

ACOUSTIC SOLUTIONS

Consultant in Noise and Vibration

20 Netherhall Road, Baildon, South Yorkshire BD17 6QD;
Telephone: 01274580796/07786028451;
Email: acousticsolutions@email.com

Ref: AS24-08

Date: 22 February 2024

NOISE IMPACT ASSESSMENT FOR PROPOSED DEVELOPMENT:

Adjacent, Britannia Road, Golcar, Huddersfield, HD3 4QB

Prepared for:

SP1 Property
The Studio
Flockton Chapel
11 Barnsley Road
Flockton
WF4 4DP

Prepared by:

Acoustic Solutions
20 Netherhall Road
Baildon
BD17 6QD

Institute of Acoustics number: 43468

Test Report Number: AS24-08

This report has been prepared by Acoustic Solutions with all reasonable skill, care and diligence within the terms of the Contract with the client, incorporating our General Terms and Conditions of Business and taking account of the resources devoted to us by agreement with the client.

We disclaim any responsibility to the client and others in respect of any matters outside the scope of the above.

This report is confidential to the client, and we accept no responsibility of whatsoever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies upon this report at its own risk.
The author of this report represents Acoustic Solutions to the exclusion of all other organisations.

1.0 INTRODUCTION

1.1

Acoustic Solutions has been commissioned by SP1 Property to undertake a noise impact assessment for a proposed development at the Land adjacent to Britannia Road, Golcar, Huddersfield.

1.2

The objectives for the noise impact assessment were as follows:

- Establish the daytime, evening and night time ambient and background sound levels at the application site and its surrounding environs;
- Establish the likely daytime and night time noise impact arising from the noise sources identified in the course of the assessment;
- If appropriate, provide recommendations with respect to management and/or structural controls to mitigate and control the potential noise impact upon future occupiers of the proposed development.

1.3

This report details the methodology and results of the assessment. It has been prepared to accompany an application for planning permission that is to be submitted to Kirklees Council for the proposed development of the application site.

1.4

This report has been prepared for the sole purpose described above and no extended duty of care to any third party is implied or offered. Third parties referring to the report should consult SP1 Property and Acoustic Solutions as to the extent to which the findings may be appropriate for their use.

1.5

A glossary of acoustic terms used in the main body of the text is contained in Appendix 1.

2.0 NOISE IMPACT ASSESSMENT CRITERIA

2.1

In terms of noise impact assessment criteria, Paragraph 170e of the National Planning Policy Framework (NPPF) 2018 states that planning policies and decisions should contribute to and enhance the natural local environment by *‘preventing 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.’*

2.2

Planning Practice Guidance specifically dealing with noise was uploaded to the Government’s Planning Portal in March 2014 as an accompaniment to the National Planning Policy Framework. This guidance is summarised herein.

2.3

The guidance states that noise needs to be considered when new developments may create additional noise. Whilst noise can override other planning concerns, neither the Noise Policy Statement for England nor the National Planning Policy Framework (which reflects the Noise Policy Statement for England) expects noise to be considered in isolation, separately from the economic, social and other environmental dimensions of proposed development.

2.4

In order to determine noise impact, local planning authorities’ plan-making and decision taking should take account of the acoustic environment and in doing so consider:

- Whether or not a significant adverse effect is occurring or likely to occur;
- Whether or not an adverse effect is occurring or likely to occur, and;
- Whether or not a good standard of amenity can be achieved.

2.5

In line with the Explanatory Note of the Noise Policy Statement for England, this would include identifying whether the overall effect of the noise exposure is, or would be, above or below the significant observed adverse effect level and the Lowest observed adverse effect level for the given situation.

2.6

In terms of Observed Effect Levels:

- No Observed Adverse Effect Level (NOAEL) – This is the level of noise exposure below which no effect at all on health or quality of life can be detected;
- Lowest Observed Adverse Effect Level (LOAEL) – This is the level of noise exposure above which adverse effects on health and quality of life can be detected, and;
- Significant Observed Adverse Effect Level (SOAEL) – This is the level of noise exposure above which significant adverse effects on health and quality of life occur.

2.7

At the Lowest extreme, when noise is not noticeable, there is by definition no effect. As the noise exposure increases, it will cross the 'no observed' effect level as it becomes noticeable. However, the noise has no adverse effect so long as the exposure is such that it does not cause any change in behaviour or attitude. The noise can slightly affect the acoustic character of an area but not to the extent there is a perceived change in quality of life. If the noise exposure is at this level no specific measures are required to manage the acoustic environment.

2.8

As the exposure increases further, it crosses the Lowest observed adverse effect level boundary above which the noise starts to cause small changes in behaviour and attitude, for example, having to turn up the volume on the television or needing to speak more loudly to be heard. The noise therefore starts to have an adverse effect and consideration needs to be given to mitigating and minimising those effects (taking account of the economic and social benefits being derived from the activity causing the noise).

2.9

Increasing noise exposure will at some point cause the significant observed adverse effect level boundary to be crossed. Above this level the noise causes a material change in behaviour such as keeping windows closed for most of the time or avoiding certain activities during periods when the noise is present. If the exposure is above this level the planning process should be used to avoid this effect occurring, by use of appropriate mitigation such as by altering the design and layout. Such decisions must be made taking account of the economic and social benefit of the activity causing the noise, but it is undesirable for such exposure to be caused.

2.10

At the highest extreme, noise exposure would cause extensive and sustained changes in behaviour without an ability to mitigate the effect of noise. The impacts on health and quality of life are such that regardless of the benefits of the activity causing the noise, this situation should be prevented from occurring.

2.11

Table 2.1 summarises noise exposure hierarchy, based on likely average response.

Table 2.1 LOAEL and SOAEL Values

Noise Source	Assessment Location	LOAEL	SOAEL	Time
	Outdoor living space	55 dB L _{Aeq} , 1 hour (A)	56-60 dB L _{Aeq} , 1 hour (A)	Day (07:00-23:00)
	Façade	50 dB L _{Aeq} , 1 hour (A)	72 dB L _{Aeq} , 16 hour (A)	Day (07:00-23:00)
General environmental noise: Road/Rail	Façade	45 dB L _{Aeq} , 8 hour (B)	67 dB L _{Aeq} , 8 hour (A)	Night (23:00-07:00)
	Habitable Room	30 dB L _{Aeq} , 8 hour (B)	40 dB L _{Aeq} , 8 hour (A)	Night (23:00-07:00)
	Habitable Room	35 dB L _{Aeq} , 16 hour (A)	45 dB L _{Aeq} , 16 hour (A)	Day (07:00-23:00)

A: World Health Organisation: Guideline for Community Noise (1999)

B: World Health Organisation: Noise Guidance for Europe (2009)

2.12

The subjective nature of noise means that there is not a simple relationship between noise levels and the impact on those affected. This will depend on how various factors combine in any particular situation. These factors include:

- The source and absolute level of the noise together with the time of day it occurs;
- For non-continuous sources of noise, the number of noise events, and the frequency and pattern of occurrence of the noise;
- The spectral content of the noise (i.e. whether or not the noise contains particular high or low frequency content) and the general character of the noise (i.e. whether or not the noise contains particular tonal characteristics or other particular features);
- The local acoustic character of the area.

2.13

In addition, further useful contextual guidance is provided in:

- British Standard 8233:2014 'Guidance on Sound Insulation and Noise Reduction for Buildings' (BS 8233);
- World Health Organisation (WHO) Guidelines for Community Noise (1999)

2.14

British Standard 8233:2014 'Guidance on Sound Insulation and Noise Reduction for Buildings' sets indoor ambient noise levels from residential dwellings (see table below).

Table 2.2 – Indoor Ambient Noise Levels in Dwellings (BS 8233): 2014

Action	Location	Good Indoor Ambient Noise Levels, dB	
Resting	Living Room	L _{Aeq} (0700-2300)	N/A
Sleeping	Bedroom	L _{Aeq} (0700-2300)	30 L _{Aeq} (2300-0700)
			45 L _{Amax} (2300-0700)

2.15

With regard to sound attenuation through the building envelope, the 'weak points' in the building façade are generally considered to be the windows. The worked example (G.1) at Annex G of BS 8233 suggests that a partially opened window would provide sound attenuation of approximately 15 dB *R_w*. The Standard also suggests that *"..standard insulating glass units have an insulation value of approximately 30 dB *R_w*"* when closed.

2.16

With respect to noise affecting external areas, i.e. gardens, BS 8233 states that *".. it is desirable that the steady noise level does not exceed 50 dB L_{Aeq}, and 55 dB L_{Aeq} should be regarded as the upper limit"*.

2.17

The World Health Organisation's Guidelines for Community Noise (1999) sets indoor ambient noise levels from residential dwellings (see table below).

Table 2.3 – Indoor Ambient Noise Levels in Dwellings (WHO 1999)

Action	Location	Good Indoor Ambient Noise Levels, dB	
Resting	Living Room	$L_{Aeq} (0700-2300)$	N/A
Sleeping	Bedroom	$L_{Aeq} (0700-2300)$	30 $L_{Aeq} (2300-0700)$
			45 $L_{Amax} (2300-0700)$

3.0 BASELINE NOISE SURVEY

3.1 Site Setting

The application site is Land adjacent to Britannia Road, Golcar, Huddersfield. The application is for the erection of 9 (three storey) dwellings and associated works. The application has received planning approval, subject to a number of conditions. Condition 13 states:

“Notwithstanding the submitted details, prior to the installation of fenestration, an updated Noise Impact Assessment shall be submitted to, and approved in writing by, the Local Planning Authority. The Noise Impact Assessment shall include an assessment of all significant noise sources likely to affect the proposed development including road and/or rail traffic/commercial and/or industrial premises. The report shall:

- a) Determine the existing noise climate;
- b) Predict the noise climate in living rooms and gardens (daytime), bedrooms (night time) and other habitable rooms of the development;
- c) Detail the proposed attenuation/design necessary to protect the amenity of the occupants of the new residences;
- d) If the noise attenuation measures include windows being kept closed, then details of alternative ventilation over background ventilation shall be included within the mitigation measures. Thereafter the development shall be undertaken in accordance with the approved details.

Reason: In the interest of residential amenity, through mitigating potential noise pollution, in accordance with Policies LP24 and LP51 of the Kirklees Local Plan.

Based upon this, this report will then specify the measures to be taken to protect the development from noise from all significant noise sources that are likely to affect the proposed development. The report shall:

- a) Determine the existing noise climate;
- b) Predict the noise climate in living rooms (daytime), bedrooms (night-time) and other habitable rooms of the development;
- c) Detail the proposed attenuation/design necessary to protect the amenity of the occupants of the new residences (including ventilation if required).

This information will be presented in accordance with the aims of Chapter 15 of the National Planning Policy Framework.

3.2 Site Description

The application site is situated in the Golcar district of Huddersfield city. It is located at Land adjacent to Britannia Road. Britannia Road is a moderately quiet highway that runs east-west along the northern bank of the Colne Valley. A number of domestic dwellings are dotted along Britannia Road, alongside commercial and industrial premises.

The proposed semi-detached dwellings are to be built upon land that abuts onto Britannia Road's northern side. The dwellings will be configured so that their gardens will be situated to the north of the dwellings. (Figures 3.1 & 3.2). This being the case, the structure of the houses will form an acoustic shadow that will act to reduce the sound level within the rear gardens arising from southerly noise sources (see paragraph 3.3). This report predicts a -6 dB noise reduction.

Figure 3.1 Configuration of Dwellings

mission.



Figure 3.2 Side elevation of dwellings and their gardens



The land rises northward for approximately 40 metres. Immediately north of the land's northern boundary stand existing dwellings. A double railway line, running east-west, stands approximately 45 metres north of the land's northern boundary. The line takes rail traffic between West Yorkshire and Manchester. From the development site, the railway line (or the trains that run along it) is not visible.

Acoustic Solutions

Consultant in Noise & Vibration

AS24-08

Noise Impact Assessment: Adjacent, Britannia Road, Golcar, Huddersfield, HD3 4QB

pg. 12

To the south of Britannia Road stand a number of industrial premises: Mallinson Yorkshire Limited (stone merchants), Malrose Metals, PG Stone (Yorkshire) Limited and I & S Garage Services. I & S Garage Services stands close to the southern edge of Britannia Road; albeit approx. 4 metres below road level, and separated from the road by a 3 metre high stone wall (Figures 3.3).

Figure 3.1: Location of nearby industrial on the southern side of Britannia Road



3.3 Noise Sources

The railway line to the north and the industrial premises to the south of the application site comprise of the noise sources that have the potential to impact upon the dwellings' future occupiers. Table 3.1 summarises these noise sources.

Table 3.1 Observed Noise Sources

Noise Sources Potentially Affecting Occupiers of Proposed Dwellings					
Source	Distance at its closest point, metres				Notes
	North	South	East	West	
Railway Line	45	N/A	N/A	N/A	Train noise
PG Stone (Yorkshire) Limited	N/A	50	N/A	N/A	Vehicle Movements. Impact noise of stone being loaded into vehicles
Mallinson Yorkshire Limited	N/A	90	N/A	N/A	Vehicle Movements. Impact noise of stone being loaded into vehicles
Maltrose Metals	N/A	100	N/A	N/A	Vehicle Movements. Impact noise of metal being loaded into vehicles
I & S Garage	N/A	8	N/A	N/A	Misc motor repair noise
Britannia Road	N/A	5	N/A	N/A	Road traffic: private vehicles, heavy commercial vehicles, buses

3.2

In order to establish the daytime, evening and night time background noise levels at the application site and its surrounding environs, a baseline noise survey was undertaken on 19 and 20 February 2024 between 07:00 and 23:00 hours (daytime/evening) and 23:00-07:00 hours (night time).

3.3

For the purpose of the assessment, two noise monitoring positions, MP1 and MP2 and were adopted in free field environments at over 1.5 metres above ground and over 3 metres from any vertical reflective surface:

- MP1. Britannia Road. The microphone was located at the development land's southern perimeter, approximately 3 metres from Britannia Road. The noise environment at MP1 is sufficient to describe noise from road traffic and all industrial activities south of the development site.
- MP2. Northern boundary of development land. The noise environment at MP2 is sufficient to describe noise from road railway traffic, road traffic on Britannia Road and all industrial activities south of the development site.

3.4

At all microphone positions a series of hourly 15-minute noise measurements were undertaken using a Type 1 integrating sound level meter. The measurement system calibration was verified immediately before the commencement of the measurement sessions and again at the end. Weather conditions throughout the survey were dry and clear. Wind speeds were commensurate for the assessment methodology. Measurements consisted of A-weighted parameters: L_{Aeq} , L_{A90} and L_{Amax} .

3.5 MP1.

The principle daytime noise source in the vicinity of MP1 was commercial vehicle movements and general activity at PG Stone and Mallinson (Yorkshire) Limited and vehicles travelling along Britannia Road. Occasional overflying commercial aircraft were also audible. Railway noise was inaudible. Average daytime road traffic numbers were 5x vehicle passes (both directions) per-minute. This dropped to an average of 1x passes per 15-minute at night.

Table 3.2 summarises daytime, evening and night time noise measurement data. For the purposes of this report, the average L_{Aeq} and L_{Amax} values measured will be used so to provide an accurate illustration of the noise environment.

Table 3.2 – MP1: Baseline Noise Measurement Data, Daytime, Evening and Night Time Noise Measurements

Measurement Time	Residual Noise Level, dB, $L_{Aeq, 15 \text{ min}}$	Background Noise Level, dB $L_{A90, 15 \text{ min}}$	Measured Noise Level, dB $L_{A_{Max}, 15 \text{ min}}$
07:00	61.1	54.6	72.6
08:00	63.0	54.8	74.0
09:00	64.3	55.0	79.1
10:00	63.9	54.4	78.9
11:00	63.0	54.1	78.2
12:00	62.6	55.2	79.5
13:00	62.9	54.9	80.4
14:00	64.5	54.3	80.7
15:00	63.5	54.7	79.8
16:00	62.7	55.3	80.0
17:00	64.0	55.1	79.3
18:00	64.2	54.2	78.6
Average/Max	63	55	81
19:00	61.4	52.6	79.4
20:00	60.3	52.6	79.2
21:00	58.7	51.5	78.1
22:00	52.5	50.2	80.3
Average/Max	58	52	80
23:00	52.4	45.3	78.7
00:00	50.8	46.9	80.4
01:00	49.2	44.2	79.5
02:00	45.5	40.1	78.5
03:00	45.9	40.6	79.8
04:00	45.1	40.5	79.8
05:00	45.7	39.7	78.4
06:00	50.0	44.6	79.3
Average/Max	48	43	80

3.6 MP2.

The principle daytime noise source in the vicinity of MP2 was commercial vehicle movements and general activity at PG Stone and Mallision (Yorkshire) Limited and vehicles travelling along Britannia Road. Occasional overflying commercial aircraft were also audible. Railway noise was slightly audible (night time) to inaudible. In any event, noise from train movements is not significant. Average daytime road traffic numbers were 5x vehicle passes (both directions) per-minute. This dropped to an average of 1x passes per 15-minute at night.

Table 3.2 summarises daytime, evening and night time noise measurement data. For the purposes of this report, the average L_{Aeq} and L_{Amax} values measured will be used so to provide an accurate illustration of the noise environment.

Table 3.3 – MP2: Baseline Noise Measurement Data, Daytime, Evening and Night Time Noise Measurements

Measurement Time	Residual Noise Level, dB, L_{Aeq} , 15 min	Background Noise Level, dB L_{A90} , 15 min	Measured Noise Level, dB L_{Amax} , 15 min
07:00	52.0	43.2	74.6
08:00	51.6	43.1	41
09:00	51.4	48.4	67.4
10:00	51.3	48.0	67.1
11:00	52.2	48.5	67.9
12:00	51.9	48.4	67.2
13:00	52.3	48.1	67.6
14:00	51.2	48.2	67.8
15:00	51.0	49.0	68
16:00	51.8	48.0	67.3
17:00	52.4	48.2	67.5
18:00	51.1	48.5	67.9
Average/Max	52	47	75
19:00	50.0	43.8	60.1
20:00	49.7	44.0	61.1
21:00	48.0	43.2	60.2
22:00	47.6	43.0	60.8
Average/Max	49	44	61.1
23:00	43.0	38.1	60.6
00:00	43.1	38.0	61.2
01:00	43.2	36.8	60.4
02:00	40.9	35.9	60.3
03:00	41.0	35.0	60.0
04:00	40.5	35.4	59.9
05:00	40.4	34.7	60.4
06:00	43.8	36.5	57.9
Average/Max	42	36	61

4.0 DISCUSSION

4.1 External Noise Levels

4.1.1 Noise Policy Statement for England

Table 4.1 summaries the Observed Effect Levels for predicted daytime, evening and night time external SPL at MP1 and MP2. A -6 dB correction has been applied to the MP2 values to account for the acoustic shadow that the dwellings' structure will afford the rear gardens.

Table 4.1: Predicted External Evening and Night Time Observed Effect Levels arising from Noise from external noise as predicted at MP1 and MP2

Location	Predicted Daytime Observed Effect Level	Predicted Evening Observed Effect Level	Predicted Night Time Observed Effect Level
MP1	SOAEL+	SOAEL	NOAEL
MP2	NOAEL	NOAEL	NOAEL

4.2 Internal Noise Levels

4.2.1 World Health Organisation: 1999 and BS8233: 2014 (Internal)

Assuming a -15 dB attenuation provided by a slightly open window, daytime, evening and night time internal sound pressure levels arising from daytime, evening and night time noise sources can be predicted within north and south-facing rooms. A -6 dB correction has been applied to the MP2 values to account for the acoustic shadow that the dwellings' structure will afford the dwellings' north-facing windows.

These values can then be compared against maximum noise criteria, as set out in the World Health Organisation's 'Guidelines for Community Noise (1999) and BS8233: 2014. Tables 4.2 to 4.5 summarise the predicted internal noise levels.

Table 4.2: Predicted Internal Daytime/Evening and Night Time noise levels at MP1, L_{Aeq}

Time	Location	External SPL, dB	Building's Acoustic Shadow Correction dB	Open Window Attenuation, dB	Predicted Internal SPL, dB	WHO & BS8233 35 dB Criteria met?	Exceeds by, dB
Daytime/Evening	MP1	63	N/A	15	48	No	13
Night	MP1	48	N/A	15	33	No	3

Table 4.3: Predicted Internal Daytime/Evening and Night Time noise levels at MP1, L_{Amax}

Time	Location	External SPL, dB	Building's Acoustic Shadow Correction dB	Open Window Attenuation, dB	Predicted Internal SPL, dB	WHO & BS8233 35 dB Criteria met?
Daytime/Evening	MP1	81	N/A	15	66	N/A
Night	MP1	80	N/A	15	65	No

Table 4.4: Predicted Internal Daytime/Evening and Night Time noise levels at MP2, L_{Aeq}

Time	Location	External SPL, dB	Building's Acoustic Shadow Correction dB	Open Window Attenuation, dB	Predicted Internal SPL, dB	WHO & BS8233 35 dB Criteria met?	Exceeds by, dB
Daytime/Evening	MP2	57	6	15	36	No	1
Night	MP2	42	6	15	21	Yes	-9

Table 4.5: Predicted Internal Daytime/Evening and Night Time noise levels at MP1, L_{Amax}

Time	Location	External SPL, dB	Building's Acoustic Shadow Correction dB	Open Window Attenuation, dB	Predicted Internal SPL, dB	WHO & BS8233 35 dB Criteria met?
Daytime/Evening	MP2	61	6	15	40	Yes
Night	MP2	61	6	15	40	Yes

Table 4.2 indicates a significant daytime/evening (0700-2300 hours) exceedance of BS8233: 2014 and WHO: 1999 daytime internal criteria within the dwellings' south-facing rooms (+13 dB, L_{Aeq} and +20 dB, L_{Amax} (night time)).

5.0 RECOMMENDATIONS

5.1 Internal

5.1.1 North-Facing Glazing

It is predicted that internal daytime noise levels, L_{Aeq} , will be +1 dB greater than the WHO; 1999 and BS8233: 2014 maximum criteria. It is predicted that internal noise levels, L_{AMax} , will be below all maximum sound level criteria.

Consequently, it is recommended that all habitable north-facing rooms should have glazing of 6.4mm laminated glass, 12mm air-filled cavity, 8.8mm toughened glass. Optional acoustic vents. The Pilkington datasheet (Pilkington, 2023) cites an insulation value of 32 dB, R_w (window closed) for this approximate specification. Ventilation should be made available either by open window or trickle ventilation.

Open Window ventilation. BS8233: 2014 states that where a development is considered necessary or desirable, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved (Table 5.1). Should this relaxation be applied, it is predicted that the daytime and night-time internal noise levels will meet all maximum sound level criteria.

Table 5.1: +5 dB Relaxation of BS8233: 2014 daytime and night time criteria

Time	Relaxed BS8233 +5 dB Criteria
Daytime/ Evening	40
Night	35
Night, L_{AMax}	50

5.1.2 South-Facing Glazing

The windows of all habitable south-facing rooms should be fitted with glazing with the following specification: 6 mm / 16 mm argon / 8.8 mm Pilkington Optiphon™. The Pilkington datasheet (Pilkington, 2024) cites an insulation value of 35 dB, R_w (window closed) for this approximate specification. This would reduce the internal sound levels to 28 dB (daytime) and 13 dB (night time). Closed window attenuation would also result in an internal night time sound level of 45 dB, $L_{A_{Max}}$. All these values meet maximum sound criteria.

The glazing must incorporate sufficient ventilation so to prevent overheating. ProPG calls for glazing with 'good ventilation'. For south-facing glazing, closed-window mechanical ventilation must be available. The risk of overheating should be prevented by means of controllable mechanical ventilation, with a control range extending from background/trickle through to purge. It is recommended that all habitable south-facing rooms be ventilated by 1x Titon Ultimate dMEV decentralised mechanical extract fan per room (Titon 2024).

Table 5.1.b of Approved Document F, 'Approved means of ventilation' (2022) prescribes a whole dwelling ventilation rate of 13 l/s per bedroom. The Titon Ultimate dMEV meets this criteria. Additionally, its sound rating is 10 dB. Assuming an existing night time internal sound level of 13 dB, an additional 10 dB would result in a combined noise level of 15 dB. This would be comfortably within the WHO: 1999 and BS8233: 2014 criteria.

5.2 External

It is predicted that daytime sound levels in the rear gardens will meet NOAEL daytime and night time Observed Effect Levels. This being the case, no recommendations to mitigate external noise levels are necessary.

Appendix 1

Glossary of Acoustic Terms

Sound Pressure Level (L_p)

The basic unit of sound measurement is the sound pressure level. As the pressures to which the human ear responds can range from 20 μ Pa to 200 Pa, a linear measurement of sound levels would involve many orders of magnitude. Consequently, the pressures are converted to a logarithmic scale and expressed in decibels (dB) as follows:

$$L_p = 20 \log_{10}(p/p_0)$$

Where L_p = sound pressure level in dB; p = rms sound pressure in Pa; and p_0 = reference sound pressure (20 μ Pa).

A-weighting Network

A frequency filtering system in a sound level meter, which approximates under defined conditions the frequency response of the human ear. The A-weighted sound pressure level, expressed in dB(A), has been shown to correlate well with subjective response to noise.

Equivalent continuous A-weighted sound pressure level, $L_{Aeq, T}$

The A-weighted 'equivalent continuous noise level' which is an average of the total sound energy measured over a specified period of time. In other words, L_{Aeq} is the level if a continuous noise which has the same total (A-weighted) energy as the real fluctuating noise, measured over the same time period. L_{Aeq} is increasingly being used as the preferred parameter for all forms of environmental noise.

$L_{A90, T}$

The A-weighted sound pressure level of the residual noise in decibels exceeded 90% of a given time interval, T . L_{A90} is typically taken as representative of background noise.

LA max

The maximum A-weighted noise level recorded during the measurement period.

Hz

The unit of frequency. The number of cycles (in the context of acoustics, the number of complete sound waves generated) per second.

Appendix 2

Location Plan and Noise Monitoring Positions



MP1: Southern Façade

MP2: Northern Façade

Appendix 3

Equipment Used

Noise measurements were undertaken using a precision grade sound level meter:

Norsonic Nor145 Model integrating sound level meter.
Serial Number 14529307
Certificate Number U35939/U35940
Last Laboratory Calibrated 17/10/22

B & K 4230 Model calibrator
Serial Number 724157
Last Laboratory Calibrated 21/1/24

The Sound Level Meter was calibrated before and after both measurement periods, with no significant change in calibration. All calibrations took place at the measurement position.

The SLM met the requirements of BS EN 60651: 1994 and BS EN 60804: 2001 IEC 60804: 2000. It was capable of simultaneously measuring Leq and Ln values. Batteries for the SLM and calibrator were checked prior to all measurements.

Appendix 4

References

Pilkington (2023) [Online]. Available at:

[assetmanager-ws.pilkington.com/fileserver.aspx?cmd=get_file&ref=8222&cd...](assetmanager-ws.pilkington.com/fileserver.aspx?cmd=get_file&ref=8222&cd...)

[Accessed 22 February 2024];

Anon (2022) *Building Regulations Part F: Ventilation* [Online]. Available at:

<https://assets.publishing.service.gov.uk/media/61deba42d3bf7f054fcc243d/ADF1.pdf>

[Accessed 22 February 2024];

Titon (2024) Brochure [Online]. Available at:

<https://www.titon.com/uk/wp-content/uploads/sites/10/2023/09/VS-Product-Overview-Brochure.pdf>

[Accessed 22 February 2024]