

Acoustic Consultancy Report

20926/3/1/3

Acoustic Report

Report Prepared For

Createspace Design Ltd
63 London Street
15 September 2022

Report Author

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Checked By

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i) Executive Summary

A residential re-development is proposed at 63 London Street, Reading. This acoustic report has been prepared by LCP on behalf of Createspace Design Ltd., to assist in technical design and compliance with regulations.

The proposed re-development is to allow for the conversion of roof space to a two-bedroom flat.

This is an acoustic design report. It is principally concerned with the following aspects of the design:

Design Aspect(s) Assessed in This Report

Existing site noise levels;

Internal ambient noise levels.

In all cases the design has been assessed, and where the specification has not been met, mitigation has been specified.

This report concludes that:

With the construction and glazing specified within section 5 of this report, internal ambient noise levels can achieve local authority and BS8233 design criteria.

ii) Document History

Issue	Date	Issue Details	Issued By	Checked By
1	15 th September 2022	Initial Issue	JT	MB

1 Introduction

A residential re-development is proposed at 63 London Street, Reading. This acoustic report has been prepared by LCP on behalf of Createspace Design, to assist in technical design and compliance with regulations.

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Internal ambient noise levels.

2 Policy, Standards and Guidance

2.1 National Policy

2.1.1 National Planning Policy Framework (NPPF)

The National Planning Policy Framework (NPPF) sets out the Government's planning policies for England.

The planning system is required to contribute to and enhance the natural and local environment. One of the aims is therefore to prevent both new and existing development from contributing to or being put at unacceptable risk from noise, or being adversely affected by unacceptable levels of noise pollution.

Paragraph 123 of the NPPF states that planning policies and decisions should aim to:

- avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;
- mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions;
- recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established; and
- identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.

2.1.2 Noise Policy for England (NPSE)

The overarching framework for national noise policy is the Noise Policy Statement for England (NPSE). The long-term vision identified in the policy is to:

'Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development.'

The aims of the policy are:

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

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

The NPSE introduces the concept of adverse effects common to toxicology to the assessment of noise impacts:

No Observed Effect Level (NOEL) - the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.

Lowest Observed Adverse Effect Level (LOAEL) - the level above which adverse effects on health and quality of life can be detected.

Significant Observed Adverse Effect Level (SOAEL) - the level above which significant adverse effects on health and quality of life occur.

Noise effect levels are not set at fixed figures but vary depending on the context and character of the noise and site-specific factors which may impact on the severity of the effect. The NPSE states:

'It is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times. It is acknowledged that further research is required to increase our understanding of what may constitute a significant adverse impact on health and quality of life from noise. However, not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available.'

2.1.3 National Planning Practice Guidance

Practical guidance on how the NPPF should be applied is contained within the National Planning Practice Guidance (NPPG). *The guidance includes qualitative examples of how to interpret adverse effect levels in a Planning context.*

Table 1: NPPF Procedure for residential developments

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

The NPPG also gives further guidance on the factors influencing whether noise may be a concern at the planning stage and how adverse effects can be mitigated, including through the use of good acoustic design.

2.2 Reading Borough Council Policy

7. **[Pre-commencement]** No development shall commence on site until a detailed scheme, informed by an assessment of the current noise environment, including the commercial unit below, 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 scheme itself shall be designed, specified and constructed so that the sound insulation performance of the structure and the layout of the dwellings are such that the indoor ambient noise levels do not exceed the values detailed in

Table 4 of BS 8233:2014 and the and that the individual noise events do not exceed 45 dB LA,max,F more than 10 times a night. Where opening windows will lead to an internal noise level increase of 5 dBA or greater above BS 8233:2014 recommended internal levels, the scheme shall include provision of alternative mechanical ventilation with minimum performance equivalent to a mechanical heat recovery (MVHR) system with cool air bypass as an alternative means of cooling and ventilation. Noise from the system should not result in BS8233 internal levels being exceeded. 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: These details are required due to insufficient information being contained within this submission and in order to safeguard the amenity of occupants in accordance with Policy CC8 of the Reading Borough Local Plan 2019.

2.3 Relevant Standards and Guidance

2.3.1 World Health Organisation (WHO) Guidelines for Community Noise (1999)

The WHO's 'Guidelines for Community Noise' gives the following relevant noise criteria:

Table 2: Guideline values for community noise, from Guidelines for Community Noise (WHO, 1999)

Specific Environment	L _{Aeq, T} dB	Time Base (hours)	L _{Amax, fast} dB
Outdoor living area (serious annoyance, daytime and evening)	55	16	-
Outdoor living area (moderate annoyance, daytime and evening)	50	16	-
Dwelling, indoors	35	16	-
Inside bedrooms	30	8	45
Outside bedrooms	45	8	60

A secondary criterion of 45dB L_{Amax} is also considered in relation noise. WHO only considers it appropriate to provide a criterion for the internal L_{Amax} level during the night-time period as it is a useful parameter to assess sleep disturbance. It is recommended that internal noise levels should not exceed 45dB L_{Amax} during the night and the document states that:

'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'

The WHO's 'Guidelines for Community Noise' also gives the following general guidance on the expected sound insulation performance of a façade with a partly open window, it states that:

"At night, sound pressure levels at the outside facades of the living spaces should not exceed 45 dB L_{Aeq} and 60 dB L_{Amax} , so that people may sleep with bedroom windows open. These values have been obtained by assuming that the noise reduction from outside to inside with the window partly open is 15 dB."

2.3.2 BS8233:2014

Guidance is provided in BS8233:2014, this is shown in the following table:

Table 3: BS8233 Indoor ambient noise levels for dwellings, dB $L_{Aeq,T}$

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

The levels provided in the above table assume normal diurnal fluctuations in external noise. In cases where local conditions do not follow a typical diurnal pattern an appropriate alternative period may be used.

If relying on closed windows to meet the guide values, there needs to be appropriate alternative ventilation that does not compromise the façade insulation or the resulting noise level.

BS8233:2014 also states that where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved.

In addition, BS8233:2014 provides the guidance regarding design criteria for external noise:

'For traditional external areas that are used for amenity space, such as such as garden and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq, T}$, with an upper guideline value of 55 dB $L_{Aeq, T}$ which would be acceptable in noisier environments. However, it is also recognised that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.'

3 Noise Monitoring

3.1 Site Description

The site layout and measurement position are shown in Appendix A. The predominant noise source was light road traffic from local road networks, and, to a lesser extent, air traffic noise.

3.2 Measurements

The noise monitoring took place between the 30th-31st August 2022. Measurements were taken in one unattended monitoring position for the full extent of this period. The weather conditions monitored during the survey are shown in the following table.

Table 4: Weather Conditions at Measurement Location

Weather	30/08/22	31/08/22
Average Wind Speed	5m/s	4m/s
Wind Direction	SW	S
Cloud Cover	50%	40%
Max. Temperature	24°C	22°C
Min. Temperature	16°C	10°C
Precipitation	None	None

3.3 Survey Results

3.3.1 Average L_{Aeq}

The average noise levels during the daytime and night-time period are shown in table 7. Measurement data can be found in Appendix B. Values are external façade noise levels.

Table 5: Averaged measured external façade noise levels, dB re 2×10^{-5} Pa

Description	Indices	Octave Band Centre Frequency (Hz)								dB(A)
		63	125	250	500	1k	2k	4k	8k	
Average day time sound pressure level	$L_{Aeq,16hr}$	73	67	63	63	64	60	54	45	67
Average night time sound pressure level	$L_{Aeq,8hr}$	64	59	53	54	54	50	43	35	58

3.3.2 L_{AFMax}

Table 6: Tenth Highest external façade L_{AFMax} at night, dB re 2×10^{-5} Pa

Description	Indices	dB(A)
MP1 - 10 th highest night time maximum	L_{AFMax}	69

4 Proposed Design Internal Ambient Noise Assessment

4.1 Façade Noise Break-in

The assessment outlined within this section uses construction details as in table 7 below. Sound reduction data for the constructions were obtained from computer models of the construction drawings, using a proprietary package called INSUL.

Table 7: Sound Reduction Index data used, dB

Element	Construction	Octave Band Centre Frequency (Hz)							Rw	Rw (-C _{tr})
		63	125	250	500	1k	2k	4k		
Glazing*	Recommended glazing	-	23	24	34	42	43	52	37	33
Pitch	Roof tiles, timber stud, Rockwool (40kg, 150mm), 12.5mm plasterboard	16	30	43	49	54	56	56	52	44
Flat Roof	12mm Plywood, timber stud, Rockwool (40kg, 150mm), 12.5mm Plasterboard.	8	18	33	39	44	46	46	41	33

*Based on Pilkington 6mm / 6 to 20mm / 6.8mm Pilkington IGU.

4.2 Calculated Internal Ambient Noise Levels

The predicted internal ambient noise levels during the daytime and night-time are shown in table 8 and table 9 and 10 below respectively. The predicted maximum noise level during the night-time is shown in table 11. Calculations use the façade and glazing sound reduction shown in the table 7.

Table 8: Predicted daytime indoor ambient noise levels, dB L_{Aeq, T}

Location	Indices	Criteria	Predicted Noise Level
Living Room	L _{Aeq, daytime}	35	40

Table 9: Predicted night-time indoor ambient noise levels, dB L_{Aeq, T}

Location	Indices	Criteria	Predicted Noise Level
Master Bedroom	L _{Aeq, night time}	30	34

Table 10: Predicted night-time indoor ambient noise levels, dB L_{Aeq, T}

Location	Indices	Criteria	Predicted Noise Level
Bedroom 2	L _{Aeq, night time}	30	36

Table 11: Predicted night-time indoor maximum noise levels, dB $L_{Amax, T}$

Location	Indices	Criteria	Predicted Noise Level
Bedroom 2	L_{Amax} , night time	45	46

5 Mitigated Internal Ambient Noise Assessment

5.1 Façade Noise Break-in

As the proposed constructions shown in section 4 do not enable the noise criteria to be met, the following mitigation, comprising of resilient bars and uprated plasterboard, has been added to improve the sound insulation performance.

The assessment outlined within this section uses construction details as in table 16 below. Sound reduction data for the constructions were obtained from computer models of the construction drawings, using a proprietary package called INSUL.

Table 12: Sound Reduction Index data used, dB

Element	Construction	Octave Band Centre Frequency (Hz)							R_w	R_w (-C _{tr})
		63	125	250	500	1k	2k	4k		
Glazing*	Recommended glazing	-	23	24	34	42	43	52	37	33
Pitch	Roof tiles, timber stud resilient rail, Rockwool (40kg, 150mm), 15mm SoundBloc	21	42	52	58	62	60	64	60	54
Flat Roof	12mm Plywood, timber joist with resilient rail, Rockwool (40kg 150mm), 15mm SoundBloc.	13	32	43	50	54	51	56	51	45

*Based on Pilkington 6mm / 6 to 20mm / 6.8mm Pilkington IGU.

5.2 Calculated Internal Ambient Noise Levels

The predicted internal ambient noise levels during the daytime and night-time are shown in table 13 and table 14 and 15 below respectively. The predicted maximum noise level during the night-time is shown in table 16. Calculations use the façade and glazing sound reduction shown in the table 12.

Table 13: Predicted daytime indoor ambient noise levels, dB $L_{Aeq, T}$

Location	Indices	Criteria	Predicted Noise Level
Living Room	$L_{Aeq, \text{daytime}}$	35	35

Table 14: Predicted night-time indoor ambient noise levels, dB $L_{Aeq, T}$

Location	Indices	Criteria	Predicted Noise Level
Master Bedroom	$L_{Aeq, \text{night time}}$	30	29

Table 15: Predicted night-time indoor ambient noise levels, dB $L_{Aeq, T}$

Location	Indices	Criteria	Predicted Noise Level
Bedroom 2	$L_{Aeq, \text{night time}}$	30	30

Table 16: Predicted night-time indoor maximum noise levels, dB $L_{Amax, T}$

Location	Indices	Criteria	Predicted Noise Level
Bedroom 2	$L_{Amax, \text{night time}}$	45	40

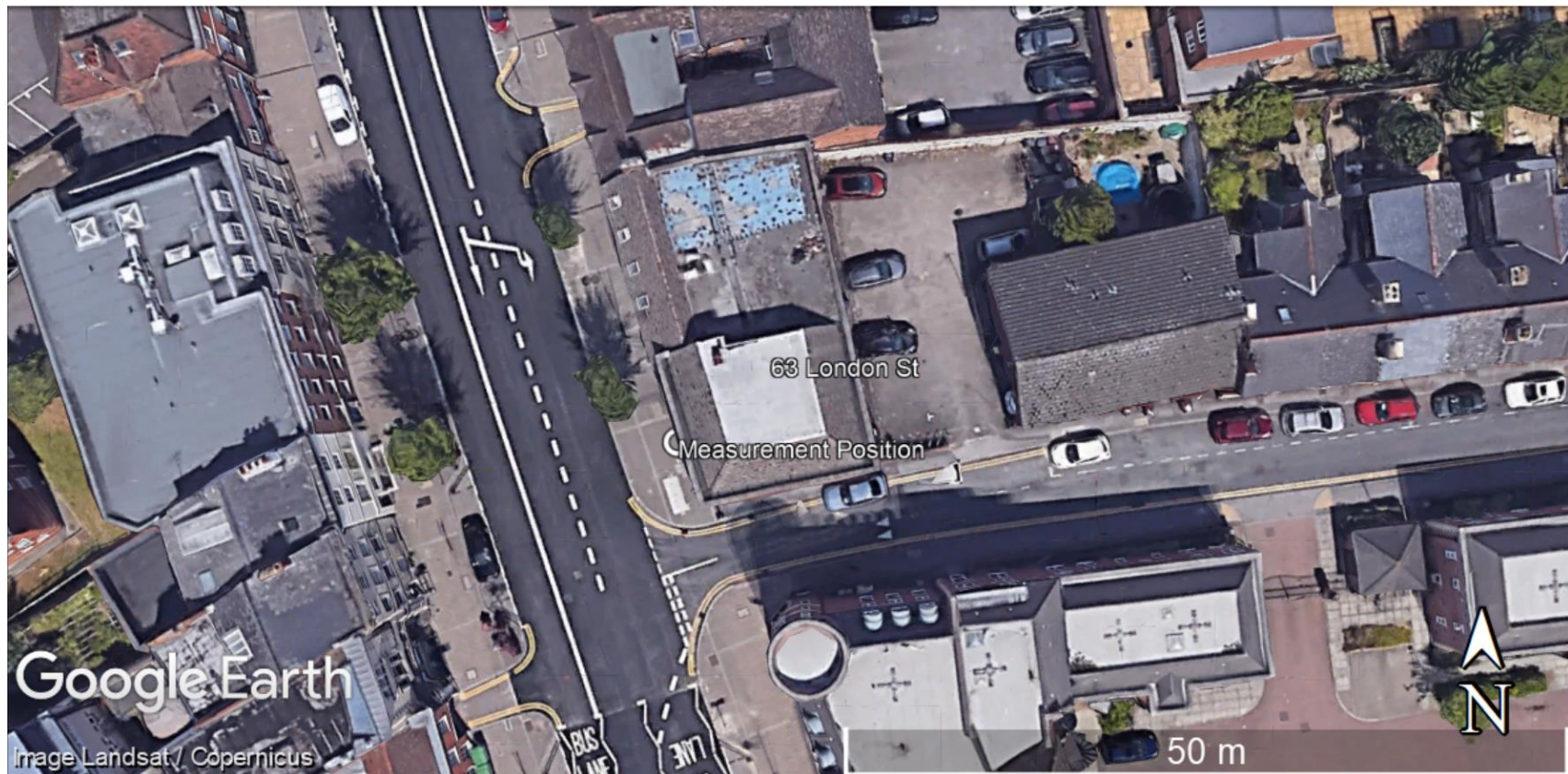
6 Conclusion

A noise survey has been undertaken and the data assessed against relevant guidance and criteria to determine the sites suitability to accommodate the development.

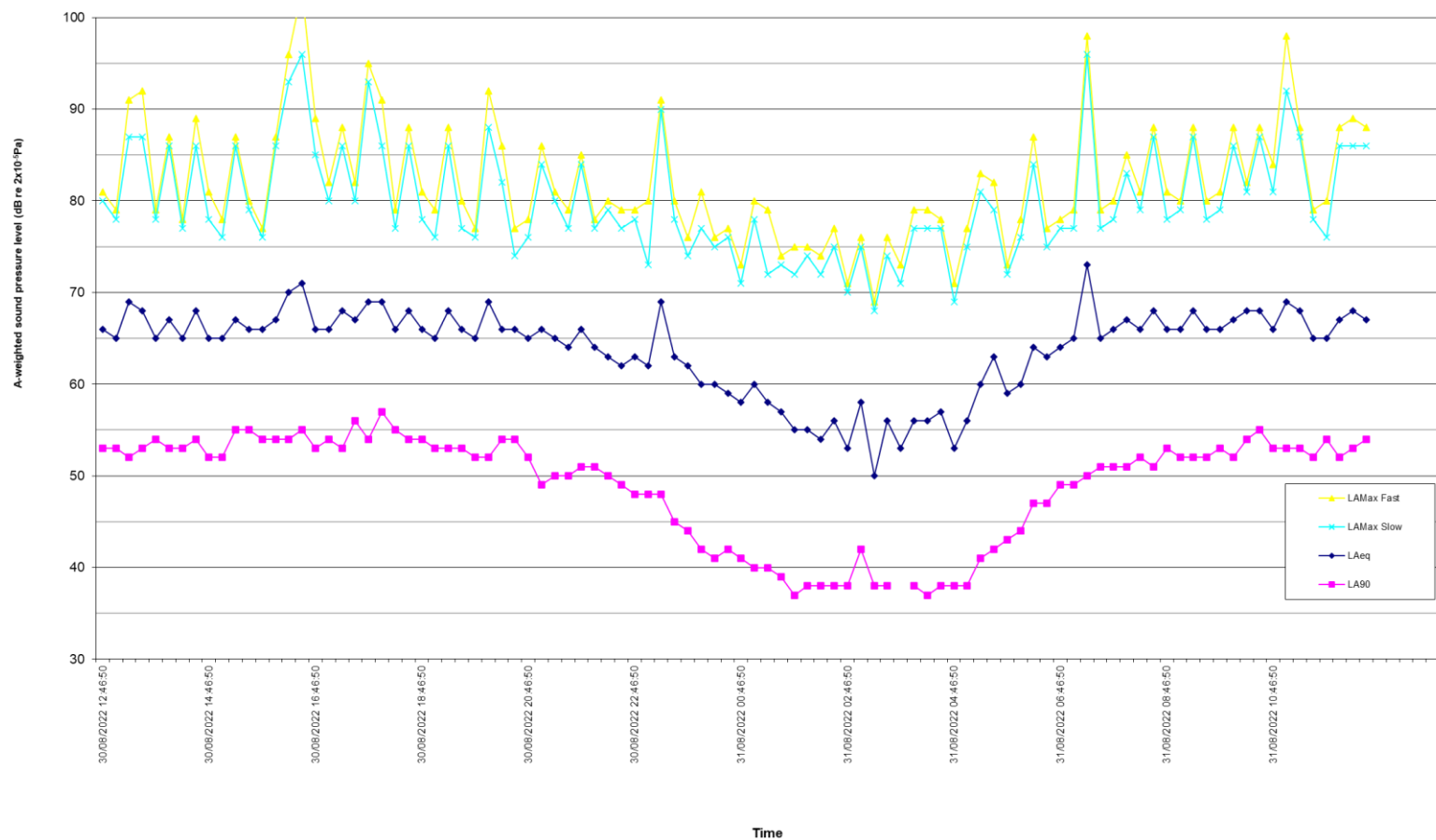
This report concludes that:

With the construction and glazing specified within this report, internal ambient noise levels can achieve local authority and BS8233 design criteria.

Appendix A: Site Plan



Appendix B: Measurement Data



Sound pressure level measurements were obtained using the following instrumentation complying with the Class 1 specification of BS EN 61672:2003

- Svantek 959 Sound Level Meter S/N: 11207 (next cal due 11/05/23) Start gain 1.88 End gain 1.66
- Svantek pre-amplifier SV12L S/N: 49860 with GRAS microphone capsule 40AE S/N: 215511

Calibration checks were made prior to and after completion of measurements using a Svantek SV30A calibrator, S/N: 10890 (next cal due 05/01/23) complying with Class 1 specification of BS EN 60942:2003, calibration level 114.0 dB @ 1.0 kHz. All acoustic instrumentation carried current manufacturer's certificates of conformance.

Appendix C: Calculations

Living Room

Façade noise Break-in façade 1 Pitched									
	63	125	250	500	1k	2k	4k	8k	dB(A)
L1	70	64	60	60	61	57	51	42	64
Directivity correction	-3								
Façade Length (m)	3.45								
Façade Width (m)	3.45								
Façade Area	11.90								
Room Length (m)	3.45								
Room Height (m)	2.40								
Room Width (m)	3.45								
Volume	28.57								
Tmf	0.50								
Sound Reduction									
Flanking/Tolerance									
L2 Room Lp	52	42	37	27	20	15	0	-9	33
	25								
NR	55	44	35	29	25	22	20	18	35
Excess	-3	-1	2	-2	-5	-7	-19	-26	-2

$$L2 = L1 - R + 10 \log(S/V) + 11 + 10 \log T$$

Partition Dimensions and Material Data:

Description	Area	Units	63	125	250	500	1000	2000	4000	R _w
Wall	5.90	m ²	21	42	52	58	62	60	64	60
Glazing	6	m ²	23	23	24	34	42	43	52	37
		m ²								
		m ²								
Composite Sound Reduction Index			22	26	27	37	45	46	55	40

Façades	Description	Directivity correction	63	125	250	500	1k	2k	4k	8k	dB(A)
Façade 1	Front wall	-3	52	42	37	27	20	15	0	-9	33
Façade 2	Roof	-6	57	32	17	10	7	6	-5	-14	31
Total			59	43	37	27	21	16	5	3	35

Façade noise Break-in façade 2 Flat									
	63	125	250	500	1k	2k	4k	8k	dB(A)
L1	70	64	60	60	61	57	51	42	64
Directivity correction	-6								
Façade Length (m)	3.65								
Façade Width (m)	3.65								
Façade Area	13.32								
Room Length (m)	3.65								
Room Height (m)	2.90								
Room Width (m)	3.65								
Volume	38.64								
Tmf	0.50								
Sound Reduction									
Flanking/Tolerance									
L2 Room Lp	57	32	17	10	7	6	-5	-14	31
NR	55	44	35	29	25	22	20	18	35
Excess	2	-11	-18	-19	-18	-16	-24	-31	-3

$$L2 = L1 - R + 10 \log(S/V) + 11 + 10 \log T$$

Partition Dimensions and Material Data:

Description	Area	Units	63	125	250	500	1000	2000	4000	R _w
Wall	13.52	m ²	13	32	43	50	54	51	56	51
		m ²								
		m ²								
Composite Sound Reduction Index			13	32	43	50	54	51	56	51

Master Bedroom

Façade noise Break-in façade 1 Pitch			63	125	250	500	1k	2k	4k	8k	dB(A)
L1		Free Field Source Lp	64	59	53	54	54	50	43	35	58
Directivity correction	-3		-3	-3	-3	-3	-3	-3	-3	-3	-
Facade Length (m)	2.60	Façade Area (S)	7	7	7	7	7	7	7	7	-
Facade Width (m)	2.60	Volume (V)	16	16	16	16	16	16	16	16	
Facade Area	6.76	S/V	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Room Length (m)	2.60	10log(S/V)	-3.8	-3.8	-3.8	-3.8	-3.8	-3.8	-3.8	-3.8	
Room Height (m)	2.40	11	11	11	11	11	11	11	11	11	
Room Width (m)	2.60	Rev time	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	-
Volume	16.22	10logT	-3.01	-3.01	-3.01	-3.01	-3.01	-3.01	-3.01	-3.01	-
Tmf	0.50	L2	65	60	54	55	55	51	44	36	59
Sound Reduction		R	22	26	27	37	45	46	55	55	40
Flanking/Tolerance			3	3	3	3	3	3	3	3	
L2 Room Lp			46	37	30	21	13	8	-8	-16	27
	25	NR	55	44	35	29	25	22	20	18	35
		Excess	-9	-7	-5	-8	-12	-14	-27	-34	-8

L2 = L1-R+10log(S/V)+11+10logT

Partition Dimensions and Material Data:

Description	Area	Units	ctave Band Centre Frequency (Hz)							R _w
Wall	3.56	m ²	63	125	250	500	1000	2000	4000	60
Glazing	3.2	m ²	21	42	52	58	62	60	64	37
		m ²	23	23	24	34	42	43	52	
		m ²								
		m ²								
Composite Sound Reduction Index			22	26	27	37	45	46	55	40

Façades	Description	Directivty correction	63	125	250	500	1k	2k	4k	8k	dB(A)
Façade 1	Front wall	-3	46	37	30	21	13	8	-8	-16	27
Façade 2	Roof	-6	51	27	10	4	0	-1	-13	-21	25
Total			53	37	30	21	14	10	3	3	29

Façade noise Break-in façade 2 Flat			63	125	250	500	1k	2k	4k	8k	dB(A)
L1		Free Field Source Lp	64	59	53	54	54	50	43	35	58
Directivity correction	-6	Correction	-6	-6	-6	-6	-6	-6	-6	-6	-
Facade Length (m)	2.78	Façade Area (S)	8	8	8	8	8	8	8	8	-
Facade Width (m)	2.78	Volume (V)	22	22	22	22	22	22	22	22	-
Facade Area	7.73	S/V	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	-
Room Length (m)	2.78	10log(S/V)	-4.6	-4.6	-4.6	-4.6	-4.6	-4.6	-4.6	-4.6	-
Room Height (m)	2.90	11	11	11	11	11	11	11	11	11	-
Room Width (m)	2.78	Rev time	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	-
Volume	22.41	10logT	-3.01	-3.01	-3.01	-3.01	-3.01	-3.01	-3.01	-3.01	-
Tmf	0.50	L2	61	56	50	51	51	47	40	32	55
Sound Reduction		R	13	32	43	50	54	51	56	56	51
Flanking/Tolerance			3	3	3	3	3	3	3	3	-
L2 Room Lp			51	27	10	4	0	-1	-13	-21	25
		NR	55	44	35	29	25	22	20	18	35
		Excess	-4	-16	-25	-25	-25	-23	-32	-38	-9

L2 = L1-R+10log(S/V)+11+10logT

Partition Dimensions and Material Data:

Description	Area	Units	ctave Band Centre Frequency (Hz)							R _w
Wall	7.73	m ²	13	32	43	50	54	51	56	51
		m ²								
		m ²								
		m ²								
Composite Sound Reduction Index			13	32	43	50	54	51	56	51

Bedroom 2 (Maximum noise levels)

Façade noise Break-in façade 1 Pitch			63	125	250	500	1k	2k	4k	8k	dB(A)
L1		Free Field Source Lp	75	67	63	64	66	62	51	41	69
Directivity correction	-3	Correction	-3	-3	-3	-3	-3	-3	-3	-3	-
Façade Length (m)	2.02	Façade Area (S)	4	4	4	4	4	4	4	4	
Façade Width (m)	2.02	Volume (V)	10	10	10	10	10	10	10	10	
Façade Area	4.08	S/V	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	
Room Length (m)	2.02	10log(S/V)	-3.8	-3.8	-3.8	-3.8	-3.8	-3.8	-3.8	-3.8	
Room Height (m)	2.40	11	11	11	11	11	11	11	11	11	
Room Width (m)	2.02	Rev time	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	-
Volume	9.79	10logT	-3.01	-3.01	-3.01	-3.01	-3.01	-3.01	-3.01	-3.01	-
Tmf	0.50	L2	76	68	64	65	67	63	52	42	70
Sound Reduction		R	22	28	29	39	47	47	56	56	42
Flanking/Tolerance			3	3	3	3	3	3	3	3	
L2 Room Lp			58	44	39	30	24	19	-1	-11	36
	25	NR	55	44	35	29	25	22	20	18	35
		Excess	2	0	3	0	-1	-3	-20	-29	1

L2 = L1-R+10log(S/V)+11+10logT

Partition Dimensions and Material Data:											
Description		Area	Units	ctave Band Centre Frequency (Hz)							R _w
				63	125	250	500	1000	2000	4000	
Wall		2.68	m ²	21	42	52	58	62	60	64	60
Glazing		1.4	m ²	23	23	24	34	42	43	52	37
			m ²								
			m ²								
Composite Sound Reduction Index				22	28	29	39	47	47	56	42

Façades	Description	Directivty correction	63	125	250	500	1k	2k	4k	8k	dB(A)
Façade 1	Front wall	-3	58	44	39	30	24	19	-1	-11	36
Façade 2	Roof	-6	64	37	22	16	14	13	-3	-13	38
Total			65	45	39	30	24	20	5	3	40

Façade noise Break-in façade 2 Flat				63	125	250	500	1k	2k	4k	8k	dB(A)
L1		Free Field Source Lp		75	67	63	64	66	62	51	41	69
Directivity correction	-6	Correction		-6	-6	-6	-6	-6	-6	-6	-6	-
Façade Length (m)	2.18	Façade Area (S)		5	5	5	5	5	5	5	5	
Façade Width (m)	2.18	Volume (V)		14	14	14	14	14	14	14	14	
Façade Area	4.75	S/V		0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
Room Length (m)	2.18	10log(S/V)		-4.6	-4.6	-4.6	-4.6	-4.6	-4.6	-4.6	-4.6	
Room Height (m)	2.90	11		11	11	11	11	11	11	11	11	
Room Width (m)	2.18	Rev time		0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	-
Volume	13.78	10logT		-3.01	-3.01	-3.01	-3.01	-3.01	-3.01	-3.01	-3.01	-
Tmf	0.50	L2		72	64	60	61	63	59	48	38	66
Sound Reduction		R		13	32	43	50	54	51	56	56	51
Flanking/Tolerance				5	5	5	5	5	5	5	5	
L2 Room Lp				64	37	22	16	14	13	-3	-13	38
		NR		55	44	35	29	25	22	20	18	35
		Excess		9	-6	-13	-13	-11	-9	-22	-30	4
L2 = L1-R+10log(S/V)+11+10logT												
Partition Dimensions and Material Data:												
Description	Area	Units	ctave Band Centre Frequency (Hz)								R _w	
			63	125	250	500	1000	2000	4000			
Wall	4.75	m ²	13	32	43	50	54	51	56	51		
		m ²										
		m ²										
		m ²										
Composite Sound Reduction Index			13	32	43	50	54	51	56	51		

Bedroom 2

Façade noise Break-in façade 1 Pitch			63	125	250	500	1k	2k	4k	8k	dB(A)	
L1			Free Field Source Lp	64	59	53	54	54	50	43	35	58
Directivity correction	-3		Correction	-3	-3	-3	-3	-3	-3	-3	-	
Façade Length (m)	2.02		Façade Area (S)	4	4	4	4	4	4	4		
Façade Width (m)	2.02		Volume (V)	10	10	10	10	10	10	10		
Façade Area	4.08		S/V	0.4	0.4	0.4	0.4	0.4	0.4	0.4		
Room Length (m)	2.02		10log(S/V)	-3.8	-3.8	-3.8	-3.8	-3.8	-3.8	-3.8		
Room Height (m)	2.40		11	11	11	11	11	11	11	11		
Room Width (m)	2.02		Rev time	0.50	0.50	0.50	0.50	0.50	0.50	0.50	-	
Volume	9.79		10logT	-3.01	-3.01	-3.01	-3.01	-3.01	-3.01	-3.01	-	
Tmf	0.50		L2	65	60	54	55	55	51	44	36	59
Sound Reduction			R	22	28	29	39	47	47	56	56	42
Flanking/Tolerance				3	3	3	3	3	3	3	3	
L2 Room Lp				47	36	29	20	12	7	-9	-17	26
	25		NR	55	44	35	29	25	22	20	18	35
			Excess	-9	-8	-7	-10	-13	-15	-28	-35	-9
L2 = L1-R+10log(S/V)+11+10logT												
Partition Dimensions and Material Data:												
Description		Area	Units	ctave Band Centre Frequency (Hz)							R _w	
				63	125	250	500	1000	2000	4000		
Wall		2.68	m ²	21	42	52	58	62	60	64	60	
Glazing		1.4	m ²	23	23	24	34	42	43	52	37	
			m ²									
			m ²									
Composite Sound Reduction Index				22	28	29	39	47	47	56	42	
Façades	Description	Directivty correction	63	125	250	500	1k	2k	4k	8k	dB(A)	
Façade 1	Front wall	-3	47	36	29	20	12	7	-9	-17	26	
Façade 2	Roof	-6	53	29	12	6	2	1	-11	-19	27	
Total			54	37	29	20	13	9	3	3	30	

Façade noise Break-in façade 2 Flat			63	125	250	500	1k	2k	4k	8k	dB(A)
L1		Free Field Source Lp	64	59	53	54	54	50	43	35	58
Directivity correction	-6	Correction	-6	-6	-6	-6	-6	-6	-6	-6	-
Façade Length (m)	2.18	Façade Area (S)	5	5	5	5	5	5	5	5	
Façade Width (m)	2.18	Volume (V)	14	14	14	14	14	14	14	14	
Façade Area	4.75	S/V	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
Room Length (m)	2.18	10log(S/V)	-4.6	-4.6	-4.6	-4.6	-4.6	-4.6	-4.6	-4.6	
Room Height (m)	2.90	11	11	11	11	11	11	11	11	11	
Room Width (m)	2.18	Rev time	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	-
Volume	13.78	10logT	-3.01	-3.01	-3.01	-3.01	-3.01	-3.01	-3.01	-3.01	-
Tmf	0.50	L2	61	56	50	51	51	47	40	32	55
Sound Reduction		R	13	32	43	50	54	51	56	56	51
Flanking/Tolerance			5	5	5	5	5	5	5	5	
L2 Room Lp			53	29	12	6	2	1	-11	-19	27
		NR	55	44	35	29	25	22	20	18	35
		Excess	-2	-14	-23	-23	-23	-21	-30	-36	-7
L2 = L1-R+10log(S/V)+11+10logT											
Partition Dimensions and Material Data:											
Description		Area	Units	ctave Band Centre Frequency (Hz)							R _w
Wall		4.75	m ²	13	32	43	50	54	51	56	51
			m ²								
			m ²								
			m ²								
Composite Sound Reduction Index				13	32	43	50	54	51	56	51

Appendix D: Glossary

The list below details the major acoustical terms and descriptors, with brief definitions:

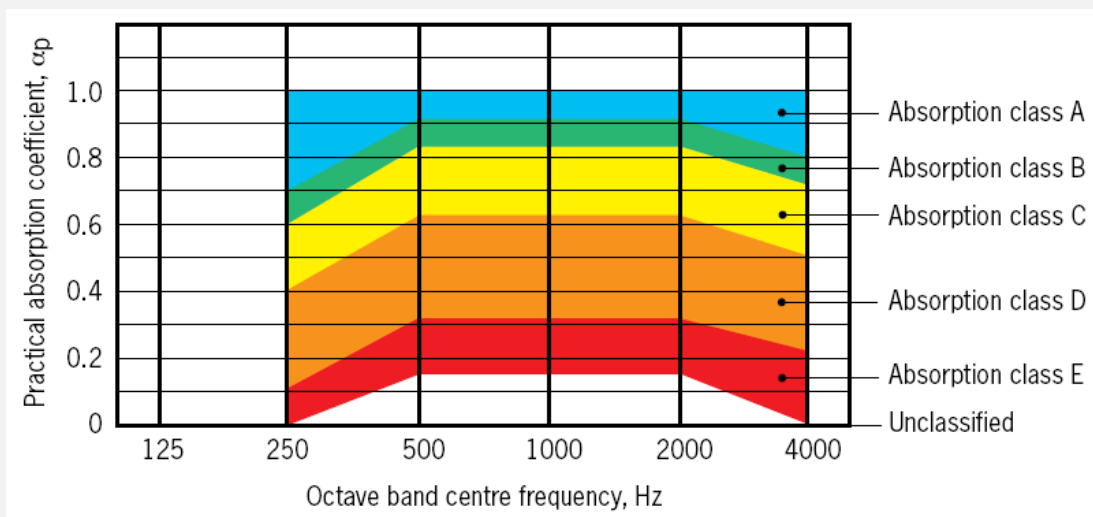
'A' Weighting

Weighting applied to the level in each stated octave band by a specified amount, in order to better represent the response of the human ear. The letter 'A' will follow a descriptor, indicating the value has been 'A' weighted. An 'A' weighted noise level may also be written as dB(A).

Absorption Class

In order to categorise the absorptive effects of different elements (such as ceiling tiles), classes from A to E were derived, as per BS EN ISO 11654:1997. A class 'A' absorber would be very acoustically absorptive, a Class 'E' absorber would be less absorptive and more reflective. A product that is highly reflective may not be classified.

The chart shown below has been extracted from BB93, and demonstrates the characteristics of each class according to BS EN ISO 11654:1997.



Absorption Coefficient (α)

A value usually between 0 and 1 assigned to a material to indicate how acoustically absorptive it is. 0 indicates a material is entirely reflective (and therefore not absorptive), and 1 indicates a material is entirely absorptive (and therefore not reflective). Absorption coefficients are usually given for each octave band between 125Hz and 4kHz, or as an overall 'practical' coefficient.

Airborne Noise

Noise transmitted through air.

Ambient Noise

The total noise level including all 'normally experienced' noise sources.

dB or Decibel

Literally meaning 'a tenth of a bel', the bel being a unit devised by the Bell Laboratory and named after Alexander Graham Bell. A logarithmically based descriptor to compare a level to a reference level. Decibel arithmetic is not linear, due to the logarithmic base. For example:

$$30 \text{ dB} + 30 \text{ dB} \neq 60 \text{ dB}$$

$$30 \text{ dB} + 30 \text{ dB} = 33 \text{ dB}$$

$D_{nTw} + C_{tr}$

The weighted, normalised difference in airborne noise levels measured in a source room (L1) and a receive room (L2) due to a separating partition.

D	Is simply $L_1 - L_2$.
D_{nT}	Is the normalisation of the measured level difference to the expected (in comparison to the measured) reverberation time in the receiving room.
D_{nTw}	Is the weighted and normalised level difference. This value is the result of applying a known octave band weighting curve to the measured result.
C_{tr}	Is a correction factor applied to the D_{nTw} to account for the known effects of particular types of noise, such as loud stereo music or traffic noise.

Frequency (Hz)

Measured in Hertz (after Heinrich Hertz), and represents the number of cycles per second of a sound or tone.

Impact Noise

Re-radiated noise as a result of impact(s) on a solid medium, such as footfalls on floors. Measured in L'_{nTw} .

Insertion Loss, dB

The amount of sound reduction offered by an attenuator or louvre once placed in the path of a noise level.

$L_{A90, T}$

The 'A' weighted noise level exceeded for 90% of the time period T, described or measured. The '90' can be substituted for any value between 1 and 99 to indicate the noise level exceeded for the corresponding percentage of time described or measured.

$L_{Aeq, T}$

The 'A' weighted 'equivalent' noise level, or the average noise level over the time period T, described or measured.

L_{Amax}

The 'A' weighted maximum measured noise level. Can be measured with a 'slow' (1 sec) or 'fast' (0.125 sec) time weighting.

L_{Amin}

The 'A' weighted minimum measured noise level.

L'_{nTw}

The weighted, normalised impact sound pressure level measured in a receive room below a source room.

L

Is the spatially averaged impact sound pressure level measured in a receive room.

L'_{nT}

Is the normalisation of the measured impact sound pressure level to the expected (in comparison to the measured) reverberation time in the receiving room.

L'_{nTw}

Is the weighted and normalised impact sound pressure level. This value is the result of applying a known octave band weighting curve to the measured result.

NR

Noise Rating (NR) level. A frequency dependent system of noise level curves developed by the International Organisation for Standardisation (ISO). NR is used to categorise and determine the acceptable indoor environment in terms of hearing preservation, speech communication and annoyance in any given application as a single figure level. The US predominantly uses the Noise Criterion (NC) system.

Octave

The interval between a frequency in Hz (f) and either half or double that frequency (0.5f or 2f).

Pa

Pascals, the SI unit to describe pressure, after physicist Blaise Pascal.

Reverberation Time, T_{mf}, RT60, RT30 or RT20

The time taken in seconds for a sound to diminish within a room by 1,000 times its original level, corresponding to a drop in sound pressure of 60 dB. When taking field measurements and where background noise levels are high, the units RT20 or RT30 are used (measuring drops of 20 or 30 dB respectively). Sometimes given as a mid-frequency reverberation time, T_{mf} which is the average of reverberation time values at 500Hz, 1kHz and 2kHz.

R_w

The sound reduction value(s) of a constructional element such as a door, as measured in a laboratory, with a known octave band weighting curve applied to the result.

Sound Power Level

A noise level obtained by calculation from measurement data, given at the face of an item of plant or machinery. Referenced to 10^{-12} W or 1pW.

Sound Pressure Level

A noise level measured or given at a distance from a source or a number of sources. Referenced to 2×10^{-5} Pa.

Speech Intelligibility, Speech Transmission Index (STI)

Speech intelligibility is the measure of how well a speaker's voice can be heard within a given space. Speech intelligibility within a room depends on a number of factors, including reverberation time and background noise.

The Speech Transmission Index or STI has emerged as the favoured method of describing speech intelligibility.

Subjective Effect of Changes in Sound Pressure Level

The table below details the subjective effects of different variations in sound pressures (adapted from Bies and Hansen).

Difference between background noise and rating levels	Increase in ambient noise level in 'real terms'	Change in apparent loudness
+ 10 dB	+ 10 dB	Twice as loud
+ 5 dB	+ 6 dB	Clearly noticeable
0 dB	+ 3 dB	Just perceptible
-10 dB	0 dB	No change

W

Watts, the SI unit to describe power, after engineer James Watt.