PENINSULAR
ACOUSTICS

Mr Saghir Hussein

First Floor, 166 Plymouth Grove, Manchester

Acoustic Assessment

PUBLIC

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Acoustic Assessment

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1. Introduction

Peninsular Acoustics (PA) has been commissioned by Mr Saghir Hussein (hereafter referred to as “the Client”), to undertake an acoustic assessment on behalf of his client, to satisfy condition 14a of planning application no. 137985/FO/2023 submitted to Manchester City Council. The application relates to the proposed change of use of the first floor of 166 Plymouth Grove, Manchester (hereafter referred to as “the Site”) into 3no. residential flats.

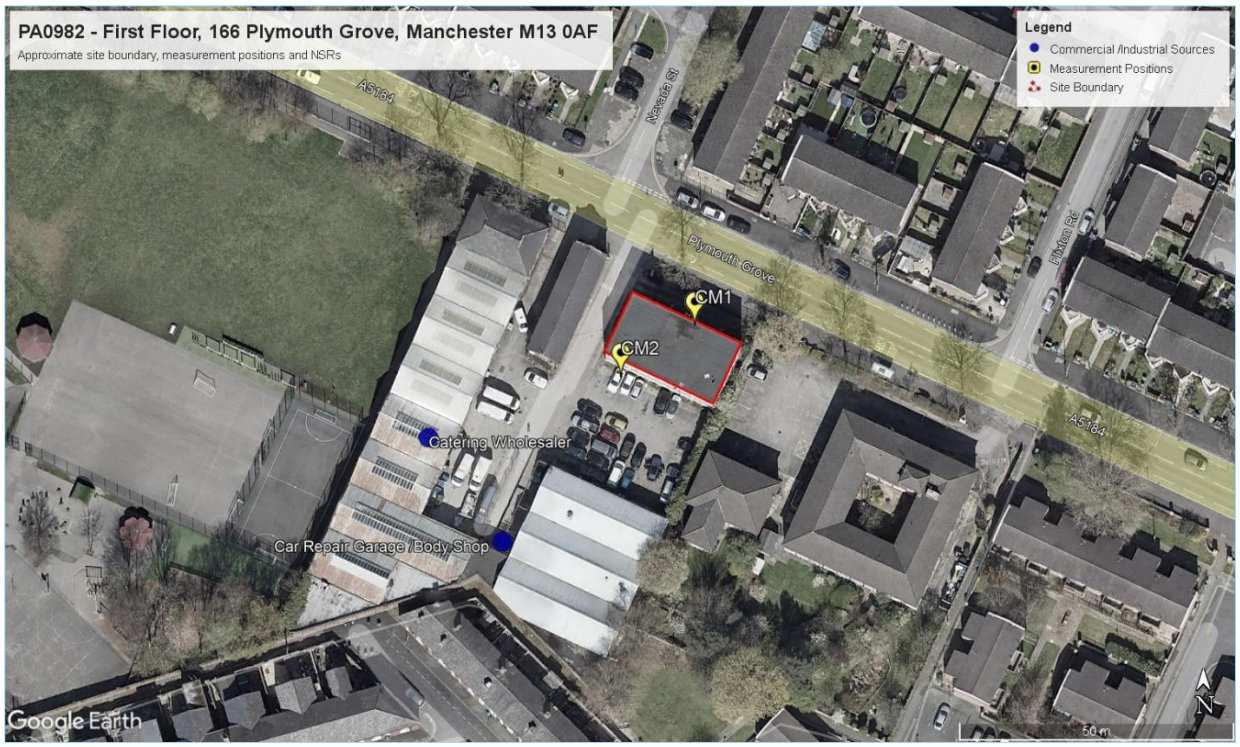
An acoustics glossary is included in Appendix A to assist the reader.

1.1. Site Description

Existing Site

The Site is a three-storey, 1960s-style building with a flat roof previously used for commercial purposes. Industrial uses in the immediate vicinity include a car garage (body shop and repair), and a wholesale catering supplier to the south. Offices of a social housing provider are located to the east. To the north, across Plymouth Grove, the area is residential (Grove Village).

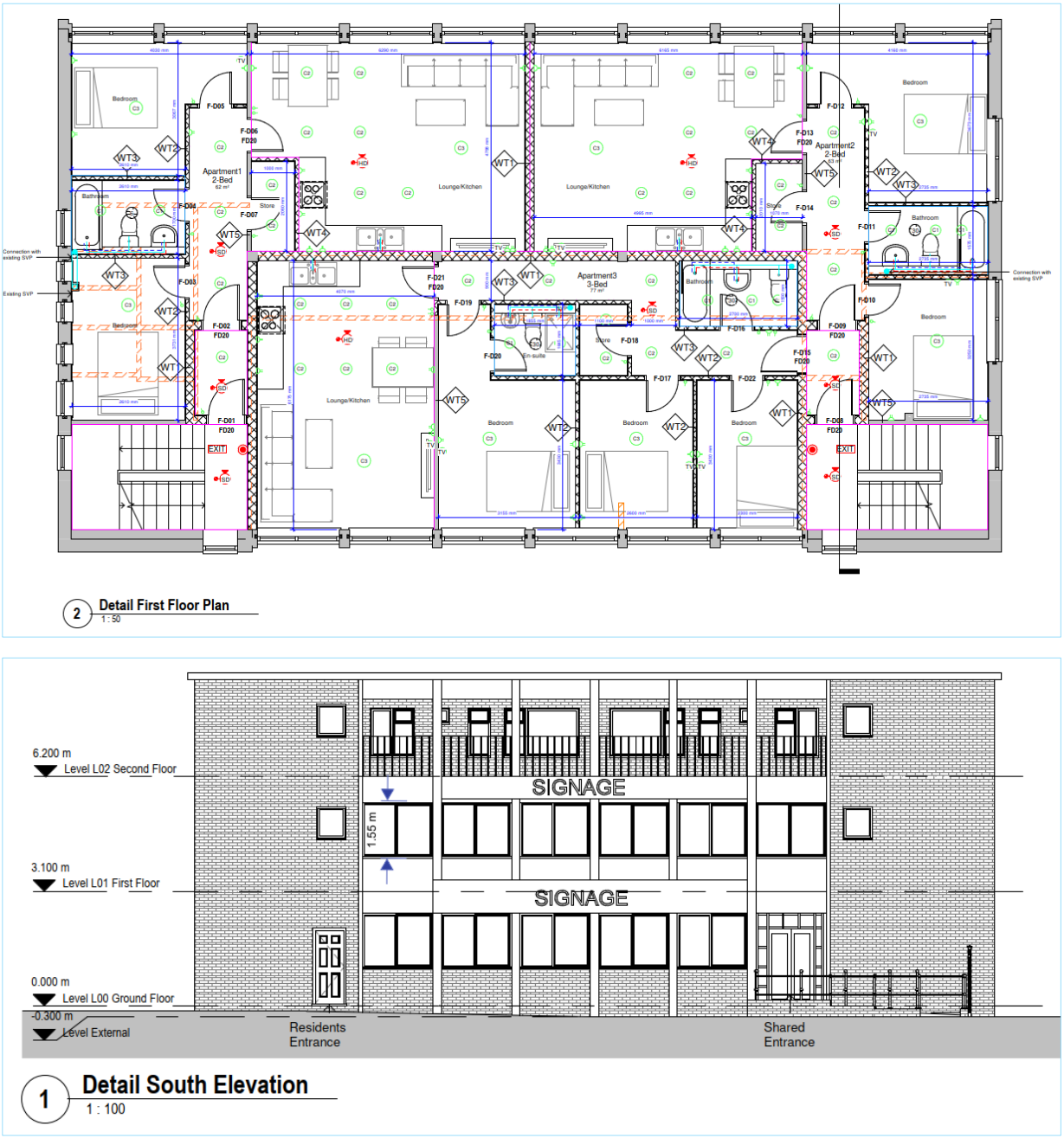
Figure 1.1: Site Plan



Development Proposals

The first floor is proposed to be converted into 3no. residential flats as shown below:

Figure 1.2: Proposed Scheme Layout



1.2. Scope of Works

The following scope of works has been undertaken:

- An unattended environmental sound survey at both the front and rear of the site to determine prevailing acoustic conditions;
- Noise break-in calculations in accordance with BS EN ISO 12354-3[1] and BS 8233[2] have been undertaken to achieve internal noise levels whilst also considering whole-dwelling ventilation in accordance with AD-F[3];
- BS 4142[4] assessment undertaken to determine the impact from the neighbouring commercial /industrial sources. Where the Rating Level exceeds the background sound level (i.e., $L_{Ar,Tr} - L_{A90}$ > 0 dB), the impact should be considered in context, following BS 4142. To help demonstrate compliance with BS 8233 and reduce the risk of adverse impacts, apply any acoustic character corrections (e.g. for tonality or intermittency) to the internal noise level after break-in[5].
- Mitigation in the form of glazing and ventilation specifications and minimum sound reduction indices for non-glazed constructions has been provided, along with recommendations for sound insulation separation between ground floor commercial and 1st floor residential.

[1] BS EN 12354-3:2000 *'Building Acoustics. Estimation of acoustic performance in buildings from the performance elements. Airborne sound insulation against outdoor sound', 2000.*
[2] BS 8233:2014 *'Guidance on sound insulation and noise reduction for buildings.'*
[3] The Building Regulations 2010 'Approved Document F'.
[4] BS 4142: 2014+A1: 2019 *'Methods for rating and assessing industrial and commercial sound'.*
[5] Further evidence of compliance as per example Condition 13 of the CIEH Noise Management Guide: Technical Guidance Note 1

2. Planning Policy and Guidance

Relevant national planning policy and guidance documents comprise:

- National Planning Policy Framework (2023);
- Noise Policy Statement for England (2010);
- BS 8233:2014 *'Guidance on sound insulation and noise reduction for buildings';*
- WHO Guidelines for Community Noise (1999); and
- BS 4142: 2014+A1: 2019 *'Methods for rating and assessing industrial and commercial sound'.*

2.1. Outline Planning Permission REF: 137985/FO/2023

Planning condition 14a of the Manchester City Council 'Grove Park, 166 Plymouth Grove' document states:

14) a) Before the occupation of the development, a scheme for acoustically insulating the proposed residential accommodation against noise from Plymouth Grove and neighbouring commercial and industrial uses, including the ground floor gallery shall be submitted to and approved in writing by the City Council as local planning authority. The approved noise insulation and ventilation scheme shall be completed before the occupation of the residential units.

2.2. BS8233:2014 Criteria

Internal acoustic targets have been informed by residential amenity within dwellings outlined in BS 8233.

Table 2.1: Indoor ambient noise levels for dwellings.

Acitivty	Location	07.00 to 23.00	23.00 to 07.00
Resting	Living Room	35 dB $L_{Aeq,16hour}$	-
Dining	Dining room /area	40 dB $L_{Aeq,16hour}$	-
Sleeping (Daytime resting)	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$

2.2.1. WHO Guidelines for Community Noise Criteria

BS 8233 does not give a definitive level for internal maximum noise levels or define an appropriate number of exceedances per night. However, the WHO guidelines state *"For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dB L_{AFmax} more that 10-15 times per night. (Vallet & Vernet),"* therefore this will be considered as additional criteria as well as the aforementioned ambient sound levels from BS 8233.

2.3. BS 4142: 2014+A1: 2019

BS 4142 describes methods for rating and assessing industrial and/or commercial sound and includes, but is not limited to, the assessment of:

- Sound from industrial and manufacturing processes;
- Sound from fixed installations which comprise mechanical and electrical equipment;
- Sound from the (un)loading of goods and materials at industrial/commercial premises; and
- Sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes such as that from forklift trucks on or around an industrial and/or commercial site.

The methods described in BS 4142 use outdoor sound levels to assess the likely effects of sound on people who are typically outside residential premises. Although indoor effects can be indicated where the façade composition is known. A summary of the approach set out in BS 4142 is set out below:

Establish or predict the specific sound level of the source(s) by considering both the ambient (includes the source to be assessed) and residual (excludes the source to be assessed but includes all remaining sources) sound level;

- Measure the representative background sound levels, typically by measuring close to the receptor location;
- Rate the specific sound level to account for any distinguishing characteristics (see below);
- Estimate the impact by subtracting the background sound level from the rating level; and
- Consider the initial estimate of impact, as determined above, in the context of the noise and its environment.

The specific sound level is rated to account for distinguishing characteristics by using penalties for tonality, impulsivity, intermittency, and other sound characteristics.

The character corrections are flexible according to whether the acoustic character is just perceptible at the noise receptor, or is clearly perceptible or highly perceptible, and range from 0 to 6 dB for tonal noise, 3 to 9 dB for impulsive noise, and 3 dB for other non-tonal/impulsive acoustic characteristics.

An initial estimate of impact of the specific sound is obtained by subtracting the background sound level from the rating level. Typically, the greater the difference, the greater the magnitude of impact.

- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context;
- A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context;
- At differences lower than +5 dB a low impact is likely, depending on the context. The lower the rating level is to the measured background sound level, the less likely it is that the specific sound source will have an impact.

The results of the initial assessment should then be considered in light of all pertinent contextual factors.

3. Sound Surveys

3.1. Methodology and Equipment

An unattended environmental sound survey has been undertaken between 12:15 on Tuesday 20th and 11:30 Thursday 22nd May 2025 to establish prevailing acoustic conditions at both the front and rear of the Site. The sound level metres (SLMs) were installed one metre out of partially opened 1st floor windows at the positions described as follows:

- **Continuous Measurements 1 (CM1):** Centre of north facing façade, overlooking Plymouth Grove;
- **CM2:** Corner of south facing façade (worst-case position), overlooking commercial units to the rear.

The approximate measurement locations are shown in **Error! Reference source not found.**.

Measurements were taken using Class 1 integrating/averaging SLMs houses, where appropriate, in environmental protection apparatus. The SLMs were field calibrated before and after the survey, using a Class 1 calibrator, with no significant drift in calibration noted.

The SLMs were setup to record A-weighted ambient, maximum and background sound levels at a minimum along with associated octave band spectra.

3.2. Survey Conditions and Observations

3.2.1. Meteorological Conditions

Weather conditions during the installation and collection of equipment were dry with low wind speeds. Historic weather data was monitored over the course of the survey which indicated suitable measurement conditions i.e., wind speeds of <5m/s and dry.

Therefore, it can be concluded that there were no adverse meteorological conditions, and all measurement data is acceptable to inform the assessment.

3.2.2. Site Observations

Site notes indicate the following:

- The Site is located close to several commercial noise sources, including two car repair garages and a wholesale catering supplier. According to Google the car garages are typically open between 09:00 – 19:00 most days;
- Noise environment was observed at the rear of the Site for approximately one hour to understand activity affecting the proposed development;
- During this period, deliveries to catering supplier (Arco Wholesale) took place, involving a forklift unloading goods at the front and transporting them to the rear. This activity produced occasional loud bangs and clattering sounds;
- Noise from the car repair garages was less prominent. Although some spray booth noise was audible from the car body shop (WrapZin Refined), it was generally masked by road traffic on Plymouth Grove.
- Plant noise from chiller units associated with Arco Wholesale was also audible. This noise was constant and noticeable during lulls in traffic along Plymouth Grove; and
- Facades facing Plymouth Grove are predominantly exposed to road traffic noise.

3.3. Results

Full time histories of measured noise survey results are provided in Appendix B.

The measured ambient levels (façade), along with the 10th highest 2-minute maximum noise level for daytime and night-time periods are presented below in Table 3.1. The highest maximum noise level at position CM2 has been reported below since the SLM did not record intervals shorter than 15-minutes.

Table 3.1: Measured facade levels

Date	Position	Daytime Ambient $L_{Aeq,16hr}$ dB	Night-time (Tuesday 20/05/25)	
			Ambient $L_{Aeq,8hr}$ dB	10th Highest Maximum $L_{AFmax,2min}$ dB
Wednesday 21/05/25	CM1	68	62	81
	CM2	59	50	75 (Highest L_{AFmax})

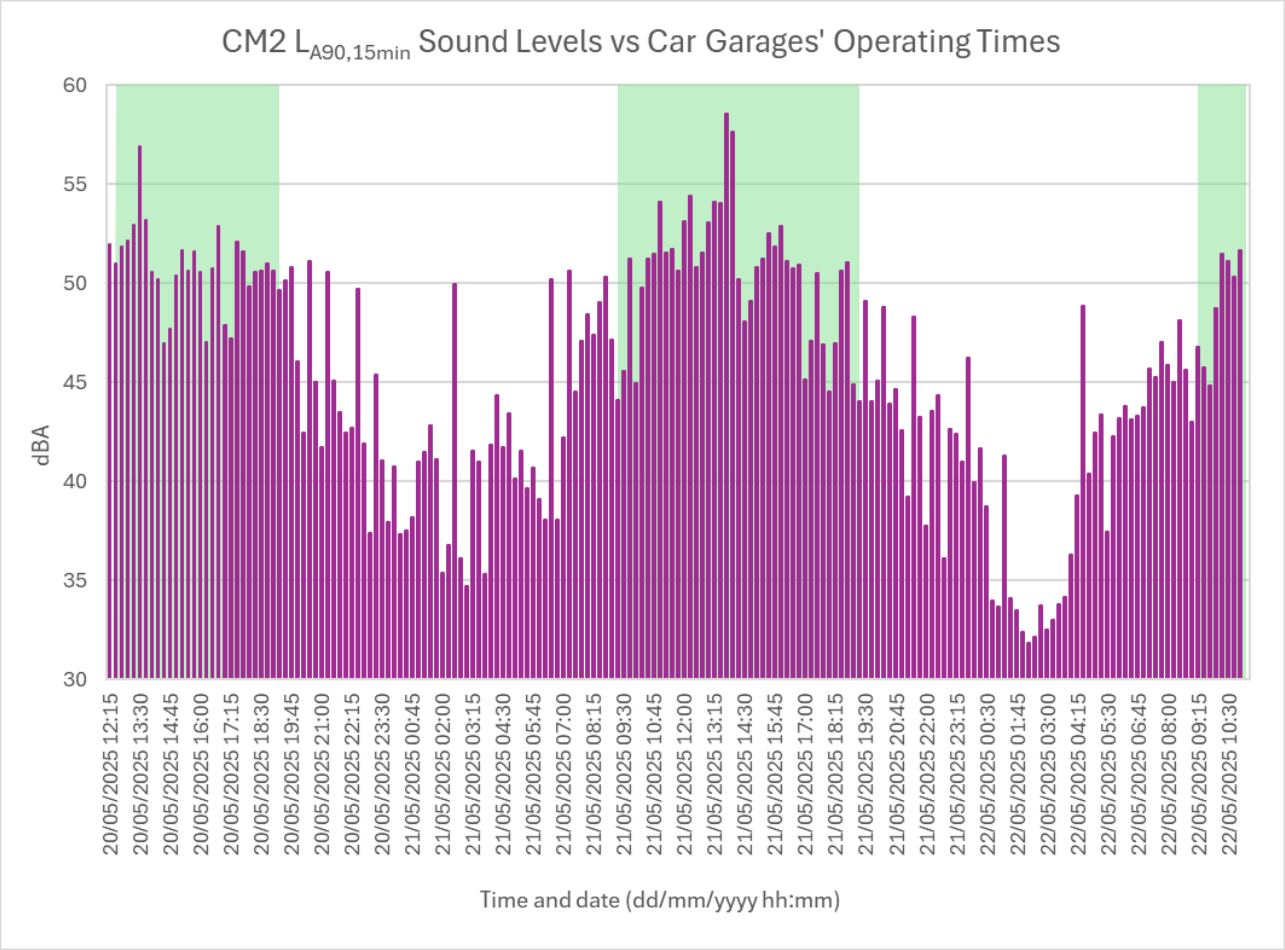
The highest $L_{Aeq,1hr}$ measured at position CM2 (overlooking the commercial units) during the car garages' operating hours (09:00 – 19:00) is shown below in Table 3.2.

Table 3.2: Highest measured ambient level $L_{Aeq,1hr}$

Date and Time	Position	Highest Hourly Ambient $L_{Aeq,1hr}$ dB
Wednesday 21/05/25 (13:00 – 14:00)	CM2	63

A time-history of background sound levels measured at position CM2 is presented below in Figure 3.1 with reference to the operating hours of the car garages, indicated by the green shaded areas.

Figure 3.1: Time-history of background sound levels at CM2 with reference to car garages' operating periods



4. Facades exposed to Industrial /Commercial Sound

4.1. Introduction

The predominant sources of noise affecting the south and west façades of the proposed Site are from nearby industrial and commercial activity. As a result, a BS 4142 assessment has been carried out for these façades during the daytime period only. In contrast, the north and east façades are predominantly affected by road traffic noise and do not require a BS 4142 assessment.

Measurements were conducted at CM2 which is representative of the worst-case Noise Sensitive Receptor (NSR).

4.2. Background Sound Level

As shown in Figure 3.1, the background sound level in the first 15 minutes after the car garages closed at 19:00 was approximately 49 dB on the first day and 45 dB on the second. Measurements at CM2 also indicate that plant noise from Arco Wholesale is not dominant. A representative background sound level of 45 dB has therefore been selected, as it reflects the lowest level immediately after operations ceased.

4.3. Specific Noise Level L_s

The highest hourly ambient level measured during daytime commercial operational hours at position CM2 is 63 dB $L_{Aeq,1hr}$.

4.4. Initial Numerical Impact Assessment

The results of the Initial Numerical Impact Assessment (INIA) at façades impacting by industrial noise sources is presented in Table 4.1.

BS 4142 states that appropriate corrections should be applied to the source value where acoustic features i.e., tonality, impulsivity and intermittency are present or expected. During the survey, loud bangs and clattering from lorry unloading by a forklift were observed. These sounds were clearly impulsive and are expected to occur frequently and intermittently due to deliveries at various times. Measurements at position CM2 were assessed in accordance with Annex C of BS 4142, and no tonal characteristics were identified at the receptor. Accordingly, a +6 dB penalty has been applied for clearly perceptible impulsive sound, along with a +3 dB penalty for readily distinctive intermittency due to periods of activity varying throughout the day.

It should be noted that façade-level measurements, have been adjusted to free-field by subtracting 3 dB.

Table 4.1: BS 4142 - INIA

Assessment Step	CM2 / NSR
Specific Sound Level at Receptor, dB $L_{Aeq,T}$	60
Acoustic Feature Correction, dB	+6 dB (Clearly perceptible impulsivity) +3 dB (Readily distinctive intermittency)
Rating Level, dB $L_{Ar,Tr}$	(60 + 9) = 69
Background Sound Level, dB $L_{A90,T}$	42
Rating over Background, dB	(69 – 42) = 27
Estimation of Impact	**Significant Adverse Impact**

The results show that the impact on receptors affected by commercial sound is significant. The recommended glazing and ventilation should therefore mitigate this impact and account for any acoustic feature corrections associated with the specific sound L_s.

4.5. Context

The initial estimate of the sound does not account for all the contextual factors. As BS 4142 suggests, the impact may be less in practice by accounting for the context where the following factors should be considered:

- The absolute level of sound;
- The character and level of the residual sound compared to the character and level of the specific sound; and
- The sensitivity of the receptor and whether dwellings will already incorporate design measures that secure good internal and/or outdoor acoustic conditions.

4.5.1. Absolute Level of Sound

BS 4142: 2014 states:

> *"Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night".*

In this case, the specific sound level affecting the site during the daytime is 60 dB, which exceeds the desirable upper guideline level of 50 dB $L_{Aeq,T}$ outlined in BS 8233 for external amenity areas. While this suggests a potential for adverse impact based on absolute level alone, this assessment must be considered in the full context, including façade design, mitigation, and the nature of the development site. The façade has been designed so as windows do not require opening to achieve adequate background ventilation.

Initial Impact Assessment	**Significant Adverse**
Modification due to absolute level of sound	**Adverse**

4.5.2. Character and Level of the Residual Sound

BS 4142: 2014 states:

> *"Consider whether it would be beneficial to compare the frequency spectrum and temporal variation of the specific sound with that of the ambient sound, to assess the degree to which the specific sound source is likely to be distinguishable and will represent an incongruous sound by comparison to the acoustic environment that would occur in the absence of the specific sound."*

The specific sound features (e.g., tonality, impulsivity, intermittency) have been accounted for in the assessment using acoustic character corrections as outlined in BS 4142. However, the façade design has been developed to address these features, ensuring internal noise levels, including the penalties, still comply with the internal ambient noise targets set out in BS 8233. As such, while the sound may have some distinguishing characteristics externally, it is not expected to be prominent inside the dwelling due to the design mitigation.

Initial Impact Assessment	**Significant Adverse**
Modification due to character and level of the residual sound	**Adverse**

4.5.3. Sensitivity of the Receptor and Design Measures that Secure Good Conditions

BS 4142 says to consider:

The sensitivity of the receptor and whether dwellings or other premises used for residential purpose will already incorporate design measures that secure good internal and/or outdoor acoustic conditions, such as:

- *Façade insulation treatment;*
- *Ventilation and/or cooling that will reduce the need to have windows open so as to provide rapid or purge ventilation; and*
- *Acoustic screening.*

The Site is in close proximity to industrial activity with apartments at the rear having direct line of sight to noise-generating operations. As such, the potential for noise disturbance is inherently higher than for dwellings in more typical residential environments. However, the design has incorporated enhanced glazing and façade specifications that ensure sufficient sound insulation. These measures ensure that internal noise levels remain within BS 8233:2014 criteria, even accounting for acoustic feature corrections from the BS 4142 rating level. To limit the need to open windows, an overheating assessment, typically required for new-build dwellings under Approved Document O, should be applied to these converted properties. This will help ensure that suitable design measures are in place to manage excess heat without exposing occupants to industrial noise.

Initial Impact Assessment	**Significant Adverse**
Modification due to receptor sensitivity and design measures	**Low Impact**

4.6. Assessment of the Plant Noise Impact

Although the absolute sound level impacting apartments to the rear is relatively high and the source is in direct view of the receptors, the building has been designed with mitigation that ensures good internal acoustic conditions. The acoustic character of the sound has been addressed through façade design, and all penalties have been incorporated into the internal noise level predictions. Significant adverse impacts have been mitigated and avoided, an while adverse impacts remain, they have been minimised in line with the aims of the NPPF.

5. Internal Noise Level Assessment

5.1. Calculation Input Parameters

Internal ambient noise levels have been calculated in accordance with BS EN ISO 12354-3 with example calculations provided in Appendix C.

The measured façade levels have been converted to free-field equivalent by subtracting 3 dB.

Room Dimensions

Internal layout dimensions have been determined as per architectural drawings received from Create It Studios as follows:

- Detail Floor Plans - A1507(03)AP001
- Details Elevations and Section - A1507(03)AP002

Non-Glazed Elements

The exact specification for the external wall construction is uncertain, therefore the sound reduction indices (R) for a solid 225mm masonry wall with no cavity has been considered as a guide.

The external wall should achieve a minimum sound insulation performance of $R_w + C_{tr}$ 50 dB.

Glazing Specification

The calculations have been undertaken for each habitable space using the glazing specifications outlined in

Table 5.1: Glazing specifications

Reference	Min. Performance $R_w + C_{tr}$	Typical Glass Configuration
A	32	4mm panel 20mm air gap 6mm panel
B	41	8.8mm Pilkington Optiphon 16mm argon 12.8mm Pilkington Optiphon

Ventilation Strategy

Break-in calculations are based upon whole-dwelling ventilation in accordance with Approved Document F. Decentralised continuous mechanical extract ventilation (DMEV) should be used in kitchens and wet rooms, with each habitable room requiring a minimum equivalent area (EA) of 4000mm^2 for background ventilation.

For the calculations, ventilation has been assumed to comprise either one 5000 mm² EA vent or two 2500 mm² EA vents per habitable room.

All ventilation details outlined in this report should be reviewed by an AD-F ventilation specialist to confirm suitability for the proposed project.

5.2. Example Calculation

The noise break-in results for the worst-case apartment affected by industrial noise sources are shown in Table 5.2.

Table 5.2: Predicted internal noise levels in Apartment 2 bedroom (overlooking rear)

Room Type	Predicted Internal Daytime Sound Level $L_{Aeq,16hr}$ dB	Predicted Internal Night-time Sound Level	
		Ambient LAeq,8hr dB	Highest Maximum L_{AFmax} dB
Bedroom	25	13	35
Living Room	22	-	-

The results demonstrate compliance with the requirements of BS 8233 and Who Guidelines.

To further support this, the overarching mitigation strategy incorporates the feature correction penalties identified through the BS 4142 assessment. These corrections, such as penalties for tonality, impulsivity or intermittency have been applied to the calculated internal noise levels to ensure a robust demonstration of compliance with BS 8233.

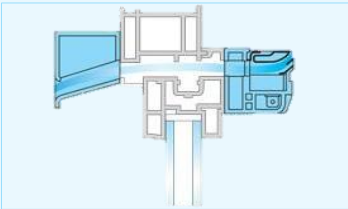
Table 5.3: Predicted internal noise level with acoustic character adjustment

Room Type	Predicted Internal Daytime Sound Level (Including acoustic character penalties) $L_{Aeq,16hr}$ dB	BS 8233 Criteria
Bedroom	(25 + 9) = 34	≤35 dB
Living Room	(22 + 9) = 31	

5.3. Façade Mitigation Summary

Based on the break-in calculations undertaken, mitigation measures have been prescribed to achieve sound levels in accordance with BS 8233 and WHO Guidelines as follows:

Table 5.4: Mitigation Summary

Ref	Glazing Requirements	AD-F Ventilation Requirements
A	4mm panel 20mm air gap 6mm panel **Minimum 32 dB $R_w + C_{tr}$**	<u>Acoustically Rated Trickle Vent</u> Example for costing purposes only: Titon SF Xtra Sound Attenuator Vent V75/C75 Canopy (5000mm^2 EA) [1no. vent per habitable room required]  **Minimum $D_{n,e,w}$ = 40 dB**
B	8.8mm Pilkington Optiphon 16mm argon 12.8mm Pilkington Optiphon **Minimum 41 dB $R_w + C_{tr}$**	

Corresponding Locations

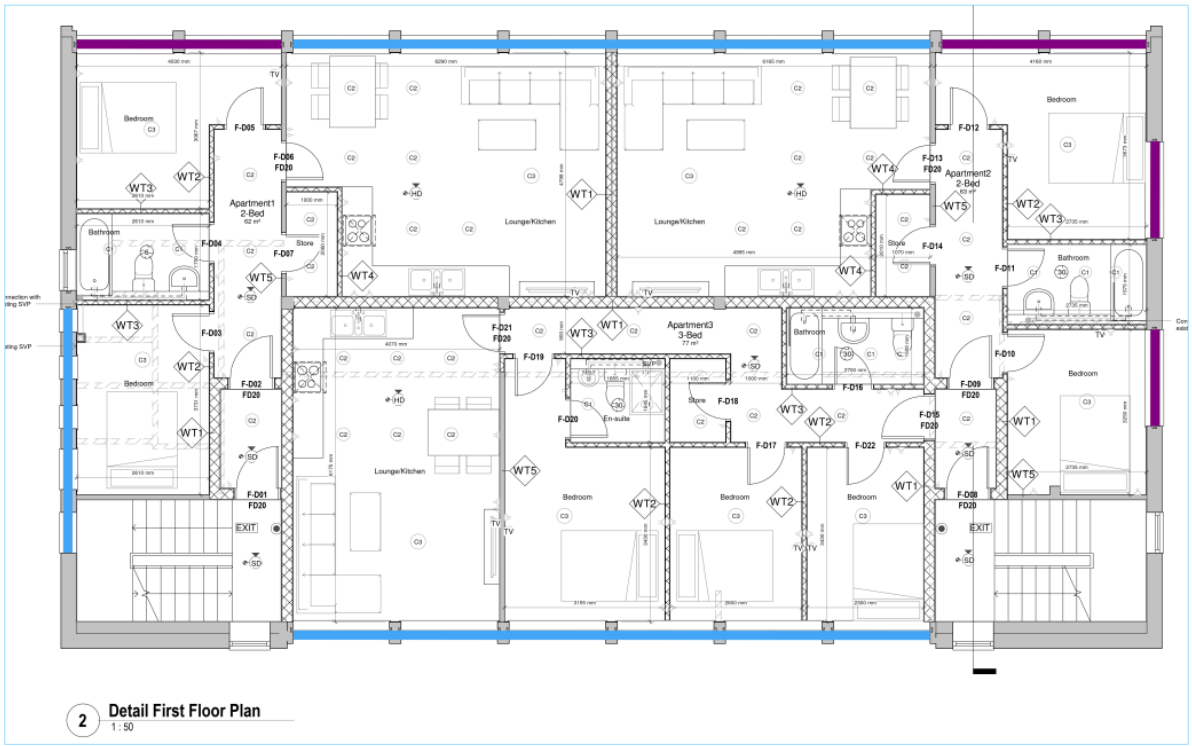
Reference A mitigation measures outlined above should be applied to habitable rooms in the following locations:

- Living rooms and bedrooms overlooking Plymouth Grove; and
- Living rooms overlooking rear industrial noise sources

Reference B mitigation measures should be applied in the following locations:

- Bedrooms overlooking rear industrial noise sources

Figure 5.1: Recommended glazing and ventilation performance locations – 1st Floor



6. Internal Noise Transfer

The separating floor between the ground floor commercial unit and residential apartments above should aim to achieve a + 10 dB improvement on standard Building Regulations performance, e.g., 53 dB $D_{nT,w}$ + C_{tr}.

The existing floor construction is currently unknown but has been assumed timber as a worst-case. Based on the limited construction details currently available, the following solutions are recommended in principle:

Ceiling Treatment (Commercial Area Below)

Option 1 – **MF Ceiling System**

- Install and MF ceiling on acoustic hangers with minimum 400mm cavity;
- 200mm mineral wool insulation in the cavity; and
- Attach two layers of 15mm Fireline plasterboard to the underside

Option 2 –**Timber Joist System**

- Install timber joists below existing ceiling, fixed only at the perimeter walls (to avoid connection with the existing joists above); and
- Use the same 200mm insulation, 400mm cavity width and 15mm Fireline plasterboard layers as in Option 1.

Floor Treatment (Above)

- Consider a floating floor and increased mass to the floor if additional acoustic performance is required

Prior to construction, a detailed investigation is essential to confirm the actual floor build-up and refine the acoustic design strategy accordingly. The above recommendations provide initial guidance only, while assuming flanking sound does not limit acoustic performance.

7. Conclusions

Peninsular Acoustics has been commissioned by Mr Saghir Hussein on behalf of his client to undertake an acoustic assessment to measure the impact from surrounding noise sources on the proposed first-floor residential development located at First Floor, 166 Plymouth Grove, Manchester M13 0AF.

An environmental sound survey has been undertaken which has determined prevailing acoustic conditions surrounding the Site.

Due to industrial noise at the rear, a BS 4142 assessment was conducted, which identified a significant adverse impact. Break-in calculations have been undertaken which demonstrate that with the installation of appropriate glazing and ventilation systems, internal noise level standards outlined in BS 8233 and WHO Guidelines for Community Noise will be achieved whilst giving due consideration to the ventilation requirements of AD-F. Additionally the feature corrections identified in the BS4142 assessment from industrial sources has been applied to the predicted internal level to further enhance the protection from the impacting noise while complying with BS 8233.

Internal noise transfer between the commercial and residential separating elements has been reviewed, and outline guidance has been provided to support adequate residential amenity in relation to noise from commercial sources.

The results of this study have demonstrated with the inclusion of the mitigation measures outlined in this report; the Site is suitable for residential amenity. Furthermore, significant adverse impacts have been mitigated and avoided, and while adverse impacts remain, they have been minimised in line with the aims of the NPPF.

Limitations applicable to this report are contained in Appendix D.

Appendix A

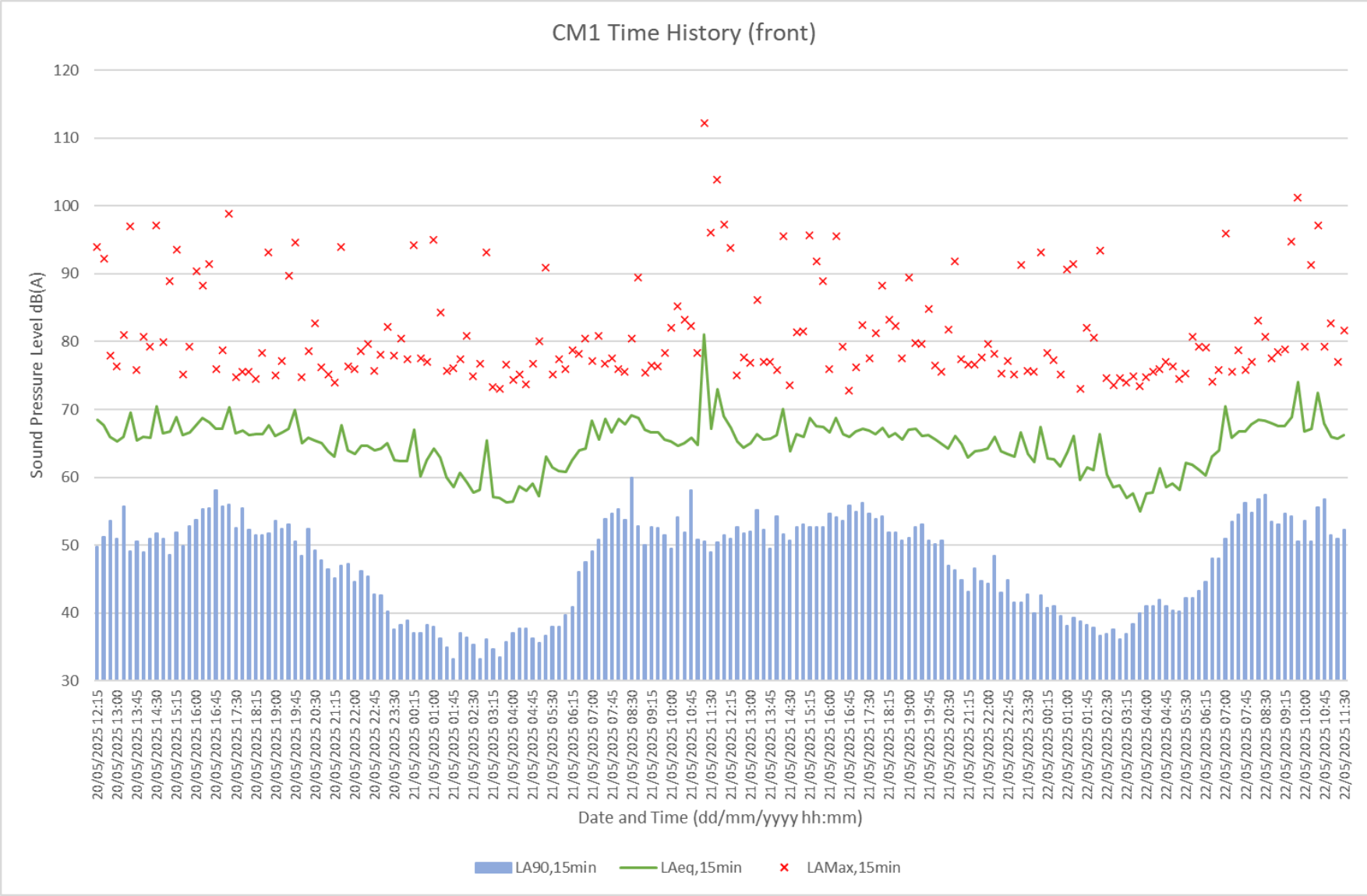
Technical Terminology

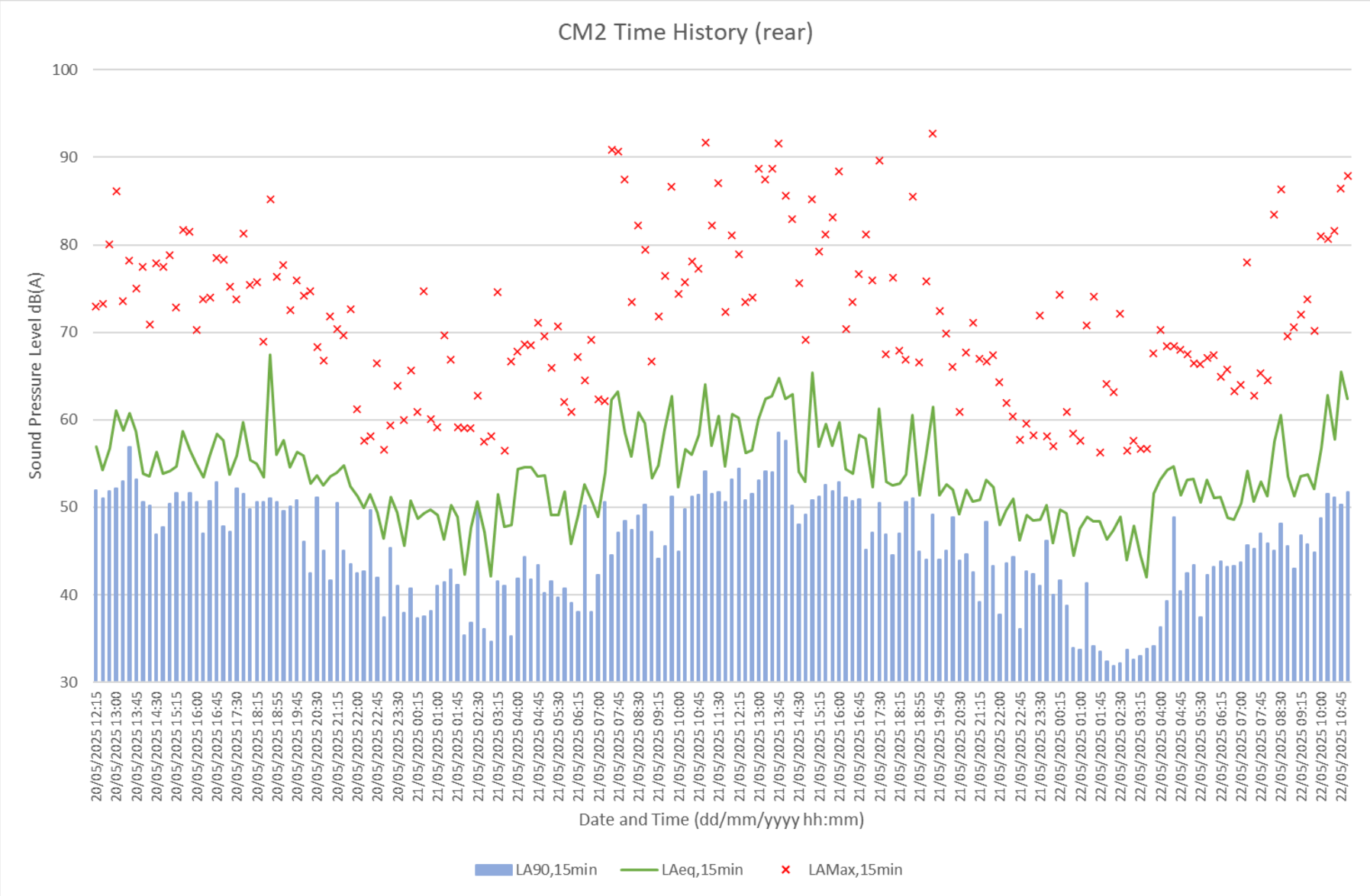
Noise	Typically defined as unwanted, unpleasant or disturbing sound
Frequency (Hz)	The number of oscillations in acoustic pressure per second. It represents the 'tone' of the sound. Often determined in octave bands
Maximum sound pressure level (L_{Fmax})	The maximum or highest sound pressure level measured with a 'fast' time weighting
Equivalent continuous sound pressure level ($L_{eq,T}$)	The average of the total sound energy over a specified time period (T). L_{eq} represents the equivalent sound level that a fluctuating source would have compared to a steady source with the same total sound energy over a specific time period. Commonly used as a descriptor of human perception of sound over time.
'A' weighting	Frequency-dependent weighting based on the response of the human auditory system which has been found to correlate well with the subjective response to sound. Denoted by the use of the letter 'A'. For example, dBA denotes an 'A' weighted sound level in decibels, or L_{Amax} denotes an 'A' weighted maximum sound pressure level.
Internal Ambient Noise Level (IANL)	The noise level within a room or enclosed space. Usually determined as an equivalent continuous sound pressure level over a specific time period ($L_{Aeq,T}$, dB)
Noise Rating (NR) curve	A single figure term used to reflect the spectral frequency content of noise. Although originally proposed to assess environmental noise, NR curves are now typically used to describe noise from mechanical ventilation systems in buildings.
$L_{night,outside}$	The incident external A-weighted long-term average sound level as defined in ISO 1996-2: 1987, determined over all the night periods of a year, in which the night is eight hours between 23:00 and 07:00.
AVO	Acoustics, Ventilation, Overheating (e.g. AVO Guide, AVO Group).
Overheating Strategy Overheating Condition	The situation where measures are in place to mitigate overheating to meet agreed compliance criteria.
Dynamic thermal modelling	A technique that can be used to simulate internal temperatures in dwellings before they are built
Ventilative cooling	Cooling by means of introducing external ambient temperature air at a high ventilation rate. Can be either passive (no fans) or mechanical (with fans).
Purge ventilation	Ventilation to aid removal of high concentrations of pollutants and water vapour released from occasional activities such as painting and decorating or accidental releases such as smoke from burnt food or spillage of water.
Mechanical cooling	Cooling by means of a refrigerant cycle. This would include 'air conditioning' systems and the use of fan coil units (FCUs).

MEV	Mechanical extract ventilation.
“Free area” as used in AD-O	Approved Document O uses the term “Minimum free area” that is required to be achieved by the Equivalent area of the window openings. AD-O provides the accepted definition of Equivalent area for the description of “free area”. The term “free area” is therefore avoided in this document to avoid further confusion.
Acoustic open area	The measurable, cross-sectional, geometric area of an opening. For a partially open window, this is considered to be the lesser of either the size of the hole in the window frame that is left by the opening light, or the combined cross-sectional area around the opening light through which air must pass to move from outside to inside. The area around a hinged opening light includes the triangular areas on the sides adjacent to the hinge, and the rectangular area on the side opposite the hinge. This should not be used for comparing the air-flow performance of elements because this will also be dependent on factors such as depth (length of air-path), surface roughness and tortuosity. Refer to reference 6 for further information.
Effective area, A_{eff}	Defined as the product of the free area and discharge coefficient, this is the preferred parameter for comparing the air-flow performance of elements. Refer to reference 6 for further information.
Equivalent area, A_{eq}	The area of a sharp-edged, circular orifice that gives the same flow rate as the actual opening at a given pressure-difference. In other words, the free-area of a notional circular hole made in an infinitely thin, infinite extent baffle that gives the same air-flow performance as the real opening. Used to describe the area of trickle vents in Approved Document F. Not to be confused with Effective area. Refer to reference 6 for further information.
Coefficient of Discharge, Cd	The ratio of the mass flow rate at the discharge end of the nozzle to that of an ideal nozzle which expands an identical working fluid from the same initial conditions to the same exit pressures.
$D_{n,e}$ / $D_{n,e,w}$	The laboratory tested sound insulation of small building elements, normalised to an equivalent absorption area of 10m2.
Façade level	The sound pressure level measured close to a building façade that includes contribution from both the incident sound and the sound reflected from the façade. Normally taken to be 3dB higher than the equivalent free-field level, when located at 1 metre from a façade.
Free-field level	A measured sound pressure level that is independent of any contributions due to reflections from nearby surfaces and is therefore representative of the direct path only.
R / R_w	The laboratory tested airborne sound insulation of a building element
Sound insulation	The capacity of a structure to prevent sound from reaching a receiving location. Sound energy is not necessarily absorbed; impedance mismatch, or reflection back toward the source, is often the principal mechanism

Appendix B

Time-Histories of Measured Noise Survey Results


CM1 Time History (front)
Sound Pressure Level dB(A)
120
110
100
90
80
70
60
50
40
30
Date and Time (dd/mm/yyyy hh:mm)
LA90,15min
LAeq,15min
LAMax,15min


CM2 Time History (rear)
Sound Pressure Level dB(A)
100
90
80
70
60
50
40
30
Date and Time (dd/mm/yyyy hh:mm)
LA90,15min
LAeq,15min
LAMax,15min

Appendix C

Example Break-In Calculations

Figure 7.1: Example noise break-in calculation, Daytime – Bedroom Overlooking Plymouth Grove (Anonymous Noise)

Annex G BS8233 Calculations

Calculation Set Up Using BS8233 Values

Frequency Independent Terms

Ao =	10	m2	Reference absorbtion area
H =	2.4	m2	Height of the room
W =	2.3	m2	Width of the room
Sf =	5.52	m2	Total façade area of the room
Swi =	3.6	m2	Window area of room
Sew =	1.92	m2	External wall area
Srr =	0	m2	Ceiling area
S =	5.52	m2	Total surface are of elements through which sound enters the room (= Sf + Srr)
d =	3.4	m2	Depth of the room
V =	18.768	m3	Room volume

Frequency Dependent Terms

			Octave Band Centre Frequency								R_w + C_{tr} or $D_{n,e,w}$ + C_{tr}
			63	125	250	500	1k	2k	4k	8k	
SRIs											
Parameter	Description	Construction									
Dn,e =	Insulation of trickle vent	Titon V75/C75 5000EA		37	37	36.1	46.9	49.2	55.2		41
Rwi =	SRI of window	4/20/6		23	24	36	44	49	52		32
Rew =	SRI of external wall	225mm Brick		39	44	52	59	63	58		50
Rrr =	SRI of roof / ceiling										
Absorption Coefficients											
carpet on underlay				0.08	0.24	0.57	0.69	0.71	0.73		
walls, painted and plastered				0.02	0.02	0.03	0.03	0.04	0.05		
double glazing				0.18	0.06	0.04	0.03	0.02	0.02		
ceiling	Armstrong Dune Supreme			0.4	0.45	0.55	0.6	0.5	0.45		
Total Absorption		area									
carpet on underlay		60.48	0	4.8384	14.5152	34.4736	41.7312	42.9408	44.1504	0	
walls, painted and plastered		23.76	0	0.4752	0.4752	0.7128	0.7128	0.9504	1.188	0	
double glazing		3.6	0	0.648	0.216	0.144	0.108	0.072	0.072	0	
ceiling		60.48	0	24.192	27.216	33.264	36.288	30.24	27.216	0	
A from rev time (RT) or abs coeff (AC)?		RT									
A =	Equiv abs area of rec room (AC)		0.00	30.15	42.42	68.59	78.84	74.20	72.63	0.00	
RT				0.5	0.5	0.5	0.5	0.5	0.5		
A =	Equiv abs area of rec room (RT)		0.00	6.01	6.01	6.01	6.01	6.01	6.01	0.00	
A =	Equiv abs area of rec room		0.00	6.01	6.01	6.01	6.01	6.01	6.01	0.00	
TERM A	Leq,ff = Leq ext ff	65.2 dB(A)		60	57	57	62	60	49		
TERM B	(Ao/S) * 10^(-Dn,e / 10)		0	0.000361	0.000361	0.000445	3.7E-05	2.18E-05	5.47E-06	0	
TERM C	(Swi/S) * 10^(-Rwi / 10)		0	0.003269	0.002596	0.000164	2.6E-05	8.21E-06	4.11E-06	0	
TERM D	(Sew/S) * 10^(-Rew / 10)		0	4.38E-05	1.38E-05	2.19E-06	4.38E-07	1.74E-07	5.51E-07	0	
TERM E	(Srr/S) * 10^(-Rrr / 10)		0	0	0	0	0	0	0	0	
TERM F	10 Log (B+C+D+E)		0	-24.3488	-25.27	-32.1417	-41.9798	-45.205	-49.9408	0	
TERM G	10 Log (S/A)		0	-0.36629	-0.36629	-0.36629	-0.36629	-0.36629	-0.36629	0	
TERM K	+3		3	3	3	3	3	3	3	3	
Leq,2	SPL in room	dB	0.0	37.8	34.8	28.0	22.4	17.8	1.7	0.0	
A-weighting			-26.2	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.1	
LAeq,2		dB(A)	0.0	21.7	26.2	24.8	22.4	19.0	2.7	0.0	
10^(LAeq,2 / 10)			0	149.5488	421.1855	299.1925	172.6805	79.1859	1.883181	0	
LAeq noise level in room =		30.5 dB(A)									
dB(A) reduction =		**34.7 dB(A)**									

Figure 7.2: Example noise break-in calculation, Night-time – Bedroom Overlooking Plymouth Grove (Anonymous Noise)

Annex G BS8233 Calculations

Calculation Set Up Using BS8233 Values

Frequency Independent Terms

Ao =	10	m2	Reference absorbtion area
H =	2.4	m2	Height of the room
W =	2.3	m2	Width of the room
Sf =	5.52	m2	Total façade area of the room
Swi =	3.6	m2	Window area of room
Sew =	1.92	m2	External wall area
Srr =	0	m2	Ceiling area
S =	5.52	m2	Total surface are of elements through which sound enters the room (= Sf + Srr)
d =	3.4	m2	Depth of the room
V =	18.768	m3	Room volume

Frequency Dependent Terms

			Octave Band Centre Frequency								$R_w + C_{tr}$ or $D_{n,e,w} + C_{tr}$
			63	125	250	500	1k	2k	4k	8k	
SRIs											
Parameter	Description	Construction									
Dn,e =	Insulation of trickle vent	Titon V75/C75 5000EA		37	37	36.1	46.9	49.2	55.2		41
Rwi =	SRI of window	4/20/6		23	24	36	44	49	52		32
Rew =	SRI of external wall	225mm Brick		39	44	52	59	63	58		50
Rrr =	SRI of roof / ceiling										
Absorption Coefficients											
carpet on underlay				0.08	0.24	0.57	0.69	0.71	0.73		
walls, painted and plastered				0.02	0.02	0.03	0.03	0.04	0.05		
double glazing				0.18	0.06	0.04	0.03	0.02	0.02		
ceiling	Armstrong Dune Supreme			0.4	0.45	0.55	0.6	0.5	0.45		
Total Absorption		area									
carpet on underlay		60.48	0	4.8384	14.5152	34.4736	41.7312	42.9408	44.1504	0	
walls, painted and plastered		23.76	0	0.4752	0.4752	0.7128	0.7128	0.9504	1.188	0	
double glazing		3.6	0	0.648	0.216	0.144	0.108	0.072	0.072	0	
ceiling		60.48	0	24.192	27.216	33.264	36.288	30.24	27.216	0	
A from rev time (RT) or abs coeff (AC)?		RT									
A =	Equiv abs area of rec room (AC)		0.00	30.15	42.42	68.59	78.84	74.20	72.63	0.00	
RT				0.5	0.5	0.5	0.5	0.5	0.5		
A =	Equiv abs area of rec room (RT)		0.00	6.01	6.01	6.01	6.01	6.01	6.01	0.00	
A =	Equiv abs area of rec room		0.00	6.01	6.01	6.01	6.01	6.01	6.01	0.00	
TERM A	Leq,ff = Leq ext ff	59.0 dB(A)		52	51	52	57	52	47		
TERM B	(Ao/S) * 10^(-Dn,e / 10)		0	0.000361	0.000361	0.000445	3.7E-05	2.18E-05	5.47E-06	0	
TERM C	(Swi/S) * 10^(-Rwi / 10)		0	0.003269	0.002596	0.000164	2.6E-05	8.21E-06	4.11E-06	0	
TERM D	(Sew/S) * 10^(-Rew / 10)		0	4.38E-05	1.38E-05	2.19E-06	4.38E-07	1.74E-07	5.51E-07	0	
TERM E	(Srr/S) * 10^(-Rrr / 10)		0	0	0	0	0	0	0	0	
TERM F	10 Log (B+C+D+E)		0	-24.3488	-25.27	-32.1417	-41.9798	-45.205	-49.9408	0	
TERM G	10 Log (S/A)		0	-0.36629	-0.36629	-0.36629	-0.36629	-0.36629	-0.36629	0	
TERM K	+3		3	3	3	3	3	3	3	3	
Leq,2	SPL in room	dB	0.0	30.7	28.6	22.3	17.6	9.3	-0.6	0.0	
A-weighting			-26.2	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.1	
LAeq,2		dB(A)	0.0	14.6	20.0	19.1	17.6	10.5	0.4	0.0	
10^(LAeq,2 / 10)			0	28.87	100.6892	80.39087	57.26018	11.33996	1.094669	0	
LAeq noise level in room =		**24.5 dB(A)**									
dB(A) reduction =		**34.5 dB(A)**									

Figure 7.3: Example noise break-in calculation, Maximum – Bedroom Overlooking Plymouth Grove (Anonymous Noise)

Annex G BS8233 Calculations

Calculation Set Up Using BS8233 Values

Frequency Independent Terms

Ao =	10	m2	Reference absorbtion area
H =	2.4	m2	Height of the room
W =	2.3	m2	Width of the room
Sf =	5.52	m2	Total façade area of the room
Swi =	3.6	m2	Window area of room
Sew =	1.92	m2	External wall area
Srr =	0	m2	Ceiling area
S =	5.52	m2	Total surface are of elements through which sound enters the room (= Sf + Srr)
d =	3.4	m2	Depth of the room
V =	18.768	m3	Room volume

Frequency Dependent Terms

			Octave Band Centre Frequency								$R_w + C_{tr}$ or $D_{n,e,w} + C_{tr}$
			63	125	250	500	1k	2k	4k	8k	
SRIs											
Parameter	Description	Construction									
Dn,e =	Insulation of trickle vent	Titon V75/C75 5000EA		37	37	36.1	46.9	49.2	55.2		41
Rwi =	SRI of window	4/20/6		23	24	36	44	49	52		32
Rew =	SRI of external wall	225mm Brick		39	44	52	59	63	58		50
Rrr =	SRI of roof / ceiling										
Absorption Coefficients											
carpet on underlay				0.08	0.24	0.57	0.69	0.71	0.73		
walls, painted and plastered				0.02	0.02	0.03	0.03	0.04	0.05		
double glazing				0.18	0.06	0.04	0.03	0.02	0.02		
ceiling	Armstrong Dune Supreme			0.4	0.45	0.55	0.6	0.5	0.45		
Total Absorption		area									
carpet on underlay		60.48	0	4.8384	14.5152	34.4736	41.7312	42.9408	44.1504	0	
walls, painted and plastered		23.76	0	0.4752	0.4752	0.7128	0.7128	0.9504	1.188	0	
double glazing		3.6	0	0.648	0.216	0.144	0.108	0.072	0.072	0	
ceiling		60.48	0	24.192	27.216	33.264	36.288	30.24	27.216	0	
A from rev time (RT) or abs coeff (AC)?		RT									
A =	Equiv abs area of rec room (AC)		0.00	30.15	42.42	68.59	78.84	74.20	72.63	0.00	
RT				0.5	0.5	0.5	0.5	0.5	0.5		
A =	Equiv abs area of rec room (RT)		0.00	6.01	6.01	6.01	6.01	6.01	6.01	0.00	
A =	Equiv abs area of rec room		0.00	6.01	6.01	6.01	6.01	6.01	6.01	0.00	
TERM A	Leq,ff = Leq ext ff	77.9 dB(A)		73	70	72	76	70	61		
TERM B	(Ao/S) * 10^(-Dn,e / 10)		0	0.000361	0.000361	0.000445	3.7E-05	2.18E-05	5.47E-06	0	
TERM C	(Swi/S) * 10^(-Rwi / 10)		0	0.003269	0.002596	0.000164	2.6E-05	8.21E-06	4.11E-06	0	
TERM D	(Sew/S) * 10^(-Rew / 10)		0	4.38E-05	1.38E-05	2.19E-06	4.38E-07	1.74E-07	5.51E-07	0	
TERM E	(Srr/S) * 10^(-Rrr / 10)		0	0	0	0	0	0	0	0	
TERM F	10 Log (B+C+D+E)		0	-24.3488	-25.27	-32.1417	-41.9798	-45.205	-49.9408	0	
TERM G	10 Log (S/A)		0	-0.36629	-0.36629	-0.36629	-0.36629	-0.36629	-0.36629	0	
TERM K	+3		3	3	3	3	3	3	3	3	
Leq,2	SPL in room	dB	0.0	51.2	47.8	42.9	36.5	27.4	13.6	0.0	
A-weighting			-26.2	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.1	
LAeq,2		dB(A)	0.0	35.1	39.2	39.7	36.5	28.6	14.6	0.0	
10^(LAeq,2 / 10)			0	3219.967	8269.367	9381.766	4452.517	731.5887	28.71416	0	
LAeq noise level in room =		**44.2 dB(A)**									
dB(A) reduction =		**33.8 dB(A)**									

Figure 7.4: Example noise break-in calculation, Specific Noise L_s – Bedroom Overlooking Rear (Commercial / Industrial Noise)

Annex G BS8233 Calculations

Calculation Set Up Using BS8233 Values

Frequency Independent Terms

Ao =	10	m2	Reference absorbtion area
H =	2.4	m2	Height of the room
W =	4.1	m2	Width of the room
Sf =	18.48	m2	Total façade area of the room
Swi =	9	m2	Window area of room
Sew =	9.48	m2	External wall area
Srr =	0	m2	Ceiling area
S =	18.48	m2	Total surface are of elements through which sound enters the room (= Sf + Srr)
d =	3.6	m2	Depth of the room
V =	27.36	m3	Room volume

Frequency Dependent Terms

			Octave Band Centre Frequency								$R_w + C_{tr}$ or $D_{n,e,w} + C_{tr}$
			63	125	250	500	1k	2k	4k	8k	
SRIs											
Parameter	Description	Construction									
Dn,e =	Insulation of trickle vent	Titon V75/C75 5000EA		37	37	36.1	46.9	49.2	55.2		41
Rwi =	SRI of window	Optiphon /16mm argon /12.8mm Pilkington Optiphon		28	36	45	53	56	64		40
Rew =	SRI of external wall	225mm Brick		39	44	52	59	63	58		50
Rrr =	SRI of roof / ceiling										
Absorption Coefficients											
carpet on underlay				0.08	0.24	0.57	0.69	0.71	0.73		
walls, painted and plastered				0.02	0.02	0.03	0.03	0.04	0.05		
double glazing				0.18	0.06	0.04	0.03	0.02	0.02		
ceiling	Armstrong Dune Supreme			0.4	0.45	0.55	0.6	0.5	0.45		
Total Absorption		area									
carpet on underlay		60.48	0	4.8384	14.5152	34.4736	41.7312	42.9408	44.1504	0	
walls, painted and plastered		27.96	0	0.5592	0.5592	0.8388	0.8388	1.1184	1.398	0	
double glazing		9	0	1.62	0.54	0.36	0.27	0.18	0.18	0	
ceiling		60.48	0	24.192	27.216	33.264	36.288	30.24	27.216	0	
A from rev time (RT) or abs coeff (AC)?		RT									
A =	Equiv abs area of rec room (AC)		0.00	31.21	42.83	68.94	79.13	74.48	72.94	0.00	
RT				0.5	0.5	0.5	0.5	0.5	0.5		
A =	Equiv abs area of rec room (RT)		0.00	8.76	8.76	8.76	8.76	8.76	8.76	0.00	
A =	Equiv abs area of rec room		0.00	8.76	8.76	8.76	8.76	8.76	8.76	0.00	
TERM A	Leq,ff = Leq ext ff	60.0 dB(A)		57	56	56	56	54	55		
TERM B	(Ao/S) * 10^(-Dn,e / 10)		0	0.000108	0.000108	0.000133	1.1E-05	6.51E-06	1.63E-06	0	
TERM C	(Swi/S) * 10^(-Rwi / 10)		0	0.000772	0.000122	1.54E-05	2.44E-06	1.22E-06	1.94E-07	0	
TERM D	(Sew/S) * 10^(-Rew / 10)		0	6.46E-05	2.04E-05	3.24E-06	6.46E-07	2.57E-07	8.13E-07	0	
TERM E	(Srr/S) * 10^(-Rrr / 10)		0	0	0	0	0	0	0	0	
TERM F	10 Log (B+C+D+E)		0	-30.2484	-36.0081	-38.1968	-48.497	-50.9766	-55.7822	0	
TERM G	10 Log (S/A)		0	3.244359	3.244359	3.244359	3.244359	3.244359	3.244359	0	
TERM K	+3		3	3	3	3	3	3	3	3	
Leq,2	SPL in room	dB	0.0	33.2	26.7	24.5	13.6	9.1	5.3	0.0	
A-weighting			-26.2	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.1	
LAeq,2		dB(A)	0.0	17.1	18.1	21.3	13.6	10.3	6.3	0.0	
10^(LAeq,2 / 10)			0	50.88469	65.0646	134.0581	23.10982	10.62413	4.257962	0	
LAeq noise level in room =		24.6 dB(A)									
dB(A) reduction =		35.4 dB(A)									
Internal noise level with BS 4142 feature corrections applied =		33.6 dB(A)									

Appendix D

Report Limitations

This report has been prepared for the titled project or named part thereof and should not be used in whole or part and relied upon for any other project without the written authorisation of Peninsular Acoustics Limited. Peninsular Acoustics Limited accept no responsibility or liability for the consequences of this document if it is used for a purpose other than that for which it was commissioned. Persons wishing to use or rely upon this report for other purposes must seek written authority to do so from the owner of this report and/ or Peninsular Acoustics Limited and agree to indemnify Peninsular Acoustics Limited for any and all loss or damage resulting therefrom. Peninsular Acoustics Limited accepts no responsibility or liability for this document to any other party other than the person by whom it was commissioned.

The findings and opinions expressed are relevant to the dates of the site works and design drawings/specifications and should not be relied upon to represent conditions at substantially later dates. Opinions included therein are based on information gathered during the study and from our experience. If additional information becomes available which may affect our comments, conclusions or recommendations Peninsular Acoustics Limited reserve the right to review the information, reassess any new potential concerns and modify our opinions accordingly.

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