

JOSTEC

BUILDING REGULATIONS COMPLIANCE SERVICES



REPORT TITLE: MIXED USE DOCUMENT AT
27-32 MARKET PLACE, READING

RECORD REFERENCE: 2212

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PART

- A noise survey and assessment has been carried out by Jostec for 22 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 and pedestrian traffic.
- The development site is not exposed to occasional or activities.
- surveys are used to assess scheme or noise insulation measures for development scheme which includes specification for acoustic performance glazing and ventilation and forces calculation of the overall building envelope.

1. INTRODUCTION

Jostec has been commissioned to undertake a noise survey and assessment for a retail/residential development at 22-23 Market Place, Reading RG1 2DE.

A scheme of noise insulation measures is proposed for consideration of any proposed commercial plant/equipment noise acoustic performance of the separating floor between commercial ground and residential first floor levels and for grazing and ventilation within the residential accommodation 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
- Details of noise survey including noise source characterisation
- Noise assessment.

2. DEVELOPMENT DESCRIPTION

The development site is located in Reading town centre, adjacent to the A4, and is currently a retail/commercial business. The site is adjacent to the A4 and the texture of ground floor is predominantly commercial.

The proposed development includes renovation and extension of the existing building to provide a mixed commercial and residential development including basement and first floor retail units above to third floor levels. The proposed development is shown in Appendix A.

Noise levels are monitored towards the front of the development and typical of an urban location. They comprise principally of contributions from road/pedestrian traffic along Market Place and commercial activity associated with businesses. Noise levels to the rear of the development are relatively lower due to shielding afforded by the building structure. 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 accommodation located on upper floors of the proposed development include:

1. noise from the lift shaft serving the commercial units;
2. noise transfer via separating ground/first floor and
3. ambient environmental noise.

The proposed development has been designed in accordance with the standards that 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
"Industrial and commercial sound"
- BS 6871:2014
"Guidance on Sound Insulation and Noise Reduction for Buildings"

The criteria detailed in these standards appropriate to the noise sources listed above are given 3.1 to 3.3.

Commercial Plant Equipment – Criteria

BS 4142: 2014 (A1): 2019

BS 4142 (A1) is currently used by local authorities such as Reading Council in assessing noise from commercial plant equipment – BS

according to the numerical difference between the rating level of the background sound level, typically measured at 1m distance from the noise-associated residential window.

Whilst the exact nature of the ground floor uses and their requirements for plant equipment is unknown at this time, the impact criteria is nonetheless considered relevant in the context of any potential commercial plant noise at its development and is summarised in Table 1 below:

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

Table 1: BS 4142 rating level impact

In addition to the BS 4142 criteria reproduced in Table 1, the Council may additionally

background sound level – i.e. Rating level ≤ background sound level +5dB or +10dB

From experience of the Council, it is anticipated that a Rating level of +10dB or greater will require Council intervention. The current Reading Borough Council noise requirement used to assess any potential commercial plant noise is summarised below in Table 2, which also includes a indication of impact criteria:

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

Table 2: Reading Borough Council impact indication together with Reading Borough

It is recommended to verify any specific Reading Borough noise requirement for the installation of any plant equipment.

2. Separation of separating ground/first floor Residential from Criteria

The author is aware that many local authorities 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 (BREVV) as a benchmark by which to set more stringent criteria.

The current BREVV minimum airborne sound insulation performance for floors in new build residential properties is $R_{w, \text{min}} \geq 45 \text{ dB}$, so various local authorities often require a +5dB and in many cases may additionally depend on the nature of the commercial units/business.

BS 6859:2014 "Guidance on Sound Insulation and Noise Reduction for Buildings" (BSI) Table 2 gives a list of minimum airborne sound insulation $D_{nT,w}$ values (which are not $R_{w, \text{min}} + C_{tr}$ values) for residential structures broadly dependent on the noise activity level shown below in Table 3.

Noise activity or source room	Noise sensitivity or receiving room		
	Very high	Medium	Sensitive
Confidential	Very high	47	57 A)
High	47	47	47
Low	47	47	47
Moderate	very high	57	57 A)
High	47	47	47
Low	37	37	37
Private	Very high	7	57 A)
High	37	47	47
Low	37	37	37

Nc also influences privacy

For $D_{nT,w}$ values, some discrepancies require these levels should be deduced where practical

Table 3. Example on site sound insulation matrix (as $R_{w, \text{min}}$)

It is recommended that you seek the advice of Building Research Association specific airborne sound insulation performance criteria for the separating ground/first floor prior to design and construction.

3 Ambient Environmental Criteria

regarding the assessment of ambient environmental noise is access to residential accommodation. The methodology and guideline noise levels given in BS 8233:2014 Section 7.7.2 *Internal ambient noise level* is typically approved for use by local authorities including Reading Council and is considered appropriate for use in this assessment.

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

Activity	Location	Daytime (07.00 to 22.00 hours)	Nighttime (22.00 to 07.00 hours)
Resting	Bedroom	45dB $L_{Aeq,15hr}$	35dB $L_{Aeq,15hr}$
Dining	Dining room	45dB $L_{Aeq,15hr}$	
Use of kitchen	Kitchen	45dB $L_{Aeq,15hr}$	

Table 4 Indoor ambient noise levels for dwellings

Note 4 to Table 4 in Section 7.7.2 of BS 8233:2014 states that 'The guideline values may be set in terms of $L_{Aeq,15hr}$ or L_{Amax} 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_{Amax} criterion for bedrooms for this device.

BS 8233:2014 does not however provide any specific numerical guidance on night period L_{Amax} values for noise into bedrooms. The previous guidance for bedrooms was 45dB L_{Amax} and is keeping with World Health Organisation noise guideline values, the 2002 WHO criterion of 45dB L_{Amax} .

The 2002 WHO criterion of 45dB L_{Amax} is intended to be exceeded no more than once per year.

The L_{Amax} value for the device is not intended to regularly exceed 45dB, it is not intended that the requirement be applicable to infrequent night period very high noise events or passing emergency vehicles.

4. STUDY VIEW

In order to assess the scheme for noise in the vicinity of the proposed development and to obtain background sound levels, a noise survey was carried out by JOSTEC at the representative location shown in the study view.

4.1 Noise Survey Details & Procedure

A noise survey has been carried out at the representative location to establish background sound level meter from Thursday 3rd March 2022 to Saturday 5th March 2022. The weather included mostly dry and calm/light wind conditions during the day and also the night periods of the survey.

A primary short term standard noise survey measurement location was selected at ground level on the front side of 17/31/51 Market Street looking over the road towards the entrance. This location was chosen as a secure location at which to record noise levels from passing road/traffic on Market Place, The Esplanade and surrounding streets.

The position was achieved by establishing measurement equipment on a tripod/pc stand externally on ground floor at a height of c.9m above ground level and 1m from the exterior of the building to provide 1m façade levels. Measurements were recorded in terms of 5 minute samples of noise levels, L_{A15} , A_{eq} and L_{Afm} values together with octave band L_p measurements during the survey.

Additional short term area noise measurements were chosen around the site with equipment positioned 1.5m above ground level. Locations relative to levels at the primary location are shown in the study view.

Fig-1 Noise survey and additional measurement locations are indicated on the aerial image shown in Appendix A.

4.2 Noise Survey Instrumentation

Details of the instrumentation used for the noise survey are shown in the study view. The sound level meter used was a Brüel & Kjær 2250 with a significant drift in sensitivity recorded.

Noise Survey Results & Observations

Noise levels to the development site comprise principally of contributions from passing road and pedestrian traffic on Town Hall Square, The Forbury and surrounding activity associated with commercial activity in the locality and distant road traffic on surrounding roads. Noise levels rise morning to midday where they remain at their highest until the late evening / night period.

Short term ground level measurements were taken at the rear of the development at 27.5m marker. Place were c.2dB higher than those recorded at the primary measurement position. Short term measurements taken at the rear of the development at 27.5m marker were c.2dB lower than those recorded at the primary measurement position. The following table summarises noise survey data recorded at the primary measurement position.

Standard assessment procedures measured the ground level 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_{Aeq} , L_{Aeq} and L_{Amax} values are provided in graphical format in Appendix C. Summary of day and night period location-specific equivalent free-field L_{Aeq} , L_{Aeq} and L_{Amax} results are shown in table 3 below.

Location	Time Period	L_{Aeq} (dB)	L_{Aeq} (dB)	L_{Amax} (dB)
Location 1: Front Facade - 175 Esplanade Street	Day (07:00 - 23:00)	47	40.0	55.0
Location 2: Front Facade - 27.5m Marker	Day (07:00 - 23:00)	49.0	42.0	50.0
Location 3: Rear Facade - 27.5m Marker	Day (07:00 - 23:00)	44	37.0	45.0

Table 3: Summary of average noise levels for day and night periods

In order to ensure compliance with the 45dB night period $L_{AFmax,t}$ criterion for residential developments, a statistical analysis of measured noise levels is required for the first five days of the development. For the worst case scenario, it is assumed that the measured night $L_{AFmax,t}$ value is exceeded 5% of the time (95th percentile) and is shown below in figure 1:

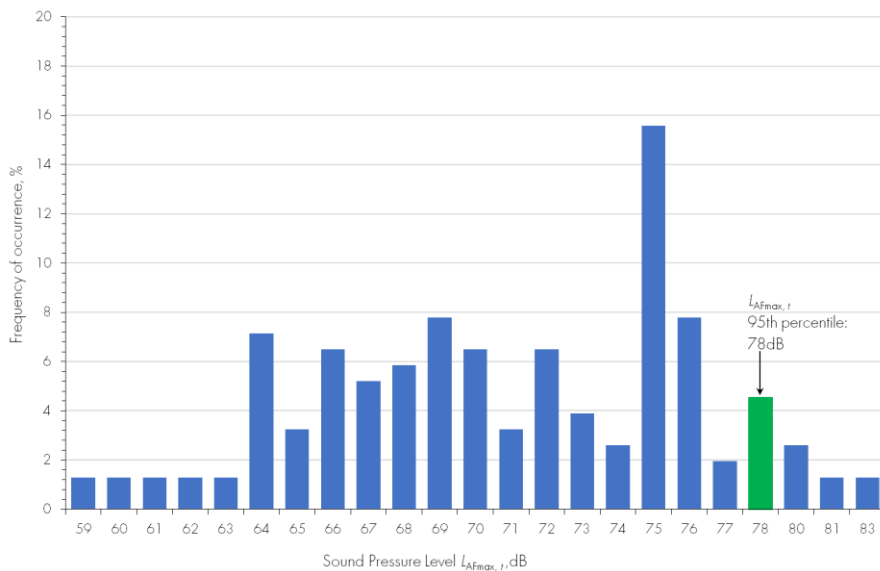


Figure 1: Frequency of occurrence of night period sound pressure levels

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

Table 5 summarises the typical night period $L_{AFmax,t}$ values taken from Table 3 together with the typically occurring highest $L_{AFmax,t}$ value from Figure 1. The calculation of the building envelope sound insulation scheme in Section 5.2

Time period	$L_{AFmax,t}$ (dB)	$L_{AFmax,t}$ (dB)
Day 0: 23:00	60	
Night 2: 00:00	55	70

Table 5: Summary noise levels for day and night calculations

NOISE ASSESSMENT

It can be seen from Table 1 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.

Partial Planning Equipment Noise Assessment

The calculated noise 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 level from the noise survey results for day and night periods. $L_{Aeq,1h}$ (Location #3, worst case scenario) has been assessed and chosen using the statistical analysis method detailed in Note 4. Section 6.1.4 of BS 4142. Statistical analysis of the background sound level results is shown in Figures 2 & 3 below and overleaf:

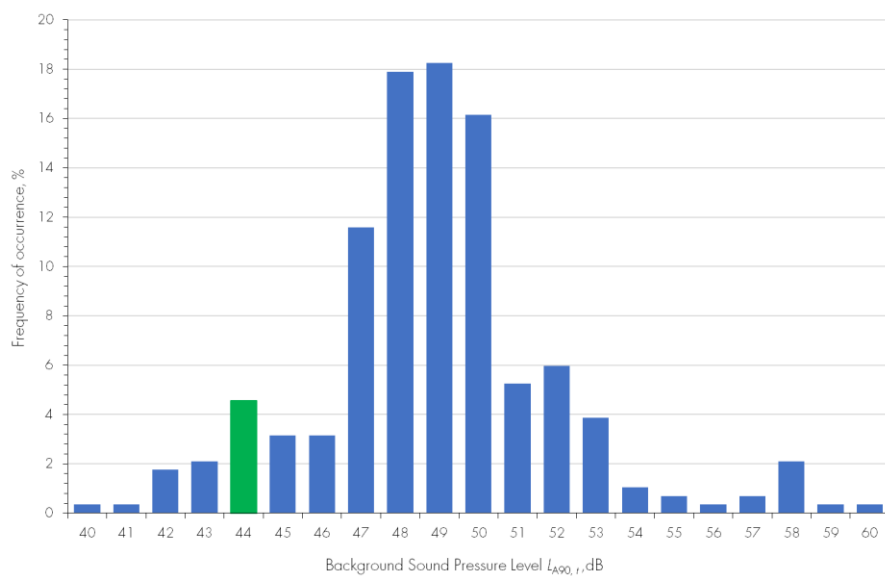


Figure 2: Frequency of occurrence of day period background sound levels

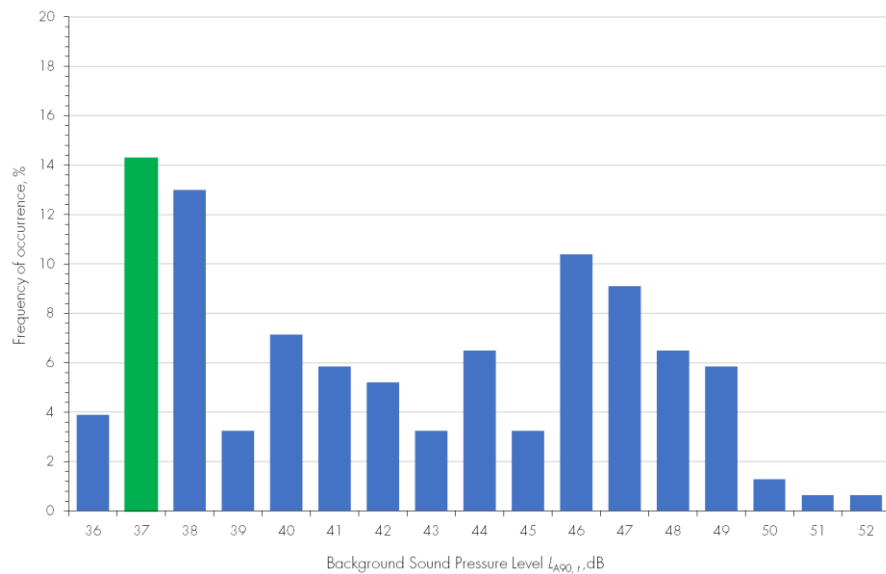


Figure 2: Frequency of occurrence of high period background sound levels

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

	Day period 07:00 – 23:00	Night 23:00 – 07:00
Background sound level $L_{Aeq,1dB}$	44 dBA	37 dBA

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

Where relevant equipment is scheduled to be installed at the proposed premises, the values in Table 7 may be used to compare against equipment rating levels using the criteria given in Section 3 – Table 3. For part or all or both day and night periods, the representative minimum background sound level value is to be used in assessment.

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

5.2 Separating Ground Floor Commercial and Residential Accommodation

The proposed separating floor between ground floor commercial units and first floor residential accommodation will be designed to protect the amenity of residents and shall be constructed as the most effective commercial building structure.

The proposed separating floor shall be constructed to the minimum $D_{nT,w}$ values detailed in Section 2.2 – Table 3 for the proposed floor construction and it is recommended to seek the advice of Reading Borough Council for any specific airborne sound insulation performance criteria relating to design and construction.

5 Building Envelope Sound

Summary

For this development the scheme of noise insulation measures to protect against noise to inside the residential dwellings relates to the acoustic design and specification of elements of the residence building envelope which includes the structure between the ground floor residential accommodation, external walls, ground floor and roof/ceiling structures.

It is recommended to consult Reading Borough Council for any specific criteria required to meet performance criteria for the separating ground/first floor prior to design and construction.

The external walls and roof/ceiling structures to be developed will be designed to 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 the windows.

It follows that the design calculation procedures outlined in Section G.2 of Annex G (Informative) of British Standard BS 8233:2014 and BS EN 12354-1:2000 have been established and a scheme for noise insulation measures for the relevant residential building envelope is provided in Sections 5.1 to 5.3 on the following pages.

The scheme provides for day and night period noise intrusion into the living/ dining/ kitchen area of the development. The scheme is based on the assumption that the building has the highest ratio of glazing to floor area, roof/ceiling system and with potentially high internal sound levels. Calculations are provided to

The calculations use a spreadsheet calculation based on Section G.2 of Annex G (Informative) of British Standard BS 8233:2014 and BS EN 12354-1:2000. 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 will be in compliance with BS 8233:2014 and BS EN 12354-1:2000 as detailed in Section 2.3 Table 1.

5.3.1 External walls

external walls of the proposed development are required to be traditional solid masonry construction:

Description	Octave Band Cent Sound Reduction Index $R_{w,fb}$ dB					
	5	250	500	1k	2k	4k
Traditional solid masonry	37	44	47	50	43	38

Table 8: External wall sound insulation performance

5.3.2 Glazing

development site includes existing glazing and consequently at the existing glazing may need to be retained and replaced with double glazing. Suitable glazing may be achieved with moderate acoustic performance. Double glazing type 4-airgap – typically $R_{w,3}$ 30.

Description	Centre frequency (Hz) Sound Reduction Index $R_{w,fb}$ dB					
	5	250	500	1k	2k	4k
Double glazing type 4-airgap $R_{w,3} \geq 30$	17	17	25	35	5	5

Table 9: Glazing sound insulation performance

5.3.3 Ventilation

ventilation system should 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 "background" ventilators or by a room by mechanical ventilation. The decision as to which ventilation system 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, or is subject to listed building conservation status, then the provision of mechanical ventilation. However, where high noise levels or listed status mean passive type ventilation is not 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; intended the developer seeks prior approval with the Reading Boro Council or whichever approach is preferred.

Option 1: Passive Ventilators

Values in Table 1 show a specification for acoustic performance for a ventilator for all parts and room types of the development.

Description	Octave Band Cent					
	125	250	500	1k	2k	4k
Model acoustic performance ventilator $D_{n,w}$ 50dB	33	33	4	35	5	32

Table 1: Specification for ventilator sound insulation performance

Option 2: Mechanical

This option is typically either a "whole house" mechanical ventilation system or a room by room mechanical ventilation system.

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

To achieve the requirements it is recommended that the system will need to be sized at least 5dB A lower than the day and night period requirements to allow for noise sources.

Therefore it is recommended that the acoustic specification of overall self-extraction from any mechanical ventilation system will need to be $\leq L_{Aeq, 20-22}$ for living / dining rooms and bedrooms during the day period, and $\leq L_{Aeq, 23-24}$ 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

Roofed ceilings are to be standard flat/pitched timber joist insulated type with double plasterboard ceilings below:

Description	Octave Band Cent					
	Sound Reduction Index $R_{w,T}$					
	50	250	500	1000	2000	4000
Standard suspended ceiling	27	37	3	47	57	61

Table 11: Roof & ceiling sound insulation performance

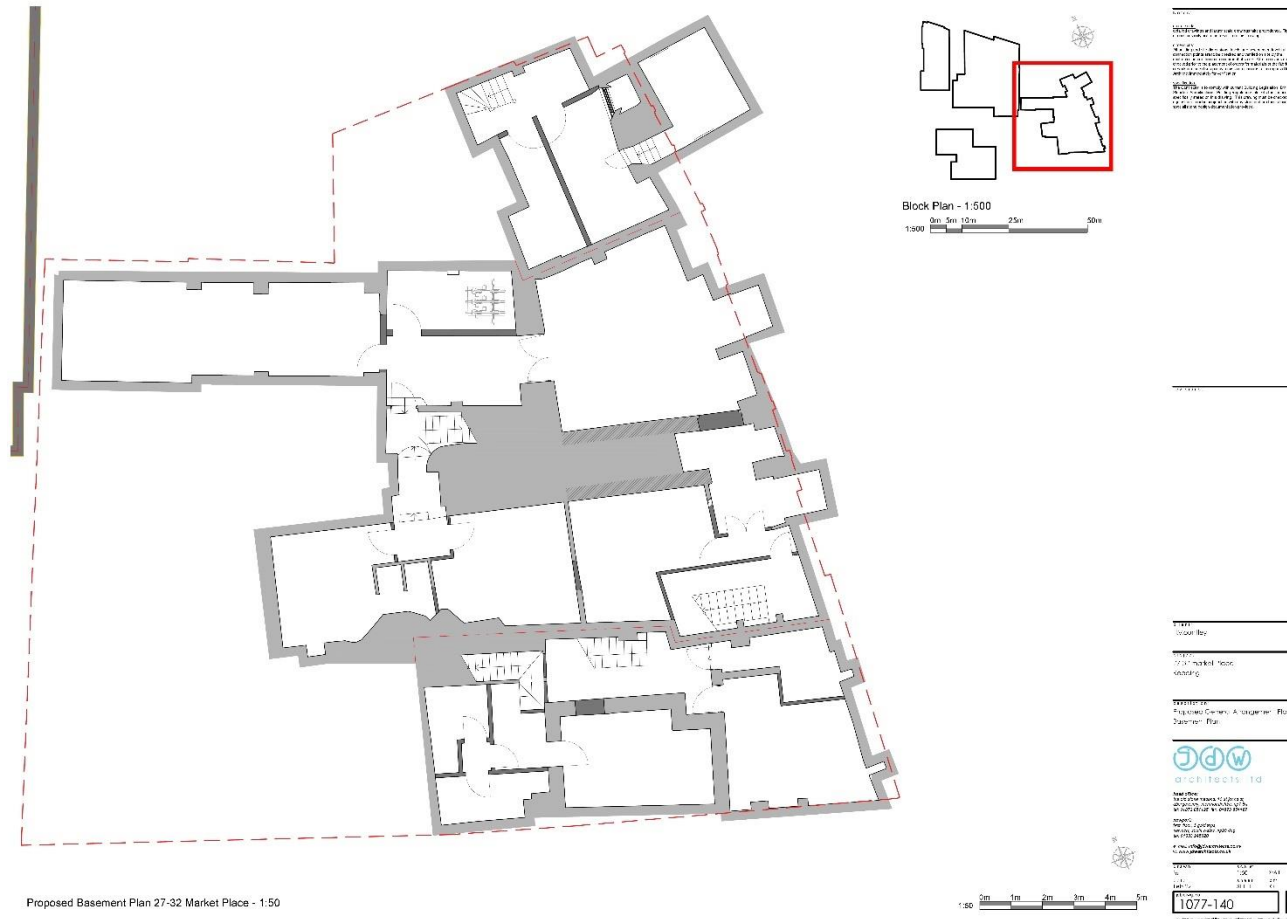
APPENDIX A

LOCATION



APPENDIX A

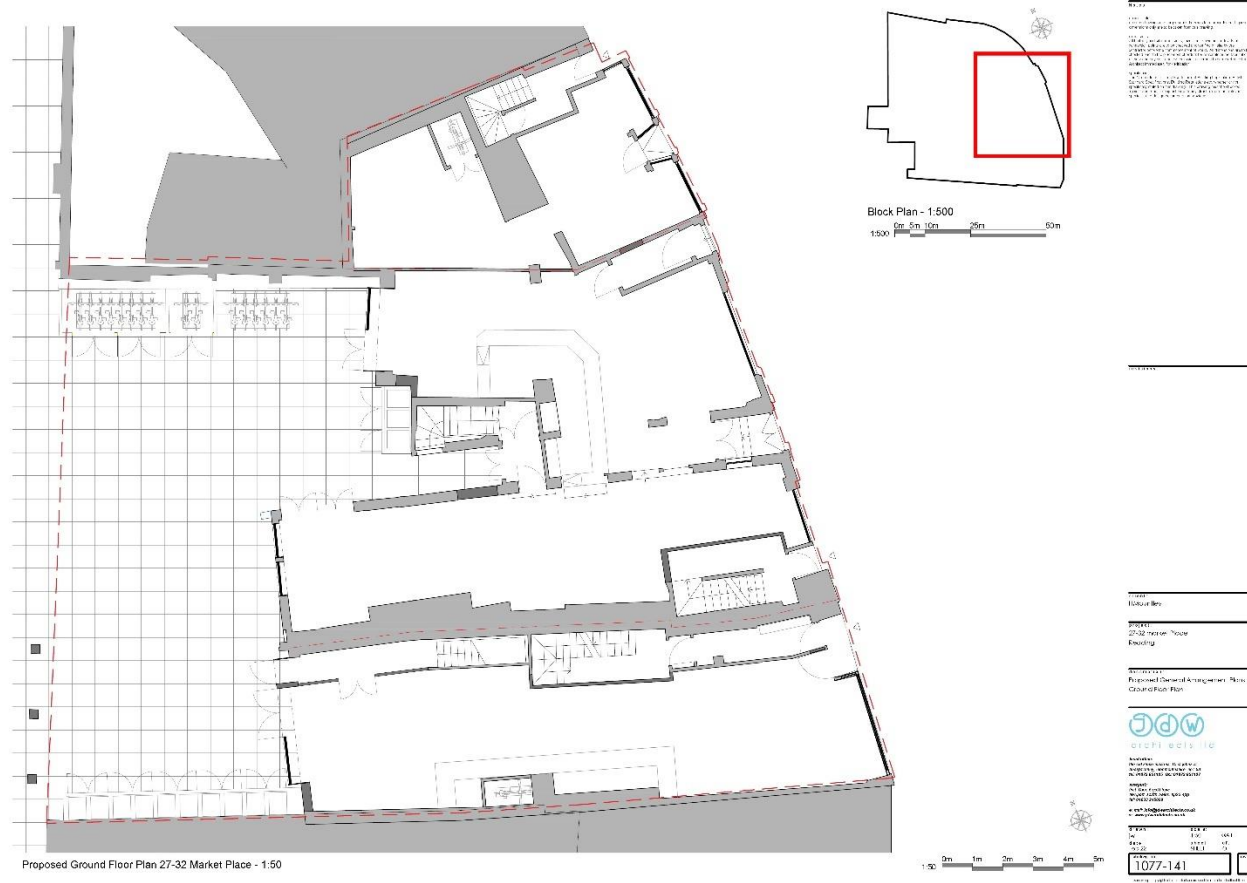
Drawings Of The Development.
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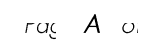
APPENDIX

Drawings Of The Development:

Block Plan - 1:500



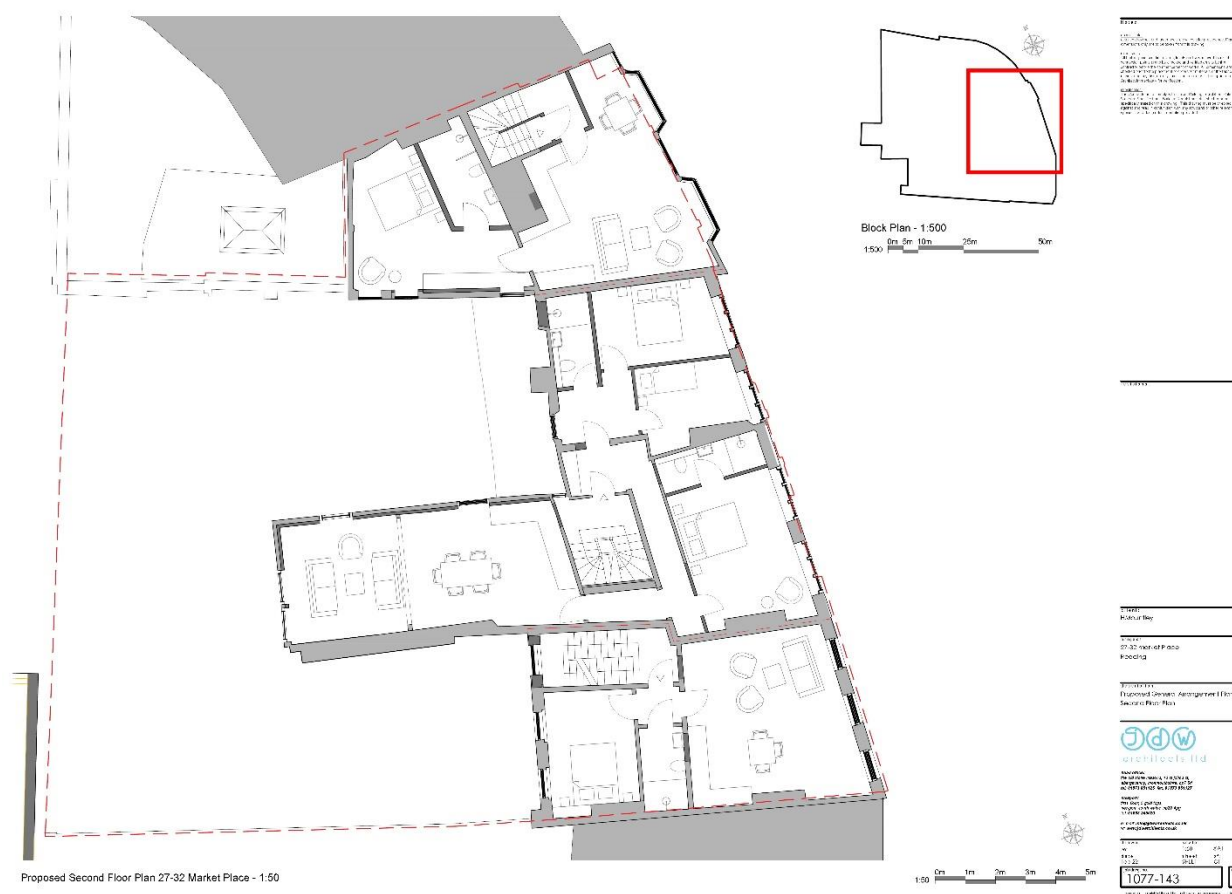
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APPENDIX

Drawings Of The Development:

Second Floor



APPEN

Drawings Development:
proposed third floor

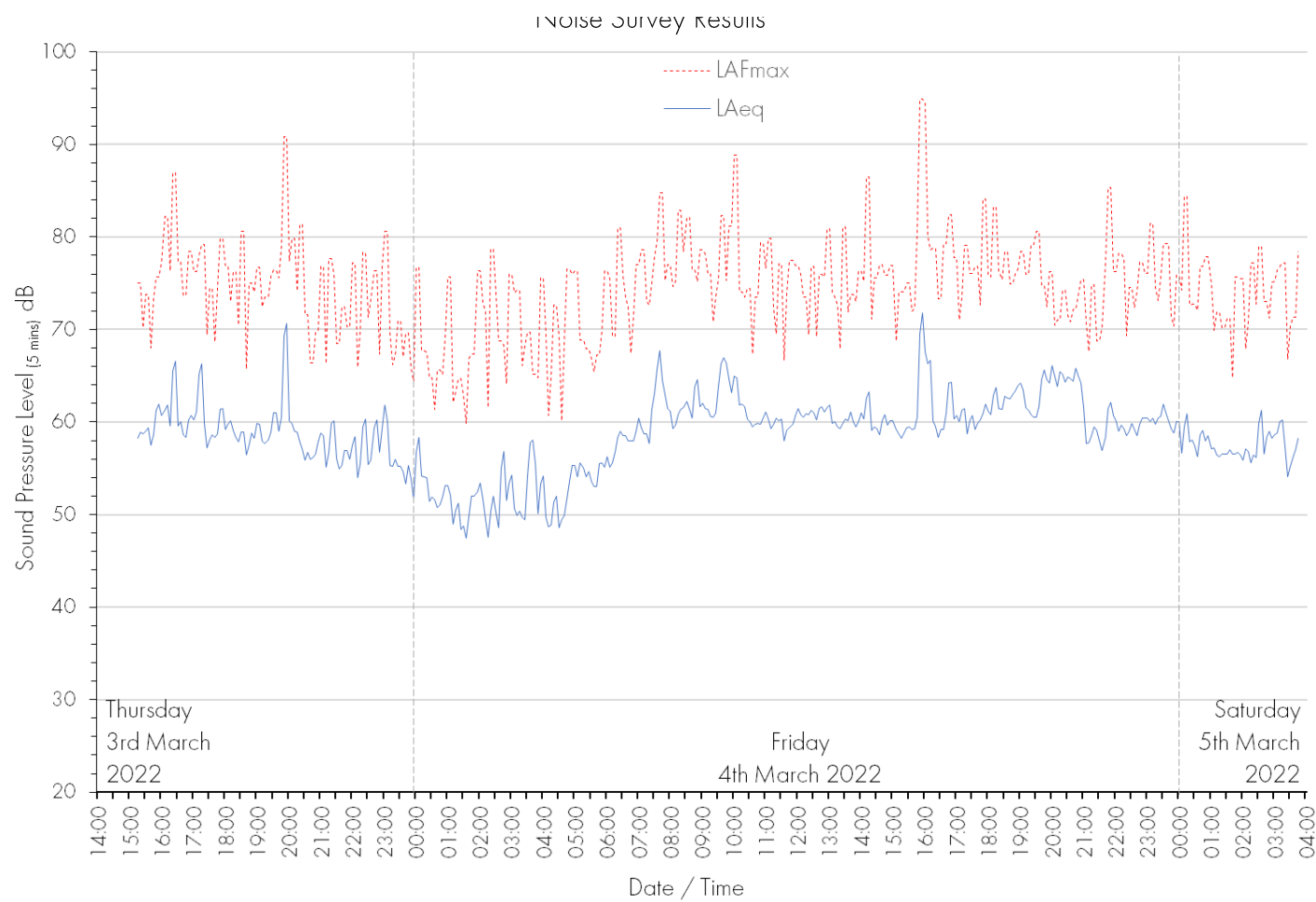


APPENDIX D

Noise Survey Instrumentation

- Brüel & Kjær type 8001 Class 1 sound level meter serial number 73902 with type 8003 microphone serial number 70575 in weatherproof outdoor environmental kit and tripod arrangement
- Brüel & Kjær type 2270 Class 1 sound level meter serial number 100000 with type 2270-0002 preamplifier serial number 14427 and type 4190 microphone serial number 2703302
- Brüel & Kjær calibration type 4221 serial number 5001014 (UKAS certified)

APPENDIX C



APPENDIX D

Building Envelope Acoustic Calculation

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:							
Element	Area (m²) or Vent No	dB at Octave Band Centre Frequency					
		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 Ac

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 (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:							
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:							
Element	Area (m²) or Vent No	dB at Octave Band Centre Frequency					
		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_{fmax} 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
Lfmax,ff	78.0	78	74	74	73	71	67
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
Lfmax,2	42.3	54.6	46.8	37.6	28.2	23.5	19.0

DIX D

Building Envelope

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 (m ²) 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:							
Element	Area (m ²) or Vent No	dB at Octave Band Centre Frequency					
		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	45
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:							
Element	Area (m²) or Vent No	dB at Octave Band Centre Frequency					
		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	15.1

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:							
Element	Area (m²) or Vent No	dB at Octave Band Centre Frequency					
		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

DIX D

Building Envelope A

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_{fmax} 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
Lfmax,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 ≥ Dn,e,w 33dB					
Element Sound Reduction Index:							
Element	Area (m ²) or Vent No	dB at Octave Band Centre Frequency					
		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
Lfmax,2	44.2	52.6	47.4	40.4	36.1	33.7	32.4