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ACOUSTICS PLUS

Proposed New Residential Accommodation

Horbury, Wrights Green Lane, Little Hallingbury, Essex, CM22 7RL.

Noise Impact Assessment

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Noise Impact Assessment Proposed New Residential Accommodation	
Project Address:	Horbury Wrights Green Lane Little Hallingbury Essex, CM22 7RL
Project Reference:	104572

Issue/Revision Record			
Issue:	**Date:**	**Remarks:**	**Author:**
1	31/01/2024	First Issue	Andy Dodd

	Signature:	Print:	Title:	Date:
Author:		**Andy Dodd**	**Senior Consultant**	**31/01/2024**
Reviewer:		**Phil Huffer**	**Principal Consultant**	**31/01/2024**

1. INTRODUCTION

1.1 Acoustics Plus Ltd (APL) is an independent firm of multi-disciplinary acoustic engineers. APL is engaged by both private and public sector clients. APL is a registered member of The Association of Noise Consultants (ANC) and the author is a corporate member of The Institute of Acoustics (IOA).

1.2 APL has been instructed by Hertford Planning Service, to advise upon the noise implications regarding the proposed demolition and erection of a replacement four bedroom dwelling.

1.3 The object of this report is to determine environmental noise levels at the proposed site in accordance with Government planning policy. Outline comments regarding noise control measures are provided to demonstrate that the ingress of noise may be properly controlled.

1.4 The report will give due regard to the following documents:

(a) *National Planning Policy Framework; December 2023 – Department for Levelling Up, Housing & Communities;*

(b) *Noise Policy Statement for England (NPSE) March 2010 – Department for Environment, Food and Rural Affairs;*

(c) *ProPG: Planning and Noise May 2017 Professional Practice Guidance on Planning and Noise;*

(d) *BS8233:2014 "Sound insulation and noise reduction for buildings – Code of Practice".*

(e) *Uttlesford District Council planning permission 20620-P002-C*

1.5 This report has been prepared by Acoustics Plus Limited (APL) with all reasonable skill, care, and diligence in accordance with generally accepted acoustic consultancy principles and taking account the services and terms agreed between APL and our client.

1.6 Any information provided by third-parties and referred to herein may not have been checked or verified by APL unless expressly stated otherwise. Certain statements made in the report are predictions based on reasonable assumptions and good industry practice.

1.7 Such statements involve risk and uncertainty which could cause measured and predicted results to differ materially. APL does therefore not guarantee or warrant any prediction contained in this report.

2. BASELINE SITUATION

2.1 The Application Site (the "site") is located at Horbury, Wrights Green Road, Little Hallingbury, Essex, CM22 7RL. A site location plan is shown in Diagram 1 below.

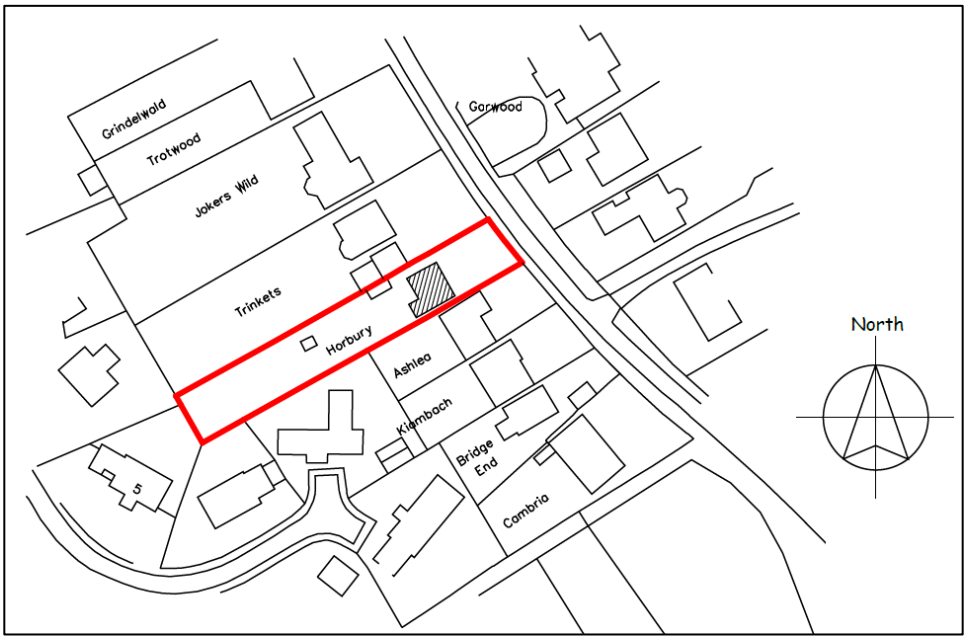


Diagram 1

2.2 The application proposes the demolition and erection of a replacement four bedroom dwelling.

3. NOISE CRITERIA

NEW RESIDENTIAL ACCOMMODATION

3.1 The National Planning Policy Framework (NPPF) was updated in December 2023 and has replaced planning policy guidance which previously covered planning and pollution control and new development in England. The purpose of the planning system is to contribute to the achievement of sustainable development. There are three dimensions to sustainable development: economic, social and environmental. The environmental role is to contribute to protecting and enhancing our natural, built and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.

3.2 One of the core planning principles is to contribute to conserving and enhancing the natural environment and reducing pollution. Planning policies and decisions should contribute to and enhance the natural and local environment by:

(a) protecting and enhancing valued landscapes, sites of biodiversity or geological value and soils (in a manner commensurate with their statutory status or identified quality in the development plan);

(b) recognising the intrinsic character and beauty of the countryside, and the wider benefits from natural capital and ecosystem services – including the economic and other benefits of the best and most versatile agricultural land, and of trees and woodland.

(c) maintaining the character of the undeveloped coast, while improving public access to it where appropriate.

(d) minimising impacts on and providing net gains for biodiversity, including by establishing coherent ecological networks that are more resilient to current and future pressures.

(e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans; and

(f) remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate.

3.3 Paragraph 191 of the NPPF 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 impacts 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; and

(c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation.

3.4 Paragraph 180 of the NPPF states that:

"Planning policies and decisions should contribute to and enhance the natural and local environment by…. e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability."

3.5 The Governments long-term policy aims relating to noise are contained in the Noise Policy Statement for England (referred to as NPSE). Stated aims of the NPSE are:

"Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy of 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*

3.6 The Professional Practice Guidance on Planning and Noise (ProPG) has been produced to provide practitioners with guidance on a recommended approach to the management of noise within the planning system in England. The recommended ProPG internal noise level guidelines are described in the table below. These guidelines reflect and extend current practice contained in BS8233:2014 (Sound Insulation and Noise Reduction for Buildings – Code of Practice). For clarity, blue italic font is used to highlight additions to the guidance contained in Table 4 of BS8233:2014. The dB values provided in the table for different activities are target levels. The table plus supporting notes are referred to as ProPG internal noise level guidelines.

Activity	Location	07:00-23:00hrs	23:00-07:00hrs
Resting	Living room	35dB $L_{Aeq,16hr}$	-
Dining	Dining room/area	40dB $L_{Aeq,16hr}$	-
Sleeping (daytime resting)	Bedroom	35dB $L_{Aeq,16hr}$	30dB $L_{Aeq,8hr}$

Table 1

NOTE 1 The Table provides recommended internal LAeq target levels for overall noise in the design of a building. These are the sum total of structure-borne and airborne noise sources. Ground-borne noise is assessed separately and is not included as part of these targets, as human response to ground-borne noise varies with many factors such as level, character, timing, occupant expectation and sensitivity.

NOTE 2 The internal LAeq target levels shown in the Table are based on the existing guidelines issued by the WHO and assume normal diurnal fluctuations in external noise. In cases where local conditions do not follow a typical diurnal pattern, for example on a road serving a port with high levels of traffic at certain times of the night, an appropriate alternative period, e.g. 1 hour, may be used, but the level should be selected to ensure consistency with the internal LAeq target levels recommended in the Table.

NOTE 3 These internal LAeq target levels are based on annual average data and do not have to be achieved in all circumstances. For example, it is normal to exclude occasional events, such as fireworks night or New Year's Eve.

NOTE 4 Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or LAmax,F, depending on the character and number of events per night. Sporadic noise events could require separate values. In most circumstances in noise sensitive rooms at night (e.g. bedrooms) good acoustic design can be used so that individual noise events do not normally exceed 45dB LAmax,F more than 10 times a night. However, where it is not reasonably practicable to achieve this guideline then the judgement of acceptability will depend not only on the maximum noise levels but also on factors such as the source, number, distribution, predictability and regularity of noise events (see Appendix A).

NOTE 5 Designing the site layout and the dwellings so that the internal target levels can be achieved with open windows in as many properties as possible demonstrates good acoustic design. Where it is not possible to meet internal target levels with windows open, internal noise levels can be assessed with windows closed, however any façade openings used to provide whole dwelling ventilation (e.g. trickle ventilators) should be assessed in the "open" position and, in this scenario, the internal LAeq target levels should not normally be exceeded, subject to the further advice in Note 7.

NOTE 6 Attention is drawn to the requirements of the Building Regulations.

NOTE 7 Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal LAeq target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved. The more often internal LAeq levels start to exceed the internal LAeq target levels by more than 5 dB, the more that most people are likely to regard them as "unreasonable". Where such exceedances are predicted, applicants should be required to show how the relevant number of rooms affected has been kept to a minimum. Once internal LAeq levels exceed the target levels by more than 10 dB, they are highly likely to be regarded as "unacceptable" by most people, particularly if such levels occur more than occasionally. Every effort should be made to avoid relevant rooms experiencing "unacceptable" noise levels at all and where such levels are likely to occur frequently, the development should be prevented in its proposed form (see Section 3.D).

UTTLESFORD DISTRICT COUNCIL CONDITION NO.3 (20620-P002-C)

"No development or demolition shall commence on site until a detailed scheme, informed by an assessment of the current noise environment, for protecting the dwellings from the external noise environment of the area has been submitted to and approved, in writing, by the Local Planning Authority.

The development shall be constructed to provide sound attenuation against external noise in accordance with BS8233:2014. The following levels shall be achieved: Maximum internal night noise levels of 30dBLAeq,T for living rooms and bedrooms with windows open (or closed with provided acoustic mechanical ventilation including heat recovery). For bedrooms at night individual noise events (measured with F time-weighting) shall not (normally) exceed 45dBLAmax. Maximum living room day (07.00-23.00 hrs) noise levels of 35 dB LAeq shall be achieved.

Thereafter, the development shall not be carried out other than in accordance with the approved scheme which shall be completed before any part of the accommodation hereby approved is occupied, unless the Local Planning Authority otherwise agrees in writing".

REASON: To ensure future occupiers enjoy a good acoustic environment, in accordance with Policy ENV10 of the Uttlesford Local Plan (adopted 2005).

4. NOISE OUTLINE

4.1 In order to determine the environmental noise level, consideration must be given to the noise levels on the site from the presence of road traffic use from the M11 south east of the site and air traffic movements in and out of Stanstead Airport.

4.2 Unmanned measurements were obtained over a 24hour period at ground floor level at the rear. This location was chosen to represent worst case noise levels that would be experienced at the façades of the proposed new residential accommodation.

4.3 The measurement location is indicated on the block plan below:

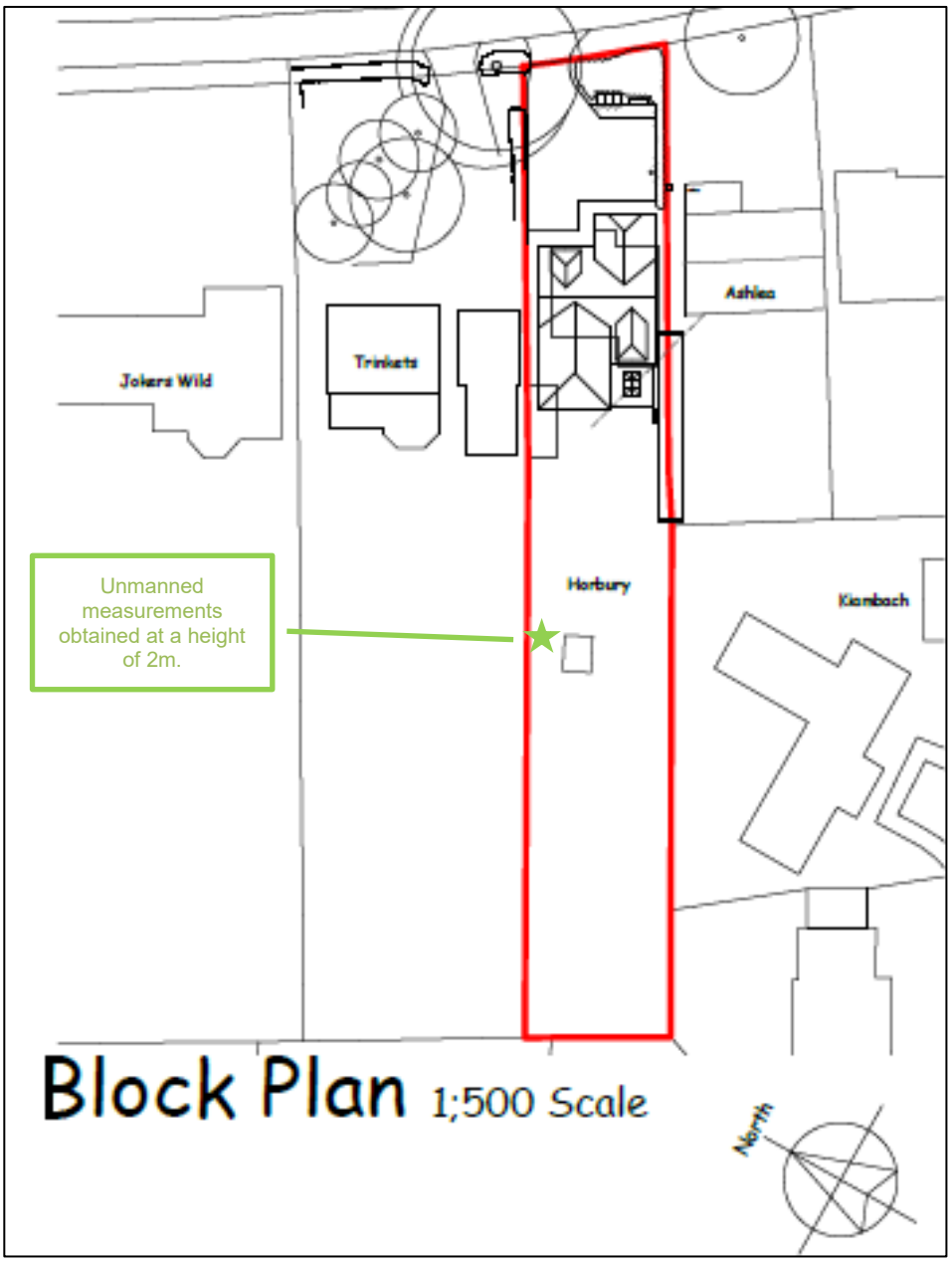


Diagram 2

4.4 The particulars of the measurement exercise are recorded below:

Date:	29th & 30th January 2024
Start Time:	11:17 hrs
Location:	Rear of Horbury, Wrights Green Lane.

4.5 The measurements carried out during the exercise are recorded below.

$L_{Aeq, 2mins}$ (dB re 20μPa) - average equivalent sound pressure level
$L_{Amax, 2mins}$ (dB re 20μPa) – maximum sound pressure level

4.6 A level vs time summary of the noise data obtained is presented in Diagram 3 below.

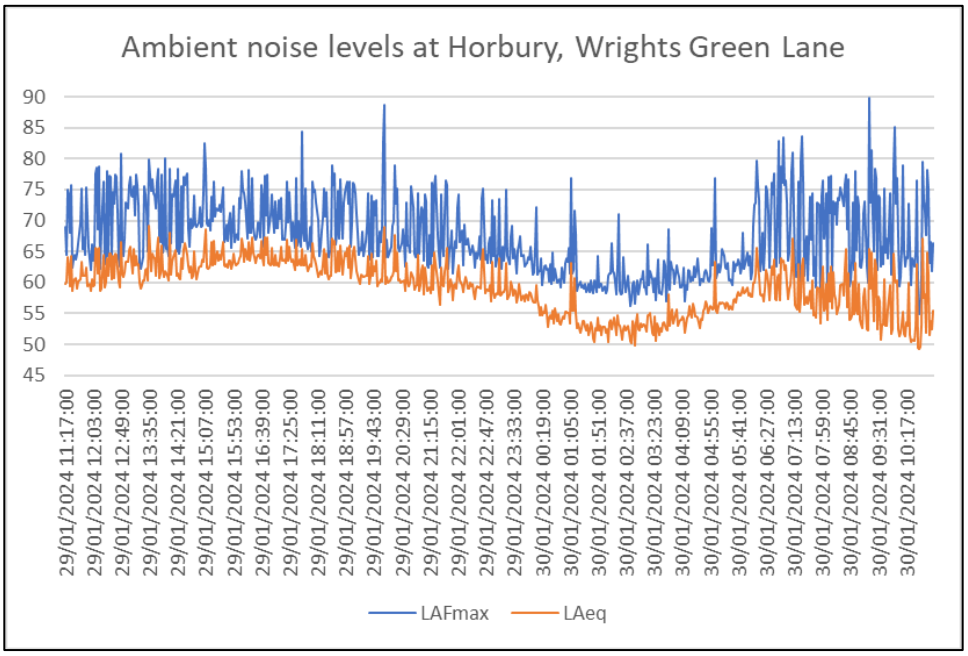


Diagram 3 – level vs time history

5. BUILDING ENVELOPE ASSESSMENT

5.1 Given the monitoring position and the measurements obtained, it is possible to calculate the $L_{Aeq,\,T}$ values experienced during the day and night-time periods.

5.2 It is understood that the noise assessment should be in accordance with the requirements of Planning Condition no.3 and BS8233:2014 and not exceed the values detailed within paragraph 3.6/Table 4 of BS8233:2014 and reinforced in ProPG. These values are reproduced in Table 1.

5.3 For the purposes of this report and in line with the recommendation of BS8233, the following time periods are referenced.

(a) 07:00 hrs to 23:00 hrs for living rooms
(b) 23:00 hrs to 07:00 hrs for bedrooms

5.4 In accordance with these time periods, the appropriate $L_{Aeq,T}$ level has been calculated.

5.5 The calculated noise levels are based on the day and night time period $L_{Aeq,2min}$ and $L_{Amax,2mins}$ measurements obtained during the assessment.

Location	**07:00 to 23:00** $L_{Aeq,16hour}$, dB	**23:00 to 07:00** $L_{Aeq,8hour}$, dB	**10th highest** L_{Amax} dB
Horbury, Wrights Green Lane	62	57	76[1]

Table 2

[1] *From the 24-hr data, the 10th highest $L_{Amax,F}$ measurement during the 8-hr night period at the façade has been considered, this is taken from WHO Guidelines for Community Noise – which states "For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45dB L_{Amax} more than 10-15 times per night" (Vallet and Vernet 1991).*

6. BUILDING ENVELOPE RECOMMENDATIONS

6.1 With regard to site noise levels, the average daytime and night-time noise levels recorded are detailed in Table 2.

6.2 In order to meet the LPA requirements, acoustic fenestration and ventilation measures need to be assessed in order to protect the daytime and night-time amenity of future occupiers. Given the measured onsite noise levels obtained during the daytime and night time periods, windows will have to be closed in order to meet the internal noise level requirements. As such, mechanical ventilation will have to be provided to the proposed new residential accommodation. As such, trickle ventilation elements will not need to be considered within the calculation exercises.

6.3 To reduce daytime and night-time noise exposure in the proposed dwelling, attention should be given to the sound insulation of the façade of the building. In this instance the windows will be the weakest element of the façade.

6.4 Based on the information supplied, it is anticipated the wall and roof constructions to be used onsite will have insulation values as detailed in Table 3 below. These performance values were obtained from proprietary prediction software 'Insul' written by Marshall Day, the values predicted have been corrected to account for workmanship and onsite installation. A copy of the prediction outputs for the noted constructions are contained within Appendix A of this report. This will provide the necessary sound insulation values to reduce the internal noise levels to an acceptable level.

Construction	Insulation value	Prediction correction
New timber clad cavity block wall construction	R_w 62dB	-4dB
Pitched roof	R_w 56dB	-6dB
Flat warm type roof	R_w 61dB	-6dB

Table 3

6.5 From the calculated levels it is possible to predict the internal noise levels within habitable rooms. In order to undertake this, the following formula has been utilised:

$$SPL_{in} = SPL_{out} + 10Log_{10}\left(\frac{A_0}{S}10^{\frac{-D_{n,e}}{10}} + \frac{S_{wi}}{S}10^{\frac{-R_{wi}}{10}} + \frac{S_{ew}}{S}10^{\frac{-R_{ew}}{10}} + \frac{S}{A}\right) + 3$$

where:

SPL_{in} =	sound pressure level inside the room
SPL_{out} =	highest sound pressure level outside the room
A_0 =	reference absorption area of $10m^2$
S_{wi} =	area in m^2 of the windows of the room
S_{ew} =	area in m^2 of the external wall of the room
R_{wi} =	weighted sound reduction index of window (R_w+C_{tr})
R_{ew} =	weighted sound reduction index of external wall
S =	area through which sound is transmitted (m^2)
A =	amount of acoustic absorption in room (m^2)
K =	a numerical factor associated with sound incidence

Equation 1

6.6 Room dimensions and the size of windows have been extracted from scaled drawings. For the purposes of the calculation exercise, an example of each of the proposed bedroom and living spaces has been assessed.

6.7 Due to the varying methods of quantifying the sound insulation performance of building elements, the following parameter is utilised and has been calculated in accordance with the rigorous method as per section G.2.1 of BS8233:2014.

- *R_w Weighted Sound Reduction Index: Single figure sound insulation value derived from the measured sound reduction index R.*

6.8 To meet the criteria, Equation 1 was rearranged in terms of R_w (the sound reduction index of the window – (glass and frame combined). This is assumed to be the weakest façade element. In order to achieve the required internal level, the sound reduction index of the windows should exceed the values detailed in Table 4. The full calculations are shown in Appendix B.

Location	Sound Reduction Index (R_w)
All habitable room windows	34

Table 4

6.9 To achieve the values of R_w as specified in Table 4, a number of glazing systems could be utilised.

6.10 The required window performance could be achieved using the following glazing configuration (taken from Guardian Glass):

Required window performance	Glazing configuration (example)
Acoustic performance 34dB R_w	6mm float glass 10mm Cavity 4mm Float glass

Table 5

6.11 Suggested window specifications are detailed in Appendix C. This glass has published performance data. The published performance figures for the 'glass only' were obtained from laboratory measurements. The best workmanship practices and installation guidelines should be followed to ensure that the stated performances can be obtained once installed within a frame.

6.12 To be confident that the internal noise levels are achieved, it is recommended that the glazing is over specified (not required where the predicted internal noise level is already 5dB below the requirements) to allow a 5dB workmanship tolerance, this is especially important at frequencies 125Hz and 250Hz.

6.13 Alternatively, a window system (glass and frame) matching or exceeding the octave band performances detailed within the calculation exercises (Appendix B) would be acceptable. The minimum octave band performance levels required for any window system (glass and frame) are confirmed below in Table 6.

Minimum performance requirements	SRI Octave Band Centre Frequency (Hz)								R_w
	63	125	250	500	1k	2k	4k	8k	
34dB R_w	-	27	26	28	37	36	29	-	34

Table 6

VENTILATION

6.14 Ventilation requirements for dwellings (and other buildings) are covered under the Building Regulations 'Approved Document F – Means of Ventilation, 2010 Volume 1:Dwellings (ADF).

6.15 ADF requires that:

"There shall be adequate means of ventilation provided for people in the building".

6.16 Ventilation is required for the following purposes:

(a) Extracts water vapour and indoor pollutants from areas where they are produced in significant quantities.
(b) Supplies a minimum level of outdoor air for occupants' health.
(c) Rapidly dilutes indoor air pollutants and disperses water vapour when necessary.

6.17 ADF describes three types of ventilation provision and associated use. The types of ventilation are summarised below:

Type of ventilation	Location	When is this required
Extract Ventilation	Kitchens Utility rooms Bathrooms Sanitary accommodation	Continuous or Intermittent
Whole Dwelling Ventilation	All habitable rooms	Continuously
Purge Ventilation	All habitable rooms	Occasionally

Table 7

6.18 It is currently required to install 'whole dwelling ventilation' to the residential unit.

6.19 In addition to the above ADF also states:

> *"Purge ventilation should be capable of extracting at least four air changes per hour per room directly to the outside."*

6.20 If required to demonstrate compliance with Part O of the Building Regulations, it is likely that higher purge ventilation rates than those given above will be required.

7. CONCLUSION

7.1 Based on the foregoing, it can be concluded that:

(a) Mechanical ventilation is required to service the residential accommodation. Mechanical ventilation will provide adequate ventilation and air quality without the need to open windows, except in the cases of purge ventilation, when it is accepted that internal noise levels will not be met.

(b) A glazing system with the appropriate acoustic performance (Table 4) would provide sufficient attenuation from noise levels generated from the adjacent highways and Stanstead Airport to reduce internal noise levels to meet the levels stated within ProPG, BS 8233:2014 and WHO guidelines for Community Noise.

(c) The required level of sound insulation needed to achieve this internal level is based on the proposed building envelope make up.

(d) This noise impact assessment demonstrates that the requirements of Condition no.3 of Uttlesford District Council planning application 20620-P002-C would be met.

Figures

Horbury, Wrights Green Lane, Little Hallingbury, Essex, CM22 7RL

Figure 1

Figure 2

Figure 3

Figure 4

Figure 5

Figure 6

Figure 7

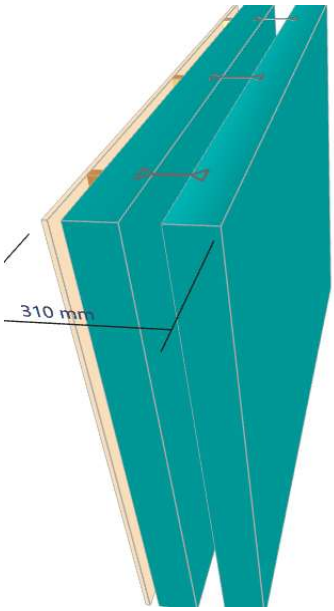
Figure 8

Appendix C

Sound Insulation Prediction (v9.0.24)

Margin of error is generally within Rw ±3 dB
- Key No. 2501
Job Name:Horbury
Job No.:104572 Initials:AD
Date:30/01/2024
File Name:Insul external wall.ixl

Notes:External wall



Rw 62 dB
C -1 dB
Ctr -5 dB

Mass-air-mass resonant frequency = =31 Hz , 193 Hz

Panel Size = 2.7 m x 4.0 m

Partition surface mass = 286 kg/m²

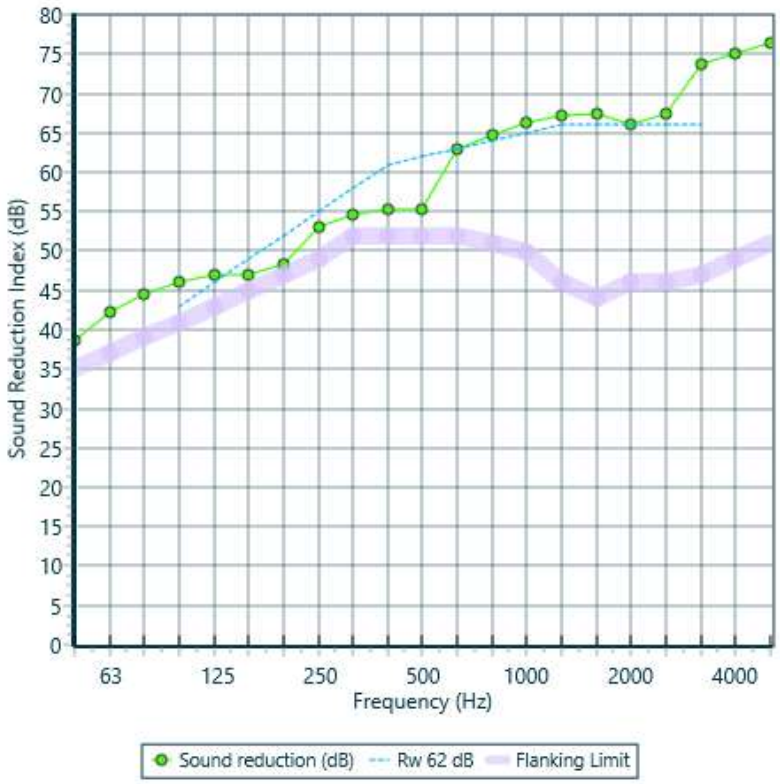
System description

Panel 1 : 1 x 10 mm Plywood

Frame: Timber stud (25 mm x 25 mm), Stud spacing 600 mm ; Cavity Width 25 mm
Panel 2 : 1 x 100 mm Medium Density Blockwork

Frame: Butterfly Tie (75 mm x 45 mm), Stud spacing 600 mm ; Cavity Width 75 mm
Panel 3 : 1 x 100 mm Medium Density Blockwork

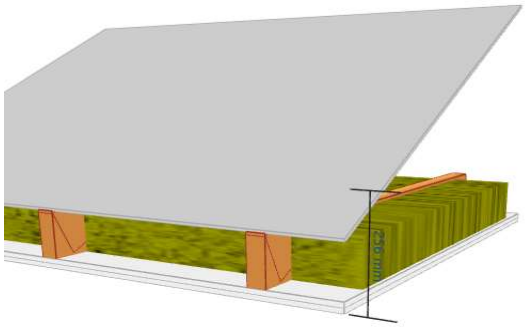
freq.(Hz)	R(dB)	R(dB)
50	39	
63	42	41
80	44	
100	46	
125	47	47
160	47	
200	48	
250	53	51
315	55	
400	55	
500	55	57
630	63	
800	65	
1000	66	66
1250	67	
1600	67	
2000	66	67
2500	67	
3150	74	
4000	75	75
5000	76	



Sound Insulation Prediction (v9.0.24)

Margin of error is generally within Rw ±3 dB
- Key No. 2501
Job Name:Horbury
Job No.:104572 Initials:AD
Date:30/01/2024
File Name:Insul pitched roof.ixl

Notes:pitched roof



Rw	56 dB
C	-1 dB
Ctr	-5 dB

Mass-air-mass resonant frequency = =34 Hz

Panel Size = 2.7 m x 4.0 m

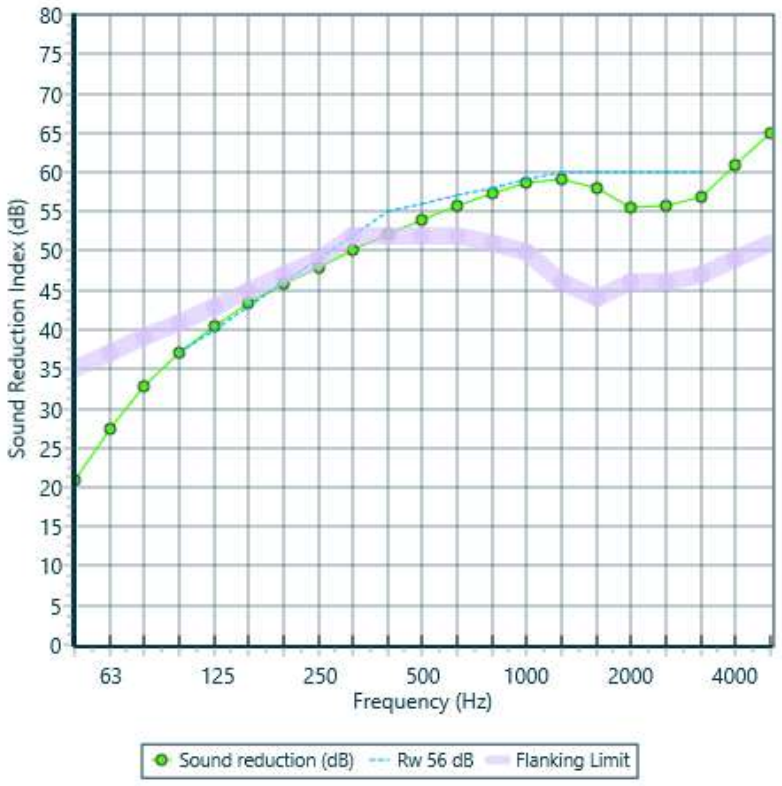
Partition surface mass = 43.1 kg/m²

System description

Panel 1 : 1 x 7 mm Roofing Slates

Frame: Pitched Roof (1.3E2 mm x 45 mm), Stud spacing 600 mm ; Cavity Width 224.2 mm , 1 x Fibreglass (10kg/m3) Thickness 150 mm
Panel 2 : 2 x 12.5 mm Gyproc SoundBloc 12.5mm

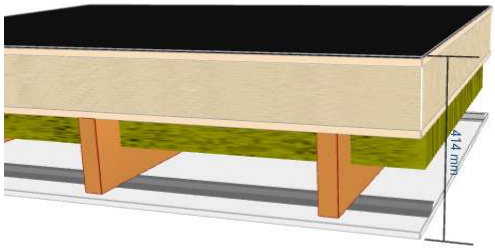
freq.(Hz)	R(dB)	R(dB)
50	21	
63	28	25
80	33	
100	37	
125	40	40
160	43	
200	46	
250	48	48
315	50	
400	52	
500	54	54
630	56	
800	57	
1000	59	58
1250	59	
1600	58	
2000	56	56
2500	56	
3150	57	
4000	61	60
5000	65	



Sound Insulation Prediction (v9.0.24)

Margin of error is generally within Rw ±3 dB
- Key No. 2501
Job Name:Horbury
Job No.:104572 Initials:AD
Date:30/01/2024
File Name:Insul warm roof.ixl

Notes:Warm roof construction



Rw 61 dB
C -2 dB
Ctr -6 dB

Mass-air-mass resonant frequency = =36 Hz

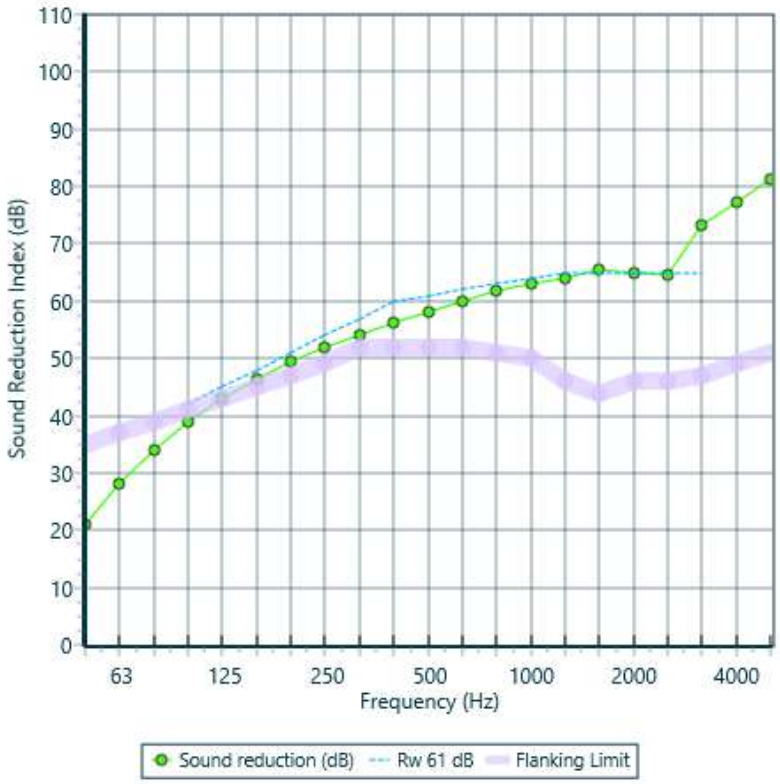
Panel Size = 2.7 m x 4.0 m

Partition surface mass = 51.9 kg/m²

System description

Panel 1 : 1 x 4 mm Nuraply waterproof membrane
+ 1 x 139.9 mm Kingspan KS 1000AWP 120/140mm
+ 1 x 17.5 mm Plywood
+ 1 x 17.5 mm Plywood
Frame: Solid Joist with resilient rail (2E2 mm x 45 mm), Stud spacing 600 mm ; Cavity Width 220 mm , 1 x Fibreglass (10kg/m3) Thickness 100 mm ...
Panel 2 : 1 x 15 mm Gyproc SoundBloc 15mm

freq.(Hz)	R(dB)	R(dB)
50	21	
63	28	25
80	34	
100	39	
125	43	42
160	46	
200	49	
250	52	51
315	54	
400	56	
500	58	58
630	60	
800	62	
1000	63	63
1250	64	
1600	66	
2000	65	65
2500	64	
3150	73	
4000	77	76
5000	81	



Appendix B

Kitchen Living - day

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Description	Term	Weighted rating	Octave Band Centre Frequency (Hz)					
			125	250	500	1000	2000	4000
Freefield External Noise Level	$L_{eq,ff}$	62dBA	62	61	59	60	52	44
Mechanical ventilation	$D_{ne,w}$	Dne,w - n/a dB	100	100	100	100	100	100
Glazing 6mm float / 10mm / 4mm float	R_w	Rw 34dB	27	26	28	37	36	29
External Wall Construction	R_{ew}	R_w 62dB	43	47	53	62	63	71
Roof Construction - Warm roof	R_{rr}	R_w 61 dB	36	45	52	57	59	70
Total room absorption (based on RT)	RT_{60}	0.75	27	29	31	31	30	30

Derivation	Term	Value
Façade area (including window)	S_f	50
Window area	S_{wi}	16
$S_f - S_{wi}$	S_{ew}	34
Area of ceiling	S_{rr}	15
$S_f + S_{rr}$	S	65
Reference absorption area	A_0	10
Room volume	V	145

Description	Term from Equation	Reference letter	Octave Band Centre Frequency (Hz)					
			125	250	500	1000	2000	4000
Freefield External Noise Level	$L_{eq,ff}$	A	62	61	59	60	52	44
Mechanical ventilation	$D_{n,e}$		100	100	100	100	100	100
	$(A_0/S)*10^{(-D_{ne,w}/10)}$	B	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Double Glazed Windows	R_{wi}		27	26	28	37	36	29
	$(S_{wi}/S)*10^{(-R_{wi}/10)}$	C	0.00049	0.00062	0.00039	0.00005	0.00006	0.00031
External Wall Construction	R_{ew}		43	47	53	62	63	71
	$(S_{ew}/S)*10^{(-R_{ew}/10)}$	D	0.00003	0.00001	0.00000	0.00000	0.00000	0.00000
Roof Construction	R_{rr}		36	45	52	57	59	70
	$(S_{rr}/S)*10^{(-R_{rr}/10)}$	E	0.00006	0.00001	0.00000	0.00000	0.00000	0.00000
Total Sound Insulation Performance	10Log(B+C+D+E)	F	-32	-32	-34	-43	-42	-35
Total Absorption Area of Receiver Room	A (furnished)		27	29	31	31	30	30
	10Log(S/A)	G	3.7	3.4	3.1	3.1	3.3	3.3
Total Internal Sound Pressure Level, Leq	Leq,2	A+F+G+3	36.4	35.1	31.5	22.6	16.3	15.4

RESULTANT INTERNAL NOISE LEVEL	**32**

Living - day

ACOUSTICS PLUS

Description	Term	Weighted rating	Octave Band Centre Frequency (Hz)					
			125	250	500	1000	2000	4000
Freefield External Noise Level	$L_{eq,ff}$	62dBA	62	61	59	60	52	44
Mechanical ventilation	$D_{ne,w}$	Dne,w - n/a dB	100	100	100	100	100	100
Glazing 6mm float / 10mm / 4mm float	R_w	Rw 34dB	27	26	28	37	36	29
External Wall Construction	R_{ew}	R_w 62dB	43	47	53	62	63	71
Roof Construction - N/A	R_{rr}	R_w n/a dB	100	100	100	100	100	100
Total room absorption (based on RT)	RT_{60}	0.75	10	12	14	14	13	13

Derivation	Term	Value
Façade area (including window)	S_f	30
Window area	S_{wi}	2
$S_f - S_{wi}$	S_{ew}	28
Area of ceiling	S_{rr}	27
$S_f + S_{rr}$	S	58
Reference absorption area	A_0	10
Room volume	V	63

Description	Term from Equation	Reference letter	Octave Band Centre Frequency (Hz)					
			125	250	500	1000	2000	4000
Freefield External Noise Level	$L_{eq,ff}$	A	62	61	59	60	52	44
Mechanical ventilation	$D_{n,e}$		100	100	100	100	100	100
	$(A_0/S)*10^{(-D_{ne,w}/10)}$	B	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Double Glazed Windows	R_{wi}		27	26	28	37	36	29
	$(S_{wi}/S)*10^{(-R_{wi}/10)}$	C	0.00007	0.00009	0.00005	0.00001	0.00001	0.00004
External Wall Construction	R_{ew}		43	47	53	62	63	71
	$(S_{ew}/S)*10^{(-R_{ew}/10)}$	D	0.00002	0.00001	0.00000	0.00000	0.00000	0.00000
Roof Construction	R_{rr}		100	100	100	100	100	100
	$(S_{rr}/S)*10^{(-R_{rr}/10)}$	E	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Total Sound Insulation Performance	10Log(B+C+D+E)	F	-40	-40	-42	-51	-50	-44
Total Absorption Area of Receiver Room	A (furnished)		10	12	14	14	13	13
	10Log(S/A)	G	7.8	6.9	6.3	6.3	6.6	6.6
Total Internal Sound Pressure Level, Leq	Leq,2	A+F+G+3	32.6	30.5	26.2	17.4	11.1	10.2

RESULTANT INTERNAL NOISE LEVEL	**27**

Study - day

ACOUSTICS PLUS

Description	Term	Weighted rating	Octave Band Centre Frequency (Hz)					
			125	250	500	1000	2000	4000
Freefield External Noise Level	$L_{eq,ff}$	62dBA	62	61	59	60	52	44
Mechanical ventilation	$D_{ne,w}$	Dne,w - n/a dB	100	100	100	100	100	100
Glazing 6mm float / 10mm / 4mm float	R_w	Rw 34dB	27	26	28	37	36	29
External Wall Construction	R_{ew}	R_w 62dB	43	47	53	62	63	71
Roof Construction - N/A	R_{rr}	R_w n/a dB	100	100	100	100	100	100
Total room absorption (based on RT)	RT_{60}	0.75	4	6	8	8	7	7

Derivation	Term	Value
Façade area (including window)	S_f	9
Window area	S_{wi}	1
$S_f - S_{wi}$	S_{ew}	8
Area of ceiling	S_{rr}	17
$S_f + S_{rr}$	S	25
Reference absorption area	A_0	10
Room volume	V	38

Description	Term from Equation	Reference letter	Octave Band Centre Frequency (Hz)					
			125	250	500	1000	2000	4000
Freefield External Noise Level	$L_{eq,ff}$	A	62	61	59	60	52	44
Mechanical ventilation	$D_{n,e}$		100	100	100	100	100	100
	$(A_0/S)*10^{(-D_{ne,w}/10)}$	B	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Double Glazed Windows	R_{wi}		27	26	28	37	36	29
	$(S_{wi}/S)*10^{(-R_{wi}/10)}$	C	0.00009	0.00012	0.00008	0.00001	0.00001	0.00006
External Wall Construction	R_{ew}		43	47	53	62	63	71
	$(S_{ew}/S)*10^{(-R_{ew}/10)}$	D	0.00001	0.00001	0.00000	0.00000	0.00000	0.00000
Roof Construction	R_{rr}		100	100	100	100	100	100
	$(S_{rr}/S)*10^{(-R_{rr}/10)}$	E	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Total Sound Insulation Performance	10Log(B+C+D+E)	F	-40	-39	-41	-50	-49	-42
Total Absorption Area of Receiver Room	A (furnished)		4	6	8	8	7	7
	10Log(S/A)	G	7.7	6.1	4.9	4.9	5.4	5.4
Total Internal Sound Pressure Level, Leq	Leq,2	A+F+G+3	33.3	30.7	26.1	17.2	11.3	10.4

RESULTANT INTERNAL NOISE LEVEL	**27**

Kitchen Living - night

ACOUSTICS PLUS

Description	Term	Weighted rating	Octave Band Centre Frequency (Hz)					
			125	250	500	1000	2000	4000
Freefield External Noise Level	$L_{eq,ff}$	57dBA	56	54	54	55	47	33
Mechanical ventilation	$D_{ne,w}$	Dne,w - n/a dB	100	100	100	100	100	100
Glazing 6mm float / 10mm / 4mm float	R_w	Rw 34dB	27	26	28	37	36	29
External Wall Construction	R_{ew}	R_w 62dB	43	47	53	62	63	71
Roof Construction - Warm roof	R_{rr}	R_w 61 dB	36	45	52	57	59	70
Total room absorption (based on RT)	RT_{60}	0.75	27	29	31	31	30	30

Derivation	Term	Value
Façade area (including window)	S_f	50
Window area	S_{wi}	16
S_f -S_{wi}	S_{ew}	34
Area of ceiling	S_{rr}	15
S_f +S_{rr}	S	65
Reference absorption area	A_0	10
Room volume	V	145

Description	Term from Equation	Reference letter	Octave Band Centre Frequency (Hz)					
			125	250	500	1000	2000	4000
Freefield External Noise Level	$L_{eq,ff}$	A	56	54	54	55	47	33
Mechanical ventilation	$D_{n,e}$		100	100	100	100	100	100
	$(A_0/S)*10^{(-D_{ne,w}/10)}$	B	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Double Glazed Windows	R_{wi}		27	26	28	37	36	29
	$(S_{wi}/S)*10^{(-R_{wi}/10)}$	C	0.00049	0.00062	0.00039	0.00005	0.00006	0.00031
External Wall Construction	R_{ew}		43	47	53	62	63	71
	$(S_{ew}/S)*10^{(-R_{ew}/10)}$	D	0.00003	0.00001	0.00000	0.00000	0.00000	0.00000
Roof Construction	R_{rr}		36	45	52	57	59	70
	$(S_{rr}/S)*10^{(-R_{rr}/10)}$	E	0.00006	0.00001	0.00000	0.00000	0.00000	0.00000
Total Sound Insulation Performance	10Log(B+C+D+E)	F	-32	-32	-34	-43	-42	-35
Total Absorption Area of Receiver Room	A (furnished)		27	29	31	31	30	30
	10Log(S/A)	G	3.7	3.4	3.1	3.1	3.3	3.3
Total Internal Sound Pressure Level, Leq	Leq,2	A+F+G+3	29.8	28.7	26.3	17.7	11.0	4.2

RESULTANT INTERNAL NOISE LEVEL	**26**

Living - night

ACOUSTICS PLUS

Description	Term	Weighted rating	Octave Band Centre Frequency (Hz)					
			125	250	500	1000	2000	4000
Freefield External Noise Level	$L_{eq,ff}$	57dBA	56	54	54	55	47	33
Mechanical ventilation	$D_{ne,w}$	Dne,w - n/a dB	100	100	100	100	100	100
Glazing 6mm float / 10mm / 4mm float	R_w	Rw 34dB	27	26	28	37	36	29
External Wall Construction	R_{ew}	R_w 62dB	43	47	53	62	63	71
Roof Construction - N/A	R_{rr}	R_w n/a dB	100	100	100	100	100	100
Total room absorption (based on RT)	RT_{60}	0.75	10	12	14	14	13	13

Derivation	Term	Value
Façade area (including window)	S_f	30
Window area	S_{wi}	2
$S_f - S_{wi}$	S_{ew}	28
Area of ceiling	S_{rr}	27
$S_f + S_{rr}$	S	58
Reference absorption area	A_0	10
Room volume	V	63

Description	Term from Equation	Reference letter	Octave Band Centre Frequency (Hz)					
			125	250	500	1000	2000	4000
Freefield External Noise Level	$L_{eq,ff}$	A	56	54	54	55	47	33
Mechanical ventilation	$D_{n,e}$		100	100	100	100	100	100
	$(A_0/S)*10^{(-D_{ne,w}/10)}$	B	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Double Glazed Windows	R_{wi}		27	26	28	37	36	29
	$(S_{wi}/S)*10^{(-R_{wi}/10)}$	C	0.00007	0.00009	0.00005	0.00001	0.00001	0.00004
External Wall Construction	R_{ew}		43	47	53	62	63	71
	$(S_{ew}/S)*10^{(-R_{ew}/10)}$	D	0.00002	0.00001	0.00000	0.00000	0.00000	0.00000
Roof Construction	R_{rr}		100	100	100	100	100	100
	$(S_{rr}/S)*10^{(-R_{rr}/10)}$	E	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Total Sound Insulation Performance	10Log(B+C+D+E)	F	-40	-40	-42	-51	-50	-44
Total Absorption Area of Receiver Room	A (furnished)		10	12	14	14	13	13
	10Log(S/A)	G	7.8	6.9	6.3	6.3	6.6	6.6
Total Internal Sound Pressure Level, Leq	Leq,2	A+F+G+3	26.0	24.1	21.0	12.4	5.9	-1.0

RESULTANT INTERNAL NOISE LEVEL	**21**

Study - night

ACOUSTICS PLUS

Description	Term	Weighted rating	Octave Band Centre Frequency (Hz)					
			125	250	500	1000	2000	4000
Freefield External Noise Level	$L_{eq,ff}$	57dBA	56	54	54	55	47	33
Mechanical ventilation	$D_{ne,w}$	Dne,w - n/a dB	100	100	100	100	100	100
Glazing 6mm float / 10mm / 4mm float	R_w	Rw 34dB	27	26	28	37	36	29
External Wall Construction	R_{ew}	R_w 62dB	43	47	53	62	63	71
Roof Construction - N/A	R_{rr}	R_w n/a dB	100	100	100	100	100	100
Total room absorption (based on RT)	RT_{60}	0.75	4	6	8	8	7	7

Derivation	Term	Value
Façade area (including window)	S_f	9
Window area	S_{wi}	1
$S_f - S_{wi}$	S_{ew}	8
Area of ceiling	S_{rr}	17
$S_f + S_{rr}$	S	25
Reference absorption area	A_0	10
Room volume	V	38

Description	Term from Equation	Reference letter	Octave Band Centre Frequency (Hz)					
			125	250	500	1000	2000	4000
Freefield External Noise Level	$L_{eq,ff}$	A	56	54	54	55	47	33
Mechanical ventilation	$D_{n,e}$		100	100	100	100	100	100
	$(A_0/S)*10^{(-D_{ne,w}/10)}$	B	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Double Glazed Windows	R_{wi}		27	26	28	37	36	29
	$(S_{wi}/S)*10^{(-R_{wi}/10)}$	C	0.00009	0.00012	0.00008	0.00001	0.00001	0.00006
External Wall Construction	R_{ew}		43	47	53	62	63	71
	$(S_{ew}/S)*10^{(-R_{ew}/10)}$	D	0.00001	0.00001	0.00000	0.00000	0.00000	0.00000
Roof Construction	R_{rr}		100	100	100	100	100	100
	$(S_{rr}/S)*10^{(-R_{rr}/10)}$	E	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Total Sound Insulation Performance	10Log(B+C+D+E)	F	-40	-39	-41	-50	-49	-42
Total Absorption Area of Receiver Room	A (furnished)		4	6	8	8	7	7
	10Log(S/A)	G	7.7	6.1	4.9	4.9	5.4	5.4
Total Internal Sound Pressure Level, Leq	Leq,2	A+F+G+3	26.7	24.4	20.9	12.3	6.0	-0.8

RESULTANT INTERNAL NOISE LEVEL	**21**

Master Bedroom - day

ACOUSTICS PLUS

Description	Term	Weighted rating	Octave Band Centre Frequency (Hz)					
			125	250	500	1000	2000	4000
Freefield External Noise Level	$L_{eq,ff}$	62dBA	62	61	59	60	52	44
Mechanical ventilation	$D_{ne,w}$	Dne,w - n/a dB	100	100	100	100	100	100
Glazing 6mm float / 10mm / 4mm float	R_w	Rw 34dB	27	26	28	37	36	29
External Wall Construction	R_{ew}	R_w 62dB	43	47	53	62	63	71
Roof Construction - pitched roof	R_{rr}	R_w 56 dB	34	42	48	52	50	54
Total room absorption (based on RT)	RT_{60}	0.5	16	18	20	20	19	19

Derivation	Term	Value
Façade area (including window)	S_f	32
Window area	S_{wi}	6.6
S_f -S_{wi}	S_{ew}	25
Area of ceiling	S_{rr}	27
S_f +S_{rr}	S	59
Reference absorption area	A_0	10
Room volume	V	62

Description	Term from Equation	Reference letter	Octave Band Centre Frequency (Hz)					
			125	250	500	1000	2000	4000
Freefield External Noise Level	$L_{eq,ff}$	A	62	61	59	60	52	44
Mechanical ventilation	$D_{n,e}$		100	100	100	100	100	100
	$(A_0/S)*10^{(-D_{ne,w}/10)}$	B	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Double Glazed Windows	R_{wi}		27	26	28	37	36	29
	$(S_{wi}/S)*10^{(-R_{wi}/10)}$	C	0.00022	0.00028	0.00018	0.00002	0.00003	0.00014
External Wall Construction	R_{ew}		43	47	53	62	63	71
	$(S_{ew}/S)*10^{(-R_{ew}/10)}$	D	0.00002	0.00001	0.00000	0.00000	0.00000	0.00000
Roof Construction	R_{rr}		34	42	48	52	50	54
	$(S_{rr}/S)*10^{(-R_{rr}/10)}$	E	0.00018	0.00003	0.00001	0.00000	0.00000	0.00000
Total Sound Insulation Performance	10Log(B+C+D+E)	F	-34	-35	-37	-46	-45	-38
Total Absorption Area of Receiver Room	A (furnished)		16	18	20	20	19	19
	10Log(S/A)	G	5.6	5.1	4.6	4.6	4.8	4.8
Total Internal Sound Pressure Level, Leq	Leq,2	A+F+G+3	37.0	33.8	29.8	21.2	15.1	13.6

RESULTANT INTERNAL NOISE LEVEL	**30**

Master Bedroom - night

ACOUSTICS PLUS

Description	Term	Weighted rating	Octave Band Centre Frequency (Hz)					
			125	250	500	1000	2000	4000
Freefield External Noise Level	$L_{eq,ff}$	57dBA	56	54	54	55	47	33
Mechanical ventilation	$D_{ne,w}$	Dne,w - n/a dB	100	100	100	100	100	100
Glazing 6mm float / 10mm / 4mm float	R_w	Rw 34dB	27	26	28	37	36	29
External Wall Construction	R_{ew}	R_w 62dB	43	47	53	62	63	71
Roof Construction - pitched roof	R_{rr}	R_w 56 dB	34	42	48	52	50	54
Total room absorption (based on RT)	RT_{60}	0.5	16	18	20	20	19	19

Derivation	Term	Value
Façade area (including window)	S_f	32
Window area	S_{wi}	6.6
S_f -S_{wi}	S_{ew}	25
Area of ceiling	S_{rr}	27
S_f +S_{rr}	S	59
Reference absorption area	A_0	10
Room volume	V	62

Description	Term from Equation	Reference letter	Octave Band Centre Frequency (Hz)					
			125	250	500	1000	2000	4000
Freefield External Noise Level	$L_{eq,ff}$	A	56	54	54	55	47	33
Mechanical ventilation	$D_{n,e}$		100	100	100	100	100	100
	$(A_0/S)*10^{(-D_{ne,w}/10)}$	B	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Double Glazed Windows	R_{wi}		27	26	28	37	36	29
	$(S_{wi}/S)*10^{(-R_{wi}/10)}$	C	0.00022	0.00028	0.00018	0.00002	0.00003	0.00014
External Wall Construction	R_{ew}		43	47	53	62	63	71
	$(S_{ew}/S)*10^{(-R_{ew}/10)}$	D	0.00002	0.00001	0.00000	0.00000	0.00000	0.00000
Roof Construction	R_{rr}		34	42	48	52	50	54
	$(S_{rr}/S)*10^{(-R_{rr}/10)}$	E	0.00018	0.00003	0.00001	0.00000	0.00000	0.00000
Total Sound Insulation Performance	10Log(B+C+D+E)	F	-34	-35	-37	-46	-45	-38
Total Absorption Area of Receiver Room	A (furnished)		16	18	20	20	19	19
	10Log(S/A)	G	5.6	5.1	4.6	4.6	4.8	4.8
Total Internal Sound Pressure Level, Leq	Leq,2	A+F+G+3	30.4	27.4	24.5	16.3	9.8	2.4

RESULTANT INTERNAL NOISE LEVEL	**25**

Master Bedroom - Lamax

ACOUSTICS PLUS

Description	Term	Weighted rating	Octave Band Centre Frequency (Hz)					
			125	250	500	1000	2000	4000
Freefield External Noise Level	$Lmax_{,ff}$	78dBA	77	75	75	74	68	54
Mechanical ventilation	$D_{ne,w}$	Dne,w - n/a dB	100	100	100	100	100	100
Glazing 6mm float / 10mm / 4mm float	R_w	Rw 34dB	27	26	28	37	36	29
External Wall Construction	R_{ew}	R_w 62dB	43	47	53	62	63	71
Roof Construction - pitched roof	R_{rr}	R_w 56 dB	34	42	48	52	50	54
Total room absorption (based on RT)	RT_{60}	0.5	16	18	20	20	19	19

Derivation	Term	Value
Façade area (including window)	S_f	32
Window area	S_{wi}	6.6
S_f -S_{wi}	S_{ew}	25
Area of ceiling	S_{rr}	27
S_f +S_{rr}	S	59
Reference absorption area	A_0	10
Room volume	V	62

Description	Term from Equation	Reference letter	Octave Band Centre Frequency (Hz)					
			125	250	500	1000	2000	4000
Freefield External Noise Level	$L_{eq,ff}$	A	77	75	75	74	68	54
Mechanical ventilation	$D_{n,e}$		100	100	100	100	100	100
	$(A_0/S)*10^{(-D_{ne,w}/10)}$	B	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Double Glazed Windows	R_{wi}		27	26	28	37	36	29
	$(S_{wi}/S)*10^{(-R_{wi}/10)}$	C	0.00022	0.00028	0.00018	0.00002	0.00003	0.00014
External Wall Construction	R_{ew}		43	47	53	62	63	71
	$(S_{ew}/S)*10^{(-R_{ew}/10)}$	D	0.00002	0.00001	0.00000	0.00000	0.00000	0.00000
Roof Construction	R_{rr}		34	42	48	52	50	54
	$(S_{rr}/S)*10^{(-R_{rr}/10)}$	E	0.00018	0.00003	0.00001	0.00000	0.00000	0.00000
Total Sound Insulation Performance	10Log(B+C+D+E)	F	-34	-35	-37	-46	-45	-38
Total Absorption Area of Receiver Room	A (furnished)		16	18	20	20	19	19
	10Log(S/A)	G	5.6	5.1	4.6	4.6	4.8	4.8
Total Internal Sound Pressure Level, Leq	Leq,2	A+F+G+3	51.9	48.5	44.9	36.2	31.4	23.5

RESULTANT INTERNAL NOISE LEVEL	**45**

Bedroom 2 - day

ACOUSTICS PLUS

Description	Term	Weighted rating	Octave Band Centre Frequency (Hz)					
			125	250	500	1000	2000	4000
Freefield External Noise Level	$L_{eq,ff}$	62dBA	62	61	59	60	52	44
Mechanical ventilation	$D_{ne,w}$	Dne,w - n/a dB	100	100	100	100	100	100
Glazing 6mm float / 10mm / 4mm float	R_w	Rw 34dB	27	26	28	37	36	29
External Wall Construction	R_{ew}	R_w 62dB	43	47	53	62	63	71
Roof Construction - pitched roof	R_{rr}	R_w 56 dB	34	42	48	52	50	54
Total room absorption (based on RT)	RT_{60}	0.5	15	17	19	19	18	18

Derivation	Term	Value
Façade area (including window)	S_f	32
Window area	S_{wi}	1.7
$S_f - S_{wi}$	S_{ew}	30
Area of ceiling	S_{rr}	25
$S_f + S_{rr}$	S	57
Reference absorption area	A_0	10
Room volume	V	58

Description	Term from Equation	Reference letter	Octave Band Centre Frequency (Hz)					
			125	250	500	1000	2000	4000
Freefield External Noise Level	$L_{eq,ff}$	A	62	61	59	60	52	44
Mechanical ventilation	$D_{n,e}$		100	100	100	100	100	100
	$(A_0/S)*10^{(-D_{ne,w}/10)}$	B	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Double Glazed Windows	R_{wi}		27	26	28	37	36	29
	$(S_{wi}/S)*10^{(-R_{wi}/10)}$	C	0.00006	0.00008	0.00005	0.00001	0.00001	0.00004
External Wall Construction	R_{ew}		43	47	53	62	63	71
	$(S_{ew}/S)*10^{(-R_{ew}/10)}$	D	0.00003	0.00001	0.00000	0.00000	0.00000	0.00000
Roof Construction	R_{rr}		34	42	48	52	50	54
	$(S_{rr}/S)*10^{(-R_{rr}/10)}$	E	0.00018	0.00003	0.00001	0.00000	0.00000	0.00000
Total Sound Insulation Performance	10Log(B+C+D+E)	F	-36	-39	-42	-50	-49	-44
Total Absorption Area of Receiver Room	A (furnished)		15	17	19	19	18	18
	10Log(S/A)	G	5.9	5.3	4.8	4.8	5.0	5.0
Total Internal Sound Pressure Level, Leq	Leq,2	A+F+G+3	35.2	29.5	24.8	16.9	11.0	8.3

RESULTANT INTERNAL NOISE LEVEL	**26**

Bedroom 2 - night

ACOUSTICS PLUS

Description	Term	Weighted rating	Octave Band Centre Frequency (Hz)					
			125	250	500	1000	2000	4000
Freefield External Noise Level	$L_{eq,ff}$	57dBA	56	54	54	55	47	33
Mechanical ventilation	$D_{ne,w}$	Dne,w - n/a dB	100	100	100	100	100	100
Glazing 6mm float / 10mm / 4mm float	R_w	Rw 34dB	27	26	28	37	36	29
External Wall Construction	R_{ew}	R_w 62dB	43	47	53	62	63	71
Roof Construction - pitched roof	R_{rr}	R_w 56 dB	34	42	48	52	50	54
Total room absorption (based on RT)	RT_{60}	0.5	15	17	19	19	18	18

Derivation	Term	Value
Façade area (including window)	S_f	32
Window area	S_{wi}	1.7
S_f -S_{wi}	S_{ew}	30
Area of ceiling	S_{rr}	25
S_f +S_{rr}	S	57
Reference absorption area	A_0	10
Room volume	V	58

Description	Term from Equation	Reference letter	Octave Band Centre Frequency (Hz)					
			125	250	500	1000	2000	4000
Freefield External Noise Level	$L_{eq,ff}$	A	56	54	54	55	47	33
Mechanical ventilation	$D_{n,e}$		100	100	100	100	100	100
	$(A_0/S)*10^{(-D_{ne,w}/10)}$	B	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Double Glazed Windows	R_{wi}		27	26	28	37	36	29
	$(S_{wi}/S)*10^{(-R_{wi}/10)}$	C	0.00006	0.00008	0.00005	0.00001	0.00001	0.00004
External Wall Construction	R_{ew}		43	47	53	62	63	71
	$(S_{ew}/S)*10^{(-R_{ew}/10)}$	D	0.00003	0.00001	0.00000	0.00000	0.00000	0.00000
Roof Construction	R_{rr}		34	42	48	52	50	54
	$(S_{rr}/S)*10^{(-R_{rr}/10)}$	E	0.00018	0.00003	0.00001	0.00000	0.00000	0.00000
Total Sound Insulation Performance	10Log(B+C+D+E)	F	-36	-39	-42	-50	-49	-44
Total Absorption Area of Receiver Room	A (furnished)		15	17	19	19	18	18
	10Log(S/A)	G	5.9	5.3	4.8	4.8	5.0	5.0
Total Internal Sound Pressure Level, Leq	Leq,2	A+F+G+3	28.5	23.2	19.6	12.0	5.7	-2.9

RESULTANT INTERNAL NOISE LEVEL	**20**

Bedroom 2 - Lamax

ACOUSTICS PLUS

Description	Term	Weighted rating	Octave Band Centre Frequency (Hz)					
			125	250	500	1000	2000	4000
Freefield External Noise Level	$Lmax_{,ff}$	78dBA	77	75	75	74	68	54
Mechanical ventilation	$D_{ne,w}$	Dne,w - n/a dB	100	100	100	100	100	100
Glazing 6mm float / 10mm / 4mm float	R_w	Rw 34dB	27	26	28	37	36	29
External Wall Construction	R_{ew}	R_w 62dB	43	47	53	62	63	71
Roof Construction - pitched roof	R_{rr}	R_w 56 dB	34	42	48	52	50	54
Total room absorption (based on RT)	RT_{60}	0.5	15	17	19	19	18	18

Derivation	Term	Value
Façade area (including window)	S_f	32
Window area	S_{wi}	1.7
S_f -S_{wi}	S_{ew}	30
Area of ceiling	S_{rr}	25
S_f +S_{rr}	S	57
Reference absorption area	A_0	10
Room volume	V	58

Description	Term from Equation	Reference letter	Octave Band Centre Frequency (Hz)					
			125	250	500	1000	2000	4000
Freefield External Noise Level	$L_{eq,ff}$	A	77	75	75	74	68	54
Mechanical ventilation	$D_{n,e}$		100	100	100	100	100	100
	$(A_0/S)*10^{(-D_{ne,w}/10)}$	B	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Double Glazed Windows	R_{wi}		27	26	28	37	36	29
	$(S_{wi}/S)*10^{(-R_{wi}/10)}$	C	0.00006	0.00008	0.00005	0.00001	0.00001	0.00004
External Wall Construction	R_{ew}		43	47	53	62	63	71
	$(S_{ew}/S)*10^{(-R_{ew}/10)}$	D	0.00003	0.00001	0.00000	0.00000	0.00000	0.00000
Roof Construction	R_{rr}		34	42	48	52	50	54
	$(S_{rr}/S)*10^{(-R_{rr}/10)}$	E	0.00018	0.00003	0.00001	0.00000	0.00000	0.00000
Total Sound Insulation Performance	10Log(B+C+D+E)	F	-36	-39	-42	-50	-49	-44
Total Absorption Area of Receiver Room	A (furnished)		15	17	19	19	18	18
	10Log(S/A)	G	5.9	5.3	4.8	4.8	5.0	5.0
Total Internal Sound Pressure Level, Leq	Leq,2	A+F+G+3	50.0	44.2	39.9	31.9	27.3	18.1

RESULTANT INTERNAL NOISE LEVEL	**41**

Bedroom 3 - day

ACOUSTICS PLUS

Description	Term	Weighted rating	Octave Band Centre Frequency (Hz)					
			125	250	500	1000	2000	4000
Freefield External Noise Level	$L_{eq,ff}$	62dBA	62	61	59	60	52	44
Mechanical ventilation	$D_{ne,w}$	Dne,w - n/a dB	100	100	100	100	100	100
Glazing 6mm float / 10mm / 4mm float	R_w	Rw 34dB	27	26	28	37	36	29
External Wall Construction	R_{ew}	R_w 62dB	43	47	53	62	63	71
Roof Construction - pitched roof	R_{rr}	R_w 56 dB	34	42	48	52	50	54
Total room absorption (based on RT)	RT_{60}	0.5	3	5	7	7	6	6

Derivation	Term	Value
Façade area (including window)	S_f	15
Window area	S_{wi}	1.7
S_f -S_{wi}	S_{ew}	13
Area of ceiling	S_{rr}	10
S_f +S_{rr}	S	25
Reference absorption area	A_0	10
Room volume	V	22

Description	Term from Equation	Reference letter	Octave Band Centre Frequency (Hz)					
			125	250	500	1000	2000	4000
Freefield External Noise Level	$L_{eq,ff}$	A	62	61	59	60	52	44
Mechanical ventilation	$D_{n,e}$		100	100	100	100	100	100
	$(A_0/S)*10^{(-D_{ne,w}/10)}$	B	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Double Glazed Windows	R_{wi}		27	26	28	37	36	29
	$(S_{wi}/S)*10^{(-R_{wi}/10)}$	C	0.00014	0.00017	0.00011	0.00001	0.00002	0.00009
External Wall Construction	R_{ew}		43	47	53	62	63	71
	$(S_{ew}/S)*10^{(-R_{ew}/10)}$	D	0.00003	0.00001	0.00000	0.00000	0.00000	0.00000
Roof Construction	R_{rr}		34	42	48	52	50	54
	$(S_{rr}/S)*10^{(-R_{rr}/10)}$	E	0.00015	0.00002	0.00001	0.00000	0.00000	0.00000
Total Sound Insulation Performance	10Log(B+C+D+E)	F	-35	-37	-39	-48	-47	-41
Total Absorption Area of Receiver Room	A (furnished)		3	5	7	7	6	6
	10Log(S/A)	G	8.9	6.8	5.4	5.4	6.0	6.0
Total Internal Sound Pressure Level, Leq	Leq,2	A+F+G+3	39.0	33.6	28.5	20.1	14.4	12.7

RESULTANT INTERNAL NOISE LEVEL	**30**

Bedroom 3 - night

ACOUSTICS PLUS

Description	Term	Weighted rating	Octave Band Centre Frequency (Hz)					
			125	250	500	1000	2000	4000
Freefield External Noise Level	$L_{eq,ff}$	57dBA	56	54	54	55	47	33
Mechanical ventilation	$D_{ne,w}$	Dne,w - n/a dB	100	100	100	100	100	100
Glazing 6mm float / 10mm / 4mm float	R_w	Rw 34dB	27	26	28	37	36	29
External Wall Construction	R_{ew}	R_w 62dB	43	47	53	62	63	71
Roof Construction - pitched roof	R_{rr}	R_w 56 dB	34	42	48	52	50	54
Total room absorption (based on RT)	RT_{60}	0.5	3	5	7	7	6	6

Derivation	Term	Value
Façade area (including window)	S_f	15
Window area	S_{wi}	1.7
$S_f - S_{wi}$	S_{ew}	13
Area of ceiling	S_{rr}	10
$S_f + S_{rr}$	S	25
Reference absorption area	A_0	10
Room volume	V	22

Description	Term from Equation	Reference letter	Octave Band Centre Frequency (Hz)					
			125	250	500	1000	2000	4000
Freefield External Noise Level	$L_{eq,ff}$	A	56	54	54	55	47	33
Mechanical ventilation	$D_{n,e}$		100	100	100	100	100	100
	$(A_0/S)*10^{(-D_{ne,w}/10)}$	B	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Double Glazed Windows	R_{wi}		27	26	28	37	36	29
	$(S_{wi}/S)*10^{(-R_{wi}/10)}$	C	0.00014	0.00017	0.00011	0.00001	0.00002	0.00009
External Wall Construction	R_{ew}		43	47	53	62	63	71
	$(S_{ew}/S)*10^{(-R_{ew}/10)}$	D	0.00003	0.00001	0.00000	0.00000	0.00000	0.00000
Roof Construction	R_{rr}		34	42	48	52	50	54
	$(S_{rr}/S)*10^{(-R_{rr}/10)}$	E	0.00015	0.00002	0.00001	0.00000	0.00000	0.00000
Total Sound Insulation Performance	10Log(B+C+D+E)	F	-35	-37	-39	-48	-47	-41
Total Absorption Area of Receiver Room	A (furnished)		3	5	7	7	6	6
	10Log(S/A)	G	8.9	6.8	5.4	5.4	6.0	6.0
Total Internal Sound Pressure Level, Leq	Leq,2	A+F+G+3	32.4	27.3	23.3	15.1	9.1	1.5

RESULTANT INTERNAL NOISE LEVEL	**24**

Bedroom 3 - Lamax

ACOUSTICS PLUS

Description	Term	Weighted rating	Octave Band Centre Frequency (Hz)					
			125	250	500	1000	2000	4000
Freefield External Noise Level	$Lmax_{,ff}$	78dBA	77	75	75	74	68	54
Mechanical ventilation	$D_{ne,w}$	Dne,w - n/a dB	100	100	100	100	100	100
Glazing 6mm float / 10mm / 4mm float	R_w	Rw 34dB	27	26	28	37	36	29
External Wall Construction	R_{ew}	R_w 62dB	43	47	53	62	63	71
Roof Construction - pitched roof	R_{rr}	R_w 56 dB	34	42	48	52	50	54
Total room absorption (based on RT)	RT_{60}	0.5	3	5	7	7	6	6

Derivation	Term	Value
Façade area (including window)	S_f	15
Window area	S_{wi}	1.7
$S_f - S_{wi}$	S_{ew}	13
Area of ceiling	S_{rr}	10
$S_f + S_{rr}$	S	25
Reference absorption area	A_0	10
Room volume	V	22

Description	Term from Equation	Reference letter	Octave Band Centre Frequency (Hz)					
			125	250	500	1000	2000	4000
Freefield External Noise Level	$L_{eq,ff}$	A	77	75	75	74	68	54
Mechanical ventilation	$D_{n,e}$		100	100	100	100	100	100
	$(A_0/S)*10^{(-D_{ne,w}/10)}$	B	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Double Glazed Windows	R_{wi}		27	26	28	37	36	29
	$(S_{wi}/S)*10^{(-R_{wi}/10)}$	C	0.00014	0.00017	0.00011	0.00001	0.00002	0.00009
External Wall Construction	R_{ew}		43	47	53	62	63	71
	$(S_{ew}/S)*10^{(-R_{ew}/10)}$	D	0.00003	0.00001	0.00000	0.00000	0.00000	0.00000
Roof Construction	R_{rr}		34	42	48	52	50	54
	$(S_{rr}/S)*10^{(-R_{rr}/10)}$	E	0.00015	0.00002	0.00001	0.00000	0.00000	0.00000
Total Sound Insulation Performance	10Log(B+C+D+E)	F	-35	-37	-39	-48	-47	-41
Total Absorption Area of Receiver Room	A (furnished)		3	5	7	7	6	6
	10Log(S/A)	G	8.9	6.8	5.4	5.4	6.0	6.0
Total Internal Sound Pressure Level, Leq	Leq,2	A+F+G+3	53.9	48.3	43.6	35.0	30.7	22.6

RESULTANT INTERNAL NOISE LEVEL	**45**

Bedroom 4 - day

ACOUSTICS PLUS

Description	Term	Weighted rating	Octave Band Centre Frequency (Hz)					
			125	250	500	1000	2000	4000
Freefield External Noise Level	$L_{eq,ff}$	62dBA	62	61	59	60	52	44
Mechanical ventilation	$D_{ne,w}$	Dne,w - n/a dB	100	100	100	100	100	100
Glazing 6mm float / 10mm / 4mm float	R_w	Rw 34dB	27	26	28	37	36	29
External Wall Construction	R_{ew}	R_w 62dB	43	47	53	62	63	71
Roof Construction - pitched roof	R_{rr}	R_w 56 dB	34	42	48	52	50	54
Total room absorption (based on RT)	RT_{60}	0.5	5	7	9	9	8	8

Derivation	Term	Value
Façade area (including window)	S_f	19
Window area	S_{wi}	1.7
$S_f - S_{wi}$	S_{ew}	17
Area of ceiling	S_{rr}	12
$S_f + S_{rr}$	S	31
Reference absorption area	A_0	10
Room volume	V	27

Description	Term from Equation	Reference letter	Octave Band Centre Frequency (Hz)					
			125	250	500	1000	2000	4000
Freefield External Noise Level	$L_{eq,ff}$	A	62	61	59	60	52	44
Mechanical ventilation	$D_{n,e}$		100	100	100	100	100	100
	$(A_0/S)*10^{(-D_{ne,w}/10)}$	B	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Double Glazed Windows	R_{wi}		27	26	28	37	36	29
	$(S_{wi}/S)*10^{(-R_{wi}/10)}$	C	0.00011	0.00014	0.00009	0.00001	0.00001	0.00007
External Wall Construction	R_{ew}		43	47	53	62	63	71
	$(S_{ew}/S)*10^{(-R_{ew}/10)}$	D	0.00003	0.00001	0.00000	0.00000	0.00000	0.00000
Roof Construction	R_{rr}		34	42	48	52	50	54
	$(S_{rr}/S)*10^{(-R_{rr}/10)}$	E	0.00015	0.00002	0.00001	0.00000	0.00000	0.00000
Total Sound Insulation Performance	10Log(B+C+D+E)	F	-35	-38	-40	-49	-47	-41
Total Absorption Area of Receiver Room	A (furnished)		5	7	9	9	8	8
	10Log(S/A)	G	8.1	6.6	5.5	5.5	6.0	6.0
Total Internal Sound Pressure Level, Leq	Leq,2	A+F+G+3	37.8	32.7	27.7	19.4	13.6	11.7

RESULTANT INTERNAL NOISE LEVEL	**29**

Bedroom 4 - night

ACOUSTICS PLUS

Description	Term	Weighted rating	Octave Band Centre Frequency (Hz)					
			125	250	500	1000	2000	4000
Freefield External Noise Level	$L_{eq,ff}$	57dBA	56	54	54	55	47	33
Mechanical ventilation	$D_{ne,w}$	Dne,w - n/a dB	100	100	100	100	100	100
Glazing 6mm float / 10mm / 4mm float	R_w	Rw 34dB	27	26	28	37	36	29
External Wall Construction	R_{ew}	R_w 62dB	43	47	53	62	63	71
Roof Construction - pitched roof	R_{rr}	R_w 56 dB	34	42	48	52	50	54
Total room absorption (based on RT)	RT_{60}	0.5	5	7	9	9	8	8

Derivation	Term	Value
Façade area (including window)	S_f	19
Window area	S_{wi}	1.7
$S_f - S_{wi}$	S_{ew}	17
Area of ceiling	S_{rr}	12
$S_f + S_{rr}$	S	31
Reference absorption area	A_0	10
Room volume	V	27

Description	Term from Equation	Reference letter	Octave Band Centre Frequency (Hz)					
			125	250	500	1000	2000	4000
Freefield External Noise Level	$L_{eq,ff}$	A	56	54	54	55	47	33
Mechanical ventilation	$D_{n,e}$		100	100	100	100	100	100
	$(A_0/S)*10^{(-D_{ne,w}/10)}$	B	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Double Glazed Windows	R_{wi}		27	26	28	37	36	29
	$(S_{wi}/S)*10^{(-R_{wi}/10)}$	C	0.00011	0.00014	0.00009	0.00001	0.00001	0.00007
External Wall Construction	R_{ew}		43	47	53	62	63	71
	$(S_{ew}/S)*10^{(-R_{ew}/10)}$	D	0.00003	0.00001	0.00000	0.00000	0.00000	0.00000
Roof Construction	R_{rr}		34	42	48	52	50	54
	$(S_{rr}/S)*10^{(-R_{rr}/10)}$	E	0.00015	0.00002	0.00001	0.00000	0.00000	0.00000
Total Sound Insulation Performance	10Log(B+C+D+E)	F	-35	-38	-40	-49	-47	-41
Total Absorption Area of Receiver Room	A (furnished)		5	7	9	9	8	8
	10Log(S/A)	G	8.1	6.6	5.5	5.5	6.0	6.0
Total Internal Sound Pressure Level, Leq	Leq,2	A+F+G+3	31.2	26.3	22.5	14.4	8.3	0.5

RESULTANT INTERNAL NOISE LEVEL	**23**

Bedroom 4 - Lamax

ACOUSTICS PLUS

Description	Term	Weighted rating	Octave Band Centre Frequency (Hz)					
			125	250	500	1000	2000	4000
Freefield External Noise Level	$Lmax_{,ff}$	78dBA	77	75	75	74	68	54
Mechanical ventilation	$D_{ne,w}$	Dne,w - n/a dB	100	100	100	100	100	100
Glazing 6mm float / 10mm / 4mm float	R_w	Rw 34dB	27	26	28	37	36	29
External Wall Construction	R_{ew}	R_w 62dB	43	47	53	62	63	71
Roof Construction - pitched roof	R_{rr}	R_w 56 dB	34	42	48	52	50	54
Total room absorption (based on RT)	RT_{60}	0.5	5	7	9	9	8	8

Derivation	Term	Value
Façade area (including window)	S_f	19
Window area	S_{wi}	1.7
$S_f - S_{wi}$	S_{ew}	17
Area of ceiling	S_{rr}	12
$S_f + S_{rr}$	S	31
Reference absorption area	A_0	10
Room volume	V	27

Description	Term from Equation	Reference letter	Octave Band Centre Frequency (Hz)					
			125	250	500	1000	2000	4000
Freefield External Noise Level	$L_{eq,ff}$	A	77	75	75	74	68	54
Mechanical ventilation	$D_{n,e}$		100	100	100	100	100	100
	$(A_0/S)*10^{(-D_{ne,w}/10)}$	B	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Double Glazed Windows	R_{wi}		27	26	28	37	36	29
	$(S_{wi}/S)*10^{(-R_{wi}/10)}$	C	0.00011	0.00014	0.00009	0.00001	0.00001	0.00007
External Wall Construction	R_{ew}		43	47	53	62	63	71
	$(S_{ew}/S)*10^{(-R_{ew}/10)}$	D	0.00003	0.00001	0.00000	0.00000	0.00000	0.00000
Roof Construction	R_{rr}		34	42	48	52	50	54
	$(S_{rr}/S)*10^{(-R_{rr}/10)}$	E	0.00015	0.00002	0.00001	0.00000	0.00000	0.00000
Total Sound Insulation Performance	10Log(B+C+D+E)	F	-35	-38	-40	-49	-47	-41
Total Absorption Area of Receiver Room	A (furnished)		5	7	9	9	8	8
	10Log(S/A)	G	8.1	6.6	5.5	5.5	6.0	6.0
Total Internal Sound Pressure Level, Leq	Leq,2	A+F+G+3	52.7	47.3	42.8	34.3	29.9	21.6

RESULTANT INTERNAL NOISE LEVEL	**44**

Appendix A

Acoustic Performance

Glazing Configuration

6mm Float Glass

10mm Cavity

4mm Float Glass

.

Sound Reduction Indices

Frequency, Hz / dB						Rw	C	Ctr	OITC	STC
125	250	500	1000	2000	4000	34	-1	-3	29	34
27	26	28	37	36	29					

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