

Acoustic Consultancy Report

06718/3/2/3

Acoustic Report

Report Prepared For

Maverick Property Investments Ltd
601 Oxford Road
17 September 2021

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i) Executive Summary

A residential development is proposed at 601 Oxford Road, in Reading.

A noise survey has been undertaken and the data assessed against Local Authority criteria to determine the sites suitability to accommodate the residential development.

The building envelope has been reviewed in order to assess its sound reduction performance in terms of internal noise level requirements set out in BS8233:2014.

This report concludes that:

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

ii) Document History

Issue	Date	Issue Details	Issued By	Checked By
1	17 th September 2021	Initial Issue	RM	MB

1 Introduction

A residential development is proposed at 601 Oxford Road, in Reading.

A noise survey has been undertaken and the data assessed against Local Authority criteria to determine the sites suitability to accommodate the residential development.

The building envelope has been reviewed in order to assess its sound reduction performance in terms of internal noise level requirements set out in BS8233:2014.

2 Noise Monitoring

2.1 Site Description

The site layout and measurement position are shown in Appendix A.

2.2 Measurements

The noise monitoring took place from the 15/09/2021 to the 16/09/2021. The predominant noise source was road traffic noise from the Oxford Road.

The measurement periods were considered sufficient to establish the highest noise levels at the site.

The weather conditions monitored during the survey are shown in the following table.

Table 1: Weather Conditions at Measurement Location

Weather	Value
Average Wind Speed	2.5m/s
Wind Direction	NW
Cloud Cover	80%
Max. Temperature	16°C
Min. Temperature	14°C
Precipitation	09:00 to 12:00 - Medium Rain

2.3 Survey Results

2.3.1 Average L_{Aeq}

The average noise levels during the day and night time period are shown in the following table. Measurement data can be found in Appendix B.

Table 2: Averaged measured 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	$L_{Aeq,16hr}$	71	66	63	62	64	61	62	57	69
Average night time sound pressure level	$L_{Aeq,8hr}$	65	57	55	56	57	53	43	35	60

2.3.2 L_{AFMax}

Table 3: Tenth Highest L_{AFMax} at night, dB re 2×10^{-5} Pa

Description	Indices	dB(A)
MP1 - 10 th highest night time maximum	L_{AFMax}	77

3 Indoor Ambient Design Criterion

3.1 BS8233:2014

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

Table 4: 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.

The measured levels are considered to follow normal diurnal fluctuations.

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.

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

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

Table 5: 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:

4 Internal Ambient Noise Assessment

4.1 Façade Noise Break-In

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

The assessment outlined within this section uses the façade and glazing performance shown below.

Table 6: Sound Reduction Index data used, dB

Description	Octave Band Centre Frequency (Hz)							Rw	Rw+Ctr
	63	125	250	500	1k	2k	4k		
External façade - 102.5mm facing brickwork, 125mm Dritherm32 insulation 27kg/m ³ , 100mm blockwork, 12.5mm Plasterboard on dabs.	43	48	47	49	59	69	79	56	53
Roof – Slate tiles, 47x150mm rafters at 400mm centres, 150mm Celotex GA4000 insulation, 12.5mm Plasterboard.	16	8	25	42	47	47	47	34	22
Glazing – 6mm / (6mm Argon) / 6.8mm*	21	21	28	37	48	48	54	40	34

*Data provided in Appendix C.

4.2 Calculated Internal Ambient Noise Levels

The predicted internal ambient noise levels are shown in the table below. Calculations are shown in Appendix D.

Table 7: Predicted indoor ambient noise levels, dB $L_{Aeq, T}$

Location	Predicted Noise Level	BS8233 Design	
		07:00 – 23:00	23:00 – 07:00
Flat 1 Bedroom 1	48 $L_{Aeq,16hr}$	35 $L_{Aeq,16hr}$	-
	40 $L_{Aeq,8hr}$	-	30 $L_{Aeq,8hr}$
Flat 1 Living room	34 $L_{Aeq,16hr}$	35 $L_{Aeq,16hr}$	-
Flat 3 Bedroom 1	43 $L_{Aeq,16hr}$	35 $L_{Aeq,16hr}$	-
	34 $L_{Aeq,8hr}$	-	30 $L_{Aeq,8hr}$
Flat 3 Bedroom 2	43 $L_{Aeq,16hr}$	35 $L_{Aeq,16hr}$	-
	35 $L_{Aeq,8hr}$	-	30 $L_{Aeq,8hr}$

The L_{Amax} will exceed 45dB at night in all instances.

5 Noise Mitigation

The predicted internal noise levels shown in section 4.2 are currently above the criteria recommended in BS8233:2014. To meet the specified criteria, the roof design will require mitigation. The following mitigation measure should be incorporated for the areas of roof above the bedrooms on the 1st and 2nd floor.

Table 8: Sound Reduction Index data used, dB

Description	Octave Band Centre Frequency (Hz)							Rw	Rw+Ctr
	63	125	250	500	1k	2k	4k		
Roof – Slate tiles, 47x150mm rafters at 400mm centres, 150mm Rockwool (40kg/m ³), 2 x 15mm Gyproc SoundBloc.	23	20	36	46	51	48	53	45	38

5.1 Mitigated Results

The design rating levels to be adopted for this project, together with the predicted noise levels inclusive of the mitigation detailed in Section 5, are set out in the table below. Calculations can be seen in Appendix D.

Table 9: Predicted indoor ambient noise levels, dB $L_{Aeq, T}$

Location	Predicted Noise Level	BS8233 Design	
		07:00 – 23:00	23:00 – 07:00
Flat 1 Bedroom 1	35 $L_{Aeq,16hr}$	35 $L_{Aeq,16hr}$	-
	29 $L_{Aeq,8hr}$	-	30 $L_{Aeq,8hr}$
Flat 1 Living room	34 $L_{Aeq,16hr}$	35 $L_{Aeq,16hr}$	-
Flat 3 Bedroom 1	35 $L_{Aeq,16hr}$	35 $L_{Aeq,16hr}$	-
	27 $L_{Aeq,8hr}$	-	30 $L_{Aeq,8hr}$
Flat 3 Bedroom 2	35 $L_{Aeq,16hr}$	35 $L_{Aeq,16hr}$	-
	27 $L_{Aeq,8hr}$	-	30 $L_{Aeq,8hr}$

The L_{Amax} will not exceed 45dB at night.

6 Conclusion

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

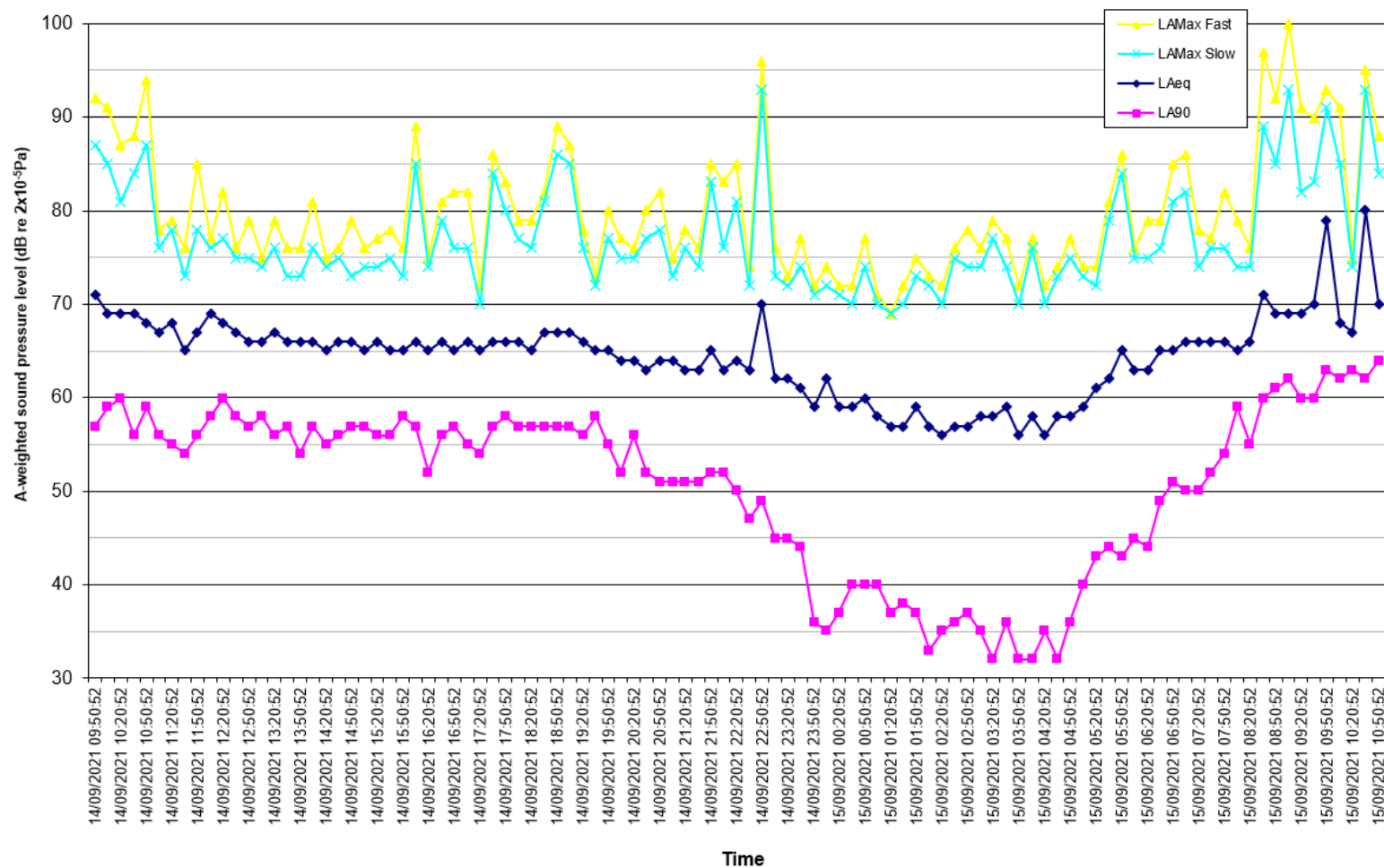
This report concludes that:

With the glazing and roof construction specified within this report, internal ambient noise levels can achieve the 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: 11258 (next cal due 17/02/22) Start gain +0.2 End gain -0.15
- Svantek pre-amplifier SV12L S/N: 13111 with GRAS microphone capsule 40AE S/N: 241965

Calibration checks were made prior to and after completion of measurements using a Svantek SV30A calibrator, S/N: 43066 (next cal due 05/02/22) complying with Class 1 specification of BS EN 60942:2003, calibration level 94.0 dB @ 1.0 kHz. All acoustic instrumentation carried current manufacturer's certificates of conformance.

Appendix C: Construction Specifications

Glazing:

Sound insulation data for Pilkington Optiphon™

Glass	Sound reduction index (dB)									
	Octaveband Centre Frequency (Hz)						R _w (C; C _{tr})	R _w	R _w + C	R _w + C _{tr}
	125	250	500	1000	2000	4000				
Single glazing										
6.8 mm Pilkington Optiphon™	22	26	31	37	40	40	36 (-1; -4)	36	35	32
8.8 mm Pilkington Optiphon™	27	29	34	38	40	43	37 (0; -2)	37	37	35
10.8 mm Pilkington Optiphon™	26	30	35	39	40	46	38 (-1; -3)	38	37	35
12.8 mm Pilkington Optiphon™	29	32	36	41	42	51	40 (-1; -3)	40	39	37
16.8 mm Pilkington Optiphon™	31	33	38	41	43	54	41 (-1; -3)	41	40	38
Insulating glass units										
6 mm / 16 mm argon / 6.8 mm Pilkington Optiphon™	21	28	37	48	48	54	40 (-2; -6)	40	38	34
6 mm / 16 mm argon / 8.8 mm Pilkington Optiphon™	25	27	38	48	47	55	41 (-2; -6)	41	39	35
8 mm / 16 mm argon / 8.8 mm Pilkington Optiphon™	21	30	39	47	50	55	42 (-3; -8)	42	39	34
10 mm / 16 mm argon / 8.8 mm Pilkington Optiphon™	28	31	42	45	50	58	44 (-2; -6)	44	42	38
10 mm / 20 mm argon / 8.8 mm Pilkington Optiphon™	28	36	43	47	49	58	46 (-2; -6)	46	44	40
8.8 mm Pilkington Optiphon™ / 16 mm argon / 12.8 mm Pilkington Optiphon™	28	36	45	53	56	64	48 (-2; -7)	48	46	41
10.8 mm Pilkington Optiphon™ / 24 mm argon / 16.8 mm Pilkington Optiphon™	35	41	48	53	55	65	52 (-2; -6)	52	50	46
12.8 mm Pilkington Optiphon™ / 20 mm argon / 16.8 mm Pilkington Optiphon™	35	45	49	50	54	65	51 (-1; -4)	51	50	47

Measurements undertaken in accordance with BS EN ISO 10140 and R_w (C; C_{tr}) determined in accordance with BS EN ISO 717-1.

For insulating glass units, there is little difference in the sound insulation for cavity widths in the range 6 to 16 mm.

To calculate performance data for Pilkington products, please use our Spectrum online calculator at <https://spectrum.pilkington.com/>

For glass combinations to achieve an R_w value higher than 52 dB, please contact us for more details.

Appendix D: Facade Assessment Calculations

Proposed design Flat 1 Bedroom 1 Day:

Façade noise Break-in façade 1		63	125	250	500	1k	2k	4k	8k	dB(A)		
L1	Free Field Source Lp	71	66	63	62	64	61	62	57	69		
Directivity correction	0	0	0	0	0	0	0	0	0	-		
Façade Length (m)	1.40	4	4	4	4	4	4	4	4	-		
Façade Width (m)	2.50	23	23	23	23	23	23	23	23	-		
Façade Area	3.50	S/V	0.2	0.2	0.2	0.2	0.2	0.2	0.2	-		
Room Length (m)	3.60	10log(S/V)	-8.1	-8.1	-8.1	-8.1	-8.1	-8.1	-8.1	-		
Room Height (m)	2.50	11	11	11	11	11	11	11	11	-		
Room Width (m)	2.50	Rev time	0.65	0.60	0.55	0.50	0.50	0.50	0.50	-		
Volume	22.50	10logT	-1.87	-2.22	-2.60	-3.01	-3.01	-3.01	-3.01	-		
Tmf	0.50	L2	72	67	63	62	64	61	62	57		
Sound Reduction		R	28	28	35	43	54	55	61	61		
L2 Room Lp			49	44	34	24	15	11	6	1		
	25	NR	55	44	35	29	25	22	20	18		
		Excess	-6	0	-2	-5	-10	-11	-13	-17		
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	2.78	m ²	43	48	47	49	59	69	79	56	
	Glazing	0.72	m ²	21	21	28	37	48	48	54	39	
Composite Sound Reduction Index				28	28	35	43	54	55	61	46	
Façades		Description	Directivity correction	63	125	250	500	1k	2k	4k	8k	dB(A)
Façade 1	Front wall		0	49	44	34	24	15	11	6	1	31
Façade 2	Roof		-3	61	64	44	25	22	19	20	15	48
Total				62	64	44	28	23	20	21	16	48

Façade noise Break-in façade 2											
L1		Free Field Source Lp	63	125	250	500	1k	2k	4k	8k	dB(A)
Directivity correction	-3	Correction	71	66	63	62	64	61	62	57	69
Façade Length (m)	2.50	Façade Area (S)	-3	-3	-3	-3	-3	-3	-3	-3	-
Façade Width (m)	3.00	Volume (V)	23	23	23	23	23	23	23	23	-
Façade Area	7.50	S/V	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	-
Room Length (m)	3.60	10log(S/V)	-4.8	-4.8	-4.8	-4.8	-4.8	-4.8	-4.8	-4.8	-
Room Height (m)	2.50	11	11	11	11	11	11	11	11	11	-
Room Width (m)	2.50	Rev time	0.65	0.60	0.55	0.50	0.50	0.50	0.50	0.50	-
Volume	22.50	10logT	-1.87	-2.22	-2.60	-3.01	-3.01	-3.01	-3.01	-3.01	-
Tmf	0.50	L2	72	67	64	62	64	61	62	57	69
Sound Reduction		R	16	8	25	42	47	47	47	47	33
L2 Room Lp			61	64	44	25	22	19	20	15	48
		NR	55	44	35	29	25	22	20	18	35
		Excess	6	20	8	-4	-3	-3	1	-3	14

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	
Roof		6	m ²	16	8	25	42	47	47	47	33
			m ²								
Composite Sound Reduction Index				16	8	25	42	47	47	47	33

Proposed design Flat 1 Bedroom 1 Night-time:

Façade noise Break-in façade 1		63	125	250	500	1k	2k	4k	8k	dB(A)	
L1	Free Field Source Lp	65	57	55	56	57	53	43	35	60	
Directivity correction	0	0	0	0	0	0	0	0	0	-	
Façade Length (m)	1.40	Façade Area (S)	4	4	4	4	4	4	4	-	
Façade Width (m)	2.50	Volume (V)	23	23	23	23	23	23	23	-	
Façade Area	3.50	S/V	0.2	0.2	0.2	0.2	0.2	0.2	0.2	-	
Room Length (m)	3.60	10log(S/V)	-8.1	-8.1	-8.1	-8.1	-8.1	-8.1	-8.1	-	
Room Height (m)	2.50	11	11	11	11	11	11	11	11	-	
Room Width (m)	2.50	Rev time	0.65	0.60	0.55	0.50	0.50	0.50	0.50	-	
Volume	22.50	10logT	-1.87	-2.22	-2.60	-3.01	-3.01	-3.01	-3.01	-	
Tmf	0.50	L2	66	58	55	56	57	53	43	35	
Sound Reduction		R	28	28	35	43	54	55	61	46	
L2 Room Lp			43	35	26	18	9	3	-13	-21	
	20	NR	51	39	31	24	20	17	14	13	
		Excess	-8	-5	-5	-6	-11	-13	-27	-34	
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	2.78	m ²	43	48	47	49	59	69	79	56	
Glazing	0.72	m ²	21	21	28	37	48	48	54	39	
Composite Sound Reduction Index			28	28	35	43	54	55	61	46	
Façades											
Façades	Description	Directivity correction	63	125	250	500	1k	2k	4k	8k	dB(A)
Façade 1	Front wall	0	43	35	26	18	9	3	-13	-21	23
Façade 2	Roof	-3	55	55	36	19	16	11	1	-7	40
Total			56	55	36	22	17	13	5	3	40

Façade noise Break-in façade 2		63	125	250	500	1k	2k	4k	8k	dB(A)
L1	Free Field Source Lp	65	57	55	56	57	53	43	35	60
Directivity correction	-3	-3	-3	-3	-3	-3	-3	-3	-3	-
Façade Length (m)	2.50	8	8	8	8	8	8	8	8	-
Façade Width (m)	3.00	23	23	23	23	23	23	23	23	-
Façade Area	7.50	S/V	0.3	0.3	0.3	0.3	0.3	0.3	0.3	-
Room Length (m)	3.60	10log(S/V)	-4.8	-4.8	-4.8	-4.8	-4.8	-4.8	-4.8	-
Room Height (m)	2.50	11	11	11	11	11	11	11	11	-
Room Width (m)	2.50	Rev time	0.65	0.60	0.55	0.50	0.50	0.50	0.50	-
Volume	22.50	10logT	-1.87	-2.22	-2.60	-3.01	-3.01	-3.01	-3.01	-
Tmf	0.50	L2	66	58	56	56	58	53	43	35
Sound Reduction		R	16	8	25	42	47	47	47	33
L2 Room Lp			55	55	36	19	16	11	1	-7
		NR	51	39	31	24	20	17	14	13
		Excess	4	16	5	-5	-4	-5	-13	-20
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	
Roof	6	m ²	16	8	25	42	47	47	47	33
		m ²								
Composite Sound Reduction Index			16	8	25	42	47	47	47	33

Proposed design Flat 1 Living room Day:

Façade noise Break-in façade 1			63	125	250	500	1k	2k	4k	8k	dB(A)
L1	Free Field Source Lp		71	66	63	62	64	61	62	57	69
Directivity correction	Correction		0	0	0	0	0	0	0	0	-
Façade Length (m)	Façade Area (S)		13	13	13	13	13	13	13	13	
Façade Width (m)	Volume (V)		43	43	43	43	43	43	43	43	
Façade Area	S/V		0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
Room Length (m)	10log(S/V)		-5.3	-5.3	-5.3	-5.3	-5.3	-5.3	-5.3	-5.3	
Room Height (m)			11	11	11	11	11	11	11	11	
Room Width (m)	Rev time		0.65	0.60	0.55	0.50	0.50	0.50	0.50	0.50	-
Volume	10logT		-1.87	-2.22	-2.60	-3.01	-3.01	-3.01	-3.01	-3.01	-
Tmf	L2		75	69	66	65	67	64	65	60	72
Sound Reduction	R		28	28	35	43	54	55	61	61	46
L2 Room Lp			52	46	36	27	18	14	9	4	34
	25	NR	55	44	35	29	25	22	20	18	35
	Excess		-4	3	1	-3	-7	-8	-11	-14	-1

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

Partition Dimensions and Material Data:

Description	Area	Units	Octave Band Centre Frequency (Hz)							R _w
			63	125	250	500	1000	2000	4000	
Wall	10.2	m²	43	48	47	49	59	69	79	56
Glazing	2.4	m²	21	21	28	37	48	48	54	39
Composite Sound Reduction Index			28	28	35	43	54	55	61	46

Façades	Description	Directivity correction	63	125	250	500	1k	2k	4k	8k	dB(A)
Façade 1	Front wall	0	52	46	36	27	18	14	9	4	34
Total			52	46	36	27	18	14	9	4	34

Proposed design Flat 3 Bedroom 1 Day:

Façade noise Break-in façade 1			63	125	250	500	1k	2k	4k	8k	dB(A)
L1	Free Field Source Lp		71	66	63	62	64	61	62	57	69
Directivity correction	Correction		0	0	0	0	0	0	0	0	-
Façade Length (m)	Façade Area (S)		9	9	9	9	9	9	9	9	
Façade Width (m)	Volume (V)		31	31	31	31	31	31	31	31	
Façade Area	S/V		0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
Room Length (m)	10log(S/V)		-5.5	-5.5	-5.5	-5.5	-5.5	-5.5	-5.5	-5.5	
Room Height (m)			11	11	11	11	11	11	11	11	
Room Width (m)	Rev time		0.65	0.60	0.55	0.50	0.50	0.50	0.50	0.50	-
Volume	10logT		-1.87	-2.22	-2.60	-3.01	-3.01	-3.01	-3.01	-3.01	-
Tmf	L2		75	69	66	64	66	63	64	59	71
Sound Reduction	R		30	30	37	44	55	57	63	63	48
L2 Room Lp			50	44	34	25	16	12	6	1	32
	25	NR	55	44	35	29	25	22	20	18	35
	Excess		-6	0	-1	-4	-9	-10	-13	-16	-3

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

Partition Dimensions and Material Data:

Description	Area	Units	Octave Band Centre Frequency (Hz)							R _w
			63	125	250	500	1000	2000	4000	
Wall	7.72	m²	43	48	47	49	59	69	79	56
Glazing	1.08	m²	21	21	28	37	48	48	54	39
Composite Sound Reduction Index			30	30	37	44	55	57	63	48

Façades	Description	Directivity correction	63	125	250	500	1k	2k	4k	8k	dB(A)
Façade 1	Front wall	0	50	44	34	25	16	12	6	1	32
Façade 2	Roof	-3	56	58	38	20	17	14	15	10	43
Total			57	58	39	26	20	16	15	11	43

Façade noise Break-in façade 2			63	125	250	500	1k	2k	4k	8k	dB(A)
L1	Free Field Source Lp		71	66	63	62	64	61	62	57	69
Directivity correction	Correction		-3	-3	-3	-3	-3	-3	-3	-3	-
Façade Length (m)	Façade Area (S)		3	3	3	3	3	3	3	3	
Façade Width (m)	Volume (V)		31	31	31	31	31	31	31	31	
Façade Area	S/V		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Room Length (m)	10log(S/V)		-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	
Room Height (m)			11	11	11	11	11	11	11	11	
Room Width (m)	Rev time		0.65	0.60	0.55	0.50	0.50	0.50	0.50	0.50	-
Volume	10logT		-1.87	-2.22	-2.60	-3.01	-3.01	-3.01	-3.01	-3.01	-
Tmf	L2		67	61	58	57	59	56	57	52	63
Sound Reduction	R		16	8	25	42	47	47	47	47	33
L2 Room Lp			56	58	38	20	17	14	15	10	43
		NR	55	44	35	29	25	22	20	18	35
	Excess		0	15	3	-10	-8	-8	-5	-8	8

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

Partition Dimensions and Material Data:

Description	Area	Units	Octave Band Centre Frequency (Hz)							R _w
			63	125	250	500	1000	2000	4000	
Roof	2.8	m²	16	8	25	42	47	47	47	33
Composite Sound Reduction Index			16	8	25	42	47	47	47	33

Proposed design Flat 3 Bedroom 1 night-time:

Façade noise Break-in façade 1		63	125	250	500	1k	2k	4k	8k	dB(A)
L1	Free Field Source Lp	65	57	55	56	57	53	43	35	60
Directivity correction	0	0	0	0	0	0	0	0	0	-
Façade Length (m)	4.00	Façade Area (S)								
Façade Width (m)	2.20	Volume (V)								
Façade Area	8.80	S/V								
Room Length (m)	4.00	10log(S/V)								
Room Height (m)	2.90	11								
Room Width (m)	2.70	Rev time								
Volume	31.32	10logT								
Tmf	0.50	L2								
Sound Reduction		R								
L2 Room Lp		NR								
20		Excess								

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

Partition Dimensions and Material Data:

Description	Area	Units	octave Band Centre Frequency (Hz)							R _w
Wall	7.72	m ²	63	125	250	500	1000	2000	4000	56
Glazing	1.08	m ²	21	21	28	37	48	48	54	39
Composite Sound Reduction Index			30	30	37	44	55	57	63	48

Façades	Description	Directivity correction	63	125	250	500	1k	2k	4k	8k	dB(A)
Façade 1	Front wall	0	44	35	26	19	10	4	-12	-21	24
Façade 2	Roof	-3	50	49	30	13	10	6	-4	-13	34
Total			51	49	32	20	13	9	4	3	34

Façade noise Break-in façade 2		63	125	250	500	1k	2k	4k	8k	dB(A)
L1	Free Field Source Lp	65	57	55	56	57	53	43	35	60
Directivity correction	-3	-3	-3	-3	-3	-3	-3	-3	-3	-
Façade Length (m)	4.00	Façade Area (S)								
Façade Width (m)	0.70	Volume (V)								
Façade Area	2.80	S/V								
Room Length (m)	4.00	10log(S/V)								
Room Height (m)	2.90	11								
Room Width (m)	2.70	Rev time								
Volume	31.32	10logT								
Tmf	0.50	L2								
Sound Reduction		R								
L2 Room Lp		NR								
		Excess								

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

Partition Dimensions and Material Data:

Description	Area	Units	octave Band Centre Frequency (Hz)							R _w
Roof	2.8	m ²	63	125	250	500	1000	2000	4000	33
Composite Sound Reduction Index			16	8	25	42	47	47	47	33

Proposed design Flat 3 Bedroom 2 Day:

Façade noise Break-in façade 1		63	125	250	500	1k	2k	4k	8k	dB(A)
L1	Free Field Source Lp	71	66	63	62	64	61	62	57	69
Directivity correction	0	0	0	0	0	0	0	0	0	-
Façade Length (m)	3.40	Façade Area (S)								
Façade Width (m)	2.20	Volume (V)								
Façade Area	7.48	S/V								
Room Length (m)	4.00	10log(S/V)								
Room Height (m)	2.90	11								
Room Width (m)	2.10	Rev time								
Volume	24.36	10logT								
Tmf	0.50	L2								
Sound Reduction		R								
L2 Room Lp		NR								
25		Excess								

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

Partition Dimensions and Material Data:

Description	Area	Units	octave Band Centre Frequency (Hz)							R _w
Wall	6.4	m ²	43	48	47	49	59	69	79	56
Glazing	1.08	m ²	21	21	28	37	48	48	54	39
Roof		m ²	23	20	36	46	51	48	53	44
Composite Sound Reduction Index			29	29	36	44	55	56	62	47

Façades	Description	Directivity correction	63	125	250	500	1k	2k	4k	8k	dB(A)
Façade 1	Front wall	0	51	45	35	26	17	13	8	3	33
Façade 2	Side wall	0	33	23	20	17	9	-4	-13	-18	17
Façade 3	Roof	-3	56	59	38	20	17	14	15	10	43
Total			57	59	40	27	20	16	16	11	43

Façade noise Break-in façade 2		63	125	250	500	1k	2k	4k	8k	dB(A)
L1	Free Field Source Lp	71	66	63	62	64	61	62	57	69
Directivity correction	0	0	0	0	0	0	0	0	0	-
Façade Length (m)	1.00	Façade Area (S)								
Façade Width (m)	2.90	Volume (V)								
Façade Area	2.90	S/V								
Room Length (m)	4.00	10log(S/V)								
Room Height (m)	2.90	11								
Room Width (m)	2.10	Rev time								
Volume	24.36	10logT								
Tmf	0.50	L2								
Sound Reduction		R								
L2 Room Lp		NR								
		Excess								

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

Partition Dimensions and Material Data:

Description	Area	Units	octave Band Centre Frequency (Hz)							R _w
Wall	2.9	m ²	43	48	47	49	59	69	79	56
Composite Sound Reduction Index			43	48	47	49	59	69	79	56

Façade noise Break-in façade 3		63	125	250	500	1k	2k	4k	8k	dB(A)
L1	Free Field Source Lp	71	66	63	62	64	61	62	57	69
Directivity correction	-3	-3	-3	-3	-3	-3	-3	-3	-3	-
Façade Length (m)	3.40	Façade Area (S)								
Façade Width (m)	0.70	Volume (V)								
Façade Area	2.38	S/V								
Room Length (m)	4.00	10log(S/V)								
Room Height (m)	2.90	11								
Room Width (m)	2.10	Rev time								
Volume	24.36	10logT								
Tmf	0.50	L2								
Sound Reduction		R								
L2 Room Lp		NR								
		Excess								

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

Partition Dimensions and Material Data:

Description	Area	Units	octave Band Centre Frequency (Hz)							R _w
Roof	2.38	m ²	16	8	25	42	47	47	47	33
Composite Sound Reduction Index			16	8	25	42	47	47	47	33

Proposed design Flat 3 Bedroom 2 Night-time:

Façade noise Break-in façade 1											
L1	Free Field Source Lp		63	125	250	500	1k	2k	4k	8k	dB(A)
Directivity correction	0		65	57	55	55	57	53	43	35	60
Façade Length (m) <td colspan="2">3.40</td> <td colspan="2">Correction Area (S)</td> <td colspan="7"></td>	3.40		Correction Area (S)								
Façade Width (m) <td colspan="2">2.20</td> <td colspan="2">Volume (V)</td> <td colspan="7"></td>	2.20		Volume (V)								
Façade Area <td colspan="2">7.48</td> <td colspan="2">S/V</td> <td colspan="7"></td>	7.48		S/V								
Room Length (m) <td colspan="2">4.00</td> <td colspan="2">10log(S/V)</td> <td colspan="7"></td>	4.00		10log(S/V)								
Room Height (m) <td colspan="2">2.90</td> <td colspan="2">11</td> <td colspan="7"></td>	2.90		11								
Room Width (m) <td colspan="2">2.10</td> <td colspan="2">Rev.time</td> <td colspan="7"></td>	2.10		Rev.time								
Volume <td colspan="2">24.36</td> <td colspan="2">10logT</td> <td colspan="7"></td>	24.36		10logT								
Tmf	0.50		L2								
Sound Reduction			NR								
L2 Room Lp			NR								
	20		Excess								
L2 = L1-R+10log(S/V)+11+10logT											
Partition Dimensions and Material Data:											
Description	Area	Units	Octave Band Centre Frequency (Hz)								Rw
Wall	6.4	m ²	63	125	250	500	1000	2000	4000		
Glazing	1.08	m ²	21	21	28	37	48	48	54	64	39
Composite Sound Reduction Index			29	29	36	44	55	56	62	67	
Façades											
Description	Directivity correction	63	125	250	500	1k	2k	4k	8k	dB(A)	
Façade 1	0	45	36	27	20	11	5	-11	-20	25	
Façade 2	0	27	13	12	11	2	-12	-32	-41	11	
Façade 3	-3	50	50	30	14	10	6	-4	-12	34	
Total		51	50	32	21	14	9	2	0	0	

Façade noise Break-in façade 2									
L1	Free Field Source Lp	63	125	250	500	1k	2k	4k	8k dB(A)
		65	57	55	56	57	53	43	35
Directivity correction	0	0	0	0	0	0	0	0	0
Façade Length (m)	1.00	Façade Area (S)							
		3	3	3	3	3	3	3	3
Façade Width (m)	2.90	Volume (V)							
		24	24	24	24	24	24	24	24
Façade Area	2.90	S/V							
		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Room Length (m)	4.00	10log(S/V)							
		-2.2	-2.1	-2.2	-2.2	-2.2	-2.2	-2.2	-2.2
Room Height (m)	2.90	11							
		11	11	11	11	11	11	11	11
Room Width (m)	2.10	Rev time							
		0.65	0.60	0.55	0.50	0.50	0.50	0.50	0.50
Volume	24.36	10logT							
		-1.67	-2.22	-2.60	-3.01	-3.01	-3.01	-3.01	-3.01
Tmf	0.50	L2							
		65	56	54	55	56	52	42	33
Sound Reduction		R							
		-43	-48	-47	-49	-59	-69	-79	-79
L2 Room Lp		NR							
		27	13	12	11	2	-12	-32	-41
		51	39	31	24	20	17	14	13
		Excess							
		-24	-26	-24	-14	-18	-29	-46	-53
		-20							
L2 = L1-R+10log(S/V)+11+10logT									
Partition Dimensions and Material Data:									
Description	Area	Units	Octave Band Centre Frequency (Hz)						Rw
			63	125	250	500	1000	2000	4000
Wall	2.9	m²	43	48	47	49	59	69	79
		m²							
Composite Sound Reduction Index			43	48	47	49	59	69	79
			56						

Façade noise Break-in façade 3		63	125	250	500	1k	2k	4k	8k	dB
L1		85	57	56	56	57	53	43	36	61
Free Field Source Lp										
Correction		-3	-3	-3	-3	-3	-3	-3	-3	
Façade Area (S)		2	2	2	2	2	2	2	2	
Façade Width (m)		0.70	24	24	24	24	24	24	24	
Façade Area		2.38	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Room Length (m)		4.00	10log(S/V)	-10.1	-10.1	-10.1	-10.1	-10.1	-10.1	
Room Height (m)		2.90	11	11	11	11	11	11	11	
Room Width (m)		2.10	0.65	0.60	0.55	0.50	0.50	0.50	0.50	
Volume		24.36	10logT	-1.87	-2.27	-2.60	-3.01	-3.01	-3.01	
Tmf		0.50	L2	61	53	50	51	42	38	
Sound Reduction			R	16	8	25	42	47	47	
L2 Room Lp				50	50	30	14	10	6	
				31	24	20	17	14	13	
				10	0	-10	-10	-11	-18	
				Excess	-1	-10	0	-10	-11	
L2 = L1-R+10log(S/V)+11+10logT										
Partition Dimensions and Material Data:										
Description	Area	Units	Octave Band Centre Frequency (Hz)						Rw	
Roof	2.38	m²	63	125	250	500	1000	2000	4000	
		m²	16	8	25	42	47	47	33	
Composite Sound Reduction Index			16	8	25	42	47	47	33	

Flat 1 Bedroom 1 Day with mitigated roof:

Façade noise Break-in façade 1		63	125	250	500	1k	2k	4k	8k	dB(A)	
L1	Free Field Source Lp Correction Façade Area (S) Volume (V) S/V 10log(S/V) Rev time 10logT	71	66	63	62	64	61	62	57	69	
Directivity correction		0	0	0	0	0	0	0	0	-	
Façade Length (m)		1.40	4	4	4	4	4	4	4		
Façade Width (m)		2.50	23	23	23	23	23	23	23		
Façade Area		3.50	0.2	0.2	0.2	0.2	0.2	0.2	0.2		
Room Length (m)		3.60	-8.1	-8.1	-8.1	-8.1	-8.1	-8.1	-8.1		
Room Height (m)		2.50	11	11	11	11	11	11	11		
Room Width (m)		2.50	0.65	0.60	0.55	0.50	0.50	0.50	0.50	-	
Volume		22.50	-1.87	-2.22	-2.60	-3.01	-3.01	-3.01	-3.01	-	
Tmf		0.50	L2	72	67	63	62	61	62	57	69
Sound Reduction		R	28	28	35	43	54	55	61	46	
L2 Room Lp			47	42	32	22	13	9	4	-1	29
	25										
		NR	55	44	35	29	25	22	20	18	35
		Excess	-8	-2	-4	-7	-12	-13	-15	-19	-6
L2 = L1-R+10log(S/V)+11+10logT											
Partition Dimensions and Material Data:											
Description		Area	Units	Octave Band Centre Frequency (Hz)						Rw	
				63	125	250	500	1000	2000	4000	
Wall		2.78	m²	43	48	47	49	59	69	79	56
Glazing		0.72	m²	21	21	28	37	48	48	54	39
Composite Sound Reduction Index				28	28	35	43	54	55	61	46
Façades											
Façades	Description	Directivity correction	63	125	250	500	1k	2k	4k	8k	dB(A)
Façade 1	Front wall	0	47	42	32	22	13	9	4	-1	29
Façade 2	Roof	-3	51	49	30	18	15	15	11	6	34
Total			53	50	34	24	17	16	13	8	33

Façade noise Break-in façade 2		63	125	250	500	1k	2k	4k	8k	dB
L1	Free Field Source Lp	71	66	63	62	64	61	62	57	65
Directivity correction	-3	-3	-3	-3	-3	-3	-3	-3	-3	-
Façade Length (m)	2.50	Façade Area (S)								
Façade Width (m)	3.00	Volume (V)								
Façade Area	7.50	S/V								
Room Length (m)	3.60	10log(S/V)								
Room Height (m)	2.50	11								
Room Width (m)	2.50	Rev time								
Volume	22.50	10logT								
Tmf	0.50	L2								
Sound Reduction		R								
L2 Room Lp		51	49	30	18	15	15	11	5	34
		NR	55	44	35	29	25	22	20	18
		Excess	-4	5	-6	-11	-10	-7	-8	-12
L2 = L1-R+10log(S/V)+11+10logT										
Partition Dimensions and Material Data:										
Description	Area	Units	Octave Band Centre Frequency (Hz)							Rw
			63	125	250	500	1000	2000	4000	
Roof	6	m²	23	20	36	46	51	48	53	44
		m²								
Composite Sound Reduction Index			23	20	36	46	51	48	53	44

Flat 1 Bedroom 1 night-time with mitigated roof:

Façade noise Break-in façade 1		63	125	250	500	1k	2k	4k	8k	dB(A)	
L1	Free Field Source Lp	65	57	55	56	57	53	43	35	60	
Directivity correction	0	0	0	0	0	0	0	0	0	-	
Façade Length (m)	1.40	Façade Area (S)	4	4	4	4	4	4	4	-	
Façade Width (m)	2.50	Volume (V)	23	23	23	23	23	23	23	-	
Façade Area	3.50	S/V	0.2	0.2	0.2	0.2	0.2	0.2	0.2	-	
Room Length (m)	3.60	10log(S/V)	-8.1	-8.1	-8.1	-8.1	-8.1	-8.1	-8.1	-	
Room Height (m)	2.50	11	11	11	11	11	11	11	11	-	
Room Width (m)	2.50	Rev time	0.65	0.60	0.55	0.50	0.50	0.50	0.50	-	
Volume	22.50	10logT	-1.87	-2.22	-2.60	-3.01	-3.01	-3.01	-3.01	-	
Tmf	0.50	L2	66	58	55	56	57	53	43	60	
Sound Reduction		R	28	28	35	43	54	55	61	46	
L2 Room Lp			43	35	26	18	9	3	-13	-21	23
	20	NR	51	39	31	24	20	17	14	13	30
		Excess	-8	-5	-5	-6	-11	-13	-27	-34	-7
L2 = L1-R+10log(S/V)+11+10logT											
Partition Dimensions and Material Data:											
Description		Area	Units	Octave Band Centre Frequency (Hz)							R _w
				63	125	250	500	1000	2000	4000	
Wall		2.78	m ²	43	48	47	49	59	69	79	56
Glazing		0.72	m ²	21	21	28	37	48	48	54	39
Composite Sound Reduction Index				28	28	35	43	54	55	61	46
Façades	Description	Directivity correction	63	125	250	500	1k	2k	4k	8k	dB(A)
Façade 1	Front wall	0	43	35	26	18	9	3	-13	-21	23
Façade 2	Roof	-3	47	42	24	14	11	9	-6	-14	28
Total			49	43	28	20	13	11	4	3	29

Façade noise Break-in façade 2		63	125	250	500	1k	2k	4k	8k	dB(A)	
L1	Free Field Source Lp	65	57	55	56	57	53	43	35	60	
Directivity correction	-3	-3	-3	-3	-3	-3	-3	-3	-3	-	
Façade Length (m)	2.50	8	8	8	8	8	8	8	8	-	
Façade Width (m)	3.00	23	23	23	23	23	23	23	23	-	
Façade Area	7.50	S/V	0.3	0.3	0.3	0.3	0.3	0.3	0.3	-	
Room Length (m)	3.60	10log(S/V)	-4.8	-4.8	-4.8	-4.8	-4.8	-4.8	-4.8	-	
Room Height (m)	2.50	11	11	11	11	11	11	11	11	-	
Room Width (m)	2.50	Rev time	0.65	0.60	0.55	0.50	0.50	0.50	0.50	-	
Volume	22.50	10logT	-1.87	-2.22	-2.60	-3.01	-3.01	-3.01	-3.01	-	
Tmf	0.50	L2	66	58	56	56	58	53	43	61	
Sound Reduction		R	23	20	36	46	51	48	53	44	
L2 Room Lp			47	42	24	14	11	9	-6	-14	28
		NR	51	39	31	24	20	17	14	13	30
		Excess	-4	3	-7	-10	-9	-7	-20	-27	-3
L2 = L1-R+10log(S/V)+11+10logT											
Partition Dimensions and Material Data:											
Description	Area	Units	Octave Band Centre Frequency (Hz)							R _w	
			63	125	250	500	1000	2000	4000		
Roof	6	m ²	23	20	36	46	51	48	53	44	
		m ²									
Composite Sound Reduction Index			23	20	36	46	51	48	53	44	

Flat 3 Bedroom 1 day with mitigated roof:

Façade noise Break-in façade 1			63	125	250	500	1k	2k	4k	8k	dB(A)
L1		Free Field Source Lp	71	66	63	62	64	61	62	57	69
Directivity correction	0	Correction	0	0	0	0	0	0	0	0	-
Façade Length (m)	4.00	Façade Area (S)	9	9	9	9	9	9	9	9	-
Façade Width (m)	2.20	Volume (V)	31	31	31	31	31	31	31	31	-
Façade Area	8.80	S/V	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	-
Room Length (m)	4.00	10log(S/V)	-5.5	-5.5	-5.5	-5.5	-5.5	-5.5	-5.5	-5.5	-
Room Height (m)	2.90	11	11	11	11	11	11	11	11	11	-
Room Width (m)	2.70	Rev time	0.65	0.60	0.55	0.50	0.50	0.50	0.50	0.50	-
Volume	31.32	10logT	-1.87	-2.22	-2.60	-3.01	-3.01	-3.01	-3.01	-3.01	-
Tmf	0.50	L2	75	69	66	64	66	63	64	59	71
Sound Reduction		R	30	30	37	44	55	57	63	63	48
L2 Room Lp			50	44	34	25	16	12	6	1	32
	25	NR	55	44	35	29	25	22	20	18	35
		Excess	-6	0	-1	-4	-9	-10	-13	-16	-3
L2 = L1-R+10log(S/V)+11+10logT											
Partition Dimensions and Material Data:											
Description		Area	Units	Octave Band Centre Frequency (Hz)							R _w
				63	125	250	500	1000	2000	4000	
Wall		7.72	m ²	43	48	47	49	59	69	79	56
Glazing		1.08	m ²	21	21	28	37	48	48	54	39
Composite Sound Reduction Index				30	30	37	44	55	57	63	48
Façades	Description	Directivity correction	63	125	250	500	1k	2k	4k	8k	dB(A)
Façade 1	Front wall	0	50	44	34	25	16	12	6	1	32
Façade 2	Roof	-3	49	46	27	16	13	13	9	4	31
Total			52	48	35	25	18	15	11	8	35

Façade noise Break-in façade 2		63	125	250	500	1k	2k	4k	8k	dB(A)	
L1	Free Field Source Lp	71	66	63	62	64	61	62	57	69	
Directivity correction	-3	-3	-3	-3	-3	-3	-3	-3	-3	-	
Façade Length (m)	4.00	Façade Area (S)	3	3	3	3	3	3	3	-	
Façade Width (m)	0.70	Volume (V)	31	31	31	31	31	31	31	-	
Façade Area	2.80	S/V	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-	
Room Length (m)	4.00	10log(S/V)	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-	
Room Height (m)	2.90	11	11	11	11	11	11	11	11	-	
Room Width (m)	2.70	Rev time	0.65	0.60	0.55	0.50	0.50	0.50	0.50	-	
Volume	31.32	10logT	-1.87	-2.22	-2.60	-3.01	-3.01	-3.01	-3.01	-	
Tmf	0.50	L2	67	61	58	57	59	56	57	52	63
Sound Reduction		R	23	20	36	46	51	48	53	44	
L2 Room Lp			49	46	27	16	13	13	9	4	31
		NR	55	44	35	29	25	22	20	18	35
		Excess	-7	3	-8	-14	-12	-9	-11	-14	-3
L2 = L1-R+10log(S/V)+11+10logT											
Partition Dimensions and Material Data:											
Description	Area	Units	Octave Band Centre Frequency (Hz)							R _w	
			63	125	250	500	1000	2000	4000		
Roof	2.8	m ²	23	20	36	46	51	48	53	44	
		m ²									
Composite Sound Reduction Index			23	20	36	46	51	48	53	44	

Flat 3 Bedroom 1 night-time with mitigated roof:

Façade noise Break-in façade 1									
L1	Free Field Source Lp	63	125	250	500	1k	2k	4k	8k dB(A)
Directivity correction	0	0	0	0	0	0	0	0	-
Façade Length (m)	4.00	9	9	9	9	9	9	9	9
Façade Width (m)	2.20	31	31	31	31	31	31	31	31
Façade Area	8.80	S/V	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Room Length (m)	4.00	10log(S/V)	-5.5	-5.5	-5.5	-5.5	-5.5	-5.5	-5.5
Room Height (m)	2.90	11	11	11	11	11	11	11	11
Room Width (m)	2.70	Rev time	0.65	0.60	0.55	0.50	0.50	0.50	0.50
Volume	31.32	10logT	-1.87	-2.22	-2.60	-3.01	-3.01	-3.01	-3.01
Tmf	0.50	L2	69	60	58	58	60	56	46
Sound Reduction	R	30	30	37	44	55	57	63	63
L2 Room Lp		44	35	26	19	10	4	-12	-21
	25	NR	55	44	35	29	25	20	18
		Excess	-12	-9	-9	-10	-15	-18	-32

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

Partition Dimensions and Material Data:

Description	Area	Units	63	125	250	500	1000	2000	4000	R _w
Wall	7.72	m²	43	48	47	49	59	69	79	56
Glazing	1.08	m²	21	21	28	37	48	48	54	39
Composite Sound Reduction Index			30	30	37	44	55	57	63	48

Façades	Description	Directivity correction	63	125	250	500	1k	2k	4k	8k	dB(A)
Façade 1	Front wall	0	44	35	26	19	10	4	-12	-21	24
Façade 2	Roof	-3	43	37	19	9	6	5	-10	-19	23
Total			46	39	27	19	12	9	3	3	27

Façade noise Break-in façade 2									
L1	Free Field Source Lp	63	125	250	500	1k	2k	4k	8k dB(A)
Directivity correction	-3	-3	-3	-3	-3	-3	-3	-3	-3
Façade Length (m)	4.00	3	3	3	3	3	3	3	3
Façade Width (m)	0.70	31	31	31	31	31	31	31	31
Façade Area	2.80	S/V	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Room Length (m)	4.00	10log(S/V)	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5
Room Height (m)	2.90	11	11	11	11	11	11	11	11
Room Width (m)	2.70	Rev time	0.65	0.60	0.55	0.50	0.50	0.50	0.50
Volume	31.32	10logT	-1.87	-2.22	-2.60	-3.01	-3.01	-3.01	-3.01
Tmf	0.50	L2	61	52	50	50	52	48	38
Sound Reduction	R	23	20	36	46	51	48	53	53
L2 Room Lp		43	37	19	9	6	5	-10	-19
		NR	55	44	35	29	25	22	20
		Excess	-13	-7	-16	-20	-19	-17	-30

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

Partition Dimensions and Material Data:

Description	Area	Units	63	125	250	500	1000	2000	4000	R _w
Roof	2.8	m²	23	20	36	46	51	48	53	44
Composite Sound Reduction Index			23	20	36	46	51	48	53	44

Flat 3 Bedroom 2 day with mitigated roof:

Façade noise Break-in façade 1									
L1	Free Field Source Lp	63	125	250	500	1k	2k	4k	8k dB(A)
Directivity correction	0	0	0	0	0	0	0	0	-
Façade Length (m)	3.40	7	7	7	7	7	7	7	7
Façade Width (m)	2.20	24	24	24	24	24	24	24	24
Façade Area	7.48	S/V	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Room Length (m)	4.00	10log(S/V)	-5.1	-5.1	-5.1	-5.1	-5.1	-5.1	-5.1
Room Height (m)	2.90	11	11	11	11	11	11	11	11
Room Width (m)	2.10	Rev time	0.65	0.60	0.55	0.50	0.50	0.50	0.50
Volume	24.36	10logT	-1.87	-2.22	-2.60	-3.01	-3.01	-3.01	-3.01
Tmf	0.50	L2	75	70	66	65	67	64	65
Sound Reduction	R	29	29	36	44	55	56	62	62
Flanking/Tolerance		5	5	5	5	5	5	5	5
L2 Room Lp		51	45	35	26	17	13	8	3
	25	NR	55	44	35	29	25	22	20
		Excess	-4	2	0	-3	-8	-9	-12

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

Partition Dimensions and Material Data:

Description	Area	Units	63	125	250	500	1000	2000	4000	R _w
Wall	6.4	m²	43	48	47	49	59	69	79	56
Glazing	1.08	m²	21	21	28	37	48	48	54	39
Composite Sound Reduction Index			29	29	36	44	55	56	62	47

Façades	Description	Directivity correction	63	125	250	500	1k	2k	4k	8k	dB(A)
Façade 1	Front wall	0	51	45	35	26	17	13	8	3	33
Façade 2	Roof	0	33	23	20	17	9	4	-13	-18	17
Façade 3	Side wall	-3	48	46	26	15	12	12	8	3	31
Total			53	49	36	27	19	15	11	7	35

Façade noise Break-in façade 2									
L1	Free Field Source Lp	63	125	250	500	1k	2k	4k	8k dB(A)
Directivity correction	0	0	0	0	0	0	0	0	-
Façade Length (m)	1.00	3	3	3	3	3	3	3	3
Façade Width (m)	2.90	24	24	24	24	24	24	24	24
Façade Area	2.90	S/V	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Room Length (m)	4.00	10log(S/V)	-9.2	-9.2	-9.2	-9.2	-9.2	-9.2	-9.2
Room Height (m)	2.90	11	11	11	11	11	11	11	11
Room Width (m)	2.10	Rev time	0.65	0.60	0.55	0.50	0.50	0.50	0.50
Volume	24.36	10logT	-1.87	-2.22	-2.60	-3.01	-3.01	-3.01	-3.01
Tmf	0.50	L2	71	66	62	61	63	60	61
Sound Reduction	R	43	48	47	49	59	69	79	79
Flanking/Tolerance		5	5	5	5	5	5	5	5
L2 Room Lp		33	23	20	17	9	4	-13	-18
		NR	55	44	35	29	25	22	20
		Excess	-22	-21	-15	-12	-16	-26	-33

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

Partition Dimensions and Material Data:

Description	Area	Units	63	125	250	500	1000	2000	4000	R _w
Wall	2.9	m²	43	48	47	49	59	69	79	56
Composite Sound Reduction Index			43	48	47	49	59	69	79	56

Façade noise Break-in façade 3									
L1	Free Field Source Lp	63	125	250	500	1k	2k	4k	8k dB(A)
Directivity correction	-3	-3	-3	-3	-3	-3	-3	-3	-3
Façade Length (m)	3.40	2	2	2	2	2	2	2	2
Façade Width (m)	0.70	24	24	24	24	24	24	24	24
Façade Area	2.38	S/V	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Room Length (m)	4.00	10log(S/V)	-10.1	-10.1	-10.1	-10.1	-10.1	-10.1	-10.1
Room Height (m)	2.90	11	11	11	11	11	11	11	11
Room Width (m)	2.10	Rev time	0.65	0.60	0.55	0.50	0.50	0.50	0.50
Volume	24.36	10logT	-1.87	-2.22	-2.60	-3.01	-3.01	-3.01	-3.01
Tmf	0.50	L2	67	62	58	57	59	56	57
Sound Reduction	R	23	20	36	46	51	48	53	53
Flanking/Tolerance		4	4	4	4	4	4	4	4
L2 Room Lp		48	46	26	15	12	12	8	3
		NR	55	44	35	29	25	22	20
		Excess	-7	2	-9	-14	-13	-10	-12

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

Partition Dimensions and Material Data:

Description	Area	Units	63	125	250	500	1000	2000	4000	R _w
Roof	2.38	m²	23	20	36	46	51	48	53	44
Composite Sound Reduction Index			23	20	36	46	51	48	53	44

Flat 3 Bedroom 2 night-time with mitigated roof:

Façade noise Break-in façade 1		63	125	250	500	1k	2k	4k	8k	dB(A)
L1	Free Field Source Lp	65	57	55	56	57	53	43	35	60
Directivity correction	0	0	0	0	0	0	0	0	0	-
Façade Length (m)	3.40	Façade Area (S)								
Façade Width (m)	2.20	Volume (V)								
Façade Area	7.48	S/V								
Room Length (m)	4.00	10log(S/V)								
Room Height (m)	2.90	11								
Room Width (m)	2.10	Rev time								
Volume	24.36	10logT								
Tmf	0.50	L2								
Sound Reduction	R	29	29	36	44	55	56	62	62	47
L2 Room Lp	25	45	36	27	20	11	5	-11	-20	25
Excess	-11	-8	-8	-9	-14	-17	-31	-38	-10	

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

Partition Dimensions and Material Data:

Description	Area	Units	octave Band Centre Frequency (Hz)								Rw
Wall	6.4	m²	63	125	250	500	1000	2000	4000		56
Glazing	1.08	m²	21	21	28	37	48	48	54	39	
Composite Sound Reduction Index			29	29	36	44	55	56	62	47	

Façades	Description	Directivity correction	63	125	250	500	1k	2k	4k	8k	dB(A)
Façade 1	Front wall	0	45	36	27	20	11	5	-11	-20	25
Façade 2	Roof	0	27	13	12	11	2	-12	-32	-41	11
Façade 3	Side wall	-3	43	38	19	10	6	5	-10	-18	23
Total			47	40	28	21	13	9	1	0	27

Façade noise Break-in façade 2		63	125	250	500	1k	2k	4k	8k	dB(A)
L1	Free Field Source Lp	65	57	55	56	57	53	43	35	60
Directivity correction	0	0	0	0	0	0	0	0	0	-
Façade Length (m)	1.00	Façade Area (S)								
Façade Width (m)	2.90	Volume (V)								
Façade Area	2.90	S/V								
Room Length (m)	4.00	10log(S/V)								
Room Height (m)	2.90	11								
Room Width (m)	2.10	Rev time								
Volume	24.36	10logT								
Tmf	0.50	L2								
Sound Reduction	R	43	48	47	49	59	69	79	79	56
L2 Room Lp		27	13	12	11	2	-12	-32	-41	11
Excess	-28	-30	-23	-18	-23	-34	-52	-58	-24	

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

Partition Dimensions and Material Data:

Description	Area	Units	octave Band Centre Frequency (Hz)								Rw
Wall	2.9	m²	63	125	250	500	1000	2000	4000		56
Composite Sound Reduction Index			43	48	47	49	59	69	79	56	

Façade noise Break-in façade 3		63	125	250	500	1k	2k	4k	8k	dB(A)
L1	Free Field Source Lp	65	57	55	56	57	53	43	35	60
Directivity correction	-3	-3	-3	-3	-3	-3	-3	-3	-3	-
Façade Length (m)	3.40	Façade Area (S)								
Façade Width (m)	0.70	Volume (V)								
Façade Area	2.38	S/V								
Room Length (m)	4.00	10log(S/V)								
Room Height (m)	2.90	11								
Room Width (m)	2.10	Rev time								
Volume	24.36	10logT								
Tmf	0.50	L2								
Sound Reduction	R	23	20	36	46	51	48	53	53	44
L2 Room Lp		43	38	19	10	6	5	-10	-18	23
Excess	-12	-6	-16	-19	-19	-17	-29	-36	-11	

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

Partition Dimensions and Material Data:

Description	Area	Units	octave Band Centre Frequency (Hz)								Rw
Roof	2.38	m²	63	125	250	500	1000	2000	4000		44
Composite Sound Reduction Index			23	20	36	46	51	48	53	44	

Appendix E: Glossary

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

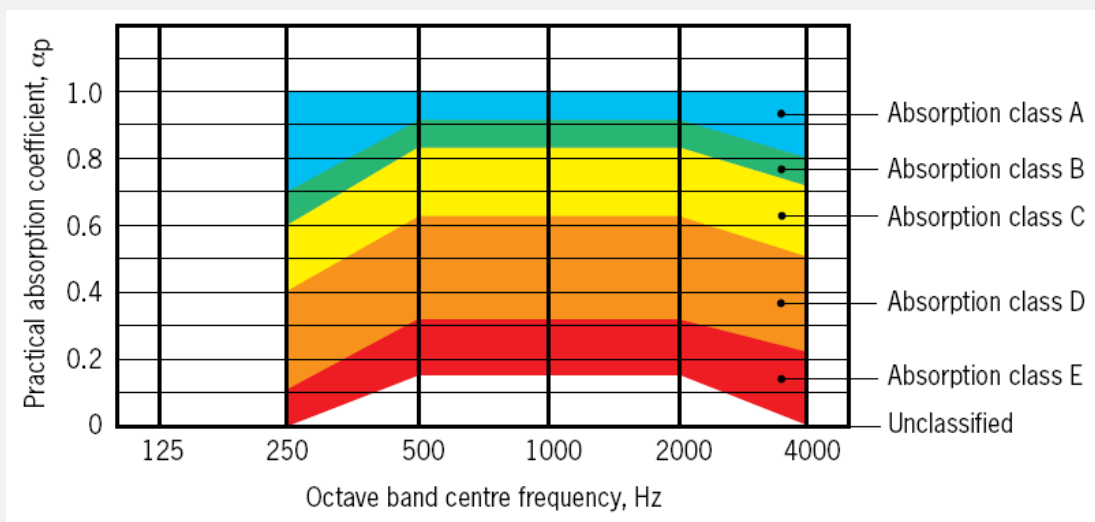
'A' Weighting

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 $L1 - L2$.

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.