



Alexander House, King's Road, Reading

Noise impact assessment

7102.1

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Revision C



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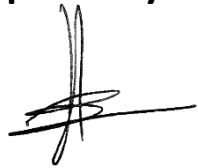
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Prepared for

P.J. Alexander Estates Ltd

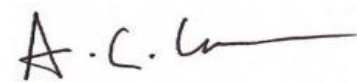
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2 Summary

- 2.1 This report has been prepared in support of a Planning Application for a residential development at Alexander House, King's Road, Reading.
- 2.2 Noise criteria have been proposed based on guidance in BS 8233 and WHO as typically required by the Local Authority.
- 2.3 Noise levels affecting the proposed development from road traffic have been measured during the day and night, and the façade noise impact calculated.
- 2.4 Calculated noise levels are used to determine the potential façade sound insulation treatments to meet the internal noise level requirements of the Local Planning Authority.
- 2.5 A set of minimum glazing and ventilation strategy options, interpreted from Approved Document F (AD-F), is proposed as shown in Table 1.

Façade affected	Glazing / mm	Performance requirement	Potential ventilation strategy	Trickle ventilator
	6/16/6.8 Laminate double glazing	37 dB $R_w + C$	AD-F System 4, mechanical supply and extract with heat recovery (MVHR)	No trickle ventilator has been assessed as not required for AD-F System 4
	6/12/6.4 Laminate double glazing	32 dB $R_w + C$		
	4/12/4 double glazing	30 dB $R_w + C$		

Table 1: Summary of minimum façade sound insulation treatment



Figure 1: Façade layout

3 Scope of appointment

- 3.1 Apex Acoustics has been commissioned by P. J. Alexander Estates Ltd to undertake a noise survey and provide advice on the sound insulation of the façade to achieve the internal levels required by the Local Planning Authority.
- 3.2 Our scope of services includes:
- Measure the noise impact from road traffic on the development at up to two locations;
 - Advise on suitable façade sound insulation treatments to achieve the identified requirements.
- 3.3 Internal noise transmission and the sound insulation requirements of the Building Regulations are not considered in this report.

4 Introduction

- 4.1 A residential development is proposed at Alexander House, King's Road, Reading.
- 4.2 The site location is shown in Figure 2.
- 4.3 The purpose of this report is to identify the usual acoustic design parameters of the Local Environmental Health Department, and the manner in which internal noise levels may be achieved in practice.
- 4.4 This assessment is based on measurements of road traffic noise and other noise sources, room and window dimensions on the architects' plans, assumptions about room conditions, with glazing and ventilation strategy options proposed in this report.

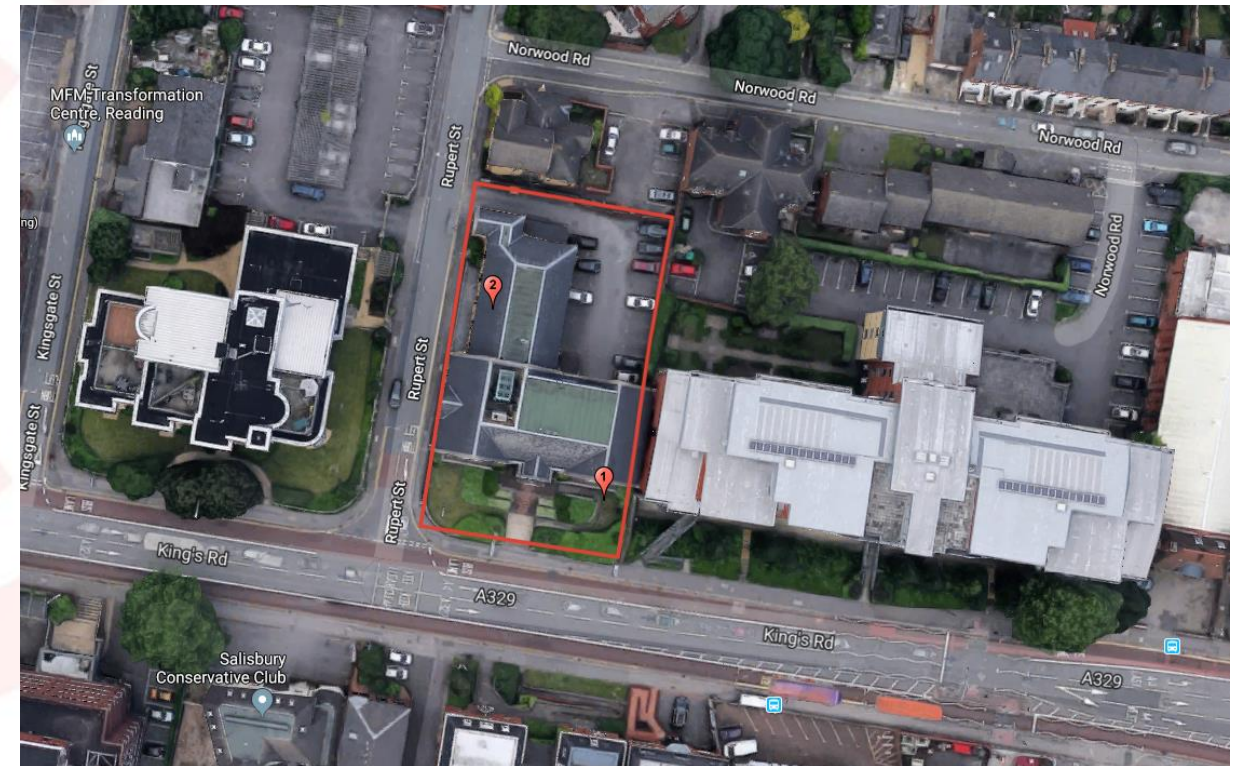


Figure 2: Proposed site outlined in red and measurements position indicated by 'markers'

5 Guidance and acceptable levels

- 5.1 The National Planning Policy Framework (NPPF, 2018), Reference 1, sets out the Government’s planning policies for England and how these should be applied. It provides a framework within which locally-prepared plans for housing and other development can be produced.
- 5.2 The Noise Policy Statement for England (NPSE) set out the long term vision of Government noise policy, “Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development”, Reference 2.
- 5.3 The aims and further details of the NPPF and NPSE are discussed in Appendix 3.
- 5.4 Adverse impact may occur if the noise level exceeds certain limits in either the outdoor amenity areas or inside habitable rooms.
- 5.5 WHO guidance and BS 8233 define guideline upper limits for noise to achieve good sleep and desired sound environment in outdoor amenity spaces.
- 5.6 Table 4 of BS 8233, Reference 3, defines guideline upper limits for internal ambient noise levels in dwellings for steady external noise sources, as shown in Table 2.

Activity	Location	Guideline upper limit, L _{Aeq, T} / dB	
		07:00 to 23:00	23:00 to 07:00
Resting	Living rooms	35	-
Dining	Dining room/area	40	-
Sleeping (daytime resting)	Bedroom	35	30

Table 2: Guideline indoor ambient noise levels defined in BS 8233

- 5.7 Note 4 to Table 4 of BS 8233 states:
- 5.8 “Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or L_{Amax}, F, depending on the character and number of events per night. Sporadic noise events could require separate values.”

- 5.9 The World Health Organisation (WHO), Reference 4, guidance on sleep disturbance is considered appropriate to assess maximum events, as discussed in Appendix 4.
- 5.10 Section 3.4 of the WHO guidelines states:
- 5.11 “For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dB L_{Amax} more than 10 – 15 times per night.”
- 5.12 The above guidance is adopted to assess the impact on internal levels within proposed bedrooms during the night time period, 23:00 to 07:00 hours.
- 5.13 The usual criteria for the internal noise levels from general external sources adopted by the Local Environmental Health Department are consistent with these values and presented in Table 3.

Situation	Proposed upper limits / dB	
	L _{Aeq, T}	L _{AFmax}
Living rooms and Bedrooms, daytime	35	-
Bedrooms, night time	30	45

Table 3: Proposed Local Authority internal noise level requirements

6 Noise sources and measurements

6.1 Measurements positions are indicated in Figure 2.

6.2 The equipment used is listed in Table 4.

Equipment	Model	Serial no.
Sound Level Meter	XL2	A2A-11084-E0
Calibrator	Larson Davis CAL 200	10665
Sound Level Meter	XL2	A2A-11062-E0
Calibrator	Larson Davis CAL 200	13403

Table 4: Equipment used

6.3 Both meters and calibrators have current calibration certificates traceable to national standards.

6.4 The time histories recorded are shown in Appendix 1 and illustrations of measurements in progress in Appendix 2.

6.5 Position 1

6.6 Measurements at Position 1 were made for a 24-hour period starting on 13th November 2018.

6.7 Measurements were made with the microphone located out of the 1st floor window of the existing building, such that they are considered to be façade level.

6.8 At the start of the measurements, the temperature was around 13°C; the wind speed measured was between 0 and 1 m/s.

6.9 The most significant noise source affecting the proposed development during the daytime was road traffic on King's Road.

6.10 Other noise sources included sirens from emergency service vehicles.

6.11 Position 2

6.12 Measurements at Position 2 were made with the microphone located at 2.6 m above street level and 1 metre away from the façade such that they are considered to be façade levels.

6.13 Measurements at Position 2 were made for a 1-hour period during daytime on both the 13th and the 14th of November 2018.

6.14 On the 14th November, the temperature was around 13°C; the wind speed measured was between 1.5 and 2.5 m/s.

6.15 The most significant noise source affecting the proposed development during the daytime was road traffic on King's Road. Traffic was light on Rupert Street.

6.16 Results

6.17 The measured daytime $L_{Aeq, 16 \text{ hr}}$, night-time $L_{Aeq, 8 \text{ hr}}$ and 10th highest $L_{Amax,F}$ noise levels at Position 1 are shown in Table 5.

Position	Parameter	dB(A)	Octave Band Centre Frequency / Hz				
			125	250	500	1k	2k
1	Daytime $L_{Aeq, 16hr}$	72	49	56	60	68	68
	Night time $L_{Aeq, 8hr}$	67	42	52	57	64	61
	Night $L_{Amax,F}$	80	54	64	74	78	72

Table 5: Measured noise levels at Position 1

6.18 The measured daytime periods $L_{Aeq, 1h}$ at Position 2 are averaged. The averaged levels are taken as the $L_{Aeq, 16hr}$, a prudent assumption.

6.19 To represent night time levels, the difference between day and night time $L_{Aeq,T}$ at Position 1 is subtracted to the calculated averaged daytime levels at Position 2. Maximum levels L_{AFmax} are taken from Position 1 and corrected for distance. As traffic on Rupert's road was observed to be light compared to King's Road, this is considered as prudent assumptions.

6.20 Calculated levels at Position 2 are shown in Table 6.

Position	Parameter	dB(A)	Octave Band Centre Frequency / Hz				
			125	250	500	1k	2k
2	Daytime $L_{Aeq, 16hr}$	65	49	54	55	60	60
	Night time $L_{Aeq, 8hr}$	60	44	49	50	55	56
	Night $L_{Amax,F}$	73	47	57	67	71	65

Table 6: Calculated noise levels at Position 2

7 Facade noise calculations

- 7.1 As the measurements were taken at the position of the proposed façade, they are taken to be representative of the likely noise levels affecting the building once constructed.
- 7.2 To represent free-field levels, 3 dB is subtracted from the measured levels.
- 7.3 The calculation method for façade sound insulation is in accordance with BS 8233 and the principles of BS EN 12354-3, Reference 5, as described in Appendix 5 and detailed in the Apex Method, Reference 6.
- 7.4 **Ventilation strategy**
- 7.5 The proposed development will be required to meet Part F of the Building Regulations, with regards to ventilation provision, as described in Approved Document F (AD-F), Reference 7.
- 7.6 As the ventilation strategy is not yet known, three strategies are considered for their acoustic implications, as follows:
- System 1: Background ventilators and intermittent extract fans, with background ventilation provision as defined in Table 5.2a of AD-F;
 - System 3: Continuous mechanical extract (MEV), as defined in Table 5.2c of AD-F;
 - System 4: Mechanical ventilation with heat recovery (MVHR), as defined in Table 5.2d of AD-F.
- 7.7 Suitable ventilation strategies are summarised in the summary and the acoustic performance of the proposed ventilators taken from RW Simon, Reference 9.
- 7.8 It should be emphasised that the above is not intended to constitute a ventilation strategy design, which is the responsibility of the mechanical engineers. Assumptions regarding the ventilation strategy are required in order to carry out the acoustic assessment.

7.9 Reverberation time

- 7.10 From ISO 16283, Reference 8, the reverberation time is typically 0.5 seconds across the relevant frequency range for a furnished living room. This value is used for both living rooms and bedrooms.

7.11 Dimensions and unit descriptions

- 7.12 The room and window dimensions are taken from the architect's plans and elevations, Reference 10.

7.13 Glazing

- 7.14 The acoustic performance of the proposed glazing listed in the summary table is taken from Pilkington, Reference 11.

- 7.15 It is understood that windows can be opened by the occupant. This however is not part of the ventilation strategy. Calculations are therefore carried out with closed windows.

- 7.16 Opening windows may be acceptable to provide purge ventilation; all opening lights should be well fitted with compressible seals.

7.17 Rooms most exposed to noise ingress

- 7.18 Calculations are carried out for those rooms most exposed to noise ingress as the worst cases. If these have sufficient sound insulation to meet the internal level criteria, noise levels in less exposed but similarly protected rooms will be lower and therefore also comply with the Local Authority requirements.

- 7.19 The most exposed rooms are those with the largest ratio of window area to room volume, as well as those closest and most exposed to the noise sources.

7.20 Calculated noise impact

7.21 Façade noise calculations are carried out in octave bands between 125 Hz and 2 kHz.

7.22 The measured $L_{Aeq,T}$ octave band spectra in this range have therefore been adjusted so that the single figure A-weighted noise level matches the measured level, which includes minor contributions from frequency bands outside of the calculation range.

7.23 A summary of the calculated internal levels is shown in Table 7.

Dwelling description	Calculated internal level / dB			Full calculation
	Daytime	Night time		
	L _{Aeq, T}		L _{AFmax}	
Studio, south façade	29	24	37	Table 9
Studio, west facade	30	26	42	Table 10

Table 7: Summary of calculated worst case internal noise levels

8 Noise aspects of mechanical services design

- 8.1 An upper limit of 28 dB(A) in bedrooms and living rooms is suggested for mechanical services noise when ventilating at the minimum low rate in accordance with AD-F. This would be classified as a Class C environment according to the COST TU0901 collaboration programme, Reference 12.
- 8.2 The mechanical services noise limits are both to prevent the total noise from all sources exceeding the limits identified, and to prevent mechanical services noise causing annoyance that may result in occupants curtailing the operation of the ventilation system as described in Problems in Residential Design for Ventilation and Noise, Reference 13.
- 8.3 It is suggested that the specification includes a requirement for commissioning measurements of noise from the mechanical services, to ensure that the contractor pays sufficient attention to the design and construction requirements to meet this limit.
- 8.4 Measurements of mechanical services noise should be made in accordance with the Association of Noise Consultants Guidelines, Reference 14.

9 Conclusion

- 9.1 Noise levels affecting the proposed development have been measured and the highest noise impact calculated.
- 9.2 On the basis of the measurements, assumptions and details in this report, it is calculated that the minimum façade sound insulation provision as shown in the summary table is required.

10 References

- 1 National Planning Policy Framework, Ministry of Housing, Communities & Local Government, July 2018.
- 2 Noise Policy Statement for England, Department for Environment, Food and Rural Affairs, March 2010.
- 3 BS 8233: 2014, Guidance on sound insulation and noise reduction for buildings.
- 4 Guidelines for Community Noise, Edited by Birgitta Berglund, Thomas Lindvall, Dietrich H Schwela, World Health Organisation, 1999.
- 5 BS EN 12354-3:2000, Building Acoustics – Estimation of acoustic performance of buildings from the performance of elements – Part 3: Airborne sound insulation against outdoor sound.
- 6 Practical Acoustic Design – the Apex Method, Proceedings of the Institute of Acoustics Vol 36 Pt 3 2014. Full paper and Poster presentation at Institute of Acoustics Conference 2014, available to download from www.apexacoustics.co.uk
- 7 Approved Document F 2010 Edition, The Building Regulations 2000.
- 8 BS EN ISO 16283-1:2014 Acoustics – Field measurement of sound insulation in buildings and of building elements – Part 1: Airborne sound insulation.
- 9 RW Simon technical data sheet
- 10 Broadway Malyan architect's drawings. Job no. 33443. Drawings no. A-03-100, 101, 102, 103, 104, 105, A-04-100, 102, 103, A-05-100, 101, 102, 103.
- 11 Pilkington Optiphon™ Laminated Glass for noise control, Pilkington, 8222 – June 2014
- 12 Integrating and Harmonizing Sound Insulation Aspects in Sustainable Urban Housing Constructions. Building acoustics throughout Europe Volume 1: Towards a common framework in building acoustics throughout Europe, COST Action TU0901, 2014, free download from <http://goo.gl/y6Xj3K>
- 13 Harvie-Clark, J. and Siddall, M. Problems in residential design for ventilation and noise, Proc. Institute of Acoustics 2013; 35 (1): 74-87, download from www.apexacoustics.co.uk
- 14 ANC Guidelines: Noise Measurement in Buildings, Part 1: Noise from Building.

12 Appendix 2: Illustrations

12.1 Measurements in progress are shown in Table 8.



Table 8: Measurements in progress. a) Position 1, b) Position 2

13 Appendix 3: Current policy and guidance

13.1 National Planning Policy Framework (NPPF)

13.2 The National Planning Policy Framework (NPPF, 2018) sets out the Government's planning policies for England and how these should be applied. It provides a framework within which locally-prepared plans for housing and other development can be produced. In respect of noise, Paragraph 170, 180 and 182 of the NPPF states the following:

13.3 Paragraph 170:

"e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution..."

13.4 Paragraph 180:

"Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

- a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;
- b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; ... "

13.5 Paragraph 182:

" Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed."

13.6 Noise Policy Statement for England (NPSE)

13.7 The Noise Policy Statement for England states three policy aims as follows:

"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."

13.8 The NPSE defines adverse noise impact as follows:

- **No Observed Effect Level (NOEL)**
This is 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)**
This is the level above which adverse effects on health and quality of life can be detected.
- **Significant Observed Adverse Effect Level (SOAEL)**
This is the level above which significant adverse effects on health and quality of life occur

13.9 The first two aims of the NPSE require that no significant adverse impact should occur and that, where a noise level which falls between a level which represents the lowest observable adverse effect and a level which represents a significant observed adverse effect, then according to the explanatory notes in the statement:

"... all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life whilst also taking into consideration the guiding principles of sustainable development. This does not mean that such effects cannot occur."

13.10 It is considered that meeting the internal ambient noise level limits given in BS 8233, which are in line with those given by the World Health Organisation, adequately achieve the first and second aims of the NPSE.

14 Appendix 4: WHO Community Noise Guideline values

- 14.1 Section 4.2.3 of WHO Community Noise Guideline Values discusses how electrophysiological and behavioural methods have demonstrated that both continuous and intermittent noise indoors lead to sleep disturbance.
- 14.2 The more intense the background noise, the more disturbing is its effect on sleep. Measurable effects on sleep start at background noise levels of about 30 dB L_{Aeq} . Physiological effects include changes in the pattern of sleep stages, especially a reduction in the proportion of REM sleep.
- 14.3 Subjective effects have also been identified, such as difficulty in falling asleep, perceived sleep quality, and adverse after-effects such as headache and tiredness. Sensitive groups mainly include elderly persons, shift workers and persons with physical or mental disorders.
- 14.4 Where noise is continuous, the equivalent sound pressure level should not exceed 30 dB(A) indoors, if negative effects on sleep are to be avoided. When the noise is composed of a large proportion of low-frequency sounds a still lower guideline value is recommended, because low frequency noise (e.g. from ventilation systems) can disturb rest and sleep even at low sound pressure levels. It should be noted that the adverse effect of noise partly depends on the nature of the source.
- 14.5 If the noise is not continuous, L_{Amax} or SEL are used to indicate the probability of noise induced awakenings. Effects have been observed at individual L_{Amax} exposures of 45 dB or less. Consequently, it is important to limit the number of noise events with a L_{Amax} exceeding 45 dB. Therefore, the guidelines should be based on a combination of values of 30 dB $L_{Aeq,8h}$ and 45 dB L_{Amax} . However, Section 3.4 of the WHO guidelines note that for a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dB L_{Amax} more than 10–15 times per night (Vallet & Vernet 1991).
- 14.6 To protect sensitive persons, a still lower guideline value would be preferred when the background level is low. Sleep disturbance from intermittent noise events increases with the maximum noise level. Even if the total equivalent noise level is fairly low, a small number of noise events with a high maximum sound pressure level will affect sleep.

- 14.7 Therefore, to avoid sleep disturbance, guidelines for community noise should be expressed in terms of equivalent sound pressure levels, as well as L_{Amax} / SEL and the number of noise events. Measures reducing disturbance during the first part of the night are believed to be the most effective for reducing problems in falling asleep.

15 Appendix 5: Calculation of façade noise ingress

15.1 The noise level in a room due to sound penetrating a façade element may be calculated according to BS EN 12354-3 and BS 8233 from:

$$L_2 = L_{1,in} - R + 10 \times \log\left(\frac{S}{V}\right) + 10 \times \log(T) + 11 \quad \text{Equation 1.}$$

Where:

- L_2 = noise level in room due to sound through façade portion of area S and mean sound reduction index R , dB
- $L_{1,in}$ = external free-field noise level at the position of the façade, dB.
- R = sound reduction index of portion, dB
- S = area of façade portion, m^2 .
- V = room volume, m^3
- T = reverberation time, s.

15.2 For small façade components, such as ventilators, the noise level in a room may be calculated according to the same standards as above from:

$$L_2 = L_{1,in} - D_{n,e} - 10 \times \log(V) + 10 \times \log(T) + 21 \quad \text{Equation 2.}$$

Where:

- $D_{n,e}$ = element-normalised sound level difference of the ventilator.

Other components have the same meaning as above.

15.3 The sound reduction of the masonry portion of the facade is much higher than that of the glazing and ventilation provision. Therefore noise penetration through the masonry is disregarded as insignificant compared to noise penetration through the glazing and ventilation provision.

15.4 The noise penetration through the vents and the glazing is calculated as above and then combined in each frequency band to give an overall internal level from the external sources by these routes. Calculations are carried out in five octave bands as indicated in BS 8233.

Studio, south façade	
Volume, V / m^3	26
Window area, S / m^2	2
Reverberation Time, T / s	0.5
Number of vents feasible	0

Daytime $L_{Aeq, 16 \text{ hr}}$ (dB)	dB(A)	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz
External free-field noise, L_{1in}	69	46	54	58	65	65
Glazing: 6/16/6.8 mm, R		22	27	35	42	41
Equation 1, $L_2(a)$	29	22	24	20	21	21

Night-time $L_{Aeq, 8 \text{ hr}}$ (dB)	dB(A)	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz
External free-field noise, L_{1in}	64	39	49	54	62	58
Glazing: 6/16/6.8 mm, R		22	27	35	42	41
Equation 1, $L_2(a)$	24	15	19	17	17	15

Night-time L_{AFmax} (dB)	dB(A)	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz
External free-field noise, L_{1in}	77	51	61	71	75	69
Glazing: 6/16/6.8 mm, R		22	27	35	42	41
Equation 1, $L_2(a)$	37	26	32	33	30	25

Table 9: Calculations for Studio, south façade

Studio, west facade	
Volume, V / m³	26
Window area, S / m²	2
Reverberation Time, T / s	0.5
Number of vents feasible	0

Daytime L _{Aeq, 16 hr} (dB)	dB(A)	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz
External free-field noise, L _{1in}	62	46	51	52	57	58
Glazing: 6/12/6.4 mm, R		21	20	31	39	37
Equation 1, L ₂ (a)	30	23	29	18	16	18

Night-time L _{Aeq, 8 hr} (dB)	dB(A)	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz
External free-field noise, L _{1in}	57	42	47	47	53	53
Glazing: 6/12/6.4 mm, R		21	20	31	39	37
Equation 1, L ₂ (a)	26	18	24	14	11	13

Night-time L _{AFmax} (dB)	dB(A)	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz
External free-field noise, L _{1in}	77	51	61	71	75	69
Glazing: 6/12/6.4 mm, R		21	20	31	39	37
Equation 1, L ₂ (a)	42	27	39	37	33	29

Table 10: Calculations for Studio, west façade