

JOSTEC

BUILDING REGULATIONS COMPLIANCE SERVICES



REPORT TITLE: NOISE SURVEY REPORT INCLUDING ASSESSMENT OF
SCHEME OF NOISE INSULATION MEASURES FOR
MIXED USE DEVELOPMENT AT
23-24 MARKET PLACE, READING

REPORT REFERENCE: 2265102

ISSUED TO: THE KEEN PARTNERSHIP
THE COURTYARD
FLAT 1
EDINBURGH ROAD RG30 2UA

ISSUED BY: MATT HINE MIOA

DATE: 09 December 2022

CONTENTS:

SUMMARY

1. INTRODUCTION
2. DEVELOPMENT DESCRIPTION
3. NOISE ASSESSMENT CRITERIA
4. NOISE SURVEY
5. NOISE ASSESSMENT

Appendix A:	Location Plan & Drawings of The Development
Appendix B:	Noise Survey Instrumentation
Appendix C:	Noise Survey Results
Appendix D:	Building Envelope Acoustic Calculations

SUMMARY

- A noise survey and assessment has been carried out by JosTec for 23-24 Market Place, Reading RG1 2DE.
- The noise assessment is to be submitted to Reading Borough Council as part of a planning application.
- Day and night period noise to the development site includes contributions from road and pedestrian traffic.
- The development site is not exposed to especially high overall noise levels throughout the day or night periods.
- Results of the noise survey are used to assess a scheme of noise insulation measures for the development. The scheme, which includes specification for acoustic performance glazing and ventilation, is verified by composite sound reduction indices calculation of the overall building envelope.

1. INTRODUCTION

JosTec has been commissioned to undertake a noise survey and assessment for a proposed commercial/residential development at 23-24 Market Place, Reading RG1 2DE.

A scheme of noise insulation measures for the development including consideration of any proposed commercial plant equipment noise, acoustic performance of the separating floor between commercial ground and residential first floor levels and for glazing and ventilation within the residential accommodation is required to protect the amenity of future residents of the development. This report presents results of a noise survey and assessment of the scheme and includes:

- Description of the development.
- Review of noise limit criteria.
- Details of noise survey including subjective observations.
- Noise assessment.

2. DEVELOPMENT DESCRIPTION

The development site is located in Reading town centre with a mixture of ground floor retail/commercial businesses with residential properties on upper floors.

The proposed development includes renovation and conversion of the existing buildings to provide a mixed commercial and residential space, including ground floor retail space with flats above to third floor level. A location plan and drawings of the proposed development are included in Appendix A.

Overall noise levels are moderate towards the front of the development and typical of this type of town centre location. They comprise principally of contributions from road/pedestrian traffic along Market Place together with commercial activity associated with nearby businesses. Noise levels to the rear of the development are relatively lower due to shielding afforded by the building structure from Market Place. Further details on noise levels and sources are provided in Section 4.3 of this report.

3. NOISE ASSESSMENT CRITERIA

Potential sources of noise affecting the residential flats accommodation located on upper floors with ground floor commercial units below at the proposed development include:

1. noise due to any plant equipment serving the commercial units;
2. noise transfer via separating ground/first floor and
3. ambient environmental noise.

Similar developments in Reading Borough and other local authorities have approved and employed the methodology and guideline noise levels given in the standards listed below, which are considered relevant to this development:

- BS 4142: 2014 +A1: 2019
"Methods for rating and assessing industrial and commercial sound"
- BS 8233:2014
"Guidance on Sound Insulation and Noise Reduction for Buildings"

Guideline criteria detailed in these standards appropriate to the noise sources listed above are outlined in Sections 3.1 to 3.3.

3.1 Commercial Plant Equipment Noise Criteria

BS 4142: 2014 +A1: 2019 "*Methods for rating and assessing industrial and commercial sound*" ("BS 4142") is routinely used by local authorities such as Reading Borough Council in assessing noise from commercial plant equipment. BS 4142 describes an indication of the impact according to the numerical difference between the rating level of the equipment and the background sound level, typically assessed at a 1m distance from the nearest non-associated residential window.

Whilst the exact nature of the ground floor businesses and their requirements for plant equipment is unknown at the time of writing, the BS 4142 indication of impact criteria is nonetheless considered relevant in the assessment of any potential commercial plant noise at this development and is summarised in Table 1 below:

Rating level - Background sound level	Indication of impact
+10dB	Significant adverse impact
+5dB	Adverse impact
≤0dB	Low impact

Table 1: BS 4142 rating level impact indication

In addition to the BS 4142 criteria reproduced in Table 1, local authorities may additionally require a more stringent requirement such that the rating level be at a specified level below the background sound level, e.g.: Rating level ≤ Background sound level -5dB or -10dB.

From experience with similar plant noise assessments carried out within Reading Borough Council it is anticipated that a Rating level of ≤ Background sound level -10dB criteria may be required. The potential Reading Borough Council noise requirement used to assess any potential commercial plant noise is summarised below in Table 2 together with the BS 4142 indication of impact criteria:

Rating level - Background sound level	Indication of impact
+10dB	Significant adverse impact
+5dB	Adverse impact
≤0dB	Low impact
-10dB	Reading Borough Council requirement

Table 2: BS 4142 rating level impact indication together with Reading Borough Council requirement

It is recommended to verify any specific Reading Borough Council noise requirements prior to the installation of any plant equipment.

3.2 Separating Ground Floor Commercial/First Floor Residential Noise Criteria

The author is aware that many local authorities use minimum airborne sound insulation performance requirements for floors in new build/conversion residential properties given in Part E of Building Regulations for England and Wales (BREW) as a benchmark by which to set more stringent criteria.

The current BREW minimum airborne sound insulation performance for floors in new build residential properties is $D_{nT,w} + C_{tr} \geq 45$ dB, to which local authorities often require a +5dB and in some cases a +10dB improvement that may additionally depend on the nature of the commercial units' business.

BS 8233:2014 "*Guidance on Sound Insulation and Noise Reduction for Buildings*" ("BS 8233:2014"), Section 7.5 *Internal sound insulation* Table 3 provides a matrix of minimum airborne sound insulation $D_{nT,w}$ values (note: these are not $D_{nT,w} + C_{tr}$ values) for partitioning structures broadly dependent on the noise activity, sensitivity and privacy requirements for each room and is shown below in Table 3:

Privacy requirement	Activity noise of source room	Noise sensitivity of receiving rooms		
		Low sensitivity	Medium sensitivity	Sensitive
Confidential	Very high	47	52	57 ^{A)}
	High	47	47	52
	Typical	47	47	47
	Low	42	42	47
Moderate	Very high	47	52	57 ^{A)}
	High	37	42	47
	Typical	37	37	42
	Low	No rating	No rating	37
Not private	Very high	47	52	57 ^{A)}
	High	37	42	47
	Typical	No rating	37	42
	Low	No rating	No rating	37

Note Background noise can also influence privacy.

A) $D_{nT,w}$ 55 dB or greater is difficult to obtain on site and room adjacencies requiring these levels should be avoided wherever practical.

Table 3: Example on-site sound insulation matrix (dB $D_{nT,w}$)

It is recommended to seek the advice of Reading Borough Council for their specific airborne sound insulation performance criteria for the separating ground/first floor prior to design and construction.

3.3 Ambient Environmental Noise Criteria

Regarding the assessment of ambient environmental noise ingress to residential accommodation, the methodology and guideline noise levels given in BS 8233:2014 Section 7.7.2 *Internal ambient noise levels for dwellings* is typically approved for use by local authorities including Reading Borough Council and is considered appropriate for use in this assessment and report.

Guidance in BS 8233:2014 Section 7.7.2 Table 4 advises it is desirable that ambient noise levels to inside residential dwellings do not exceed the guideline values shown below in Table 4:

Activity	Location	07:00 to 23:00 (day period)	23:00 to 07:00 (night period)
Resting	Living room	$\leq 35\text{dB } L_{Aeq,16\text{hour}}$	-
Dining	Dining room/area	$\leq 40\text{dB } L_{Aeq,16\text{hour}}$	-
Sleeping (daytime resting)	Bedroom	$\leq 35\text{dB } L_{Aeq,16\text{hour}}$	$\leq 30\text{dB } L_{Aeq,8\text{hour}}$

Table 4: Indoor ambient noise levels for dwellings

Note 4 to Table 4 in Section 7.7.2 of BS 8233 additionally advises that regular individual noise events can cause sleep disturbance and that a guideline value may be set in terms of SEL or $L_{A\text{fmax}}$ depending on the character and number of events per night. Whilst this guidance relates principally to night period noise from aircraft and trains it is nonetheless considered appropriate to apply an $L_{A\text{fmax}}$ criterion for bedrooms during the night period for this development.

BS8233:2014 does not however provide any specific numerical guidance on night period $L_{A\text{fmax}}$ values for noise into bedrooms - the previous $L_{A\text{fmax}}$ limit guidance for bedrooms in BS8233:1999 is removed from BS8233:2014. Notwithstanding this, and in keeping with World Health Organisation Noise Guideline Values, the noise assessment in this report includes the BS8233:1999 criterion of $L_{A\text{fmax}}$ 45dB for bedrooms during the night period.

The $L_{A\text{fmax}}$ criterion is applied on the basis that noise events should not regularly exceed $L_{A\text{fmax}}$ 45dB, it is not intended that the requirement be applicable to infrequent night period very high noise level events such as the sirens of passing emergency vehicles.

4. NOISE SURVEY

In order to assess the scheme for noise insulation measures proposed for the development and to obtain background sound levels it is necessary to determine day and night period noise levels at representative positions. Details of the noise survey carried out by JosTec are provided in the following sections.

4.1 Noise Survey Details & Procedure

A noise survey has been carried out previously at the site of 27-32 Market place, which is the build next door using a logging type sound level meter from Thursday 3rd March 2022 to Saturday 5th March 2022. As the survey is less than 10 months old, it is fitting to use the same noise data and not to carry out another survey. The weather included mostly dry and calm/light wind conditions during the day and also the night periods of the survey.

A primary long term unattended noise survey measurement location was selected at third floor level on the front façade of 173-175 Friar Street looking out over the pedestrianised Town Hall Square. This location was chosen as a secure location at which to record noise levels from passing road/pedestrian traffic on Market Place, The Forbury and surrounding streets.

The position was achieved by establishing measurement equipment on a tripod/pole arrangement externally at third floor level at a height of c.8m above ground level and 1m from the exterior of the building to provide 1m façade levels. Measurements were recorded in terms of continuous 5 minute samples of principally broadband $L_{A\{90\}}$, L_{Aeq} , and L_{Amax} values together with octave band L_{Zeq} values over the duration of the survey.

Additional short term attended measurement positions were chosen around the site with equipment positioned 1.5m above ground level to assess variations in noise levels at other locations relative to levels at the primary location.

Long-term noise survey and additional measurement locations are indicated on the aerial image site location plan in Appendix A.

4.2 Noise Survey Instrumentation

Details of the instrumentation used for the noise survey are provided in Appendix B. Sound level meters were calibrated before and after measurements using a certified calibrator with no significant drift in sensitivity recorded.

4.3 Noise Survey Results & Observations

Noise levels to the development site comprise principally of contributions from passing road and pedestrian traffic on Town Hall Square, Market Place, The Forbury and surrounding streets, activity associated with commercial activity in the locality and distant road traffic on surrounding roads. Noise levels rise steadily from early morning to midday where they remain at their highest until the late evening/night and are at their lowest between approximately 04:00 and 06:00.

Short term ground level measurements taken at the façade of the development at 27-32 Market Place were c.2dB higher than those recorded concurrently at the primary measurement position. Short term measurements taken at the rear of the development at 27-32 Market Place were c.3dB lower than those recorded concurrently at the primary measurement position. These variations are used to location-calibrate noise survey data recorded at the primary measurement position.

In accordance with normal acoustic measurement and assessment procedures, measured 1m façade noise survey levels are taken to be 3dB higher than levels measured away from buildings (i.e.: equivalent free-field values). Complete raw results of the noise survey in terms of $L_{A_{f90}}$, $L_{A_{eq}}$ and $L_{A_{fmax}}$ values are provided in graphical format in Appendix C. Summary average day and night period location-calibrated equivalent free-field $L_{A_{f90}}$, $L_{A_{eq}}$ and $L_{A_{fmax}}$ results are shown in Table 5 below.

Location	Time Period	$L_{A_{f90}, t}$ (dB)	$L_{A_{eq}, t}$ (dB)	$L_{A_{fmax}, t}$ (dB)
Location #1: Front Façade, 173-175 Friar Street	Day 07:00 - 23:00	47.0	58.7	-
	Night 23:00 - 07:00	40.0	53.5	76.0
Location #2: Front Façade, 27-32 Market Place	Day 07:00 - 23:00	49.0	60.7	-
	Night 23:00 - 07:00	42.0	55.5	78.0
Location #3: Rear Façade, 27-32 Market Place	Day 07:00 - 23:00	44.0	55.7	-
	Night 23:00 - 07:00	37.0	50.5	73.0

Table 5: Summary average noise levels for day and night periods

In order to accurately assess the 45dB night period $L_{A_{fmax}}$ criterion for environmental noise, statistical analysis of measured noise survey data for the front façade of the development (Location #2, worst case scenario) is used to establish a typically occurring high $L_{A_{fmax}}$ level that is exceeded 5% of the time (95th percentile) and is shown below in Figure 1:

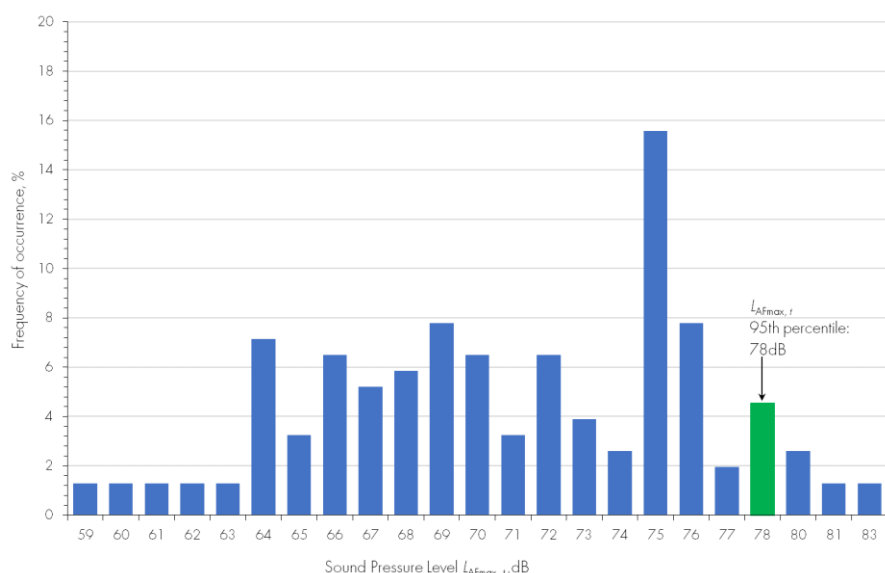


Figure 1: Frequency of occurrence of night period maximum sound pressure levels

A measured maximum night period value of $L_{A_{fmax}}$ 78dB is exceeded 5% of the time.

Table 6 below summarises the average day and night period $L_{A_{eq}}$ values taken from Table 5 together with the typically occurring highest $L_{A_{fmax}}$ value from Figure 1 used in the calculations and assessment of the building envelope sound insulation scheme in Section 5.3.

Time Period	$L_{A_{eq,t}}$ (dB)	$L_{A_{fmax,t}}$ (dB)
Day 07:00 - 23:00	60.7	-
Night 23:00 - 07:00	55.5	78.0

Table 6: Summary noise levels for day and night periods used in calculations

5. NOISE ASSESSMENT

It can be seen from Table 6 that day and night period levels are moderate and the site is suitable for the proposed development providing that an appropriate specification of noise insulation is included within the scheme design to ensure compliance with the noise criteria as detailed in Section 3.

5.1 Commercial Plant Equipment Noise Assessment

The measured or calculated rating level of any plant at the proposed development will need to be compared to the representative background sound level during hours of operation of the equipment and its noise impact assessed at the nearest residential window.

Representative minimum background sound levels of the noise survey results for day and night period L_{Aeq} levels for the front façade of the development (Location #3, worst case scenario) have been assessed and chosen using the statistical analysis method detailed in Note 4, Section 8.1.4 of BS 4142. Statistical analysis of the background sound level results is shown in Figures 2 & 3 below and overleaf:

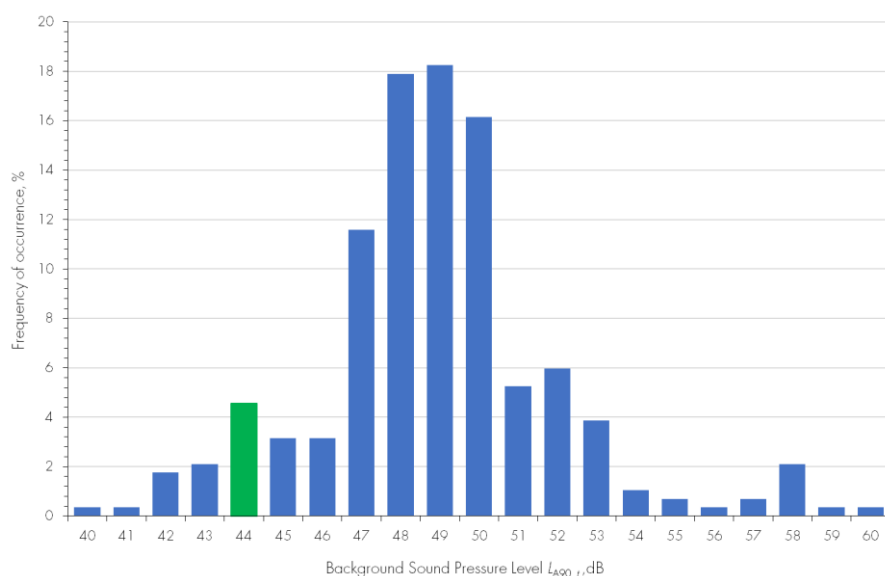


Figure 2: Frequency of occurrence of day period background sound levels

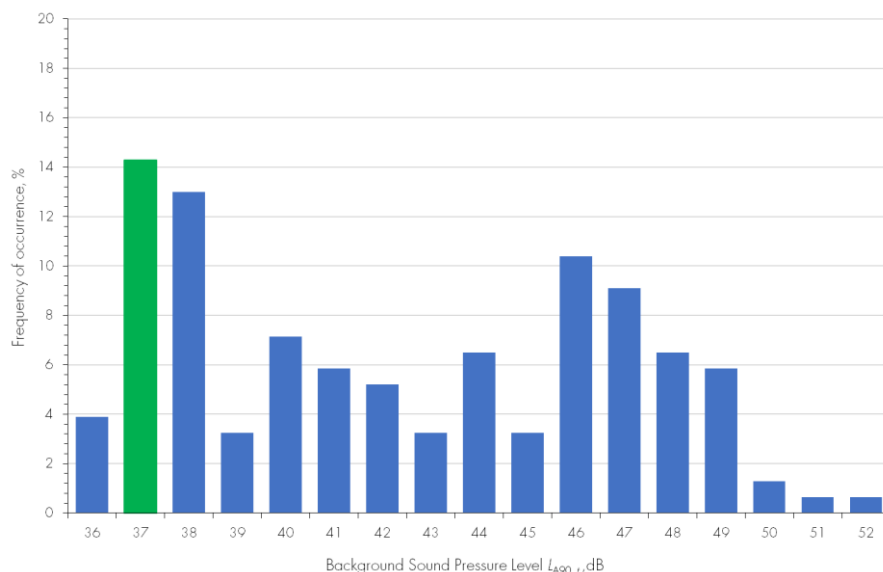


Figure 3: Frequency of occurrence of night period background sound levels

Representative minimum background sound levels for day and night periods are summarised below in Table 7:

	Day period 07:00 - 23:00	Night period 23:00 - 07:00
Background Sound Level $L_{A90,1}$	44dB	37dB

Table 7: Representative minimum background sound levels for day and night periods

Where plant equipment is scheduled to be installed at the proposed development to serve the commercial units, values in Table 7 may be used to compare against equipment rating levels using the criteria given in Section 3.1 Table 2. Note that where plant equipment is operational for part or all of both day and night periods, the lower night period representative minimum background sound level value is to be used in assessment.

It is recommended to verify any additional or alternative noise criteria requirements with Reading Borough Council prior to the installation of any equipment.

5.2 Separating Ground/First Floor Noise Assessment

The selection of construction build up for the separating floor between ground floor commercial units and first floor residential accommodation will need to include sufficient sound insulation to protect the amenity of residents and will largely depend on the nature of the commercial businesses.

The BS 8233 matrix of minimum airborne sound insulation $D_{nT,w}$ values detailed in Section 3.2 Table 3 may be used to aid selection of the floor construction and it is recommended to seek the advice of Reading Borough Council for any specific airborne sound insulation performance criteria prior to design and construction.

5.3 Building Envelope Sound Insulation Scheme Assessment

For this development the scheme of noise insulation measures to protect against noise to inside the residential dwelling relates to the acoustic design and specification of elements of the residential building envelope which includes the separating floor between the ground floor commercial units and first floor residential accommodation, external walls, glazing, ventilators and roof/ceiling structures.

It is recommended to seek the advice of Reading Borough Council for any specific airborne sound insulation performance criteria for the separating ground/first floor prior to design and construction.

The external walls and roof/ceiling structures to the development will by default provide a relatively high level of noise insulation and therefore as for most residential sites the dominant path for external noise to enter rooms will be via glazing and any ventilation system.

By following the rigorous calculation procedures outlined in Section G.2 of Annex G (informative) of British Standard BS 8233:2014 a specification for acoustic performance has been established and a scheme for noise insulation measures for the whole residential building envelope is assessed item by item in Sections 5.3.1 to 5.3.4 on the following pages.

Acoustic calculations are provided for day and night period noise intrusion into the living/dining room and single bedroom of the loft apartment, selected as representing worst case scenario rooms with the highest ratio of glazing to masonry, roof/ceiling system and so with potentially highest incident noise levels. Copies of calculations are provided in Appendix D.

The calculations use a spreadsheet calculation based on Section G.2 of Annex G (informative) of British Standard BS 8233:2014 and BS EN 12354-3:2000. This form of spreadsheet is used by many acoustic consultancy practices.

The calculations confirm that with the proposed scheme for noise insulation measures implemented, intrusive noise levels into rooms of the development comply with BS 8233:2014 guideline values as detailed in Section 3.3 Table 4.

5.3.1 External Walls

External walls of the proposed building are understood to be traditional solid 9" brick masonry external walls:

Description	Octave Band Centre Frequency (Hz)					
	Sound Reduction Index R dB					
	125	250	500	1k	2k	4k
Traditional solid 9" brick	39	44	51	58	63	68

Table 8: External wall sound insulation performance

5.3.2 Glazing

Suitable sound insulation performance of all windows of the development may be achieved with standards double glazing type 4-airgap-4, typically $\geq R_w 30$ dB:

Description	Octave Band Centre Frequency (Hz)					
	Sound Reduction Index R dB					
	125	250	500	1k	2k	4k
4-airgap-4 secondary glazing $\geq R_w 30$ dB	17	17	25	35	35	35

Table 9: Glazing sound insulation performance

5.3.3 Ventilation

It is anticipated that a ventilation system will need to be incorporated into the scheme design, such that residents of the properties are able to have background ventilation without necessarily needing to open windows.

This is ordinarily achieved through use of either passive type "trickle" ventilators or by a room by room or whole house type mechanical ventilation system; the decision on which ventilation strategy is adopted generally being decided for non-acoustic reasons.

It is sometimes required by a Local Planning Authority that where a residential development site is in a potentially noise affected location, then the building's sound insulation measures shall include provision of mechanical ventilation. However, in locations that are not subject to especially high noise levels or listed status then passive type ventilators provide a moderately good level of sound insulation, usually sufficient to comply with the particular noise requirements without the need for mechanical ventilation.

Specification options for either passive ventilators or mechanical ventilation are provided below; it is recommended the developer seeks prior approval with the Reading Borough Council of whichever approach is preferred.

Option 1: Passive Ventilators

Values in Table 10 show a specification for a high acoustic performance passive type ventilator suitable for all parts and room types of the development.

Description	Octave Band Centre Frequency (Hz)					
	Sound Reduction Index $D_{n,e}$ dB					
	125	250	500	1k	2k	4k
Moderate acoustic performance trickle ventilator typically $\geq D_{n,e,w}$ 33dB	33	33	34	35	35	32

Table 10: Specification for ventilator sound insulation performance

Option 2: Mechanical Ventilation

This option is typically either a “whole-house” heat recovery type mechanical ventilation system or a room by room system.

Mechanical ventilation systems by default have relatively high sound insulation performance (i.e. reduce noise from outside to inside), typically $\geq D_{n,e,w}$ 45dB and would readily reduce external noise to comply with the internal noise requirements. If a mechanical ventilation system is used then the acoustic specification is that self-noise of the system must not cause internal noise levels within the rooms of the dwellings to exceed the overall noise requirements.

To achieve the requirements it is recommended that noise from any mechanical ventilation system will need to be circa at least 5dBA lower than the day and night period requirements to allow for the accumulation of noise sources.

Therefore it is recommended that the acoustic specification of overall self-noise from any mechanical ventilation system will need to be $\leq L_{Aeq}$ 30dB for living/dining rooms and bedrooms during the day period, plus $\leq L_{Aeq}$ 25dB for bedrooms during the night period.

Where overall self-noise from mechanical ventilation systems could potentially exceed these limits then noise of the systems would be sufficiently reduced typically by using acoustic type flexible ducting as opposed to standard type flexible ducting between the ventilation system unit and individual room grilles.

5.3.4 Roof Structures & Associated Ceilings

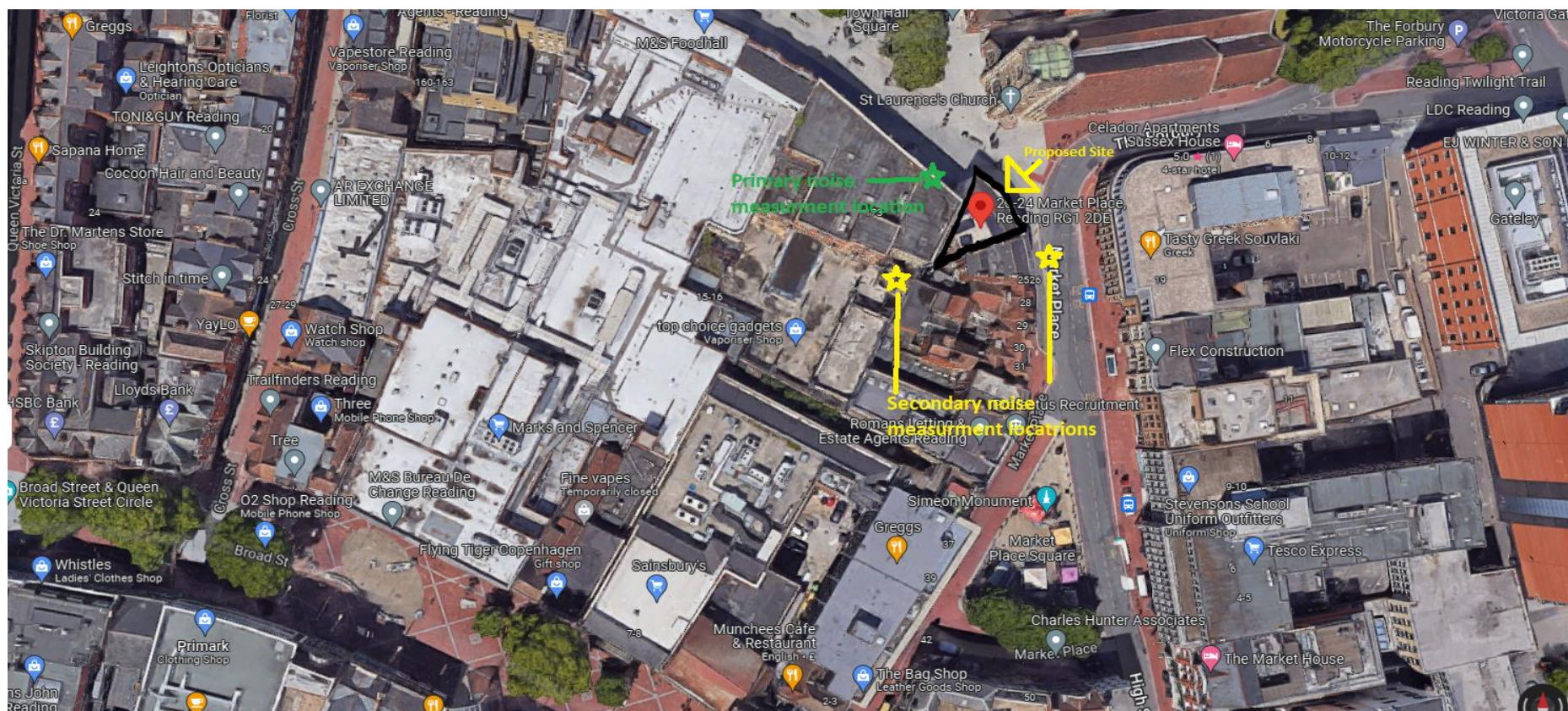
The roof structure and associated ceilings are to be standard flat/pitched timber joist insulated type with double layer plasterboard ceilings below:

Description	Octave Band Centre Frequency (Hz)					
	Sound Reduction Index R dB					
	125	250	500	1k	2k	4k
Insulated flat roof & suspended ceiling	27	37	43	49	57	61

Table 11: Roof & ceiling sound insulation performance

APPENDIX A

Site Location Plan



APPENDIX A

Drawings Of The Development:
Proposed Ground and First Floor Plans



APPENDIX A

Drawings Of The Development:
Proposed Second and Third Floor



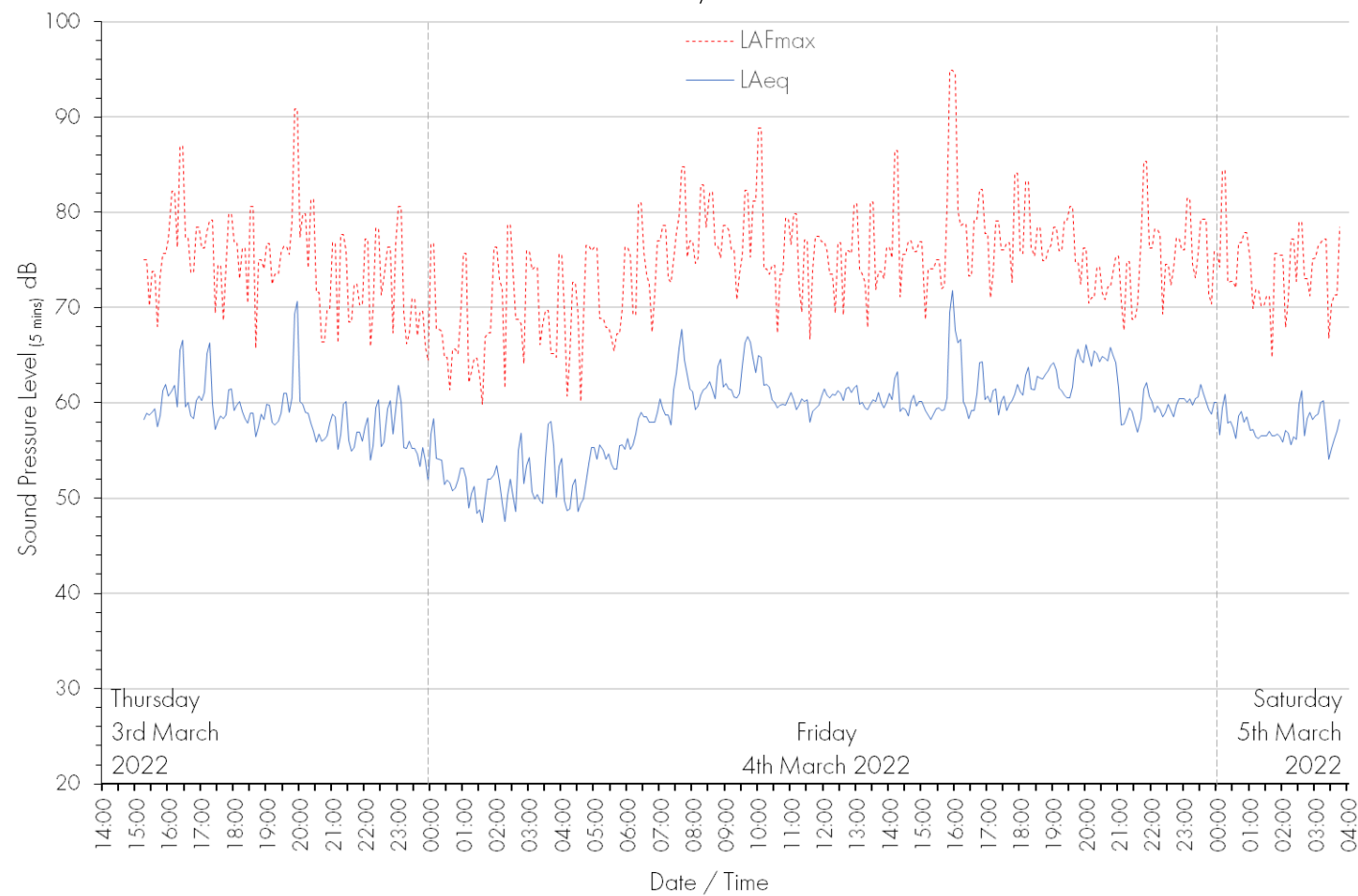
APPENDIX B

Noise Survey Instrumentation

- Svantek Class 1 noise monitoring station model 307 serial number 75982 with integrated preamplifier plus ST30 microphone serial number 78375 in weatherproof outdoor environmental kit and tripod arrangement
- Brüel & Kjær type 2270 Class 1 sound level meter serial number 100020 with type ZC-0032 preamplifier serial number 14437 and type 4189 microphone serial number 2703302
- Brüel & Kjær calibrator type 4231 serial number 3001014 (UKAS-certified)

APPENDIX C

Noise Survey Results



APPENDIX D

Building Envelope Acoustic Calculations

BS EN ISO 12354-3 BUILDING ENVELOPE SOUND INSULATION CALCULATION

SAMPLE ROOM : 3rd floor front façade apartment, living/dining

NOISE CONDITION : Daytime 16 hour Leq 60.7dBA free field level

Equivalent Free-Field External Sound Pressure Level Outside Sample Room:							
Daytime 16hr (7am - 11pm)	Overall dBA	Linear dB at Octave Band Centre Frequency					
		125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz
Leq,ff	60.7	60	57	57	56	54	50
Building Envelope Details For Sample Room:							
Element	Area (m²) or Vent No	Element Specification / Description					
Walls	20.7	Traditional solid 9" brick					
Windows	3.0	4-airgap-4 secondary glazing ≥ Rw30dB					
Doors	0.0	None to room					
Roof & associated ceiling	25.9	Standard flat/pitched timber joist roof with insulation in loft & plasterboard ceilings					
Ventilators	0	None to room					
Element Sound Reduction Index:							
		dB at Octave Band Centre Frequency					
Element	Area (m²) or Vent No	125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz
Walls	20.7	39	44	51	58	63	68
Windows	3.0	17	17	25	35	35	35
Doors	0.0						
Roof & associated ceiling	25.9	27	37	43	49	57	61
Ventilators (Dn,e)	0						
Overall Sound Reduction All Elements Combined		-26.4	-28.8	-36.6	-45.8	-46.9	-47.1
Sample Room Volume (m³):		59.5					
Sample Room Building Envelope Surface Area (m²):		49.6					
Sample Room Characteristics:							
		Reverberation Time (seconds) at Octave Band Centre Frequency					
Sample Room Type:	Living Room	125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz
Reverberation Time In Furnished Sample Room		0.40	0.40	0.35	0.30	0.30	0.30
Calculated Internal Sound Pressure Level In Sample Room:							
Daytime 16hr (7am - 11pm)	Overall dBA	Linear dB at Octave Band Centre Frequency					
		125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz
Leq,2	29.5	40.3	34.4	26.2	15.3	11.8	7.5

APPENDIX D

Building Envelope Acoustic Calculations

BS EN ISO 12354-3 BUILDING ENVELOPE SOUND INSULATION CALCULATION

SAMPLE ROOM : 3rd floor front façade apartment, bedroom

NOISE CONDITION : Daytime 16 hour Leq 60.7dBA free field level

Equivalent Free-Field External Sound Pressure Level Outside Sample Room:							
Daytime 16hr (7am - 11pm)	Overall dBA	Linear dB at Octave Band Centre Frequency					
		125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz
Leq,ff	60.7	60	57	57	56	54	50
Building Envelope Details For Sample Room:							
Element	Area (m ²) or Vent No	Element Specification / Description					
Walls	17.8	Traditional solid 9" brick					
Windows	1.3	4-airgap-4 secondary glazing ≥ Rw30dB					
Doors	0.0	None to room					
Roof & associated ceiling	29.5	Standard flat/pitched timber joist roof with insulation in loft & plasterboard ceilings					
Ventilators	0	None to room					
Element Sound Reduction Index:							
		dB at Octave Band Centre Frequency					
Element	Area (m ²) or Vent No	125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz
Walls	17.8	39	44	51	58	63	68
Windows	1.3	17	17	25	35	35	35
Doors	0.0						
Roof & associated ceiling	29.5	27	37	43	49	57	61
Ventilators (Dn,e)	0						
Overall Sound Reduction All Elements Combined		-27.5	-31.7	-39.3	-47.8	-50.1	-50.5
Sample Room Volume (m ³):		67.9					
Sample Room Building Envelope Surface Area (m ²):		48.6					
Sample Room Characteristics:							
		Reverberation Time (seconds) at Octave Band Centre Frequency					
Sample Room Type:	Bedroom	125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz
Reverberation Time In Furnished Sample Room		0.30	0.30	0.20	0.20	0.20	0.20
Calculated Internal Sound Pressure Level In Sample Room:							
Daytime 16hr (7am - 11pm)	Overall dBA	Linear dB at Octave Band Centre Frequency					
		125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz
Leq,2	25.1	37.3	29.5	20.4	10.9	6.2	1.7

APPENDIX D

Building Envelope Acoustic Calculations

BS EN ISO 12354-3 BUILDING ENVELOPE SOUND INSULATION CALCULATION

SAMPLE ROOM : 3rd floor front façade apartment, bedroom

NOISE CONDITION : Night-time 8 hour Leq 55.5dBA free field level

Equivalent Free-Field External Sound Pressure Level Outside Sample Room:							
Night-time 8hr (11pm - 7am)	Overall dBA	Linear dB at Octave Band Centre Frequency					
		125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz
Leq,ff	55.5	55	52	52	51	49	44
Building Envelope Details For Sample Room:							
Element	Area (m²) or Vent No	Element Specification / Description					
Walls	17.8	Traditional solid 9" brick					
Windows	1.3	4-airgap-4 secondary glazing ≥ Rw30dB					
Doors	0.0	None to room					
Roof & associated ceiling	29.5	Standard flat/pitched timber joist roof with insulation in loft & plasterboard ceilings					
Ventilators	0	None to room					
Element Sound Reduction Index:							
		dB at Octave Band Centre Frequency					
Element	Area (m²) or Vent No	125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz
Walls	17.8	39	44	51	58	63	68
Windows	1.3	17	17	25	35	35	35
Doors	0.0						
Roof & associated ceiling	29.5	27	37	43	49	57	61
Ventilators (Dn,e)	0						
Overall Sound Reduction All Elements Combined		-27.5	-31.7	-39.3	-47.8	-50.1	-50.5
Sample Room Volume (m³):		67.9					
Sample Room Building Envelope Surface Area (m²):		48.6					
Sample Room Characteristics:							
		Reverberation Time (seconds) at Octave Band Centre Frequency					
Sample Room Type:	Bedroom	125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz
Reverberation Time In Furnished Sample Room		0.30	0.30	0.20	0.20	0.20	0.20
Calculated Internal Sound Pressure Level In Sample Room:							
Night-time 8hr (11pm - 7am)	Overall dBA	Linear dB at Octave Band Centre Frequency					
		125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz
Leq,2	19.8	32.0	24.2	15.1	5.6	1.0	-3.5

APPENDIX D

Building Envelope Acoustic Calculations

BS EN ISO 12354-3 BUILDING ENVELOPE SOUND INSULATION CALCULATION

SAMPLE ROOM : 3rd floor front façade apartment, bedroom
 NOISE CONDITION : Night-time 8 hour L_{max} 78dBA free field level

Equivalent Free-Field External Sound Pressure Level Outside Sample Room:							
Night-time 8hr (11pm - 7am)	Overall dBA	Linear dB at Octave Band Centre Frequency					
		125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz
L _{fmax,ff}	78.0	78	74	74	73	71	67
Building Envelope Details For Sample Room:							
Element	Area (m ²) or Vent No	Element Specification / Description					
Walls	17.8	Traditional solid 9" brick					
Windows	1.3	4-airgap-4 secondary glazing ≥ R _w 30dB					
Doors	0.0	None to room					
Roof & associated ceiling	29.5	Standard flat/pitched timber joist roof with insulation in loft & plasterboard ceilings					
Ventilators	0	None to room					
Element Sound Reduction Index:							
		dB at Octave Band Centre Frequency					
Element	Area (m ²) or Vent No	125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz
Walls	17.8	39	44	51	58	63	68
Windows	1.3	17	17	25	35	35	35
Doors	0.0						
Roof & associated ceiling	29.5	27	37	43	49	57	61
Ventilators (D _{n,e})	0						
Overall Sound Reduction All Elements Combined		-27.5	-31.7	-39.3	-47.8	-50.1	-50.5
Sample Room Volume (m ³):		67.9					
Sample Room Building Envelope Surface Area (m ²):		48.6					
Sample Room Characteristics:							
		Reverberation Time (seconds) at Octave Band Centre Frequency					
Sample Room Type:	Bedroom	125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz
Reverberation Time In Furnished Sample Room		0.30	0.30	0.20	0.20	0.20	0.20
Calculated Internal Sound Pressure Level In Sample Room:							
Night-time 8hr (11pm - 7am)	Overall dBA	Linear dB at Octave Band Centre Frequency					
		125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz
L _{fmax,2}	42.3	54.6	46.8	37.6	28.2	23.5	19.0

APPENDIX D

Building Envelope Acoustic Calculations

BS EN ISO 12354-3 BUILDING ENVELOPE SOUND INSULATION CALCULATION

SAMPLE ROOM : 3rd floor rear façade apartment, living/dining

NOISE CONDITION : Daytime 16 hour Leq 55.7dBA free field level

Equivalent Free-Field External Sound Pressure Level Outside Sample Room:							
Daytime 16hr (7am - 11pm)	Overall dBA	Linear dB at Octave Band Centre Frequency					
		125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz
Leq,ff	55.7	55	52	52	51	49	45
Building Envelope Details For Sample Room:							
Element	Area (m²) or Vent No	Element Specification / Description					
Walls	50.5	Traditional solid 9" brick					
Windows	1.0	4-airgap-4 double glazing ≥ Rw30dB					
Doors	0.0	None to room					
Roof & associated ceiling	24.0	Standard flat/pitched timber joist roof with insulation in loft & plasterboard ceilings					
Ventilators	1	Moderate acoustic performance ventilator ≥ Dn,e,w 33dB					
Element Sound Reduction Index:							
		dB at Octave Band Centre Frequency					
Element	Area (m²) or Vent No	125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz
Walls	50.5	39	44	51	58	63	68
Windows	1.0	17	17	25	35	35	35
Doors	0.0						
Roof & associated ceiling	24.0	27	37	43	49	57	61
Ventilators (Dn,e)	1	33	33	34	35	35	32
Overall Sound Reduction All Elements Combined		-29.8	-33.8	-39.4	-42.9	-43.3	-40.5
Sample Room Volume (m³):		55.2					
Sample Room Building Envelope Surface Area (m²):		75.5					
Sample Room Characteristics:							
		Reverberation Time (seconds) at Octave Band Centre Frequency					
Sample Room Type:	Living Room	125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz
Reverberation Time In Furnished Sample Room		0.40	0.40	0.35	0.30	0.30	0.30
Calculated Internal Sound Pressure Level In Sample Room:							
Daytime 16hr (7am - 11pm)	Overall dBA	Linear dB at Octave Band Centre Frequency					
		125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz
Leq,2	24.0	34.0	26.5	20.5	15.3	12.6	11.2

APPENDIX D

Building Envelope Acoustic Calculations

BS EN ISO 12354-3 BUILDING ENVELOPE SOUND INSULATION CALCULATION

SAMPLE ROOM : 3rd floor rear façade apartment, bedroom

NOISE CONDITION : Daytime 16 hour Leq 55.7dBA free field level

Equivalent Free-Field External Sound Pressure Level Outside Sample Room:							
Daytime 16hr (7am - 11pm)	Overall dBA	Linear dB at Octave Band Centre Frequency					
		125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz
	Leq,ff	55.7	55	52	52	51	49
Building Envelope Details For Sample Room:							
Element	Area (m²) or Vent No	Element Specification / Description					
Walls	14.6	Traditional solid 9" brick					
Windows	2.0	4-airgap-4 double glazing ≥ Rw30dB					
Doors	0.0	None to room					
Roof & associated ceiling	13.1	Standard flat/pitched timber joist roof with insulation in loft & plasterboard ceilings					
Ventilators	2	Moderate acoustic performance ventilator ≥ Dn,e,w 33dB					
Element Sound Reduction Index:							
		dB at Octave Band Centre Frequency					
Element	Area (m²) or Vent No	125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz
Walls	14.6	39	44	51	58	63	68
Windows	2.0	17	17	25	35	35	35
Doors	0.0						
Roof & associated ceiling	13.1	27	37	43	49	57	61
Ventilators (Dn,e)	2	33	33	34	35	35	32
Overall Sound Reduction All Elements Combined		-25.8	-27.5	-32.9	-36.2	-36.3	-33.5
Sample Room Volume (m³):		30.2					
Sample Room Building Envelope Surface Area (m²):		29.7					
Sample Room Characteristics:							
		Reverberation Time (seconds) at Octave Band Centre Frequency					
Sample Room Type:	Bedroom	125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz
Reverberation Time In Furnished Sample Room		0.30	0.30	0.20	0.20	0.20	0.20
Calculated Internal Sound Pressure Level In Sample Room:							
Daytime 16hr (7am - 11pm)	Overall dBA	Linear dB at Octave Band Centre Frequency					
		125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz
	Leq,2	26.9	35.3	30.1	23.1	18.9	16.4

APPENDIX D

Building Envelope Acoustic Calculations

BS EN ISO 12354-3 BUILDING ENVELOPE SOUND INSULATION CALCULATION

SAMPLE ROOM : 3rd floor rear façade apartment, bedroom

NOISE CONDITION : Night-time 8 hour Leq 50.5dBA free field level

Equivalent Free-Field External Sound Pressure Level Outside Sample Room:							
Night-time 8hr (11pm - 7am)	Overall dBA	Linear dB at Octave Band Centre Frequency					
		125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz
Leq,ff	50.5	50	47	47	46	44	39
Building Envelope Details For Sample Room:							
Element	Area (m²) or Vent No	Element Specification / Description					
Walls	14.6	Traditional solid 9" brick					
Windows	2.0	4-airgap-4 double glazing ≥ Rw30dB					
Doors	0.0	None to room					
Roof & associated ceiling	13.1	Standard flat/pitched timber joist roof with insulation in loft & plasterboard ceilings					
Ventilators	2	Moderate acoustic performance ventilator ≥ Dn,e,w 33dB					
Element Sound Reduction Index:							
		dB at Octave Band Centre Frequency					
Element	Area (m²) or Vent No	125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz
Walls	14.6	39	44	51	58	63	68
Windows	2.0	17	17	25	35	35	35
Doors	0.0						
Roof & associated ceiling	13.1	27	37	43	49	57	61
Ventilators (Dn,e)	2	33	33	34	35	35	32
Overall Sound Reduction All Elements Combined		-25.8	-27.5	-32.9	-36.2	-36.3	-33.5
Sample Room Volume (m³):		30.2					
Sample Room Building Envelope Surface Area (m²):		29.7					
Sample Room Characteristics:							
		Reverberation Time (seconds) at Octave Band Centre Frequency					
Sample Room Type:	Bedroom	125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz
Reverberation Time In Furnished Sample Room		0.30	0.30	0.20	0.20	0.20	0.20
Calculated Internal Sound Pressure Level In Sample Room:							
Night-time 8hr (11pm - 7am)	Overall dBA	Linear dB at Octave Band Centre Frequency					
		125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz
Leq,2	21.7	30.1	24.9	17.8	13.6	11.1	9.8

APPENDIX D

Building Envelope Acoustic Calculations

BS EN ISO 12354-3 BUILDING ENVELOPE SOUND INSULATION CALCULATION

SAMPLE ROOM : 3rd floor rear façade apartment, bedroom

NOISE CONDITION : Night-time 8 hour L_{max} 73dBA free field level

Equivalent Free-Field External Sound Pressure Level Outside Sample Room:							
Night-time 8hr (11pm - 7am)	Overall dBA	Linear dB at Octave Band Centre Frequency					
		125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz
L _{fmax,ff}	73.0	73	69	69	68	66	62
Building Envelope Details For Sample Room:							
Element	Area (m ²) or Vent No	Element Specification / Description					
Walls	14.6	Traditional solid 9" brick					
Windows	2.0	4-airgap-4 double glazing ≥ Rw30dB					
Doors	0.0	None to room					
Roof & associated ceiling	13.1	Standard flat/pitched timber joist roof with insulation in loft & plasterboard ceilings					
Ventilators	2	Moderate acoustic performance ventilator ≥ D _{n,e,w} 33dB					
Element Sound Reduction Index:							
		dB at Octave Band Centre Frequency					
Element	Area (m ²) or Vent No	125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz
Walls	14.6	39	44	51	58	63	68
Windows	2.0	17	17	25	35	35	35
Doors	0.0						
Roof & associated ceiling	13.1	27	37	43	49	57	61
Ventilators (D _{n,e})	2	33	33	34	35	35	32
Overall Sound Reduction All Elements Combined		-25.8	-27.5	-32.9	-36.2	-36.3	-33.5
Sample Room Volume (m ³):		30.2					
Sample Room Building Envelope Surface Area (m ²):		29.7					
Sample Room Characteristics:							
		Reverberation Time (seconds) at Octave Band Centre Frequency					
Sample Room Type:	Bedroom	125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz
Reverberation Time In Furnished Sample Room		0.30	0.30	0.20	0.20	0.20	0.20
Calculated Internal Sound Pressure Level In Sample Room:							
Night-time 8hr (11pm - 7am)	Overall dBA	Linear dB at Octave Band Centre Frequency					
		125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz
L _{fmax,2}	44.2	52.6	47.4	40.4	36.1	33.7	32.4