

Noise Survey and Façade Acoustic Design Strategy Buildings 1 & 2, New Century Place, Reading

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1. Revision register

Version	Changes from previous version	Issued by	Date

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3. Summary

- 3.1 This report has been prepared in support of Planning Applications for residential developments at New Century Place, East Street, Reading.
- 3.2 The developments are a change of use from office (Class B1) under current permitted development rights, which require that noise impacts from commercial premises be assessed if deemed necessary by the local planning authority.
- 3.3 Noise levels affecting the proposed development have been measured during the day and night, and noise from events associated with commercial premises identified.
- 3.4 Where no noise measurement was possible during the site noise monitoring visit due to lack of events at some venues, the potential for noise impact has been qualitatively assessed.
- 3.5 Where the potential for noise impact from a venue is considered likely to be significantly greater at existing residential premises than the proposed developments, the impact from such venues is not considered to adversely affect the future occupiers of the proposed developments.
- 3.6 Calculated noise levels due to events associated with commercial premises are used to determine the potential façade sound insulation treatments to meet an appropriate internal noise level.
- 3.7 A set of minimum glazing and ventilation strategy options, interpreted from Approved Document F (AD-F), is proposed as shown in Table 1.

Glazing / mm	Trickle ventilator	Potential ventilation strategy
4 / 12 / 4 Double glazing	A single standard slot vent, e.g. Greenwoods 4000L	AD-F System 3, continuous mechanical extract (MEV), either relying on building leakage for make-up air or the use of a single trickle vent
	Not required	AD-F System 4, mechanical supply and extract with heat recovery (MVHR)

Table 1: Summary of minimum façade sound insulation treatment

4. Introduction

- 4.1 Residential developments have been proposed at Buildings 1 and 2, New Century Place, Reading.
- 4.2 The developments are a change of use from office (Class B1) under current permitted development rights.
- 4.3 The site location is shown in Figure 1.
- 4.4 Apex Acoustics has been commissioned to undertake noise surveys and provide advice on the sound insulation of the façade to mitigate against noise from operations and activities associated with commercial premises in the surrounding area.
- 4.5 The purpose of this report is to identify appropriate acoustic design parameters and the manner in which internal noise levels may be achieved in practice.
- 4.6 This assessment is based on measurements of commercial noise sources, room and window dimensions on the architects' plans, assumptions about room conditions, with glazing and ventilation strategy options proposed in this report.
- 4.7 Internal noise transmission and the sound insulation requirements of the Building Regulations are not considered in this report.



Figure 1: Site locations outlined in red and measurement positions indicated by markers

5. Planning legislation

- 5.1 Legislation was put into place as defined in Statutory Instrument 2015 no. 596 (SI 2015/596), Reference 1, for permitted development of change of use from Office (Class B1(a)) to residential dwellings (Class C3).
- 5.2 There were no restrictions with regards to noise impact on any potential dwellinghouses arising from such a change of use within the confines of the permitted development, from existing external noise sources.
- 5.3 Statutory Instrument 2016 no. 332 (SI 2016/332), Reference 2, an amendment to SI 2015/596, was issued which came into force 6th April 2016.
- 5.4 The amendments of SI 2016/332 included that Schedule 2, Part 3, Paragraph O.2 of SI 2016/596 relating to conditions for such change of use should now state:

Development under Class O is permitted subject to the condition that before beginning the development, the developer must apply to the local planning authority for a determination as to whether the prior approval of the authority will be required as to –

- (a) transport and highways impacts of the development,*
- (b) contamination risks on the site,*
- (c) flooding risks on the site, and*
- (d) impacts of noise from commercial premises on the intended occupiers of the development.*

6. Local planning authority comments

- 6.1 Communications between Apex Acoustics and Ross Jarvis, Senior Technical Officer (STO) at Reading Borough Council Environmental Protection and Nuisance took place between 5th September 2016 and 14th September 2016.
- 6.2 During the communications, it was noted by Ross that there was the potential for noise from cleaning operations associated with the multi-storey car park directly to the north of the proposed development site, on the northern side of Queens Road / A 329, during the night-time period to impact on the proposed residential development, and that this specific noise source should be investigated.
- 6.3 A consultation response to the planning case officer at Reading Borough Council was issued dated 16th September 2016 from Jodie Wilson, Senior Environmental Health Officer.
- 6.4 The response identifies the following commercial premises as potential sources of noise which could impact of the proposed development:
 - 1) RISC
 - 2) Shehnai
 - 3) South Street Arts Centre
- 6.5 The 3 no. identified commercial premises are shown in Figure 2 and are discussed in turn below.
- 6.6 The consultation response also identified that noise from road traffic has the potential to cause an adverse effect on future residents of the development and suggests that a noise assessment should be completed to ensure proposed internal ambient noise levels are not exceeded.
- 6.7 The consultation response then proposes a condition be attached to any planning consent requiring an assessment of the existing noise environment be completed to include a scheme of sound attenuation to show how the proposed internal noise levels will be met.

- 6.8 As the effect of noise from road traffic is outwith the scope of local planning authority approval under the current legislation discussed in Section 5, this is not considered further for the purposes of this report, but may be assessed by the client.

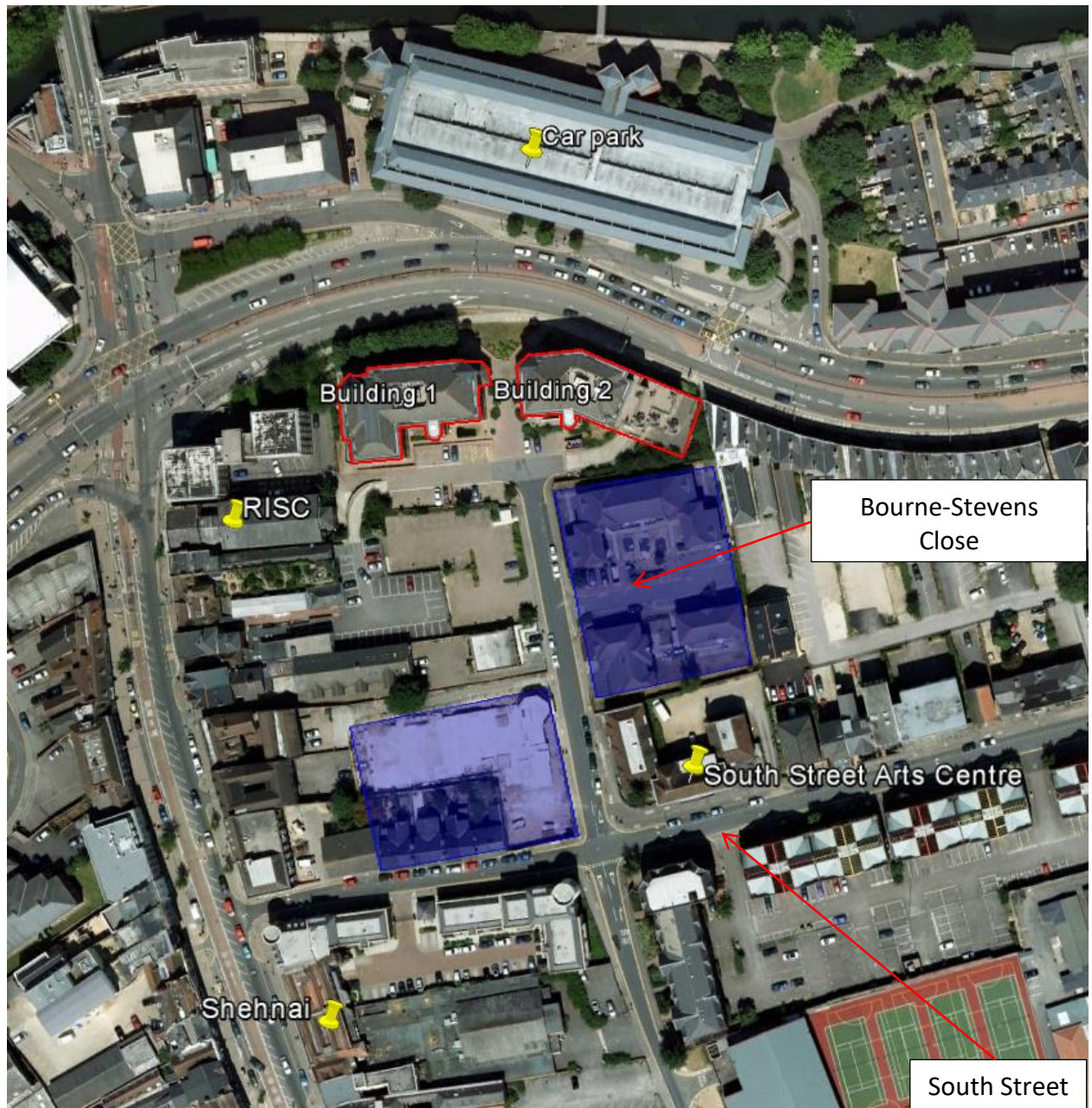


Figure 2: Commercial premises identified by the local planning authority as having the potential to adversely affect residents of the proposed developments. Existing residential properties shaded in blue.

6.9 RISC

- 6.10 It is understood that the RISC (Reading International Solidarity Centre) café and venue hosts live music events typically during evening periods.
- 6.11 RISC fronts on to London Street / A327.
- 6.12 It is understood that there is an entrance to the site from the east / rear of the premises.
- 6.13 It is proposed to measure and assess noise from this venue from live music or other observed operations or activities.

6.14 Shehnai

- 6.15 It is understood that the facilities at Shehnai are regularly used for weddings which are likely to include amplified music.
- 6.16 During the site noise monitoring visit it was not possible to ascertain if there was a function at this venue.
- 6.17 It is estimated that Shehnai is approximately 138 m from the nearest point of the proposed development site (Building 1).
- 6.18 It is understood that there are several residential properties on South Street between Shehnai and the proposed development site, the nearest being approximately 40 m from Shehnai.
- 6.19 It is considered that should noise from operations and activities be of a level whereby the future residents of the proposed development site were to be adversely affected, the noise level at the existing residential properties on South Street would be significantly higher, potentially between 6 dB to 20 dB, depending on the nature of the sources and shielding afforded by the buildings between the venue and the proposed development site, resulting in a much higher noise level, and greater nuisance, at the existing residential properties on South Street.
- 6.20 Hence, it is considered that further assessment of noise impact from activities and operations from Shehnai on the proposed residential development is not required.

6.21 **South Street Arts Centre**

- 6.22 It is understood that South Street Arts Centre holds events including amplified live music, plays and comedy.
- 6.23 During the site noise monitoring visit there were no events at the venue.
- 6.24 It is considered that Shehnai is approximately 95 m from Building 2 of the proposed development site.
- 6.25 It is understood that there are several residential properties on East Street and Bourne-Stevens Close nearby to South Street Arts Centre, the nearest being approximately 10 m from South Street Arts Centre.
- 6.26 It is considered that should noise from operations and activities be of a level whereby the future residents of the proposed development site were to be adversely affected, the noise level at the existing residential properties on East Street and Bourne-Stevens Close would be significantly higher, potentially between 10 dB to 30 dB, depending on the nature of the sources and shielding afforded by the buildings between the venue and the proposed development site, resulting in a much higher noise level, and greater nuisance, at the existing residential properties on East Street and Bourne-Stevens Close.
- 6.27 Hence, it is considered that further assessment of noise impact from activities and operations from South Street Arts Centre on the proposed residential development is not required.

7. Guidance

- 7.1 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

- 7.2 Note 4 to Table 4 of BS 8233 states:

“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.”

- 7.3 Where regular individual noise events from operations or activities associated with surrounding commercial premises are identified during the night-time, the World Health Organisation (WHO), Reference 4 guidance on sleep disturbance is considered appropriate, as discussed in Appendix 1.

- 7.4 Section 3.4 of the WHO guidelines states:

“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.”

- 7.5 The above guidance is adopted as a basis to assess the impact on internal levels within proposed residential development, but may be varied or corrections applied depending on the context of the measured noise sources, potentially with reference to the acoustic feature penalties described in BS 4142, Reference 5.

8. Noise sources and measurements

- 8.1 Measurements of the existing noise environment were made using the guidance of BS 7445, Reference 6.
- 8.2 Measurements were made during the day and night at positions 1 and 2; the measurement positions are indicated in Figure 1.
- 8.3 Measurements at position 1 were made with the microphone located at approximately 11 m above ground level on the terraced area of Building 2, between 15:22 hours on the 21st September 2016 and 10:14 hours on the 22nd September 2016.
- 8.4 Measurements were made at position 1 to capture noise from the multi-storey car park to the north of Queens Road / A 329.
- 8.5 Measurements at position 2 were made with the microphone located at approximately 3.5 m above ground level, between 16:27 hours on the 21st September 2016 and 10:59 hours on the 22nd September 2016.
- 8.6 Measurements were made at position 2 to determine the general noise environment and noise events associated with RISC occurring during night-time hours.
- 8.7 Audio recordings were made at positions 1 and 2 so that noise events could be identified.
- 8.8 All measurements were made away from other reflecting surfaces, such that they are considered to be free field.
- 8.9 The equipment used is listed in Table 3.

Equipment	Model	Serial no.
Sound Level Meter	NTi XL2	A2A-04045-D2
Calibrator	Larson Davis Cal 200	11705
Sound Level Meter	NTi XL2	A2A-05832-E0
Calibrator	Larson Davis Cal 200	9462

Table 3: Equipment used

- 8.10 Both meters and calibrators have current calibration certificates traceable to national standards.
- 8.11 During the setup of measurement positions 1 and 2, the wind speed measured was between 1.2 and 1.8 m/s; cloud cover was approximately 80 %.
- 8.12 The most significant noise source affecting the proposed development during the daytime was road traffic.
- 8.13 Other noise sources included pedestrians passing.
- 8.14 **Live music event at RISC**
- 8.15 During the evening of 21st September 2016 a live music event occurred at RISC.
- 8.16 Apex Acoustics personnel attended the eastern side of the venue at 22:00 hours.
- 8.17 No music or other noise associated with RISC was audible, and no measurements were deemed necessary.

9. Results

9.1 The measured noise levels are shown in Table 4.

Position	Start time / hh:mm	T / hh:mm	L _{Aeq,T} / dB(A)	Octave Band Centre Frequency / Hz						
				63	125	250	500	1000	2000	4000
1	15:22	06:47	71	45	50	56	61	68	64	52
	23:00	08:00	66	41	45	53	58	64	59	49
	07:00	04:04	71	46	50	57	61	69	65	54
2	16:27	06:15	55	40	42	45	47	51	47	41
	23:00	07:59	49	30	34	39	42	46	41	32
	07:00	04:16	56	37	42	47	48	52	49	44

Table 4: Measured A-weighted equivalent continuous noise levels

9.2 Further to analysis of the measured noise levels and audio recordings, a single noise event was identified as being attributable to one of the identified commercial operations.

9.3 The identified noise event was a bottle bin being emptied at 23:44 hours.

9.4 The measured level at position 2 for this event are shown in Table 5.

Position	Time / hh:mm	L _{Afmax} / dB(A)	Octave Band Centre Frequency / Hz						
			63	125	250	500	1000	2000	4000
2	23:44	66	38	44	50	52	55	61	62

Table 5: Measured A-weighted maximum noise levels

10. Calculated noise impact

- 10.1 It is considered that the bottle bin emptying noise event most likely occurred at the rear of RISC.
- 10.2 The potential noise level at the façade of the nearest bedroom proposed within Building 1 may be calculated using the following equation:

$$L_{pfac} = L_{pmeas} + 20 \times \log(r_1/r_2)$$

Where:

L_{pfac} is the free-field sound pressure level incident on the building façade

L_{pmeas} is the measured sound pressure level at position 2

r_1 is the distance from the source to the measurement position

r_2 is the distance from the source to the building façade

- 10.3 The estimated distances between source, receiver and façade positions are shown in Table 6; the calculated sound pressure level incident on the building façade are shown in Table 7.

Locations	Distance / m
RISC to measurement position 2 (r_1)	48
RISC to Building 1 façade (r_2)	23

Table 6: Estimated distances

Position	$L_{A_{fmax}}$ / dB(A)	Octave Band Centre Frequency / Hz						
		63	125	250	500	1000	2000	4000
Building 1 façade	72	44	50	57	59	61	68	69

Table 7: Calculated A-weighted maximum noise levels at Building 1 façade

11. Façade noise calculations

11.1 The calculation method for façade sound insulation is in accordance with BS 8233 and the principles of BS EN 12354-3, Reference 7, as described in Appendix 2 and detailed in the Apex Method, Reference 8.

11.2 Ventilation strategy

11.3 The proposed development will be required to meet Part F of the Building Regulations, with regard to ventilation provision, as described in Approved Document F (AD-F), Reference 9.

11.4 In this case it has been assumed AD-F System 3, Continuous mechanical extract (MEV), is to be used. This is considered in the calculation by the use of a single through-frame acoustic slot vent, Greenwoods 4000L, with manufacturer's data for the element normalised level difference, $D_{n,e}$, Reference 11. Other vents may also be assessed for suitability.

11.5 It is noted in Table 5.2C of AD-F that if the building design air permeability is greater than $5.0 \text{ m}^3/\text{m}^2\cdot\text{hr}$, then building leakage may be relied upon for make up air and no background ventilators are necessary.

11.6 Should AD-F System 4, Continuous mechanical supply and extract with heat recovery (MVHR), be implemented, trickle vents are not required.

11.7 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.

11.8 Once the ventilation strategy is established, if the details vary from those described above, the proposed details should be reassessed for acoustic performance.

11.9 Reverberation time

11.10 From ISO 16283, Reference 10, 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.

11.11 Dimensions and unit descriptions

11.12 The room and window dimensions are taken from the architect's plans and elevations, Reference 12.

11.13 Glazing

11.14 The acoustic performance of the proposed glazing listed in the summary table is taken from Pilkington Glass, Reference 13.

11.15 The exact current and proposed glazing specification is unknown, however it is understood that currently the building is double glazed.

11.16 The acoustic sound insulation performance of 4 mm glass / 12 mm gap / 4 mm glass double glazing is attributed to the glazing should the existing glazing be retained, a worst case assumption.

11.17 Rooms most exposed to noise ingress

11.18 A calculation is carried out for the room most exposed to noise ingress as the worst case. If this room has 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 proposed requirements.

11.19 Calculated noise impact

11.20 Façade noise calculations are carried out in octave bands between 125 Hz and 4 kHz since technical data from glazing and trickle vent manufacturers is typically not available outside of this range.

11.21 A summary of the calculated internal levels is shown in Table 8.

Bedroom description	Calculated internal level, $L_{A_{fmax}}$ / dB	Full calculation	
Building 1, Bedroom	38	Table 9	
		Building 1, Bedroom 0:06	
		Volume, V / m^3	62.9

om 0:06		Window area, S / m^2	4.0					
		Reverberation Time, T / s	0.5					
		Number of vents required	1					

Octave centre frequency	dB(A)	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz
Night time freefield noise, $L_{1in} / dB(A) L_{max}$	72	50	57	59	61	68	69
4/12/4 double glazing, R / dB		24	20	25	35	38	35
Equation 1, $L_2 / dB(A) L_{max}$	35	22	33	30	22	26	30
Greenwoods 4000 L trickle vent, $D_{n,e} / dB$		39	36	34	31	34	38
Equation 2, $L_2 / dB(A) L_{max}$	35	12	21	24	30	33	31
Combined noise through all building elements / $dB(A) L_{max}$	38	23	33	31	30	34	33

Table 9

Table 9

Table 8: Summary of calculated worst case internal noise level from commercial operations

11.22 The calculated worst case internal L_{AFmax} is 7 dB below the design target given in WHO guidelines. As this is a single event, this is considered an acceptable internal L_{AFmax} within a bedroom.

12. Conclusion

- 12.1 Noise levels affecting the proposed development have been measured noise events associated with commercial premises identified.
- 12.2 Potential commercial noise sources including amplified music venues have been identified by the local planning authority.
- 12.3 Where no assessment was possible during the site noise monitoring visit due to lack of events at the identified venues, the potential for noise impact has been assessed, and those venues which would have a significantly greater impact on existing residential premises than the proposed developments are not assessed further.

12.4 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.



13. References

1. Town and Country Planning (General Permitted Development) (England) Order 2015, SI 2015/596.
2. Town and Country Planning (General Permitted Development) (England) (Ammendment) Order 2016, SI 2016/332.
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 4142: 2014, Method for rating and assessing industrial and commercial sound.
6. BS 7445:2003, Description and measurement of environmental noise. Guide to quantities and procedures.
7. 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.
8. 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
9. Approved Document F 2010 Edition, The Building Regulations 2000.
10. BS EN ISO 16283-1:2014 Acoustics – Field measurement of sound insulation in buildings and of building elements – Part 1: Airborne sound insulation.
11. Greenwood technical data sheet, October 2001
12. Architects Drawings, New Century Place 1 Existing Elevations Sheet 1 of 2 Elevations 01-03 1015, New Century Place 1 Existing Elevations Sheet 2 of 2 Elevations 04-05 1016, New Century Place 1 Proposed Plan Level 0 1010, Greenwell Design.

13. Pilkington Optiphon™ Laminated Glass for noise control, Pilkington, 8222 –
June 2014



14. Appendix 1: 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 2: 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:

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

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:

$$L_2 = L_{1,in} - D_{n,e} - 10 \times \text{Log}(V) + 10 \times \text{Log}(T) + 21$$

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.

Building 1, Bedroom 0:06	
Volume, V / m^3	62.9
Window area, S / m^2	4.0
Reverberation Time, T / s	0.5
Number of vents required	1

Octave centre frequency	dB(A)	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz
Night time freefield noise, $L_{1in} / dB(A) L_{max}$	72	50	57	59	61	68	69
4/12/4 double glazing, R / dB		24	20	25	35	38	35
Equation 1, $L_2 / dB(A) L_{max}$	35	22	33	30	22	26	30
Greenwoods 4000 L trickle vent, $D_{n,e} / dB$		39	36	34	31	34	38
Equation 2, $L_2 / dB(A) L_{max}$	35	12	21	24	30	33	31
Combined noise through all building elements / $dB(A) L_{max}$	38	23	33	31	30	34	33

Table 9: Calculations for Building 1, Bedroom 0:06