

# SHARPS REDMORE

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## Report 1

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**Acoustic Assessment**  
for Residential Development  
Wakefield Road, Earlsheaton

**Prepared by**  
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## Revision Register

Revision	Date	Author	Description of changes
-	13.11.2023	AJN	First issue

This report has been prepared with all reasonable skill, care and diligence commensurate with an acoustic consultancy practice under the terms and brief agreed with our client at that time. Sharps Redmore provides no duty or responsibility whatsoever to any third party who relies upon its content, recommendations or conclusions.

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## 1.0 Executive Summary

- 1.1 This report presents an assessment of noise in relation to five proposed single-storey dwellings on land adjacent to Wakefield Road in Earlsheaton.
- 1.2 A noise survey has been carried out on the 10<sup>th</sup> and 13<sup>th</sup> October 2023 to establish the prevailing noise environment at the site.
- 1.3 This assessment considers national planning policy and guidance, including the NPPF and NPSE, as well as local planning policy contained within the Local Plan. The assessment is presented in accordance with the guidance of the ProPG: Planning and Noise and the guidance documents referenced within.
- 1.4 An initial 'Stage 1' site risk assessment, as advocated by the ProPG, indicates that the site is **Low Risk** in terms of noise during the daytime, and **Medium Risk** during the night-time. The Stage 1 assessment of noise risk is not the basis for the eventual recommendation to the decision maker.
- 1.5 Guideline criteria have been identified for internal noise levels in accordance with BS 8233:2014. It is calculated that the required indoor noise levels can be achieved with standard double-glazed windows (e.g. 4 (12) 6 mm) and with standard through-frame trickle ventilators (e.g. Greenwood 5000EA). This is with windows closed whilst providing whole dwelling ventilation. Further details and typical acoustic performance specifications are given in Section 7.0.
- 1.6 If the mitigation of overheating is necessary, it is calculated that internal noise level criteria may be achieved in bedrooms at night-time with an open window free area of 0.6 m<sup>2</sup>.
- 1.7 All assumptions and parameters regarding the ventilation and overheating strategies made in this assessment must be confirmed by a suitably qualified consultant/engineer.
- 1.8 An 'Acoustic Design Statement' is included in Section 8.0 as suggested by the ProPG, and includes a recommendation to the decision maker, which demonstrates that the site is suitable for residential development.
- 1.9 In accordance with the guidance of the ProPG and the findings detailed within this report it is recommended that **planning consent may be granted subject to the inclusion of suitable noise conditions.**

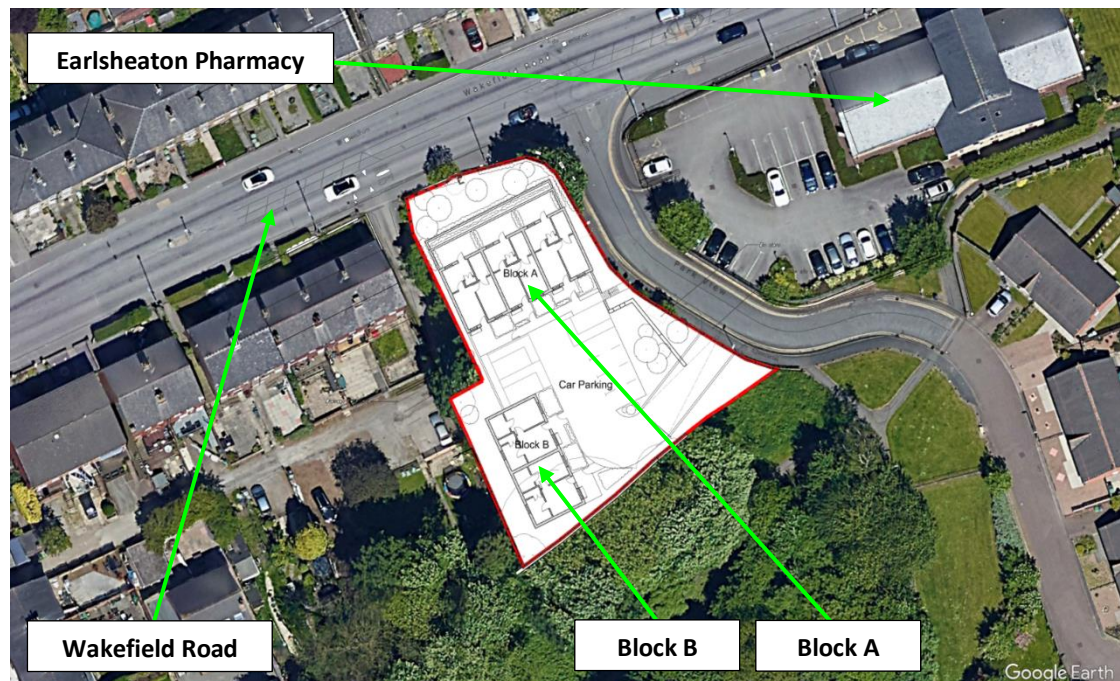
## 2.0 Introduction

- 2.1 Sharps Redmore has been engaged by Whitshaw Builders to provide an acoustic assessment for five proposed single-storey residential dwellings on land adjacent to 196 Wakefield Road in Earlsheaton.
- 2.2 The purpose of this assessment and report is to determine the existing noise climate at the site and provide minimum acoustic performance requirements for the building envelope, including windows, ventilators and the external façade.
- 2.3 Suitable internal ambient noise level criteria are identified from current standards and guidance in accordance with the aims of the National Planning Practice Framework (NPPF). It is understood this report will accompany a planning application for the proposed development.

### Site Description

- 2.4 The site is located on Wakefield Road in a primarily residential area. Wakefield Road is one of the main routes between the M1 and Dewsbury, is consequently busy and therefore the dominant noise source at the site.
- 2.5 Earlsheaton Pharmacy is situated to the east of the site with the car park entrance directly opposite, accessed from Park View. The pharmacy is only open during the daytime and the car park gates are closed outside of opening hours. Park View is a cul-de-sac with 12 dwellings.
- 2.6 The site is bounded to the west by gardens to the rear of properties on Wakefield Road and the park to the south.

**Figure 2.1 Site location**



- 2.7 The site sits on a significant gradient, falling away from Wakefield Road toward the park such that some acoustic benefit may be achieved from this screening, and the adjacent two-storey buildings.

### 3.0 Standards, Guidance, Policy & Legislation

#### National Policy

- 3.1 The National Planning Policy Framework (NPPF) revised in September 2023, sets out the Government’s economic, environmental and social planning policies for England and “these policies articulate the Government’s vision of sustainable development.” In relation to noise, paragraph 185 states:

*“Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:*

- a) mitigate and reduce to a minimum potential adverse impact resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;*
- b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.”*

- 3.2 The overarching aim should therefore be to avoid significant adverse impacts and to minimise impacts which are above the lowest observable adverse effect level, so far as reasonably possible.

- 3.3 The Government’s Planning Practice Guidance 2014 considers that it is not expected that noise is considered in isolation, separately from economic, social and other environmental dimensions of the proposed development.

- 3.4 The NPPF reinforces the March 2010 DEFRA publication, “Noise Policy Statement for England” (NPSE), which states three policy aims, as follows:

*“Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:*

- *avoid significant adverse impacts on health and quality of life;*
- *mitigate and minimise adverse impacts on health and quality of life; and*
- *where possible, contribute to the improvement of health and quality of life.”*

- 3.5 Together, the first two aims require that no significant adverse impact should occur and that, where a noise level which falls between a level which represents the lowest observable adverse effect and a level which represents a significant observed adverse effect, then according to the explanatory notes in the statement:

*“... all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life whilst also taking into consideration the guiding principles of sustainable development. This does not mean that such effects cannot occur.”*

- 3.6 It is therefore clear that the fact a noise can be heard is not reason to refuse planning permission and regard must be had to the significance of the impact and the mitigation measures available to reduce the noise.

- 3.7 Planning practice guidance on noise (last updated July 2019) defines observed effect levels as follows:
- **Significant observed adverse effect level:** This is the level of noise exposure above which significant adverse effects on health and quality of life occur.
  - **Lowest observed adverse effect level:** This is the level of noise exposure above which adverse effects on health and quality of life can be detected.
  - **No observed effect level:** This is the level of noise exposure below which no effect at all on health or quality of life can be detected.

3.8 The NPSE guidance note summarises the noise exposure hierarchy, based on the likely average response, and recommended actions. The hierarchy is presented in Table 3.1 below.

**Table 3.1 NPSE noise exposure hierarchy**

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

## Local Policy

3.9 Current local policy and guidance can be found in the Kirklees Local Plan Strategy and Policies (adopted February 2019) and the Noise Design Advice note (May 2007).

3.10 The Local Plan provides a policy justification note for Policy LP52 relating to existing noise sources and new developments as follows:

*18.20 Existing sources of noise, vibration, light, dust, odour, soil, shadow flicker, chemical or other forms of pollution can have an adverse impact on the environment and sensitive developments will need to be controlled to ensure that they do not expose new receptors to levels detrimental to healthy living or safety concerns. This policy aims to help to create and maintain quality environments that are clean, safe, and healthy and proposals which have a potential to cause pollution, when functioning and during construction, will need to be fully assessed and appropriate mitigation secured.*

3.11 The Noise Design Note refers to Planning Policy Guidance 24 (PPG24) which has been superseded, but which identifies the guideline internal noise levels within BS 8233 as “acceptable”.

## ProPG: Planning and Noise

3.12 Professional Practice Guidance on Planning and Noise (ProPG) was produced by the Chartered Institute of Environmental Health (CIEH), the Association of Noise Consultants (ANC) and the Institute of Acoustics (IOA) and published in May 2017. The guidance has been published to provide practitioners with guidance on the management of noise within the planning system in England.

3.13 The guidance is specifically for ‘new residential development’ that would be exposed predominantly to noise from existing transport sources and reflects the Government’s overarching Noise Policy Statement for England (NPSE), the National Planning Policy Framework (NPPF), and Planning Practice Guidance (including PPG-Noise), as well as other sources of guidance.

3.14 The document provides advice for Local Planning Authorities (LPAs) and developers, and their respective professional advisers which complements Government planning and noise policy and guidance and, in particular, it aims to:

- Advocate full consideration of the acoustic environment from the earliest possible stage of the development control process;
- Encourage the process of good acoustic design in and around new residential developments;
- Outline what should be taken into account in deciding planning applications for new noise-sensitive developments;
- Promote appropriate noise exposure standards; and
- Assist the delivery of sustainable development.

3.15 There are two stages of the overall approach outlined in the ProPG:

- Stage 1 – an initial noise risk assessment of the proposed development site; and
- Stage 2 – a systematic consideration of 4 key elements which is underpinned by an Acoustic Design Statement (ADS).

- 3.16 The guidance is intended for sites where the dominant noise contribution is from transportation noise. It may also be appropriate for sites where industrial or commercial noise contributes to the noise climate, provided that it is not dominant.

### WHO Guidelines for Community Noise

- 3.17 The World Health Organisation (WHO) Guidelines for Community Noise evaluates a considerable number of studies into the adverse health effects of all sources of noise, with the exception of noise at the industrial workplace. The document provides also guideline values for specific health effects in specific environments, such as in dwellings. The criteria relevant to this development are presented in Table 3.2 below and are used to inform other standards and guidance, such as BS 8233:2014.

**Table 3.2 WHO guideline values for community noise**

Specific environment	Critical health effects	$L_{Aeq,T}$ (dB)	Time base, T (hrs)	$L_{Amax,fast}$ (dB)
Outdoor living area	Serious annoyance, daytime and evening	55	16	-
	Moderate annoyance, daytime and evening	50	16	-
Dwelling, indoors	Speech intelligibility & moderate annoyance, daytime and evening	35	16	-
Inside bedrooms	Sleep disturbance, night-time	30	8	45

- 3.18 The WHO guideline values are appropriate to what are termed “critical health effects”. This means that the limits are at the lowest noise level that would result in any psychological or physiological effect. They are, as defined by the NPSE, set at the Lowest Observed Adverse Effect Level (LOAEL), but do not define the level above which effects are significant (the SOAEL). Compliance with the LOAEL could, therefore, be seen as a robust aim.
- 3.19 The National Physical Laboratory (NPL) document “Health Effect based noise assessment methods; a review and feasibility study”, (September 1998) contains an ‘interpretation’ of the WHO guidelines (then in draft form) for the DETR. The summary of this section of the NPL report states:

*“In essence, the WHO guidelines represent a consensus view of international expert opinion on the lowest threshold noise levels below which the occurrence rates of particular effects can be assumed to be negligible. Exceedances of the WHO guideline values do not necessarily imply significant noise impact and indeed, it may be that significant impacts do not occur until much higher degrees of noise exposure are reached”* (Paragraph 5.4).

### British Standard 8233:2014

- 3.20 This standard provides general guidance for the control of noise in and around buildings and is applicable to the design of a variety of buildings, both new and those undergoing refurbishments. It draws on the guidance of a number of other standards to provide typical criteria for the acoustic performance of buildings, noise mitigation methods, example acoustic performance of common materials and general construction advice.
- 3.21 Criteria described within BS 8233:2014 are consistent with those included within the WHO guidance, as presented in Table 3.2.

## AVO Residential Design Guide

- 3.22 The Institute of Acoustics (IOA) and the Association of Noise Consultants (ANC) produced the Acoustics, Ventilation and Overheating Residential Design Guide to assist acousticians with the design of new residential development which may be exposed to sound from transportation noise and aims to:
- Encourage an assessment of noise that recognises the interdependence between the acoustic, ventilation and overheating designs;
  - Provide a means of assessment to satisfy the need to consider acoustics, ventilation and overheating at the planning stage;
  - Assist in educating clients, environmental health/planning officers and other stakeholders of the interdependence of design for acoustics, ventilation and overheating.
- 3.23 The document refers to many guidance and standards documents, including research into the health effects of noise. Key guidance includes the World Health Organisation Environmental Noise Guidelines for the European region and the WHO Night Noise Guidelines.

### Approved Documents F and O

- 3.24 Approved Document F<sup>1</sup> (AD-F) describes ventilation requirements for dwellings and means of providing ventilation under different conditions, including whole dwelling ventilation, extract and purge ventilation.
- 3.25 It is normal for acoustic conditions to be considered only during provision of minimum whole dwelling ventilation as extract and purge ventilation are for short durations only and are under the control of the occupant.
- 3.26 AD-F identifies three typical methods of providing whole dwelling ventilation which are considered alongside their implications for the internal acoustic environment. A summary is provided in Table 3.3 below.

**Table 3.3 Summary of AD-F ventilation strategies**

Ventilation strategy	Description	Acoustic implications
Natural ventilation	Ventilation provided using background ventilators (e.g. through frame slot vents).	Noise ingress via background ventilators; generally unsuitable for noisy sites.
Continuous mechanical extract ventilation	Comprises background ventilators plus continuous extract from fans.	Typically fewer background ventilators required therefore lower levels of noise ingress.
Mechanical ventilation with heat recovery	Ventilation provided by a mechanical supply and extract system, with heat recovery.	Background ventilators not required so noise ingress can be controlled with the fabric of the building; generally implemented at noisier sites.

<sup>1</sup> Approved Document F Ventilation Volume 1: Dwellings, HM Government, 2021

- 3.27 Approved Document O (AD-O)<sup>2</sup> provides guidance on how to mitigate overheating and applies to new residential dwellings only.
- 3.28 AD-O states that the overheating mitigation strategy should take account of the likelihood that windows will be closed during sleeping hours (11pm – 7am) if internal noise levels exceed the following:
- 40 dB  $L_{Aeq,T}$  averaged over 8 hours (between 11pm and 7am),
  - 55 dB  $L_{AFmax}$  more than 10 times a night (between 11pm and 7am).
- 3.29 The criteria above are considered a broad guide and as such AD-O also refers to the ANC AVO Residential Design Guide which considers the acoustic implications of the overheating strategy in greater detail. For example, the  $L_{Aeq}$  criterion specifies a reference time period of eight hours; higher levels may be acceptable for shorter durations.
- 3.30 It is important to note that AD-O only refers to night-time criteria and not for the daytime period.

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<sup>2</sup> Approved Document O Overheating, HM Government, 2021

## 4.0 Criteria

4.1 Following detailed consideration of the standards and guidance outlined in Section 3.0, it is proposed that the development should be designed to achieve the internal noise levels specified in Table 4.1 with windows closed and during provision of minimum rates of whole dwelling ventilation.

4.2 It is important to note that these criteria are considered consistent with good acoustic design, but are not 'limits' nor do they represent significant observed adverse health effects.

**Table 4.1 Criteria for the internal noise level within dwellings**

Activity	Location	0700 to 2300 hrs	2300 to 0700 hrs
Resting	Living room	35 dB $L_{Aeq,16hour}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$

4.3 During the night-time it is recommended that individual maximum noise events do not exceed 45 dB  $L_{Amax,fast}$  more than 10-15 times per night.

4.4 If open windows are used to mitigate overheating, internal noise levels should not exceed the following:

- 40 dB  $L_{Aeq,T}$  averaged over 8 hours (between 11pm and 7am),
- 55 dB  $L_{AFmax}$  more than 10 times a night (between 11pm and 7am).

## 5.0 Survey

- 5.1 Sharps Redmore carried out a noise survey at the proposed site on the 10<sup>th</sup> and 13<sup>th</sup> October 2023 to determine representative noise levels.

### Survey Methodology

- 5.2 A sound level meter was set up such that it was exposed to the dominant noise sources at the site, around 1.5 m above ground level and away from other reflective surfaces. The measurement location is shown in Figure 5.1.

**Figure 5.1 Sound level meter measurement position**



- 5.3 Measurements were carried out with a 01dB Fusion Class 1 sound level meter, which is laboratory calibrated to National standards and certificates are available on request. The meter was field calibrated before and after the survey with no significant drift observed.
- 5.4 Daytime measurements were carried out over a continuous period of three hours between 10:30 and 13:30 hours. Night-time measurements were carried out between 23:00 hours and midnight.

**Table 5.1 Survey equipment**

Description	Make / model	Serial	Calibration expiry
Class 1 sound level meter	01dB Fusion	12500	March 2024
Microphone capsule	GRAS 40CD	292538	March 2024
Calibrator	Brüel & Kjær Type 4231	2123045	February 2024

- 5.5 Daytime temperatures ranged between 16°C and 20°C with no precipitation during the survey period. Temperatures during the night-time survey were around 9°C, again with no precipitation. Wind speeds were less than 5 m/s throughout both surveys at the measurement position and did not affect measurements. There was no noticeable wind rustle.

## Survey Results

- 5.6 The dominant noise source was road traffic from Wakefield Road noise during all periods. Vehicle movements in and around the Earlsheaton Pharmacy car park, and using the Park View cul-de-sac were minimal. During the night-time the car park was closed.
- 5.7 A summary of the survey results is shown in Table 5.2, with charts included in Appendix A.

**Table 5.2 Summary of survey results**

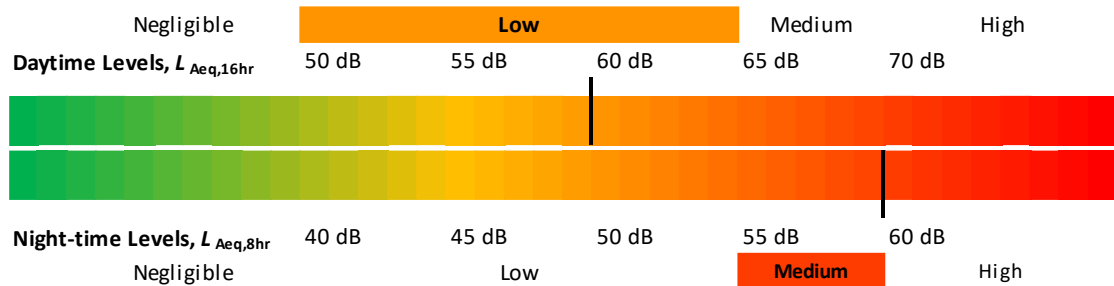
Description	Octave-band sound pressure level (dB)							Total dBA
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	
Daytime $L_{eq,T}$	68	62	58	56	56	51	44	<b>60</b>
Night-time $L_{eq,T}$	62	58	62	58	55	50	42	<b>60</b>
Night-time $L_{max,F}$ *	78	70	65	66	64	58	54	<b>68</b>

\* Typical night-time maximum.

## 6.0 ProPG: Stage 1 Initial Risk Assessment

- 6.1 Stage 1 of the ProPG assessment requires an initial risk assessment of the site to be undertaken and is intended to provide the developer, the noise practitioner and decision makers an early indication of the suitability of the site for new residential development.
- 6.2 The Stage 1 assessment of noise risk is not the basis for the eventual recommendation to the decision maker.
- 6.3 Existing noise levels at the site are assessed without inclusion of the acoustic effects of any scheme-specific mitigation measures.
- 6.4 The existing noise levels measured at the site are evaluated on the 'risk ribbon' shown below.

**Figure 6.1 ProPG Site Risk Assessment**



- 6.5 Based on the results of the noise survey and the methodology described by ProPG, the proposed development is considered '**Low Risk**' during the daytime period, and at the upper boundary of '**Medium Risk**' for the night-time period.
- 6.6 It is worth noting that the night-time survey measurement was between 1100 hours and midnight and there will be periods during the night that are quieter. As such the overall 8-hour  $L_{eq}$  is likely to be lower than the values measured. This is the reason the site has been deemed to be medium risk rather than high risk.
- 6.7 At low risk levels, the site is likely to be acceptable from a noise perspective provided that a good acoustic design process is followed and is demonstrated in an Acoustic Design Statement (ADS) which confirms how the adverse impacts of noise will be mitigated and minimised in the finished development.
- 6.8 As noise levels increase, the site is likely to be less suitable from a noise perspective and any subsequent application may be refused unless a good acoustic design process is followed and demonstrated in an ADS which confirms how the adverse impacts of noise will be mitigated and minimised, and which clearly demonstrates that a significant adverse noise impact will be avoided.
- 6.9 The ProPG Stage 2 assessment, including mitigation proposals and ADS, is discussed in the next section.

## 7.0 ProPG Stage 2: Detailed Assessment

7.1 Stage 2 of the ProPG assessment (which is not required if the Stage 1 assessment concludes a negligible risk) stipulates four key elements to be considered:

- Element 1 – demonstrate a “Good Acoustic Design Process”;
- Element 2 – observe internal “Noise Level Guidelines”;
- Element 3 – undertake an “External Amenity Area Noise Assessment”;
- Element 4 – consider “Other Relevant Issues”.

7.2 Each design element is addressed in the following sections.

### Good Acoustic Design Process

7.3 The following measures have been implemented which demonstrate good acoustic design:

- i. The slope of the site has been utilised to situate buildings below the level of Wakefield Road and this consequently reduces road traffic noise levels. This also helps to minimise sound levels in patio areas of Block A;
- ii. Block A has been placed lengthways parallel to Wakefield Road which acts as a barrier to noise for Block B and the site generally;
- iii. The most noise-sensitive rooms (i.e. bedrooms and living rooms) have been placed out of direct exposure to road traffic noise from Wakefield Road;
- iv. Buildings are single-storey, as upper floors would be more exposed to high levels of road traffic noise.

7.4 ProPG acknowledges that where noise-sensitive developments are proposed in noisy locations there is a limit to the extent to which good acoustic design can be achieved and that it may not always be possible to achieve acoustic standards with windows open or accepting that noise levels in parts of the outdoor amenity areas may not be optimal. In such cases suitable living conditions, in line with the guidance in BS 8233:2014, can still be achieved by using the building envelope to control noise levels.

7.5 In relation to this application, good acoustic design measures have been implemented where practicable. Internal noise levels will be achieved using the building envelope.

7.6 Good Acoustic Design can also be incorporated into internal acoustic elements, such as sound insulation and absorption in common areas. Minimum standards for these are a requirement of the Building Regulations.

### Internal Noise Level Guidelines

7.7 Guideline criteria for the indoor ambient noise level have been identified in Section 4.0.

7.8 Computer modelling software (SoundPLAN 8.2) has been used to calculate noise levels across the proposed site. The model represents the current location including ground levels, existing buildings and highways, as well as the proposed ground levels and buildings.

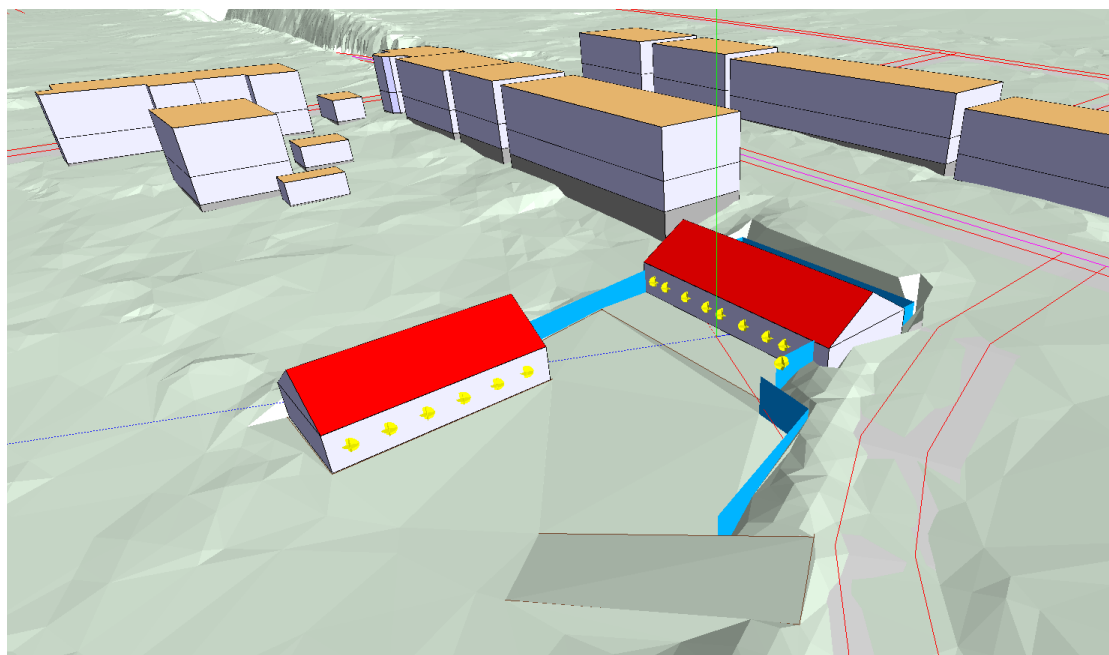
7.9 The model calculates sound propagation according to the guidance and methodology of ISO 9613-2<sup>3</sup>, and includes allowances for third order reflections, negligible ground absorption and downwind weather conditions. Road traffic noise has been calculated in octave frequency

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<sup>3</sup> ISO 9613-2:1996 Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation.

bands and the model has been calibrated to the survey results at the measurement position. Receiver positions were placed at all façade locations at the front and rear of both blocks such that representative façade levels were calculated. A 3D overview of the model is presented in Figure 7.1 below.

**Figure 7.1 SoundPLAN model**



- 7.10 Using the façade sound levels determined within the computer model, noise ingress calculations can be undertaken.

#### **Whole Dwelling Ventilation**

- 7.11 Indoor ambient noise levels are calculated during provision of whole dwelling ventilation as per a ‘natural ventilation’ strategy as described by AD-F. For the purposes of this development an equivalent area of 10,000 mm<sup>2</sup> has been adopted for each habitable room (bedrooms and living rooms) and with windows closed.
- 7.12 Assumptions regarding the ventilation and overheating strategies (e.g. ventilator equivalent areas and open window free area) should be confirmed by a suitably qualified expert.
- 7.13 The acoustic performance of example windows and ventilators used in calculations are presented in Table 7.1. Other configurations can be reviewed for suitability, as required.

**Table 7.1 Acoustic performance of façade elements**

Element	Parameter	Octave-band (Hz) centre frequency						Single-figure ISO 717-1 performance
		125	250	500	1 k	2 k	4 k	
Window, e.g. 4 (12) 6 float	$R$ (dB)	27	23	27	39	40	41	33 (-4) dB $R_w$ ( $C_{tr}$ )
Façade, cavity masonry wall	$R$ (dB)	43	42	45	55	66	77	52 (-4) dB $R_w$ ( $C_{tr}$ )
Ventilator, e.g. Greenwood 5000EA	$D_{n,e}$ (dB)	40	37	36	32	31	34	33 dB $D_{n,e,w}$

- 7.14 The sound insulation performance given for windows includes the glazing, seals and frame. Suppliers should provide evidence (e.g. laboratory test certificates) which demonstrates that the windows and ventilators can achieve the values specified.
- 7.15 Noise ingress calculations have been carried out in accordance with the methods and procedures described by BS 8233:2014 and BS 12354-3:2000<sup>4</sup>. Room dimensions have been taken from the Architect's drawings.
- 7.16 A summary of the noise ingress calculations is given in Table 7.2 below; detailed calculations are included in Appendix B.

**Table 7.2 Calculated internal noise level during provision of whole dwelling ventilation**

Period	Location	Parameter	External level	Internal level
Daytime (0700 to 2300 hrs)	Block A Living Room	$L_{Aeq,16-hr}$ (dB)	47	23
	Block A Bedroom	$L_{Aeq,16-hr}$ (dB)	47	20
	Block B Living Room	$L_{Aeq,16-hr}$ (dB)	49	24
	Block B Bedroom	$L_{Aeq,16-hr}$ (dB)	49	22
Night-time (2300 to 0700 hrs)	Block A bedroom	$L_{Aeq,8-hr}$ (dB)	47	20
		Typical $L_{Amax,F}$ (dB)	56	29
	Block B bedroom	$L_{Aeq,8-hr}$ (dB)	48	21
		Typical $L_{Amax,F}$ (dB)	58	31

- 7.17 Calculations show that proposed indoor ambient noise level criteria can be achieved with windows closed using standard double glazing and passive through-frame ventilators (natural ventilation strategy).
- 7.18 The criteria would also be achieved if the preference is to utilise another ventilation strategy described by AD-F, as summarised in the table below.

**Table 7.3 Summary of window and ventilator configurations**

Location	AD-F Ventilation Strategy*	Ventilator(s)	Window(s)
All façades	Natural ventilation	Two standard through-frame trickle vents, e.g. Greenwood 5000EA	Standard thermal double glazing, e.g. 4 (12) 6 mm
	Continuous mechanical extract ventilation (MEV)	Single standard through-frame trickle vent, e.g. Greenwood 5000EA	Standard thermal double glazing, e.g. 4 (12) 6 mm
	Mechanical ventilation with heat recovery (MVHR)	None required	Standard thermal double glazing, e.g. 4 (12) 6 mm

\* when providing continuous whole dwelling ventilation

<sup>4</sup> BS 12354-3:2000 Building acoustics. Estimation of acoustic performance in buildings from the performance of elements - Airborne sound insulation against outdoor sound

## Overheating

- 7.19 At this stage SR are not aware that an overheating assessment has been carried out to determine whether the site is at risk of overheating. As such calculations have been undertaken to provide an understanding of the acoustic implications should overheating need to be mitigated.
- 7.20 The first option considered as a method for mitigating overheating is a partially open window. AD-O suggests that for bedrooms an open window free area at least 4% of the bedroom area floor is required. For this development 4% of the bedroom floor area equates to around 0.6 m<sup>2</sup> (or 600,000 mm<sup>2</sup>) of open window free area.
- 7.21 Table 7.4 presents a summary of noise ingress calculations for bedrooms with windows open to mitigate overheating.

**Table 7.4 Calculated internal noise level with 0.6 m<sup>2</sup> free area open window**

Period	Location	Parameter	External level	Internal level
Night-time (2300 to 0700 hrs)	Block A bedroom	$L_{Aeq,8-hr}$ (dB)	47	38
		Typical $L_{Amax,F}$ (dB)	56	47
	Block B bedroom	$L_{Aeq,8-hr}$ (dB)	48	38
		Typical $L_{Amax,F}$ (dB)	58	48

- 7.22 Calculations show that the proposed internal noise level criteria during mitigation of overheating can be achieved with a partially open window.

## External Amenity Area Noise Assessment

- 7.23 BS 8233:2014 states that *“the acoustic environment of external amenity areas that are an intrinsic part of the overall design should always be assessed and noise levels should ideally not be above the range 50 – 55 dB  $L_{Aeq,16hr}$ ”*. The standards continues... *“These guideline values may not be achievable in all circumstances where a development might be desirable. In such a situation, development should be designed to achieve the lowest practicable noise levels in the external amenity spaces but should not be prohibited.”*
- 7.24 The Planning Practice Guidance on Noise, published on [planningportal.gov.uk](http://planningportal.gov.uk), gives further consideration relating to mitigating the impact of noise on residential developments and considers that noise may be partially off-set if residents of the dwellings have access to:
- A relatively quiet façade (containing windows to habitable rooms as part of their dwelling;
  - A relatively quiet external amenity space for their sole use such as a balcony which is generally considered as desirable.
  - A relatively quiet nearby external space for use by a number of residents as part of the amenity of their dwellings, and/or;
  - A relatively quiet external, publicly accessible amenity space that is nearby (e.g. within a 5-minute walk)
- 7.25 The development includes substantial external grounds which may be classed as ‘external amenity areas’ as shown on the proposed site plan, included in Appendix D.

- 7.26 The results of the survey and subsequent noise modelling indicate that external daytime noise levels could exceed the guideline range recommended by BS 8233:2014 in patio areas of Block A, with predicted noise levels of around 57 dB  $L_{Aeq}$ . This is marginally higher than the range given, but is not unacceptable considering the proximity to the surrounding strategic highway routes.
- 7.27 The development is situated directly adjacent to The Park in Earlsheaton and as such a large external amenity area is available to residents where it is likely road traffic noise would be lower.

#### **Other Relevant Issues**

- 7.28 It is considered that there are no other relevant issues.

## 8.0 ProPG: Acoustic Design Statement

- 8.1 The Stage 1 initial risk assessment found that the proposed development is '**Low Risk**' during the daytime medium and '**Medium Risk**' during the night-time based on the results of the environmental noise survey and the methodology described by ProPG. Existing acoustic conditions are dominated by road traffic noise.
- 8.2 Good acoustic design has been applied whereby dwellings are shielded from road traffic noise by the ground levels of the site, and the most sensitive rooms (bedrooms and living rooms) have been situated on the quietest façade.
- 8.3 Appropriate internal noise levels (as proposed in Section 4.0) when providing minimum whole dwelling ventilation can be achieved with standard double glazing and standard through-frame trickle ventilators during both night-time and daytime periods.
- 8.4 Furthermore, should it be necessary to consider mitigation of overheating, the proposed internal noise criteria can be achieved in bedrooms with an opening of 0.6 m<sup>2</sup>.
- 8.5 The calculated noise levels at the proposed site showed that external daytime noise levels were measured to be 57 dB  $L_{Aeq,16hr}$  in patio areas of Block A. As such noise levels in some these areas would marginally exceed the range recommended by BS 8233:2014, but is not considered excessive.
- 8.6 Residents would have access to other external amenity areas including The Park adjacent to the development.
- 8.7 Based on the outcomes of this report, the proposed development will comply with the national policy aims of the NPPF, and local policy aims of the SPG.

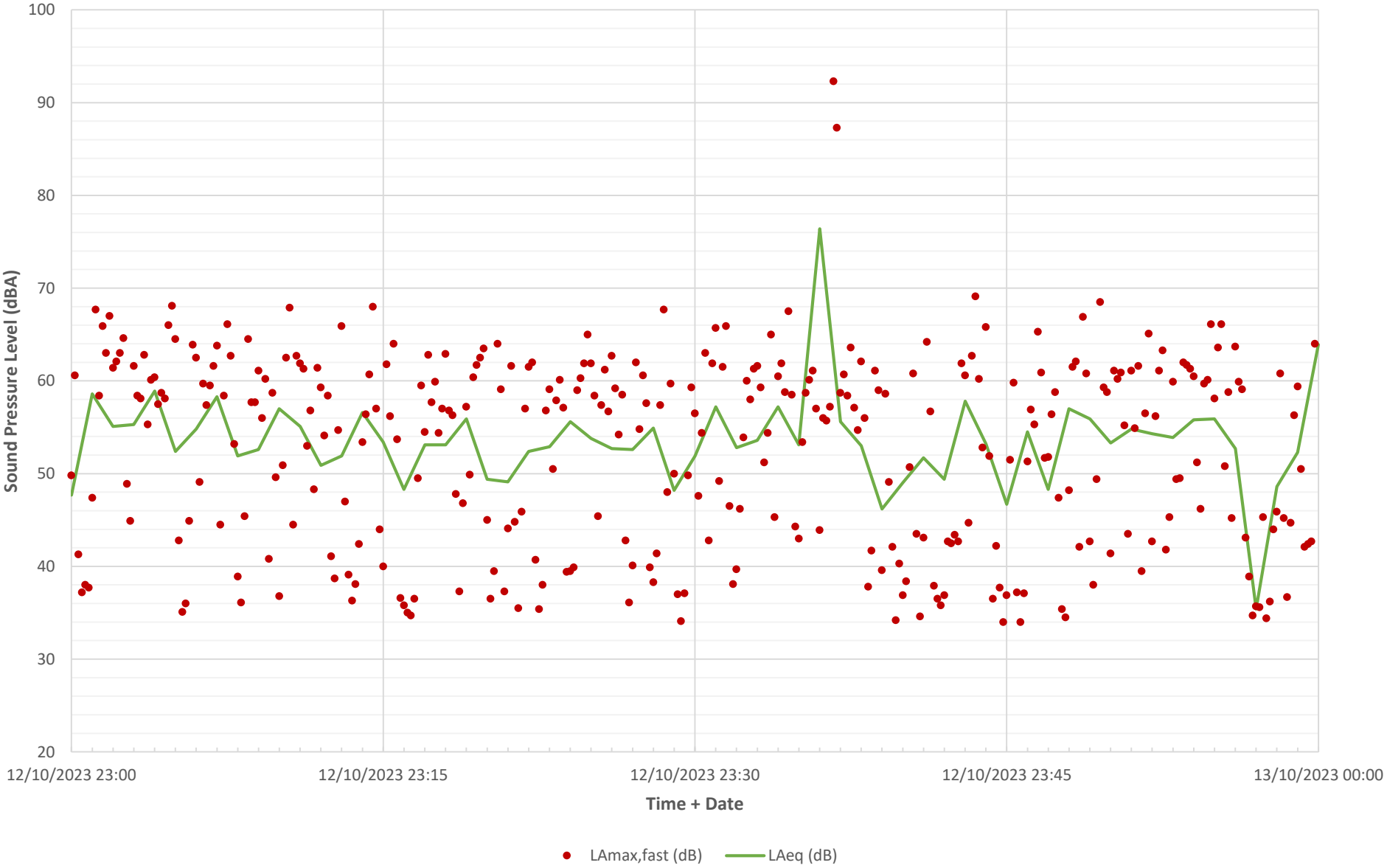
### Recommendation to the Decision Maker

- 8.8 In accordance with the guidance of the ProPG and the findings detailed within this report it is recommended that **planning consent may be granted subject to the inclusion of suitable noise conditions.**

# APPENDIX A

## Survey Time History Charts

### Night-Time (2300-0000 hrs) Survey Time History



# **APPENDIX B**

## **Noise Ingress Calculations**

**NOISE INTRUSION CALCULATION**

**ROOM:** Block A Living Room

Raw Data	63	125	250	500	1000	2000	4000	L <sub>eq</sub>
L <sub>eq,16hr</sub> measured data (dB)	63	55	49	46	42	35	27	56
L <sub>eq,8hr</sub> measured data (dB)	56	49	52	47	40	33	24	55
L <sub>max</sub> measured data (dB)	72	62	55	53	47	40	35	63

A-weight?

Shift?

Façade Correction?

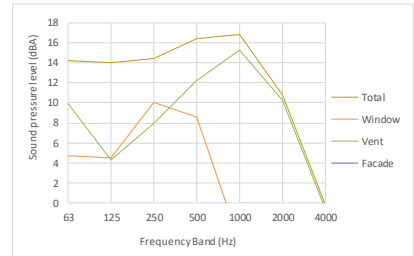
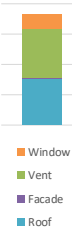
Yes 0.0 No (free-field measurement)  
 Yes 0.0 No (free-field measurement)  
 Yes 0.0 No (free-field measurement)

Frequency dependent terms	63	125	250	500	1000	2000	4000	L <sub>Aeq</sub>
Free-field 16hr day L <sub>eq,ff</sub> (dBA)	37	39	40	43	42	36	28	47
Free-field 8hr night L <sub>eq,ff</sub> (dBA)	30	33	43	43	40	34	25	47
Free-field 8hr night L <sub>max,ff</sub> (dBA)	46	46	46	50	47	42	36	54
Reveration Time, T <sub>60</sub> (s)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50

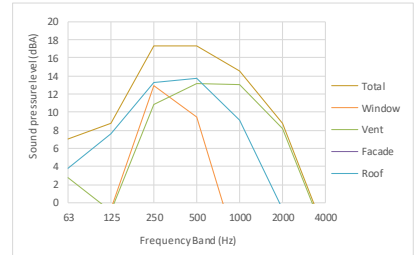
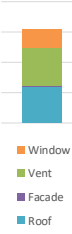
Non frequency dependent terms	
Room Volume, V (m <sup>3</sup> )	37.5
Facade Area, S <sub>f</sub> (m <sup>2</sup> )	7.3
Window Area, S <sub>w</sub> (m <sup>2</sup> )	1.2
Facade Area excl. window, S <sub>fw</sub> (m <sup>2</sup> )	4.0
Ceiling Area, S <sub>c</sub> (m <sup>2</sup> )	2.0
Number of vents	2

Element	Element description	Octave-band Centre Frequency (Hz)						
		63	125	250	500	1000	2000	4000
Window, R <sub>wi</sub> (dB)	Saint Gobain Glass 4 (12) 6	25	27	23	27	39	40	41
Vent, D <sub>n,e</sub> (dB)	Greenwood 5000EA	32	40	37	36	32	31	34
Façade, R <sub>fw</sub> (dB)	Brick-block cavity masonry wall	37	43	42	45	55	66	77
Door, R <sub>df</sub> (dB)	External door with seals	21	21	25	25	26	30	34

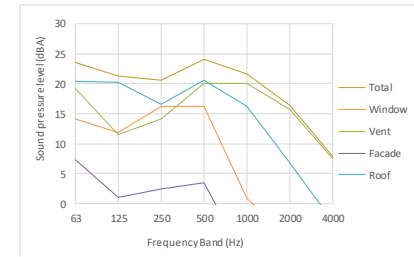
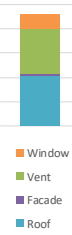
Daytime L <sub>eq</sub>	Octave-band Centre Frequency (Hz)	Octave-band Centre Frequency (Hz)						L <sub>eq</sub> (dBA)	
		63	125	250	500	1000	2000		4000
	Free-field 16hr day L <sub>eq,1</sub> (dBA)	37	39	40	43	42	36	28	47
Window R <sub>wi</sub> (dB)	Saint Gobain Glass 4 (12) 6	25	27	23	27	39	40	41	
	Window break-in, (dBA)	5	5	10	9	-4	-11	-20	14
Vent D <sub>n,e</sub> (dB)	Greenwood 5000EA	32	40	37	36	32	31	34	
	Vent break-in, (dBA)	10	4	8	12	15	10	-1	19
Façade R <sub>fw</sub> (dB)	Brick-block cavity masonry wall	37	43	42	45	55	66	77	
	Façade break-in, (dBA)	-2	-6	-4	-4	-15	-32	-51	2
Door, R <sub>df</sub> (dB)	External door with seals	21	21	25	25	26	30	34	
	Ceiling/roof break-in, (dBA)	11	13	10	13	11	1	-11	19
	TOTAL BREAK-IN, L <sub>eq,2</sub> (dBA)	14	14	14	16	17	11	0	23



Night-time L <sub>eq</sub>	Octave-band Centre Frequency (Hz)	Octave-band Centre Frequency (Hz)						L <sub>eq</sub> (dBA)	
		63	125	250	500	1000	2000		4000
	Free-field 8hr night L <sub>eq,1</sub> (dBA)	30	33	43	43	40	34	25	47
Window R <sub>wi</sub> (dB)	Saint Gobain Glass 4 (12) 6	25	27	23	27	39	40	41	
	Window break-in, (dBA)	-2	-1	13	9	-6	-13	-23	15
Vent D <sub>n,e</sub> (dB)	Greenwood 5000EA	32	40	37	36	32	31	34	
	Vent break-in, (dBA)	3	-1	11	13	13	8	-4	18
Façade R <sub>fw</sub> (dB)	Brick-block cavity masonry wall	37	43	42	45	55	66	77	
	Façade break-in, (dBA)	-9	-11	-1	-3	-17	-34	-54	2
Door, R <sub>df</sub> (dB)	External door with seals	21	21	25	25	26	30	34	
	Ceiling/roof break-in, (dBA)	4	8	13	14	9	-1	-14	18
	TOTAL BREAK-IN, L <sub>eq,2</sub> (dBA)	7	9	17	17	15	9	-3	22



Night-time L <sub>max</sub>	Octave-band Centre Frequency (Hz)	Octave-band Centre Frequency (Hz)						L <sub>max</sub> (dBA)	
		63	125	250	500	1000	2000		4000
	Free-field 8hr night L <sub>max,1</sub> (dBA)	46	46	46	50	47	42	36	54
Window R <sub>wi</sub> (dB)	Saint Gobain Glass 4 (12) 6	25	27	23	27	39	40	41	
	Window break-in, (dBA)	14	12	16	16	1	-5	-12	21
Vent D <sub>n,e</sub> (dB)	Greenwood 5000EA	32	40	37	36	32	31	34	
	Vent break-in, (dBA)	19	12	14	20	20	16	7	26
Façade R <sub>fw</sub> (dB)	Brick-block cavity masonry wall	37	43	42	45	55	66	77	
	Façade break-in, (dBA)	7	1	3	4	-10	-26	-43	10
Door, R <sub>df</sub> (dB)	External door with seals	21	21	25	25	26	30	34	
	Ceiling/roof break-in, (dBA)	20	20	17	21	16	7	-3	26
	TOTAL BREAK-IN, L <sub>max,2</sub> (dBA)	23	21	21	24	22	16	8	30



**NOISE INTRUSION CALCULATION**

**ROOM:** Block A Bedroom

Raw Data	63	125	250	500	1000	2000	4000	L <sub>req</sub>
L <sub>req,16hr</sub> measured data (dB)	63	55	49	46	40	33	25	57
L <sub>req,8hr</sub> measured data (dB)	56	50	52	47	38	31	22	55
L <sub>max</sub> measured data (dB)	73	63	57	56	49	40	34	65

**A-weight?**  
Yes  
Yes  
Yes

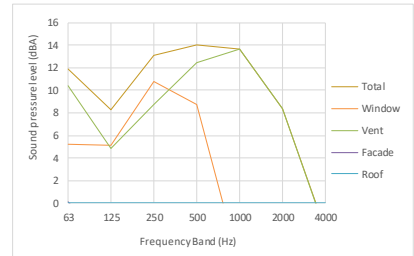
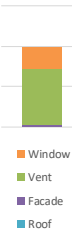
**Shift?** 0.0  
**Façade Correction?** No (free-field measurement)  
0.0 No (free-field measurement)  
0.0 No (free-field measurement)

Frequency dependent terms	63	125	250	500	1000	2000	4000	L <sub>Aeq</sub>
Free-field 16hr day L <sub>eq,ff</sub> (dBA)	37	39	41	43	40	34	26	47
Free-field 8hr night L <sub>eq,ff</sub> (dBA)	30	34	44	44	38	32	23	47
Free-field 8hr night L <sub>max,ff</sub> (dBA)	47	47	48	53	49	41	35	56
Reveration Time, T <sub>60</sub> (s)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50

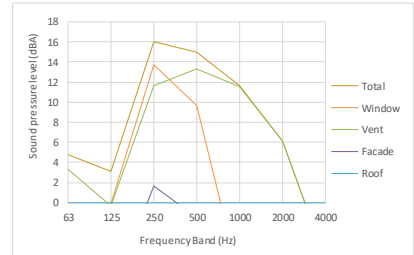
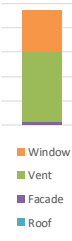
Non frequency dependent terms	
Room Volume, V (m <sup>3</sup> )	36.9
Façade Area, S <sub>f</sub> (m <sup>2</sup> )	7.1
Window Area, S <sub>w</sub> (m <sup>2</sup> )	1.2
Façade Area excl. window, S <sub>fw</sub> (m <sup>2</sup> )	5.9
Ceiling Area, S <sub>c</sub> (m <sup>2</sup> )	
Number of vents	2

Element	Element description	Octave-band Centre Frequency (Hz)						
		63	125	250	500	1000	2000	4000
Window, R <sub>wi</sub> (dB)	Saint Gobain Glass 4 (12) 6	25	27	23	27	39	40	41
Vent, D <sub>n,e</sub> (dB)	Greenwood 5000EA	32	40	37	36	32	31	34
Façade, R <sub>fw</sub> (dB)	Brick-block cavity masonry wall	37	43	42	45	55	66	77
Door, R <sub>df</sub> (dB)								

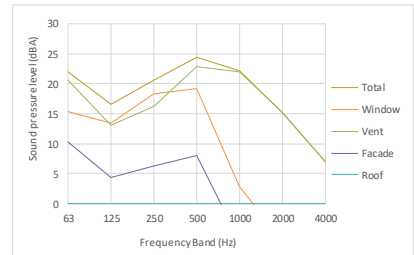
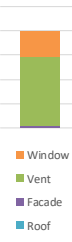
Daytime L <sub>eq</sub>	Octave-band Centre Frequency (Hz)	Octave-band Centre Frequency (Hz)						L <sub>eq</sub> (dBA)	
		63	125	250	500	1000	2000		4000
	<b>Free-field 16hr day L<sub>eq,ff</sub> (dBA)</b>	<b>37</b>	<b>39</b>	<b>41</b>	<b>43</b>	<b>40</b>	<b>34</b>	<b>26</b>	<b>47</b>
Window R <sub>wi</sub> (dB)	Saint Gobain Glass 4 (12) 6	25	27	23	27	39	40	41	
	<b>Window break-in, (dBA)</b>	<b>5</b>	<b>5</b>	<b>11</b>	<b>9</b>	<b>-6</b>	<b>-13</b>	<b>-22</b>	<b>14</b>
Vent D <sub>n,e</sub> (dB)	Greenwood 5000EA	32	40	37	36	32	31	34	
	<b>Vent break-in, (dBA)</b>	<b>10</b>	<b>5</b>	<b>9</b>	<b>12</b>	<b>14</b>	<b>8</b>	<b>-2</b>	<b>18</b>
Façade R <sub>fw</sub> (dB)	Brick-block cavity masonry wall	37	43	42	45	55	66	77	
	<b>Façade break-in, (dBA)</b>	<b>0</b>	<b>-4</b>	<b>-1</b>	<b>-2</b>	<b>-15</b>	<b>-32</b>	<b>-51</b>	<b>4</b>
Door, R <sub>df</sub> (dB)	Saint Gobain Glass 4 (12) 8.8A								
	<b>Ceiling/roof break-in, (dBA)</b>								
	<b>TOTAL BREAK-IN, L<sub>req,2</sub> (dBA)</b>	<b>12</b>	<b>8</b>	<b>13</b>	<b>14</b>	<b>14</b>	<b>8</b>	<b>-2</b>	<b>20</b>



Night-time L <sub>eq</sub>	Octave-band Centre Frequency (Hz)	Octave-band Centre Frequency (Hz)						L <sub>eq</sub> (dBA)	
		63	125	250	500	1000	2000		4000
	<b>Free-field 8hr night L<sub>eq,ff</sub> (dBA)</b>	<b>30</b>	<b>34</b>	<b>44</b>	<b>44</b>	<b>38</b>	<b>32</b>	<b>23</b>	<b>47</b>
Window R <sub>wi</sub> (dB)	Saint Gobain Glass 4 (12) 6	25	27	23	27	39	40	41	
	<b>Window break-in, (dBA)</b>	<b>-2</b>	<b>0</b>	<b>14</b>	<b>10</b>	<b>-8</b>	<b>-15</b>	<b>-25</b>	<b>15</b>
Vent D <sub>n,e</sub> (dB)	Greenwood 5000EA	32	40	37	36	32	31	34	
	<b>Vent break-in, (dBA)</b>	<b>3</b>	<b>0</b>	<b>12</b>	<b>13</b>	<b>12</b>	<b>6</b>	<b>-6</b>	<b>18</b>
Façade R <sub>fw</sub> (dB)	Brick-block cavity masonry wall	37	43	42	45	55	66	77	
	<b>Façade break-in, (dBA)</b>	<b>-7</b>	<b>-9</b>	<b>2</b>	<b>-1</b>	<b>-17</b>	<b>-34</b>	<b>-54</b>	<b>4</b>
Door, R <sub>df</sub> (dB)									
	<b>Ceiling/roof break-in, (dBA)</b>								
	<b>TOTAL BREAK-IN, L<sub>req,2</sub> (dBA)</b>	<b>5</b>	<b>3</b>	<b>16</b>	<b>15</b>	<b>12</b>	<b>6</b>	<b>-6</b>	<b>20</b>



Night-time L <sub>max</sub>	Octave-band Centre Frequency (Hz)	Octave-band Centre Frequency (Hz)						L <sub>max</sub> (dBA)	
		63	125	250	500	1000	2000		4000
	<b>Free-field 8hr night L<sub>max,ff</sub> (dBA)</b>	<b>47</b>	<b>47</b>	<b>48</b>	<b>53</b>	<b>49</b>	<b>41</b>	<b>35</b>	<b>56</b>
Window R <sub>wi</sub> (dB)	Saint Gobain Glass 4 (12) 6	25	27	23	27	39	40	41	
	<b>Window break-in, (dBA)</b>	<b>15</b>	<b>13</b>	<b>18</b>	<b>19</b>	<b>3</b>	<b>-6</b>	<b>-13</b>	<b>23</b>
Vent D <sub>n,e</sub> (dB)	Greenwood 5000EA	32	40	37	36	32	31	34	
	<b>Vent break-in, (dBA)</b>	<b>21</b>	<b>13</b>	<b>16</b>	<b>23</b>	<b>22</b>	<b>15</b>	<b>7</b>	<b>28</b>
Façade R <sub>fw</sub> (dB)	Brick-block cavity masonry wall	37	43	42	45	55	66	77	
	<b>Façade break-in, (dBA)</b>	<b>10</b>	<b>4</b>	<b>6</b>	<b>8</b>	<b>-6</b>	<b>-25</b>	<b>-42</b>	<b>14</b>
Door, R <sub>df</sub> (dB)									
	<b>Ceiling/roof break-in, (dBA)</b>								
	<b>TOTAL BREAK-IN, L<sub>max,2</sub> (dBA)</b>	<b>22</b>	<b>17</b>	<b>21</b>	<b>24</b>	<b>22</b>	<b>15</b>	<b>7</b>	<b>29</b>



**NOISE INTRUSION CALCULATION**

**ROOM:** Block A Bed (Overheating)

Raw Data	63	125	250	500	1000	2000	4000	L <sub>eq</sub>
L <sub>eq,16hr</sub> measured data (dB)	63	55	49	46	40	33	25	57
L <sub>eq,8hr</sub> measured data (dB)	56	50	52	47	38	31	22	55
L <sub>max</sub> measured data (dB)	73	63	57	56	49	40	34	65

**A-weight?**  
Yes  
Yes  
Yes

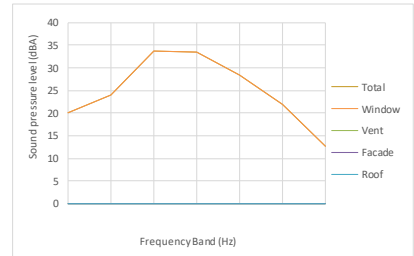
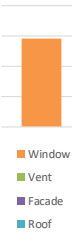
**Shift?** 0.0  
0.0  
0.0  
**Façade Correction?**  
No (free-field measurement)  
No (free-field measurement)  
No (free-field measurement)

Frequency dependent terms	63	125	250	500	1000	2000	4000	L <sub>Aeq</sub>
Free-field 16hr day L <sub>eq,ff</sub> (dBA)	37	39	41	43	40	34	26	47
Free-field 8hr night L <sub>eq,ff</sub> (dBA)	30	34	44	44	38	32	23	47
Free-field 8hr night L <sub>max,ff</sub> (dBA)	47	47	48	53	49	41	35	56
Reveration Time, T <sub>60</sub> (s)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50

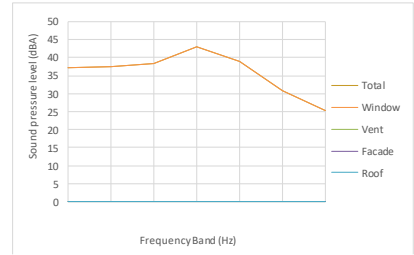
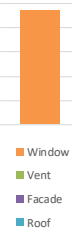
Non frequency dependent terms	
Room Volume, V (m <sup>3</sup> )	36.9
Facade Area, S <sub>f</sub> (m <sup>2</sup> )	0.6
Window Area, S <sub>w</sub> (m <sup>2</sup> )	
Facade Area excl. window, S <sub>ew</sub> (m <sup>2</sup> )	
Ceiling Area, S <sub>c</sub> (m <sup>2</sup> )	
Number of vents	

Element	Element description	Octave-band Centre Frequency (Hz)						
		63	125	250	500	1000	2000	4000
Window, R <sub>wi</sub> (dB)	No reduction	0	0	0	0	0	0	0
Vent, D <sub>n,e</sub> (dB)								
Façade, R <sub>ew</sub> (dB)								
Ceiling/roof, R <sub>r</sub> (dB)								

Night-time L <sub>eq</sub>	Octave-band Centre Frequency (Hz)	L <sub>eq</sub> (dBA)							
		63	125	250	500	1000	2000	4000	
<b>Free-field 8hr night L<sub>eq,1</sub> (dBA)</b>		<b>30</b>	<b>34</b>	<b>44</b>	<b>44</b>	<b>38</b>	<b>32</b>	<b>23</b>	<b>47</b>
Window R <sub>wi</sub> (dB)	No reduction	0	0	0	0	0	0	0	
	<b>Window break-in, (dBA)</b>	<b>20</b>	<b>24</b>	<b>34</b>	<b>34</b>	<b>28</b>	<b>22</b>	<b>13</b>	<b>38</b>
Vent D <sub>n,e</sub> (dB)	<b>Vent break-in, (dBA)</b>								
Facade R <sub>ew</sub> (dB)	<b>Facade break-in, (dBA)</b>								
Ceiling/roof R <sub>r</sub> (dB)	<b>Ceiling/roof break-in, (dBA)</b>								
<b>TOTAL BREAK-IN, L<sub>eq,2</sub> (dBA)</b>		<b>20</b>	<b>24</b>	<b>34</b>	<b>34</b>	<b>28</b>	<b>22</b>	<b>13</b>	<b>38</b>



Night-time L <sub>max</sub>	Octave-band Centre Frequency (Hz)	L <sub>max</sub> (dBA)							
		63	125	250	500	1000	2000	4000	
<b>Free-field 8hr night L<sub>max,1</sub> (dBA)</b>		<b>47</b>	<b>47</b>	<b>48</b>	<b>53</b>	<b>49</b>	<b>41</b>	<b>35</b>	<b>56</b>
Window R <sub>wi</sub> (dB)	No reduction	0	0	0	0	0	0	0	
	<b>Window break-in, (dBA)</b>	<b>37</b>	<b>37</b>	<b>38</b>	<b>43</b>	<b>39</b>	<b>31</b>	<b>25</b>	<b>47</b>
Vent D <sub>n,e</sub> (dB)	<b>Vent break-in, (dBA)</b>								
Facade R <sub>ew</sub> (dB)	<b>Facade break-in, (dBA)</b>								
Ceiling/roof R <sub>r</sub> (dB)	<b>Ceiling/roof break-in, (dBA)</b>								
<b>TOTAL BREAK-IN, L<sub>max,2</sub> (dBA)</b>		<b>37</b>	<b>37</b>	<b>38</b>	<b>43</b>	<b>39</b>	<b>31</b>	<b>25</b>	<b>47</b>



**NOISE INTRUSION CALCULATION**

**ROOM:** Block B Living Room

Raw Data	63	125	250	500	1000	2000	4000	L <sub>eq</sub>
L <sub>eq,16hr</sub> measured data (dB)	63	55	48	45	46	39	30	57
L <sub>eq,8hr</sub> measured data (dB)	56	50	50	46	44	37	27	54
L <sub>max</sub> measured data (dB)	73	64	55	55	45	46	40	65

**A-weight?**  
Yes  
Yes  
Yes

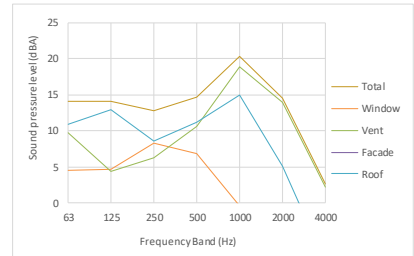
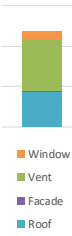
**Shift?** 0.0  
**Façade Correction?** No (free-field measurement)  
No (free-field measurement)  
No (free-field measurement)

Frequency dependent terms	63	125	250	500	1000	2000	4000	L <sub>Aeq</sub>
Free-field 16hr day L <sub>eq,ff</sub> (dBA)	37	39	39	41	46	40	31	49
Free-field 8hr night L <sub>eq,ff</sub> (dBA)	30	34	42	42	44	38	28	48
Free-field 8hr night L <sub>max,ff</sub> (dBA)	47	48	46	52	55	47	41	58
Reveration Time, T <sub>60</sub> (s)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50

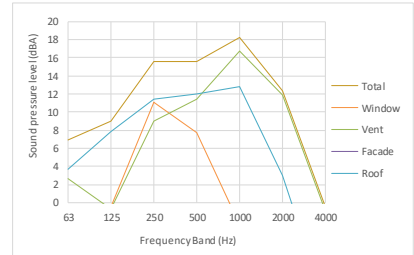
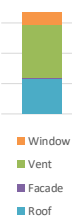
Non frequency dependent terms	
Room Volume, V (m <sup>3</sup> )	43.2
Façade Area, S <sub>f</sub> (m <sup>2</sup> )	9.8
Window Area, S <sub>w</sub> (m <sup>2</sup> )	1.2
Façade Area excl. window, S <sub>fw</sub> (m <sup>2</sup> )	6.6
Door Area, S <sub>d</sub> (m <sup>2</sup> )	2.0
Number of vents	2

Element	Element description	Octave-band Centre Frequency (Hz)						
		63	125	250	500	1000	2000	4000
Window, R <sub>wi</sub> (dB)	Saint Gobain Glass 4 (12) 6	25	27	23	27	39	40	41
Vent, D <sub>n,e</sub> (dB)	Greenwood 5000EA	32	40	37	36	32	31	34
Façade, R <sub>fw</sub> (dB)	Brick-block cavity masonry wall	37	43	42	45	55	66	77
Door, R <sub>df</sub> (dB)	External door with seals	21	21	25	25	26	30	34

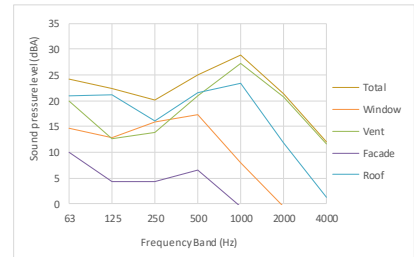
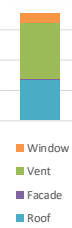
Daytime L <sub>eq</sub>	Free-field 16hr day L <sub>eq,1</sub> (dBA)	Octave-band Centre Frequency (Hz)						L <sub>eq</sub> (dBA)
		63	125	250	500	1000	2000	
Window R <sub>wi</sub> (dB)	Saint Gobain Glass 4 (12) 6	25	27	23	27	39	40	41
	Window break-in, (dBA)	5	5	8	7	0	-7	-18
Vent D <sub>n,e</sub> (dB)	Greenwood 5000EA	32	40	37	36	32	31	34
	Vent break-in, (dBA)	10	4	6	11	19	14	2
Façade R <sub>fw</sub> (dB)	Brick-block cavity masonry wall	37	43	42	45	55	66	77
	Façade break-in, (dBA)	0	-4	-3	-4	-9	-26	-46
Door, R <sub>df</sub> (dB)	External door with seals	21	21	25	25	26	30	34
	Ceiling/roof break-in, (dBA)	11	13	9	11	15	5	-8
<b>TOTAL BREAK-IN, L<sub>eq,2</sub> (dBA)</b>		<b>14</b>	<b>14</b>	<b>13</b>	<b>15</b>	<b>20</b>	<b>14</b>	<b>3</b>



Night-time L <sub>eq</sub>	Free-field 8hr night L <sub>eq,1</sub> (dBA)	Octave-band Centre Frequency (Hz)						L <sub>eq</sub> (dBA)
		63	125	250	500	1000	2000	
Window R <sub>wi</sub> (dB)	Saint Gobain Glass 4 (12) 6	25	27	23	27	39	40	41
	Window break-in, (dBA)	-3	0	11	8	-2	-9	-21
Vent D <sub>n,e</sub> (dB)	Greenwood 5000EA	32	40	37	36	32	31	34
	Vent break-in, (dBA)	3	-1	9	11	17	12	-1
Façade R <sub>fw</sub> (dB)	Brick-block cavity masonry wall	37	43	42	45	55	66	77
	Façade break-in, (dBA)	-7	-9	0	-3	-11	-28	-49
Door, R <sub>df</sub> (dB)	External door with seals	21	21	25	25	26	30	34
	Ceiling/roof break-in, (dBA)	4	8	11	12	13	3	-11
<b>TOTAL BREAK-IN, L<sub>eq,2</sub> (dBA)</b>		<b>7</b>	<b>9</b>	<b>16</b>	<b>16</b>	<b>18</b>	<b>12</b>	<b>-1</b>



Night-time L <sub>max</sub>	Free-field 8hr night L <sub>max,1</sub> (dBA)	Octave-band Centre Frequency (Hz)						L <sub>max</sub> (dBA)
		63	125	250	500	1000	2000	
Window R <sub>wi</sub> (dB)	Saint Gobain Glass 4 (12) 6	25	27	23	27	39	40	41
	Window break-in, (dBA)	15	13	16	17	8	0	-8
Vent D <sub>n,e</sub> (dB)	Greenwood 5000EA	32	40	37	36	32	31	34
	Vent break-in, (dBA)	20	13	14	21	27	21	12
Façade R <sub>fw</sub> (dB)	Brick-block cavity masonry wall	37	43	42	45	55	66	77
	Façade break-in, (dBA)	10	4	4	7	-1	-19	-37
Door, R <sub>df</sub> (dB)	External door with seals	21	21	25	25	26	30	34
	Ceiling/roof break-in, (dBA)	21	21	16	22	23	12	1
<b>TOTAL BREAK-IN, L<sub>max,2</sub> (dBA)</b>		<b>24</b>	<b>22</b>	<b>20</b>	<b>25</b>	<b>29</b>	<b>21</b>	<b>12</b>



**NOISE INTRUSION CALCULATION**

**ROOM:** Block B Bed

Raw Data	63	125	250	500	1000	2000	4000	L <sub>eq</sub>
L <sub>eq,16hr</sub> measured data (dB)	63	55	48	45	46	39	30	57
L <sub>eq,8hr</sub> measured data (dB)	56	50	51	46	44	37	26	55
L <sub>max</sub> measured data (dB)	73	64	55	55	55	46	39	65

A-weight?

Yes  
Yes  
Yes

Shift?

0.0  
0.0  
0.0

Façade Correction?

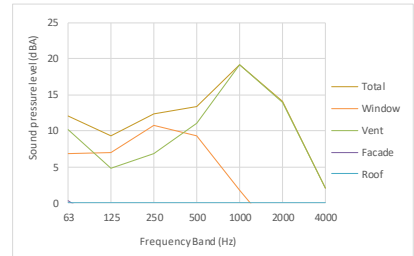
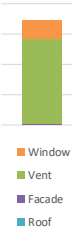
No (free-field measurement)  
No (free-field measurement)  
No (free-field measurement)

Frequency dependent terms	63	125	250	500	1000	2000	4000	L <sub>Aeq</sub>
Free-field 16hr day L <sub>eq,ff</sub> (dBA)	37	39	39	42	46	40	31	49
Free-field 8hr night L <sub>eq,ff</sub> (dBA)	30	34	42	43	44	38	27	48
Free-field 8hr night L <sub>max,ff</sub> (dBA)	47	48	47	52	55	47	40	58
Reveration Time, T <sub>60</sub> (s)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50

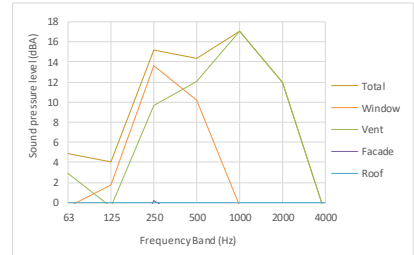
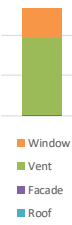
Non frequency dependent terms	
Room Volume, V (m <sup>3</sup> )	39.7
Façade Area, S <sub>f</sub> (m <sup>2</sup> )	8.5
Window Area, S <sub>w</sub> (m <sup>2</sup> )	1.9
Façade Area excl. window, S <sub>fw</sub> (m <sup>2</sup> )	6.7
Ceiling Area, S <sub>c</sub> (m <sup>2</sup> )	
Number of vents	2

Element	Element description	Octave-band Centre Frequency (Hz)						
		63	125	250	500	1000	2000	4000
Window, R <sub>wi</sub> (dB)	Saint Gobain Glass 4 (12) 6	25	27	23	27	39	40	41
Vent, D <sub>n,e</sub> (dB)	Greenwood 5000EA	32	40	37	36	32	31	34
Façade, R <sub>fw</sub> (dB)	Brick-block cavity masonry wall	37	43	42	45	55	66	77
Door, R <sub>df</sub> (dB)								

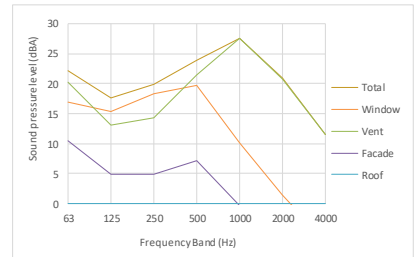
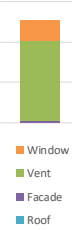
Daytime L <sub>eq</sub>	Octave-band Centre Frequency (Hz)	Octave-band Centre Frequency (Hz)						L <sub>eq</sub> (dBA)	
		63	125	250	500	1000	2000		4000
Free-field 16hr day L <sub>eq,1</sub> (dBA)		37	39	39	42	46	40	31	49
Window R <sub>wi</sub> (dB)	Saint Gobain Glass 4 (12) 6	25	27	23	27	39	40	41	
Window break-in, (dBA)		7	7	11	9	2	-5	-16	15
Vent D <sub>n,e</sub> (dB)	Greenwood 5000EA	32	40	37	36	32	31	34	
Vent break-in, (dBA)		10	5	7	11	19	14	2	21
Façade R <sub>fw</sub> (dB)	Brick-block cavity masonry wall	37	43	42	45	55	66	77	
Façade break-in, (dBA)		0	-3	-3	-3	-9	-26	-46	4
Door, R <sub>df</sub> (dB)	Saint Gobain Glass 4 (12) 8.8A								
Ceiling/roof break-in, (dBA)									
TOTAL BREAK-IN, L <sub>eq,2</sub> (dBA)		12	9	12	13	19	14	2	22



Night-time L <sub>eq</sub>	Octave-band Centre Frequency (Hz)	Octave-band Centre Frequency (Hz)						L <sub>eq</sub> (dBA)	
		63	125	250	500	1000	2000		4000
Free-field 8hr night L <sub>eq,1</sub> (dBA)		30	34	42	43	44	38	27	48
Window R <sub>wi</sub> (dB)	Saint Gobain Glass 4 (12) 6	25	27	23	27	39	40	41	
Window break-in, (dBA)		0	2	14	10	0	-7	-19	16
Vent D <sub>n,e</sub> (dB)	Greenwood 5000EA	32	40	37	36	32	31	34	
Vent break-in, (dBA)		3	0	10	12	17	12	-1	20
Façade R <sub>fw</sub> (dB)	Brick-block cavity masonry wall	37	43	42	45	55	66	77	
Façade break-in, (dBA)		-7	-9	0	-2	-11	-28	-49	3
Door, R <sub>df</sub> (dB)									
Ceiling/roof break-in, (dBA)									
TOTAL BREAK-IN, L <sub>eq,2</sub> (dBA)		5	4	15	14	17	12	-1	21



Night-time L <sub>max</sub>	Octave-band Centre Frequency (Hz)	Octave-band Centre Frequency (Hz)						L <sub>max</sub> (dBA)	
		63	125	250	500	1000	2000		4000
Free-field 8hr night L <sub>max,1</sub> (dBA)		47	48	47	52	55	47	40	58
Window R <sub>wi</sub> (dB)	Saint Gobain Glass 4 (12) 6	25	27	23	27	39	40	41	
Window break-in, (dBA)		17	15	18	20	10	1	-6	24
Vent D <sub>n,e</sub> (dB)	Greenwood 5000EA	32	40	37	36	32	31	34	
Vent break-in, (dBA)		20	13	14	22	28	21	12	30
Façade R <sub>fw</sub> (dB)	Brick-block cavity masonry wall	37	43	42	45	55	66	77	
Façade break-in, (dBA)		10	5	5	7	0	-19	-37	14
Door, R <sub>df</sub> (dB)									
Ceiling/roof break-in, (dBA)									
TOTAL BREAK-IN, L <sub>max,2</sub> (dBA)		22	18	20	24	28	21	12	31



**NOISE INTRUSION CALCULATION**

**ROOM:** Block B Bedroom (Overheating)

Raw Data	63	125	250	500	1000	2000	4000	L <sub>eq</sub>
L <sub>eq,16hr</sub> measured data (dB)	63	55	48	45	46	39	30	57
L <sub>eq,8hr</sub> measured data (dB)	56	50	51	46	44	37	26	55
L <sub>max</sub> measured data (dB)	73	64	55	55	55	46	39	65

**A-weight?**  
 Yes  
 Yes  
 Yes

**Shift?** 0.0  
 0.0  
 0.0  
**Façade Correction?**  
 No (free-field measurement)  
 No (free-field measurement)  
 No (free-field measurement)

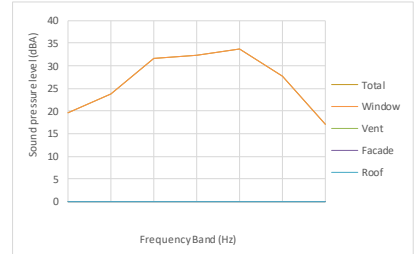
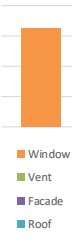
Frequency dependent terms	63	125	250	500	1000	2000	4000	L <sub>Aeq</sub>
Free-field 16hr day L <sub>eq,ff</sub> (dBA)	37	39	39	42	46	40	31	49
Free-field 8hr night L <sub>eq,ff</sub> (dBA)	30	34	42	43	44	38	27	48
Free-field 8hr night L <sub>max,ff</sub> (dBA)	47	48	47	52	55	47	40	58
Reveration Time, T <sub>60</sub> (s)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50

Non frequency dependent terms	
Room Volume, V (m <sup>3</sup> )	39.7
Facade Area, S <sub>f</sub> (m <sup>2</sup> )	
Window Area, S <sub>w</sub> (m <sup>2</sup> )	0.6
Facade Area excl. window, S <sub>fw</sub> (m <sup>2</sup> )	
Ceiling Area, S <sub>c</sub> (m <sup>2</sup> )	
Number of vents	3

0.58

Element	Element description	Octave-band Centre Frequency (Hz)						
		63	125	250	500	1000	2000	4000
Window, R <sub>wi</sub> (dB)	No reduction	0	0	0	0	0	0	0
Vent, D <sub>n,e</sub> (dB)								
Façade, R <sub>fw</sub> (dB)								
Ceiling/roof, R <sub>r</sub> (dB)								

Night-time L <sub>eq</sub>	Octave-band Centre Frequency (Hz)	L <sub>eq</sub> (dBA)						
		63	125	250	500	1000	2000	4000
<b>Free-field 8hr night L<sub>eq,1</sub> (dBA)</b>		<b>30</b>	<b>34</b>	<b>42</b>	<b>43</b>	<b>44</b>	<b>38</b>	<b>27</b>
Window R <sub>wi</sub> (dB)	No reduction	0	0	0	0	0	0	0
	<b>Window break-in, (dBA)</b>	<b>20</b>	<b>24</b>	<b>32</b>	<b>32</b>	<b>34</b>	<b>28</b>	<b>17</b>
Vent D <sub>n,e</sub> (dB)	<b>Vent break-in, (dBA)</b>							
Facade R <sub>fw</sub> (dB)	<b>Facade break-in, (dBA)</b>							
Ceiling/roof R <sub>r</sub> (dB)	<b>Ceiling/roof break-in, (dBA)</b>							
<b>TOTAL BREAK-IN, L<sub>eq,2</sub> (dBA)</b>		<b>20</b>	<b>24</b>	<b>32</b>	<b>32</b>	<b>34</b>	<b>28</b>	<b>17</b>



Night-time L <sub>max</sub>	Octave-band Centre Frequency (Hz)	L <sub>max</sub> (dBA)						
		63	125	250	500	1000	2000	4000
<b>Free-field 8hr night L<sub>max,1</sub> (dBA)</b>		<b>47</b>	<b>48</b>	<b>47</b>	<b>52</b>	<b>55</b>	<b>47</b>	<b>40</b>
Window R <sub>wi</sub> (dB)	No reduction	0	0	0	0	0	0	0
	<b>Window break-in, (dBA)</b>	<b>37</b>	<b>37</b>	<b>36</b>	<b>42</b>	<b>44</b>	<b>37</b>	<b>30</b>
Vent D <sub>n,e</sub> (dB)	<b>Vent break-in, (dBA)</b>							
Facade R <sub>fw</sub> (dB)	<b>Facade break-in, (dBA)</b>							
Ceiling/roof R <sub>r</sub> (dB)	<b>Ceiling/roof break-in, (dBA)</b>							
<b>TOTAL BREAK-IN, L<sub>max,2</sub> (dBA)</b>		<b>37</b>	<b>37</b>	<b>36</b>	<b>42</b>	<b>44</b>	<b>37</b>	<b>30</b>

