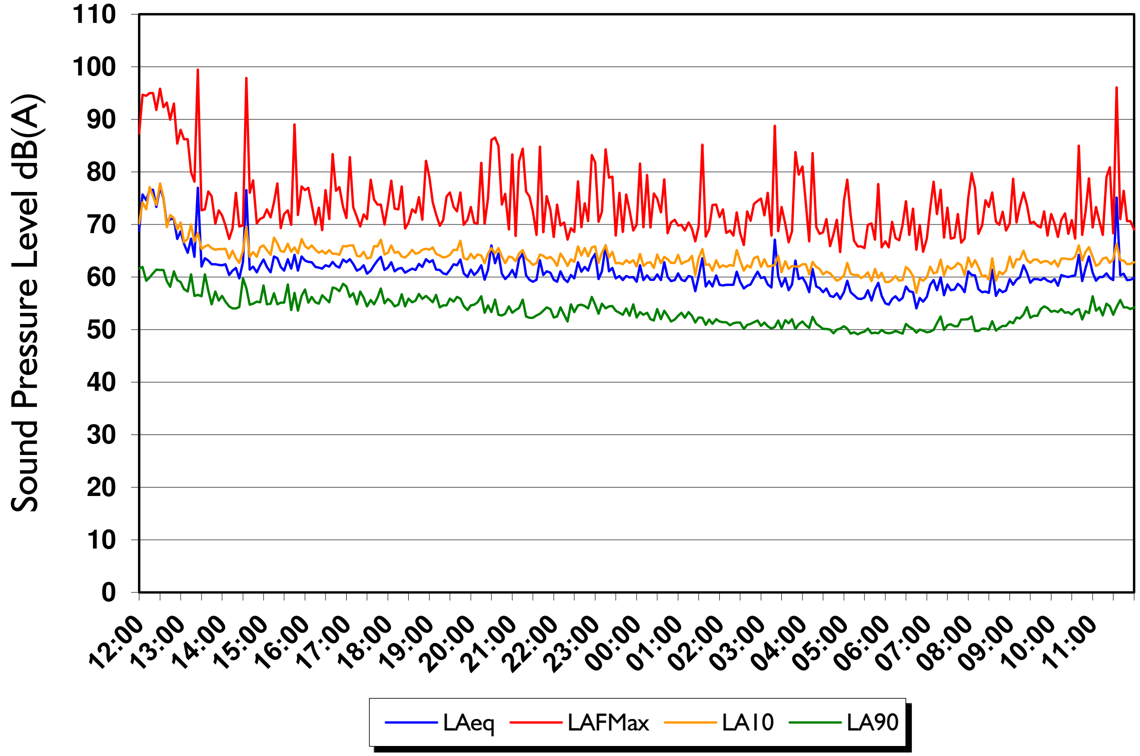


Friday 09 November to Saturday 10 November 2012

Figure AS7236/TH2

Brook House - Project Yellow Hotel

Environmental Noise Time History - Position 1

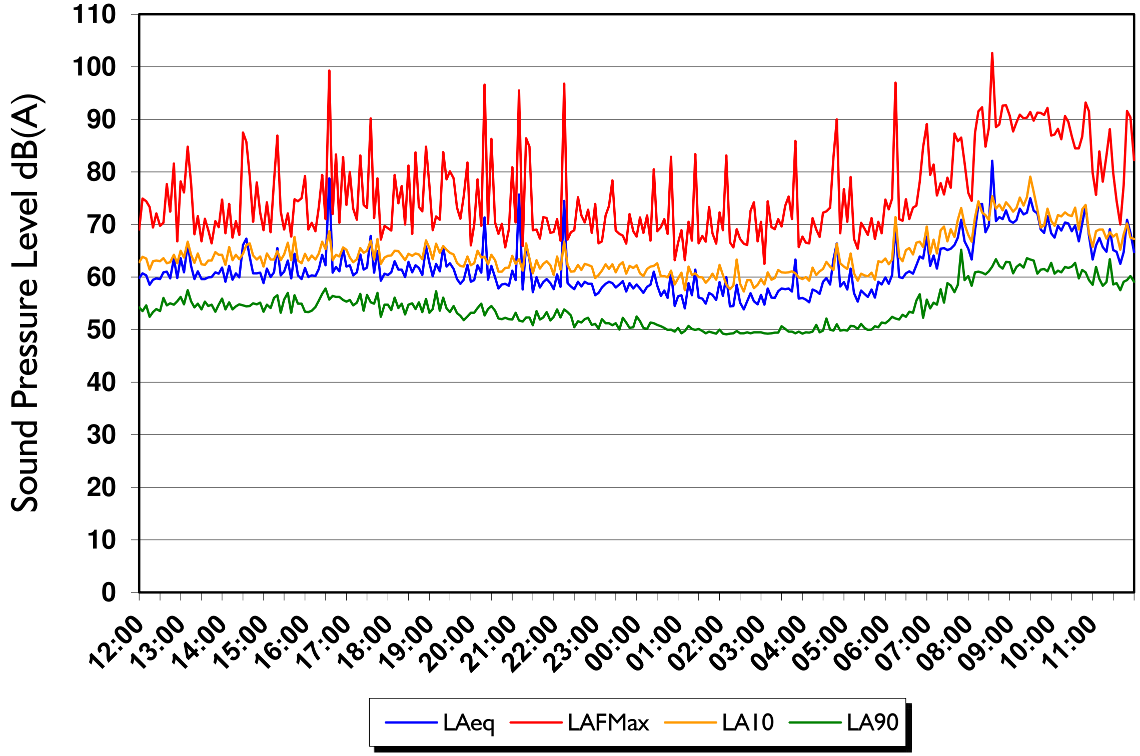


Saturday 10 November to Sunday 11 November 2012

Figure AS7236/TH3

Brook House - Project Yellow Hotel

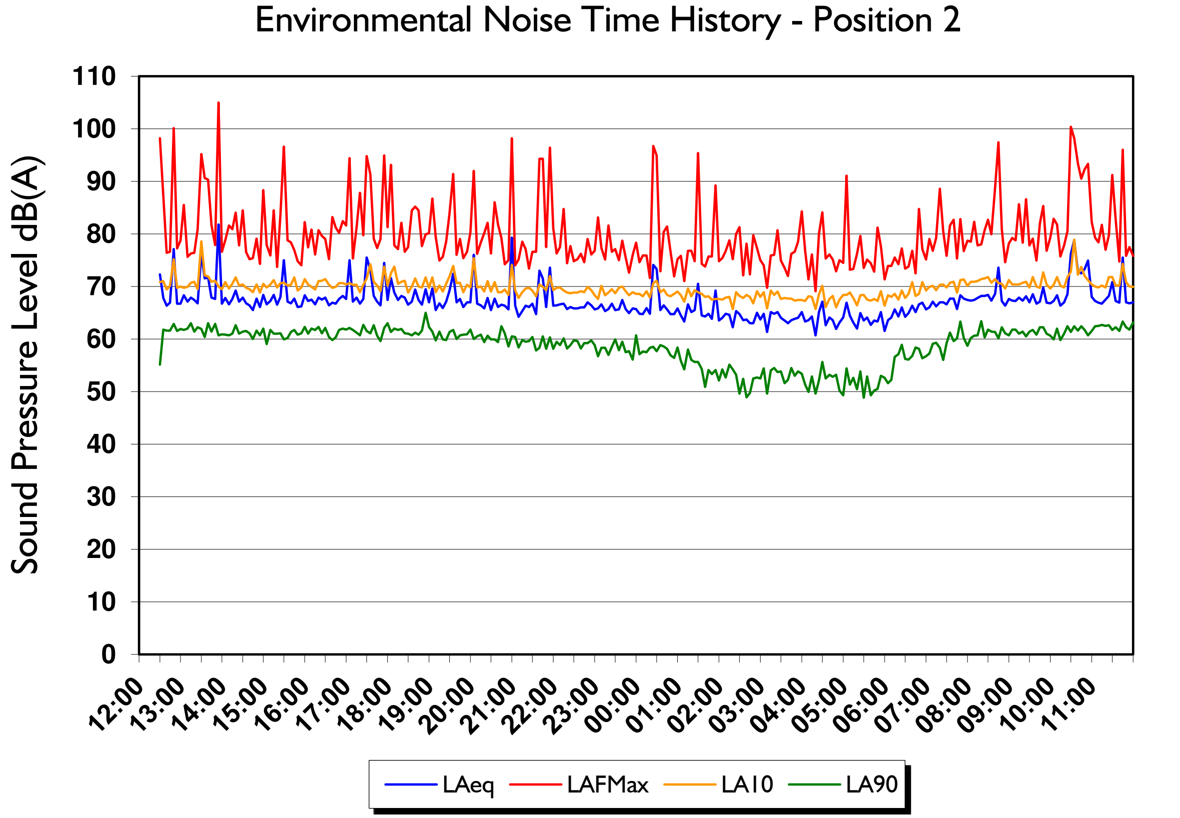
Environmental Noise Time History - Position 1



Sunday 11 November to Monday 12 November 2012

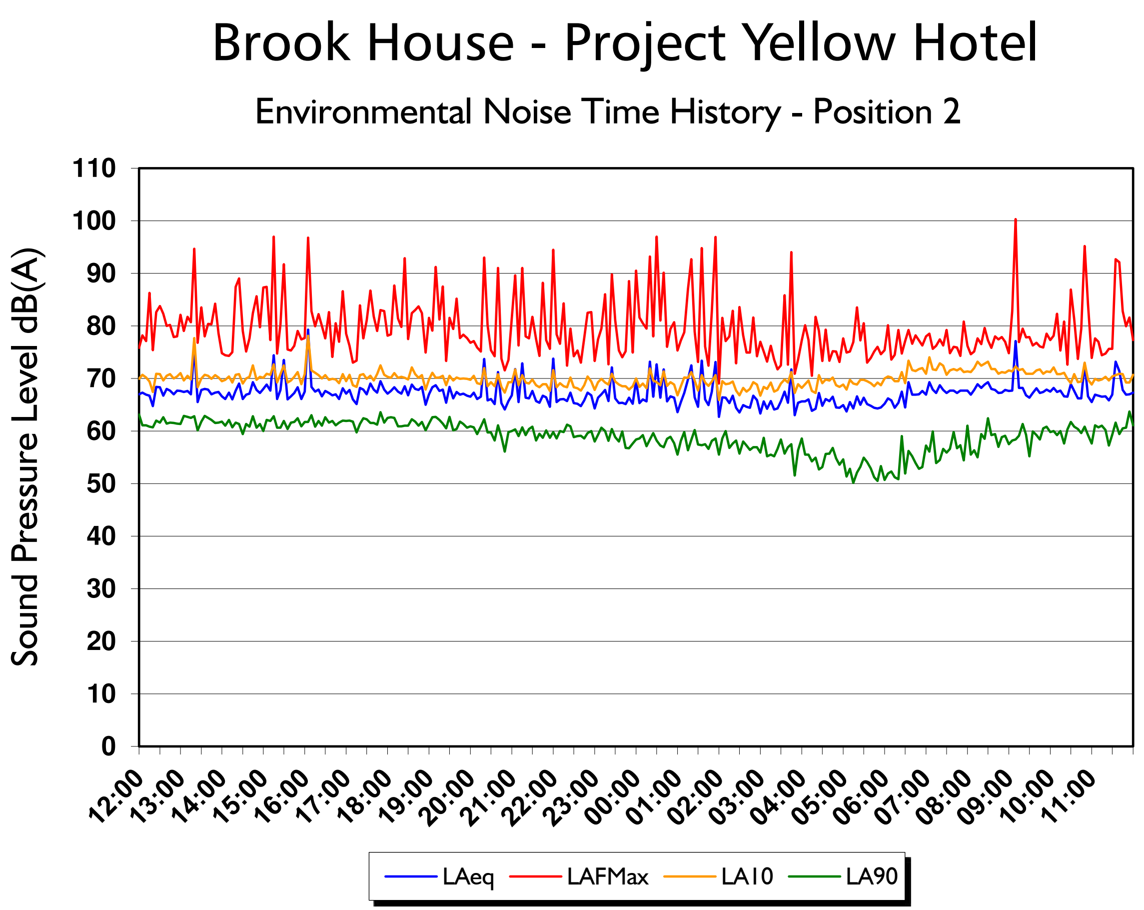
Figure AS7236/TH4

Brook House - Project Yellow Hotel



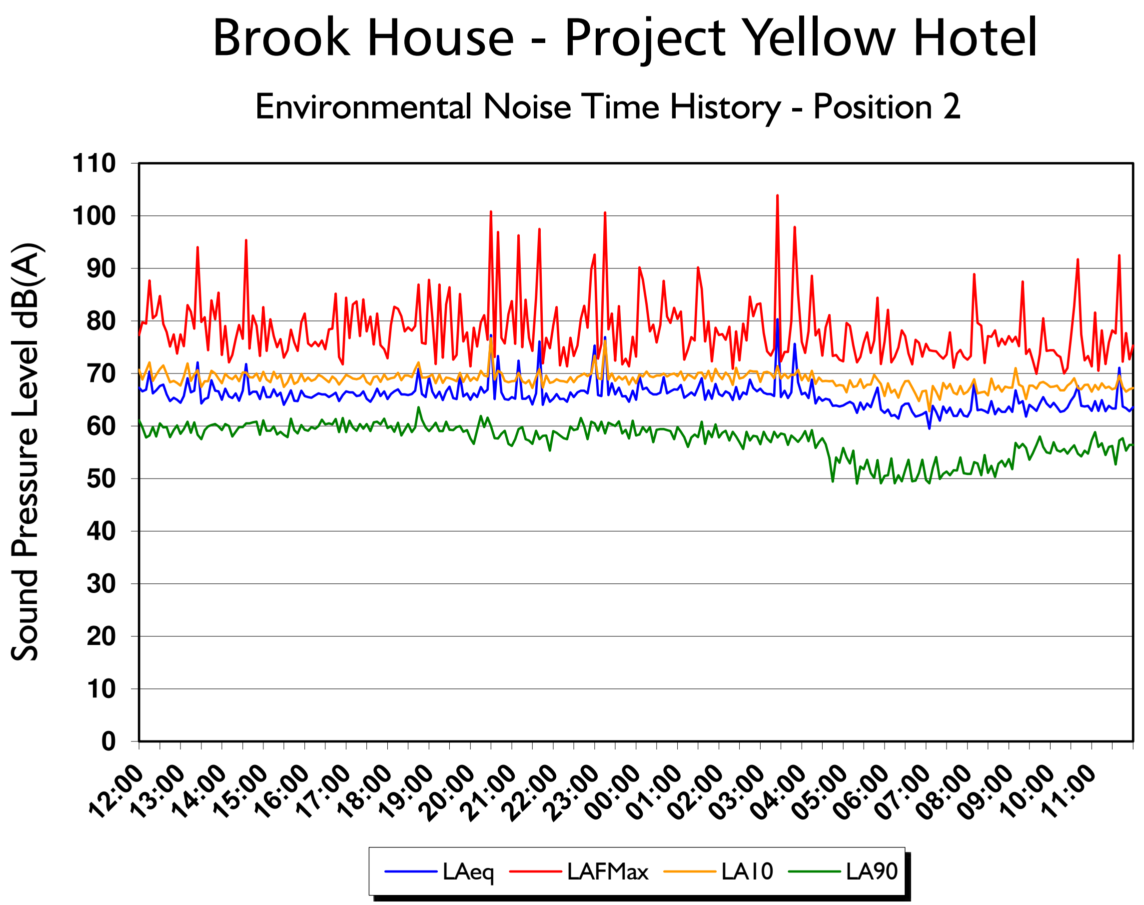
Thursday 08 November to Friday 09 November 2012

Figure AS7236/TH5



Friday 09 November to Saturday 10 November 2012

Figure AS7236/TH6

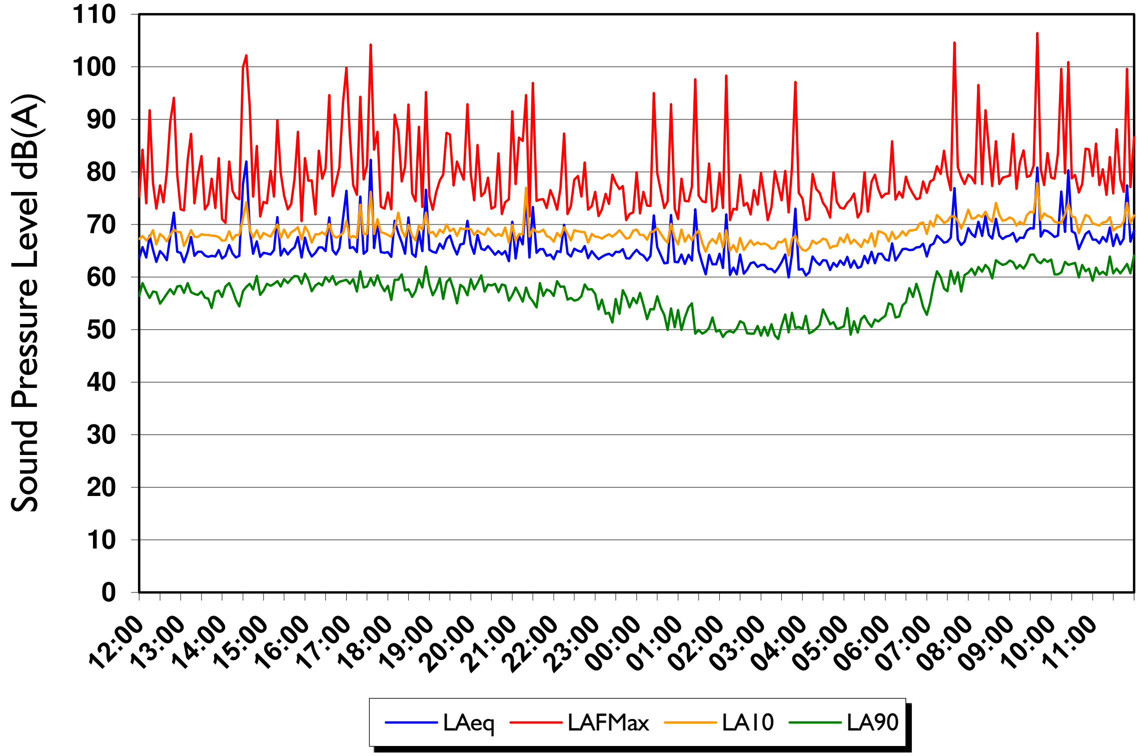


Saturday 10 November to Sunday 11 November 2012

Figure AS7236/TH7

Brook House - Project Yellow Hotel

Environmental Noise Time History - Position 2



Sunday 11 November to Monday 12 November 2012

Figure AS7236/TH8

APPENDIX A

ACOUSTIC TERMINOLOGY & HUMAN RESPONSE TO BROADBAND NOISE

1.0 ACOUSTIC TERMINOLOGY

The annoyance produced by noise is dependent upon many complex interrelated factors such as 'loudness', its frequency (or pitch) and any variations in its level. In order to have some objective measure of the annoyance, scales have been derived to allow for these subjective factors.

dB (A): The human ear is more susceptible to mid-frequency noise than the high and low frequencies. To take account of this when measuring noise, the 'A' weighting scale is used so that the measured noise corresponds roughly to the overall level of noise that is discerned by the average human. It is also possible to calculate the 'A' weighted noise level by applying certain corrections to an un-weighted spectrum. The measured or calculated 'A' weighted noise level is known as the dB(A) level.

L_{10} & L_{90}: If a non-steady noise is to be described it is necessary to know both its level and the degree of fluctuation. The L_n indices are used for this purpose, and the term refers to the level exceeded for n% of the time, hence L_{10} is the level exceeded for 10% of the time and as such can be regarded as the `average maximum level'. Similarly, L_{90} is the average minimum level and is often used to describe the background noise.

It is common practice to use the L_{10} index to describe traffic noise, as being a high average, it takes into account the increased annoyance that results from the non-steady nature of traffic noise.

L_{eq}: The concept of L_{eq} (equivalent continuous sound level) has up to recently been primarily used in assessing noise in industry but seems now to be finding use in defining many other types of noise, such as aircraft noise, environmental noise and construction noise.

L_{eq} is defined as a notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the actual, fluctuating sound measured over that period (e.g. 8 hour, 1 hour, etc).

The use of digital technology in sound level meters now makes the measurement of L_{eq} very straightforward.

Because L_{eq} is effectively a summation of a number of noise events, it does not in itself limit the magnitude of any individual event, and this is frequently used in conjunction with an absolute noise limit.

L_{max}: L_{max} is the maximum sound pressure level recorded over the period stated. L_{max} is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the L_{eq} noise level.

D The sound insulation performance of a construction is a function of the difference in noise level either side of the construction in the presence of a loud noise source in one of the pair of rooms under test. *D*, is therefore simply the *level difference* in decibels between the two rooms in different frequency bands.

D_w D_w is the *Weighted Level Difference* The level difference is determined as above, but weighted in accordance with the procedures laid down in BS EN ISO 717-1.

$D_{nT,w}$ $D_{nT,w}$ is the *Weighted Standardised Level Difference* as defined in BS EN ISO 717-1 and represents the *weighted level difference*, as described above, corrected for room reverberant characteristics.

C_{tr} C_{tr} is a spectrum adaptation term to be added to a single number quantity such as $D_{nT,w}$, to take account of characteristics of a particular sound.

$L'_{nT,w}$ $L'_{nT,w}$ is the *Weighted Standardised Impact Sound Pressure Level* as defined in BS EN ISO 717-2 and represents the level of sound pressure when measured within room where the floor above is under excitation from a calibrated tapping machine, corrected for the receive room reverberant characteristics.

APPENDIX A

ACOUSTIC TERMINOLOGY & HUMAN RESPONSE TO BROADBAND NOISE

2.0 OCTAVE BAND FREQUENCIES

In order to determine the way in which the energy of sound is distributed across the frequency range, the International Standards Organisation have agreed on "preferred" bands of frequency for sound measurement and analysis. The widest and most commonly used band for frequency measurement and analysis is the Octave Band. In these bands, the upper frequency limit is twice the lower frequency limit, with the band being described by its "centre frequency" which is the average (geometric mean) of the upper and lower limits, eg. 250 Hz octave band runs from 176 Hz to 353 Hz. The most commonly used bands are:

Octave Band Centre Frequency Hz	63	125	250	500	1000	2000	4000	8000

3.0 HUMAN PERCEPTION OF BROADBAND NOISE

Because of the logarithmic nature of the decibel scale, it should be borne in mind that noise levels in dB(A) do not have a simple linear relationship. For example, 100dB(A) is not twice as loud as 50 dB(A) sound level. It has been found experimentally that changes in the average level of fluctuating sound, such as traffic noise, need to be of the order of 3 dB(A) before becoming definitely perceptible to the human ear. Data from other experiments have indicated that a change in sound level of 10 dB(A) is perceived by the average listener as a doubling or halving of loudness. Using this information, a guide to the subjective interpretation of changes in traffic noise level can be given.

INTERPRETATION

Change in Sound Level dB(A)	Subjective Impression	Human Response
0 to 2	Imperceptible change in loudness	Marginal
3 to 5	Perceptible change in loudness	Noticeable
6 to 10	Up to a doubling or halving of loudness	Significant
11 to 15	More than a doubling or halving of loudness	Substantial
16 to 20	Up to a quadrupling or quartering of loudness	Substantial
21 or more	More than a quadrupling or quartering of loudness	Very Substantial

4.0 EARTH BUNDS AND BARRIERS - EFFECTIVE SCREEN HEIGHT

When considering the reduction in noise level of a source provided by a barrier, it is necessary to establish the "effective screen height". For example if a 3 metre high barrier exists between a noise source and a listener, with the barrier close to the listener, the listener will perceive the noise source is louder, if he climbs up a ladder (and is closer to the top of the barrier) than if he were standing at ground level. Equally if he sat on the ground the noise source would seem quieter than it was if he were standing. This may be explained by the fact that the "effective screen height" is changing with the three cases above, the greater the effective screen height, in general, the greater the reduction in noise level.

Where the noise sources are various roads, the attenuation provided by a fixed barrier at a specific property will be greater for roads close to the barrier than for roads further away.

APPENDIX A

PLANT NOISE EMISSIONS CALCULATION

Assessment to residential properties (22-24 Torrington Place)

Calculation 1:

Mitsubishi PURY-EP250 condensing units (7th floor roof level)

		63	125	250	500	1k	2k	4k	8k	dB(A)
Sound Pressure Level	1 m	72	65	62	57	54	50	47	40	60
Number of Units	10	10	10	10	10	10	10	10	10	
Distance Propagation	30 m	-30	-30	-30	-30	-30	-30	-30	-30	
Roof Edge Screening (line of sight)		-5	-5	-5	-5	-5	-5	-5	-5	
Sound Pressure Level at Receiver		47	40	37	32	29	25	22	15	35

Calculation 2:

Mitsubishi PURY-EP250 condensing units (6th floor roof level)

		63	125	250	500	1k	2k	4k	8k	dB(A)
Sound Pressure Level	1 m	72	65	62	57	54	50	47	40	60
Number of Units	10	10	10	10	10	10	10	10	10	
Distance Propagation	15 m	-24	-24	-24	-24	-24	-24	-24	-24	
Roof Edge Screening (line of sight)		-5	-5	-5	-5	-5	-5	-5	-5	
Sound Pressure Level at Receiver		53	46	43	38	35	31	28	21	41

Cumulative noise level at nearest residential receiver	**42**	**dB(A)**
24-hour design criterion at nearest residential receiver	**44**	**dB(A)**