Goodhand Acoustics

Planning Condition 4 Discharge - Noise

44 Brighton Road, Brighton, West Sussex, BN1 8YL

On Behalf of

Mr M Karmis

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Document Control

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1 Introduction

Goodhand Acoustics Ltd has been commissioned by Mr M Karmis to undertake a noise assessment to address a noise planning condition for a new residential dwelling at 44 Brighton Road Brighton, West Sussex, BN1 8YL.

A noise report is required by Adur District Council (ADC) to assess the noise from Brighton Road and identify mitigation to ensure future residents are protected from excess noise. The full wording of the planning condition is provided in Section 2.

This report presents the results of a baseline sound level survey undertaken at the application site and assesses internal noise referencing BS 8233 (1) to address Planning Condition 4. More detail on BS 8233 and associated guidance is provided in Appendix A.

2 Planning Conditions

2.1 Planning Condition 4

The following planning condition is required prior to the residential dwelling being occupied. This report addresses this condition.

> *04. The dwelling hereby approved shall not be occupied unless and until an acoustic assessment has been submitted to and agreed by the Local Planning Authority in respect of the exact noise exposure of the dwelling to traffic noise and an allied scheme prepared to protect the habitable rooms from excess noise in relation to British Standard BS 8233: 2014: Guidance. Any acoustic scheme shall include mechanical MVHR ventilation. The approved assessment and mitigation scheme shall be implemented prior to first occupation of the dwelling and retained thereafter.*
>
> ***Reason:** To protect future residents from excess traffic noise from Brighton Road in accordance with the National Planning Policy Framework and policy 34 of the Adur Local Plan.*

2.2 Policy 34 of the Adur Local Plan

The following is policy 34 from the Adur Local Plan (2).

> *Policy 34: Pollution and Contamination*
>
> *Development should not result in pollution or hazards which prejudice the health and safety of the local community and the environment, including nature conservation interests and the water environment.*
>
> *New development in Adur will be located in areas most suitable to the use of that development to avoid risks from noise, air, odour or light pollution.*
>
> *Mitigation measures will need to be implemented for developments that could increase levels of pollution or have a negative impact on drinking water supplies in Adur. Where there are significant levels of increased pollution that cannot be mitigated, development will be refused.*
>
> *Where appropriate, air quality assessments and/or noise assessments will be required in conjunction with development proposals.*
>
> *Investigations and assessments of all sites situated in or in close proximity to potentially contaminated land will be required in relation to relevant development proposals.*

2.3 Environmental Health Consultation

The Environmental Protection Team of ADC was consulted concerning the methodology in this report, which was agreed. The criteria suggested was those given in Table 4 of BS 8233 (3). Table 4 of BS 8233 is reproduced in Appendix A of this report.

3 Site Description and Proposed Development

3.1 Site Description and Environs

The location of 44 Brighton Road is shown in Figure 3.1 below highlighted in red. The site is currently occupied by a dwelling in the centre of the plot of land, highlighted in dark blue.

The site is bounded to the north by Brighton Road and to the south by Lancing Beach and the English Channel. Figure 3.2 is a site layout plan.

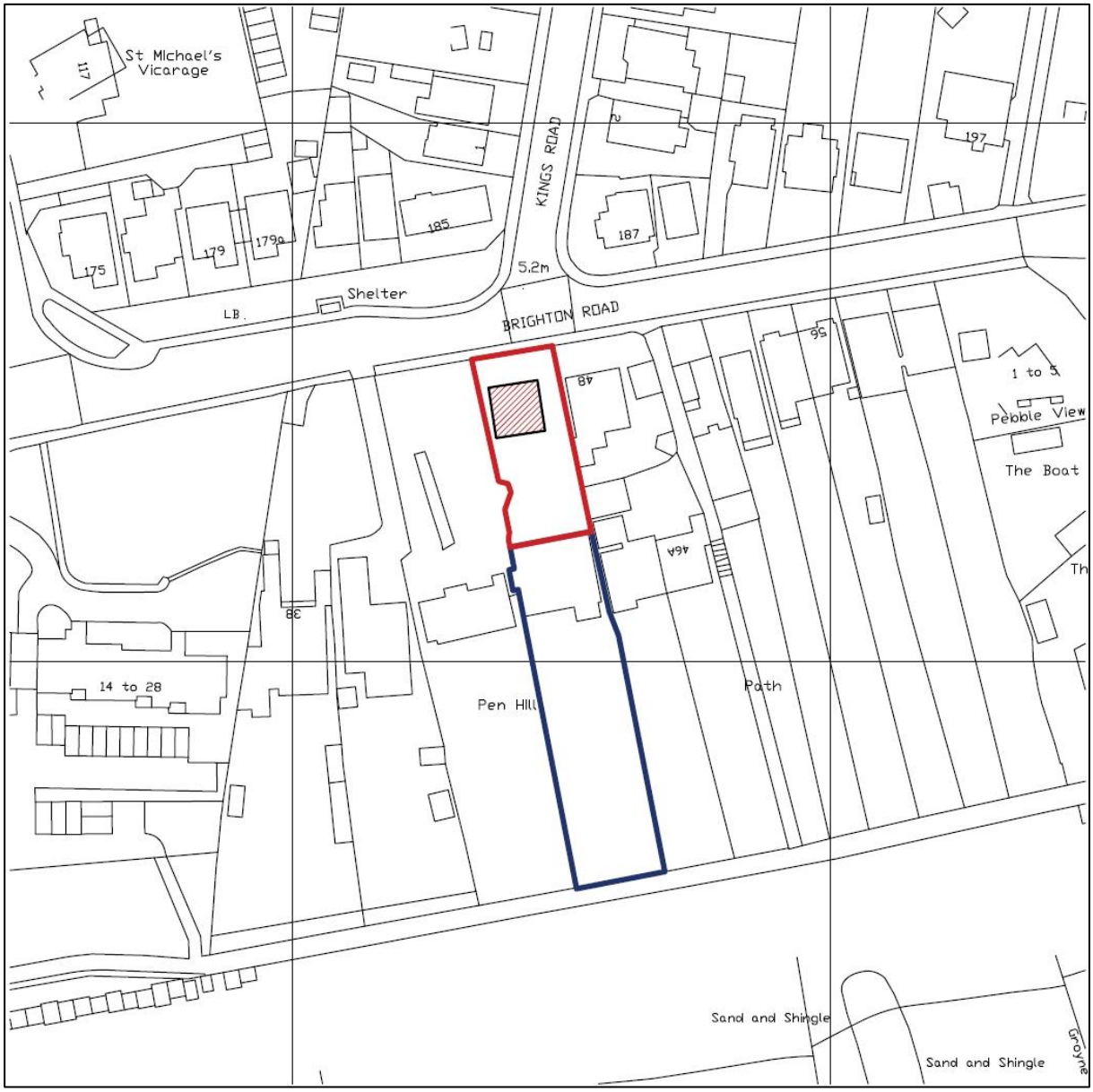


Figure 3.1 Site Location Plan

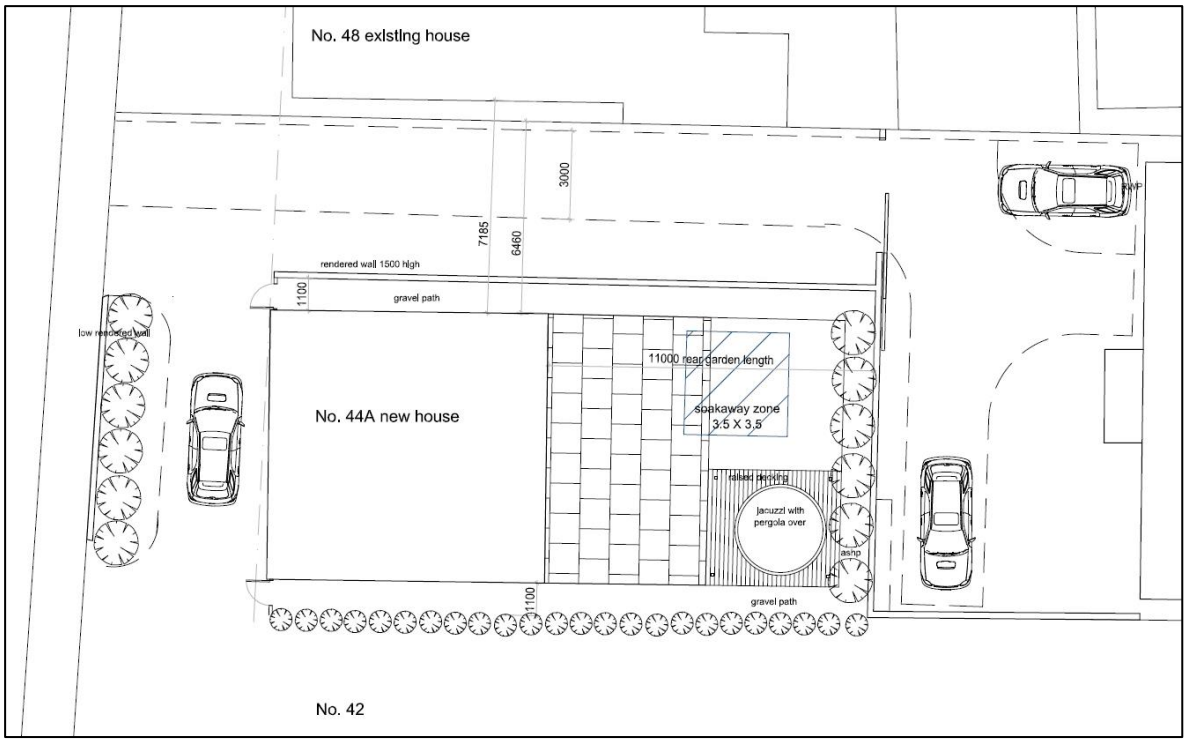


Figure 3.2: Site Layout Plan

3.2 The Development

The development is for a two-storey, two-bedroom dwelling. The dwelling is set back from Brighton Road by around 7 m. The ground floor is an open plan living area with two bedrooms in the roof space.

4 Sound Level Surveys

4.1 Equipment Details

Sound levels were measured using NTi Audio XL2, Type Approved precision integrating class 1 sound level meters.

Table 4.1 below provides details of the equipment used and calibration certificates are provided in Appendix B.

Table 4.1: Equipment Details

Sound Level Meter	NTi Audio XL2, Type Approved			
Microphone	NTi Audio M2230			
Serial Numbers	Meter	A2A-15471-E0	Microphone	7937
Date Calibrated	28/03/2023			
SLM Settings	Time Response		Fast	
	Frequency Weighting		A	
	Logging Periods		15-min	
Field Calibrator	Larson Davis CAL200			
Serial Number	10032			
Date Calibrated	21 February 2023			
Field Calibration Check	113.9 dB at 1 kHz (0.1 dB drift)			

4.2 Sound Level Survey

Baseline sound level monitoring was undertaken at the boundary with Brighton Road in a freefield location. This was the only suitable location identified during the site visit.

The location of the survey is shown in Figure 4.1 and Figure 4.2 below. The microphone was mounted on a pole at a height of 3.5 m. The measurement location was free-field. The equipment was left in place from 21:28 hrs on 17/07/2023 until 17:38 hrs on 31/07/2023.

The microphone was fitted with a weatherproof windshield.

More details of the survey are contained in Appendix C.

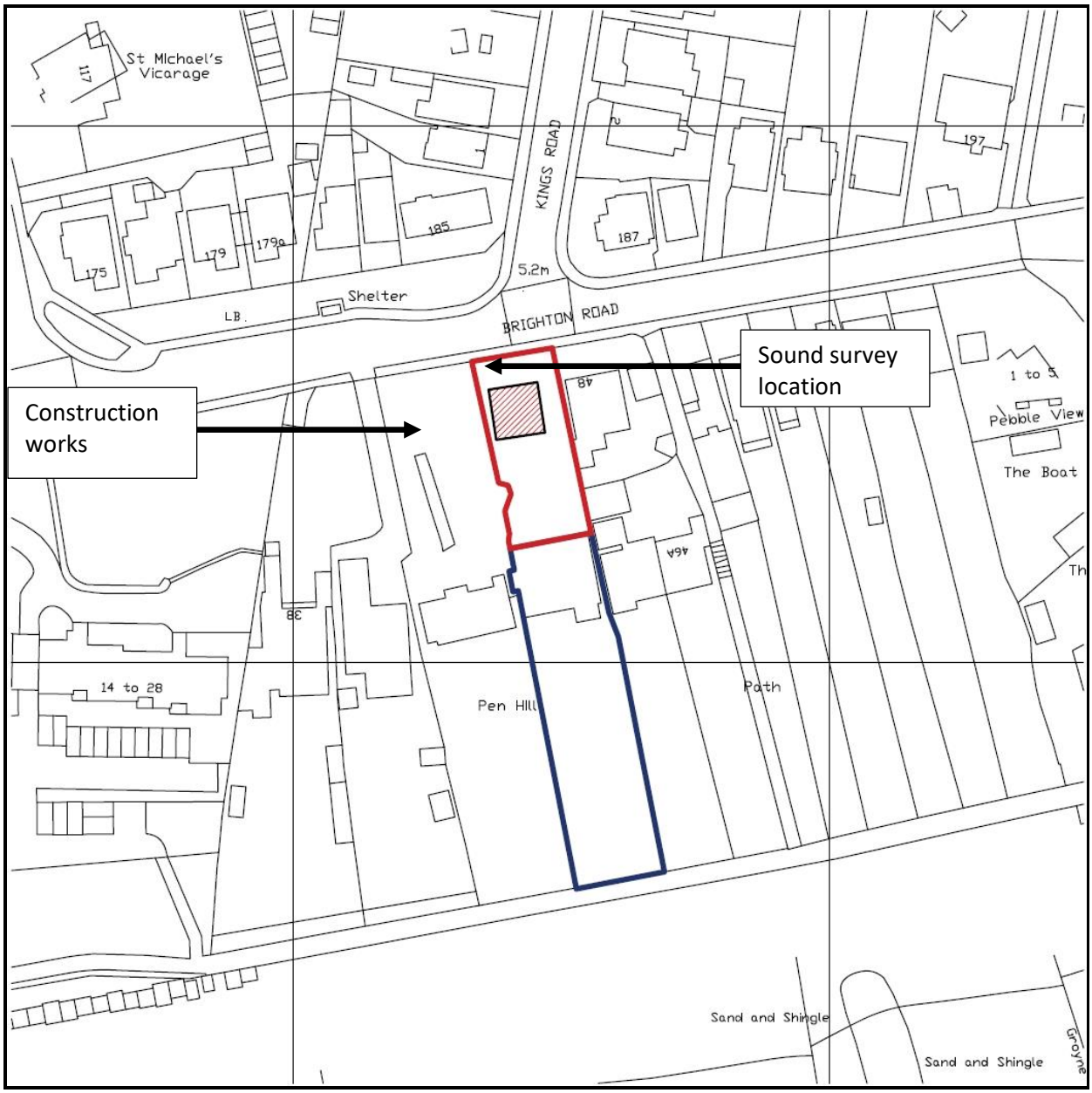


Figure 4.1: Survey Location Plan



Figure 4.2: Photograph of Sound Level Meter Location (North Facade)

Weather and Other Extraneous Noise

Audio recordings were analysed to ensure that the survey result were unaffected by adverse weather and other unrepresentative noise. The survey was undertaken during periods of stormy weather. Where wind or rain impacted the results, this data was removed.

Additionally, there was construction noise from next door. As this is temporary in nature, the audio recordings were reviewed and where this significantly affected the results, it was removed from the analysis.

Results

As the survey was closer to the road than the dwelling being assessed a -1.5 dB correction was made to the results, in line with CRTN (4) calculation procedures.

Table 4.2 and Figure 4.3 summarise the existing ambient noise levels measured and then adjusted to be representative at the façade of the proposed dwelling.

Table 4.2: Sound Level Survey Results – North Facade

Date	Day $L_{Aeq,16hrs}$ (dB)	Night $L_{Aeq,8hrs}$ (dB)	Sound level exceeded no more than 10 times per night $L_{Amax,F}$ (dB)
Mon 17/07/2023	63*	61	80
Tue 18/07/2023	66	60	80
Wed 19/07/2023	67	60	79
Thu 20/07/2023	67	61	79
Fri 21/07/2023	67	60*	80*
Sat 22/07/2023	-	-	-
Sun 23/07/2023	66	60	79
Mon 24/07/2023	67	61	79
Tue 25/07/2023	67	61	80
Wed 26/07/2023	67*	-	-
Thu 27/07/2023	-	61	80
Fri 28/07/2023	66	60	80
Sat 29/07/2023	67	61	78
Sun 30/07/2023	65*	-	-
Typical Worst Case Sound Level	**67**	**61**	**The design criterion for maximum night events is 80 dB.**

*Partial periods.

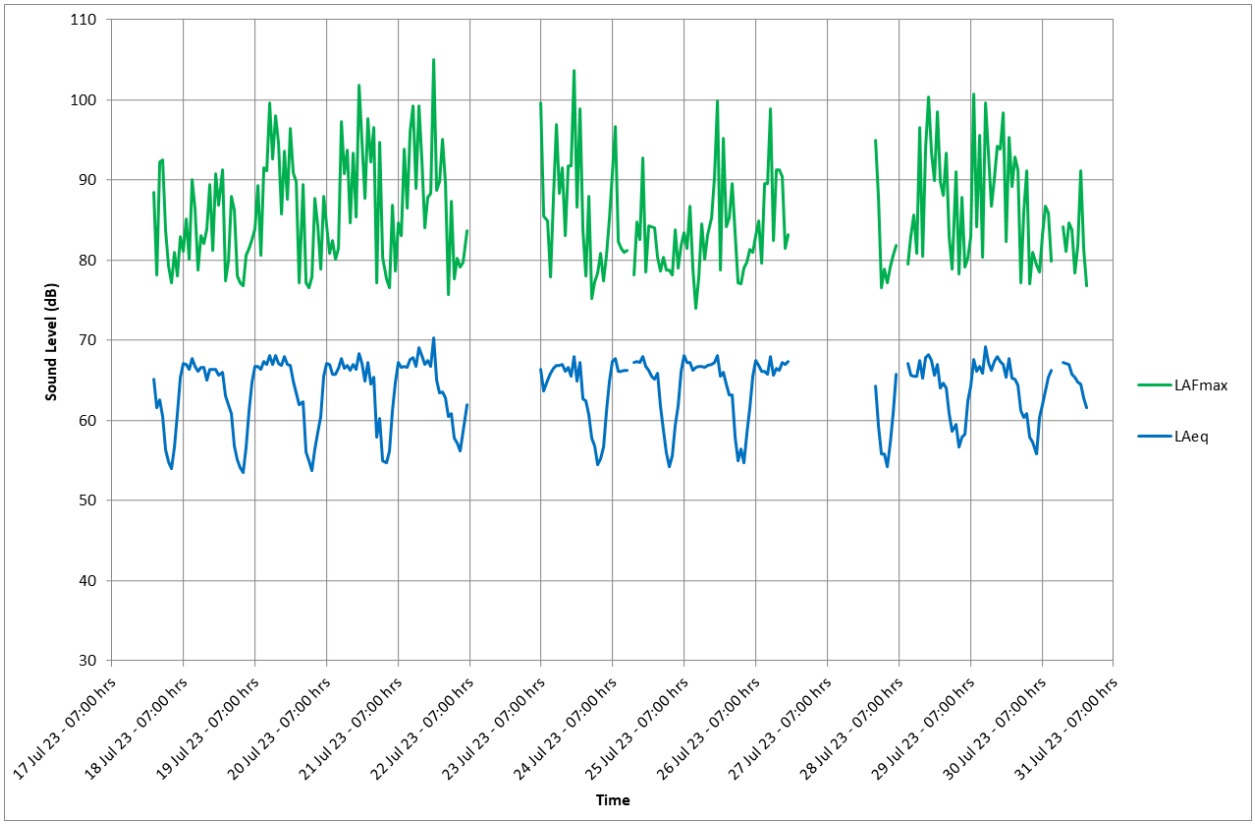


Figure 4.3: Sound Level Time History (North Facade)

5 Residential Internal Noise Assessment

5.1 Observations

Road traffic noise was dominant throughout the sound level survey. There was a significant contribution from emergency sirens and high-speed vehicles. Reviewing the audio recordings, emergency sirens and high-speed vehicles caused the nighttime maximum noise level events.

5.2 Internal Noise Level Guidance

Living rooms

Whilst separate guidance is given for living and dining rooms/areas, the design of the dwelling is open plan as so the kitchen/dining/living space has been considered as one space with the criteria for living rooms applied to it, being the more stringent criteria.

It can be seen from Table 5.1 that the internal noise level criterion is achieved with the appropriate mitigation. Detailed acoustic specifications are contained in Section 6.

Table 5.1: Calculated internal daytime (07:00-23:00 hrs) noise levels for living rooms - L_{Aeq}

	Overlooking Brighton Road
	$L_{Aeq,T}$ (dB)
External Free-field Level	67
Level Difference, external free field level and internal reverberant level	42*
Overlooking Brighton Road: Thermal glazing (Rw + Ctr = 32 dB)	
Internal Noise Level	24
Achieves BS 8233:2014 guidelines for living rooms	Yes
*1 Detailed example BS 8233 calculations are presented in Appendix D.	

Bedrooms

Table 5.2 and Table 5.3 below shows that the internal noise level L_{Aeq} criterion for bedrooms is achieved. Detailed acoustic specifications are contained in Section 6.

Table 5.2: Calculated internal daytime (07:00-23:00 hrs) noise levels for bedrooms - L_{Aeq}

	Overlooking Brighton Road
	$L_{Aeq,T}$ (dB)
External Free-field Level	67
Level Difference, external free field level and internal reverberant level	38*
Overlooking Brighton Road: Thermal glazing (Rw + Ctr = 32 dB)	
Internal Noise Level	29
Achieves BS 8233:2014 guidelines for living rooms	Yes
*1 Detailed example BS 8233 calculations are presented in Appendix D.	

Table 5.3: Calculated internal daytime (23:00-07:00 hrs) noise levels for bedrooms - L_{Aeq}

	Overlooking Brighton Road
	$L_{Aeq,T}$ (dB)
External Free-field Level	61
Level Difference, external free field level and internal reverberant level	38*
Overlooking Brighton Road: Thermal glazing (Rw + Ctr = 32 dB)	
Internal Noise Level	23
Achieves ProPG / BS 8233:2014 guidelines for living rooms	yes
*1 Detailed example BS 8233 calculations are presented in Appendix D.	

ProPG (5) advises that for the effects of individual noise events to have a negligible effect on sleep then 45 dB $L_{Amax,F}$ should not be exceeded more than 10 times per night. Therefore, further analysis of the results was undertaken to find the $L_{Amax,F}$ sound level that was not exceeded for more than 10 times per night to determine the appropriate design criteria as shown in Table 4.2.

Table 5.4 below shows that the maximum internal noise level criteria for bedrooms is met with appropriate mitigation. Detailed acoustic specifications are contained in Section 6.

Table 5.4: Calculated internal night-time (23:00-07:00 hrs) noise levels for bedrooms - L_{Amax}

	Overlooking Brighton Road
	$L_{Amax,F}$ (dB)
External Free-field Level	80
Level Difference, external free field level and internal reverberant level	38*
Overlooking Brighton Road: Thermal glazing (Rw + Ctr = 32 dB)	
Internal Noise Level	42
Achieves BS 8233:2014 guidelines for living rooms	Yes
*1 Detailed example BS 8233 calculations are presented in Appendix D.	

6 Design Recommendations

6.1 Ventilation

The ventilation strategy has been determined by the planning condition and will be Mechanical Ventilation with Heat Recovery. This should vented to the south side of the property so that the inlet and extract is shielded from noise from Brighton Road so that the noise is not transmitted through the ventilation system. Additionally, other open vents should not face Brighton Road.

Ventilation noise

Whole Dwelling Ventilation

As non-mandatory requirements, it is suggested that internal ambient noise levels due to any whole dwelling ventilation should not normally exceed:

- Bedrooms: 26 dB L_{Aeq}; and
- Living rooms: 30 dB L_{Aeq}.

Extract Ventilation

As non-mandatory requirements, it is suggested that internal ambient noise levels due to any extract ventilation should not normally exceed:

- Bedrooms: 26 dB L_{Aeq} for continuous and 30 dB L_{Aeq} for intermittent extract ventilation; and
- Living/dining rooms: 35 dB L_{Aeq}; and
- Bathroom/WC/Kitchen: 45 dB L_{Aeq}.

6.2 Windows

To achieve good internal acoustic conditions, it is assumed that the ventilation will be sufficient to allow windows to be shut in normal circumstances. The windows proposed are the 33.2SIL (18AR) 4 configuration supplied by Saint-Gobian Glass. Saint-Gobian report that the glazing meets the following acoustic specifications:

- Overlooking Brighton Road: $R_W + C_{tr}$ = 32 dB.

Windows should be properly sealed when installed and should be well sealed when shut.

6.3 Wall

The walls should be constructed from 100 mm medium density block with a 160 mm cavity. There will be 100 mm Celotex PIR insulation in the cavity. Wall ties should be spaced a far apart as possible but within the manufacturer's specifications. The cavity should be clear from debris and mortar so as not to create a bridge across the cavity.

6.4 Roof

The roof should be roofing tile on 25 x 38 mm battens. The battens will be fixed on to 18 mm OSB or equivalent. There should be a 150 mm cavity with thermal insulation between the rafters. The insulation should be open cell such as mineral wool or fibreglass to maintain a cavity. Fixed underneath the rafter will be 75 mm Celotex PIR board with 12.5 mm plasterboard on the internal face of the roof.

With the above design recommendation, it is considered that the building should meet good internal acoustics.

7 Uncertainty

7.1 Sources of Uncertainty

The modelling of environmental noise (especially when considering mitigation strategies) is often categorised into three areas: source, transmission path and receiver. Each of these areas could give rise to errors and uncertainty in the assessment. Additionally, measurements and modelling can introduce errors. In the context of this report, uncertainty has been categorised into the following elements:

- Source variations;
- Noise and vibration propagation;
- Measurement uncertainty;
- Building envelope assumptions / modelling uncertainty; and
- Human response uncertainty

7.2 Source Variations

Road noise was the dominant noise source during the noise survey. Road traffic will naturally vary during the day and over the course of months and years. There may be variations over time and other factors may influence road traffic conditions.

It is not possible to accurately determine how road traffic movements will change far into the future. By monitoring over several days, the variations over the week are accounted for.

Therefore, the road conditions can be considered a typical worst case and variations would not significantly impact the recommendations of this report.

7.3 Noise Propagation

Meteorological Effects

The effect of meteorological variations on sound level measurements can be broadly divided into two categories: direct and indirect effects. Direct effects are where rain and wind have a direct impact on the measurements by increasing the sound levels recorded. Periods of poor weather was removed from the measurements so that the direct meteorological effects were not significant.

Indirect meteorological effects are where the propagation of the sound being measured changes because of atmospheric effects, which could increase or decrease the measured sound levels. The most pronounced indirect meteorological effects occur over large distances. As the distance from the main sources to the measurement position was less than 10 m away, it is not expected that there would be any significant variations to propagation due to meteorological effects.

7.4 Measurement Uncertainty

Uncertainty introduced during measurement can be due to the following factors:

- barrier effects and reflections due to the placement of the sound level meter;
- inaccuracies introduced by the sound level meter; and
- differences that can occur in the measurements due to changes in the position of the sound level meter.

Barriers and Reflections

The effects of barriers and reflections were minimised by careful placement of the sound level meter. The sound level meter was positioned at the boundary of the property and the sound levels corrected by standard calculation procedures to be equivalent to the proposed façade of the dwelling.

Sound Level Meter

The sound level meters are Class One and laboratory calibrated approximately every two years. Additionally, a field calibration check was made of the sound level meter before and after the sound level survey and no significant drift was measured. Therefore, it is considered that the equipment did not introduce a significant amount of uncertainty.

Differences due to Changes in Measurement Position

Changes in measurement position can sometimes make a significant difference in the sound levels measured and sometimes it is possible to measure a significant change in level from a small change in position. By its very nature, small changes in measurement position that may have a significant effect are hard to mitigate. Nevertheless, aural observations were made across site. No significant variations in the sound level were observed in the vicinity of where the sound level meters were located.

7.5 Building Envelope Assumptions / Modelling Uncertainty

As this report addresses a development that has not yet been built, it has been necessary to model the performance of the building façade. The expected precision of the external to internal sound level calculation is expected to be +/-3 dB.

It is possible that a façade may not perform as predicted. The potential for inaccuracies in the predictions are greatest when designing building envelopes that have a high sound reduction index. This is because the detailing of high performing facades become particularly important and errors in design or construction that result in unexpected flanking transmission can be particularly undermining of the performance of the building envelope.

All internal noise level calculations and the acoustic performance of building material used in the above assessment assume that all the construction guidelines contained in BS 8233 (especially Section 8) are followed. As the overall performance of building envelopes can be undermined by flanking transmission (the transmission of noise via adjoining elements and air paths through or round elements), high standards of workmanship are essential to ensure that this is minimised.

7.6 Human Response Uncertainty

The range of human responses to noise is large. What might be just perceptible to one individual might be an extreme annoyance to another. The conclusions of this report should be understood as an indication of average community response and not a predictor of individual responses to noise.

8 Summary and Conclusion

Goodhand Acoustics Ltd has been commissioned by Mr M Karmis to undertake a noise assessment to address a noise planning condition for a new residential dwelling at 44 Brighton Road Brighton, West Sussex, BN1 8YL.

A noise report is required by Adur District Council (ADC) to assess the noise from Brighton Road and identify mitigation to ensure future residents are protected from excess noise. The full wording of the planning condition is provided in Section 2.

This report presents the results of a baseline sound level survey undertaken at the application site and assesses internal noise referencing BS 8233 (1) to address Planning Condition 4. More detail on BS 8233 and associated guidance is provided in Appendix A.

The main source of noise was road traffic on Brighton Road. At the façade overlooking Brighton Road, closed acoustic windows with a mechanical ventilation heat recovery (MVHR) system will allow residents to have the option of keeping windows closed to mitigate noise. The air supply/extract will be ducted to the rear of the building. Purge ventilation can be achieved through opening windows.

By implementing the design recommendations in Section 6, it is concluded that the noise effecting the proposed development could be controlled to sufficiently protect future occupants from noise and on that basis there is no reason why Planning Condition 4 of the Planning Application: AWDM/0836/22 cannot be discharged.

Appendix A – Noise Guidance and Standards

Introduction to Sound and Noise

Sound is the transmission of vibrations through a medium, commonly air, which can be measured or heard.

Noise is often defined as unwanted sound. Noise can cause effects in humans ranging from negligible to annoyance and can even have health effects. Health effects can be direct, such as noise induced hearing loss, or indirect, such cardiovascular effects.

The threshold of human hearing varies from individual to individual but is generally taken to be 0 dBA. The threshold of pain is normally taken to be around 120 dBA.

The frequency response of the ear is usually taken to be about 18 Hz (number of oscillations per second) to 18 kHz. The ear does not respond equally to different frequencies at the same level. It is more sensitive in the mid-frequency range frequencies (between around 250 Hz to 5 kHz), rather than the lower and higher frequencies. This coincides with the typical frequency content of speech. Because of this, when measuring sound, the low and high frequency components of a sound are reduced in importance by applying a weighting (filtering) circuit to the sound level meter. The weighting which is most widely used is the dBA weighting.

For variable noise sources such as traffic, a difference of 3 dB is just distinguishable. A noise change of 3 dB could be caused by a doubling of a noise source. For example, if one item of machinery results in noise levels of 70 dBA at 10 m, then two identical items of machinery adjacent to one another would result in noise levels of 73 dBA at 10 m. The change in 'loudness' of a noise is a purely subjective parameter but it is generally accepted that an increase/decrease of 10 dB corresponds to a doubling/halving in perceived loudness.

Noise sources rarely generate steady noise levels, but rise and fall according to activities within an area. To produce a noise level that relates this variable noise level to subjective response, a number of noise indices have been developed.

L_{AFmax} sound level: This is the maximum noise level recorded over the measurement period determined using a fast response time weighting, which uses a time constant of 125 ms.

L_{Aeq} sound level: Although the precise definition is a little more complex, this unit can be understood as the average noise level over the measurement period. It is a unit commonly used to describe community response and is used to assess noise affecting residential developments.

Octave band sound levels: These are sound levels measured in specific frequency bands. Each octave band has an upper frequency limit twice that of its lower frequency limit. In this manner the human hearing range can be divided into approximately 10 octave bands. Octave bands are identified by the centre frequency, e.g. 125 Hz, 250 Hz, 500 Hz, 1000 Hz, etc.

1/3rd octave band sound levels: Each octave band can be subdivided into three equal frequency bands and these are termed 1/3rd octave bands. The human hearing range can be divided into approximately thirty 1/3rd octave bands. Similarly, a 1/3rd octave band is identified by the centre frequency.

National Standards and Guidance

National Planning Policy Framework

The National Planning Policy Framework (NPPF) was published on 27 March 2012 with its latest iteration published on 20 July 2021 (6). Along with the introduction of this document, several detailed planning policy guidance notes were withdrawn, including PPG24, on planning and noise.

The NPPF sets out how the Government's planning policies should be applied by local planning authorities with the use of planning policies and decisions. The NPFF states:

> *"Planning policies and decisions should contribute to and enhance the natural and local environment by:*
>
> *[…]*
>
> *d) minimising impacts on and providing net gains for biodiversity, including by establishing coherent ecological networks that are more resilient to current and future pressures;*
>
> *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 or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans;*
>
> *[…]*
>
> *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;"

Further guidance and explanation on noise in relation to planning has been published online by the Ministry of Housing, Communities and Local Government on 6 March 2014 and was last updated on 22 July 2019 (7). The guidance provides details on key terms and sets out a noise exposure hierarchy table. The guidance also refers to the Noise Policy Statement for England.

Noise Policy Statement for England

The Noise Policy Statement for England (NPSE) (8) was published on 15 March 2010 under the previous labour government. Whilst it now precedes the revised NPPF and noise guidance, the NPPF makes clear that existing policies will continue to apply with greater weight placed on them where they are consistent with the revised framework. The online noise guidance makes direct reference to the NPSE, and the document continues to carry weight.

The NPSE sets out the long-term vision of the Government's noise policy:

"Promote good health and a good quality of life through the management of noise within the context of sustainable development."

To achieve the long-term noise policy vision the NPSE sets out the following aims:

"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."*

In the explanatory notes, the 'significant adverse' and 'adverse' impacts are defined as:

- No Observed Effect Level (NOEL) is the level below which no effects on health and quality of life can be detected;
- Lowest Observed Adverse Effect Level (LOAEL) is the level above which adverse effects on health and quality of life can be detected; and

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

The NPSE references World Health Organisation (WHO) as an example source where the above concepts are derived.

ProPG: Planning and Noise

Professional Practice Guidance on Planning and Noise (ProPG: Planning & Noise) (5) has been prepared in response to the changes in the planning system and requests from practitioners for additional technical guidance on the management of noise within the planning system.

The aims of the ProPG are to give good practice advice to Local Planning Authorities in England and to developers` professional advisers on the application of the land-use planning process to encourage good acoustic design.

With the withdrawal of PPG 24 (9) supporting technical advice and guidance is largely missing from the planning system and at the time the government advised that it did not intend to provide such technical guidance. This led to uncertainty for developers, regulators, and their advisers alike regarding the approach to take.

The guidance provides a two-stage approach to assist practitioners assess noise. Stage 1 is an initial noise risk assessment and stage 2 is a full assessment. The approach formalised the common approach of many practitioners when undertaking a PPG 24 assessment.

The initiative was overseen by a steering group consisting of representatives of the Association of Noise Consultants (ANC), Institute of Acoustics (IOA) and Chartered Institute of Environmental Health (CIEH).

Acoustics, Ventilation and Overheating: Residential Design Guide

Dealing with ventilation and overheating has often competing requirements with acoustics. In many circumstances it is required to keep windows closed to achieve good internal acoustic conditions; however, at the same time windows may also be required to be open to meet ventilation requirements and overheating strategies. Additionally, the introduction of trickle vents and other means of ventilation can often undermine the acoustic performance of the façade or even be their own source of noise. To help reconcile these competing requirements, the ANC with the IoA have issued guidance: Acoustics, Ventilation and Overheating: Residential Design Guide (10) (AVO Guide). The AVO Guide provides and explanation of:

- Approved Document F (11) (ventilation guidance); and
- CIBSE's Design methodology for the assessment of overheating risks in homes (12) (TM59)

The document also provides a two-level noise assessment procedure for overheating conditions consisting of:

- a risk assessment (Level 1); and
- the assessment of adverse effect (Level 2).

There is also a worked example of the application of the AVO Guide along with different ventilation and overheating strategies. Table A.2 below reproduces Table B-3 from the AVO Guide and provides guidance on appropriate window and ventilation strategies.

Table A.2: Summary of potential noise issues associated with ventilation strategies described in ADF

ADF System	External noise ingress considerations	Mechanical system noise considerations	Approximate guideline freefield external noise limits. [Note 1]
1 or 2	Noise ingress is likely to be defined by the performance of the background ventilators (trickle vents), windows and other façade elements. Note that use of System 1, relying on the use of open trickle vents without opening windows may give rise to poor indoor air quality in airtight dwellings outside the winter period.	For System 1, intermittent kitchen and bathroom fans should have suitable noise levels to meet the guidelines in Table 3-4. System 2 has no mechanical components.	With standard double glazing and two trickle vents: • ~$L_{Aeq,16h}$ 56 dB day • ~$L_{Aeq,\ 8h}$ 51 dB night • L_{AFmax} not normally exceeding ~ 67 dB more than 10x per night With high performing acoustic glazing and two 'acoustic' trickle vents: • ~ $L_{Aeq,16h}$ 66 dB day • ~ $L_{Aeq,\ 8h}$ 61 dB night • L_{AFmax} not normally exceeding ~ 80 dB more than 10x per night
3	Noise ingress is likely to be defined by the performance of the background ventilators (trickle vents), windows and other façade elements. ADF advises that: *"controllable background ventilators having a minimum equivalent area of 2,500 mm2 should be fitted in each room, except wet rooms…"*	This could be a centralised or decentralised MEV system. Guideline levels are shown in Table 3-4. For a centralised system, the location of the fan is important for structureborne and airborne noise. System noise may affect living rooms and bedrooms as well as the rooms in which the extract inlets are located i.e. wet rooms. For a decentralised system, there are individual fans extracting from each bathroom, toilet, kitchen and utility room. The noise effects on adjacent living rooms and bedrooms should be considered. [Note 2]	With standard double glazing and trickle vent: • ~$L_{Aeq,16h}$ 58 dB day • ~$L_{Aeq,\ 8h}$ 53 dB night • LAFmax not normally exceeding ~ 69 dB more than 10x per night With high performing acoustic glazing and an 'acoustic' trickle vent: • ~ $L_{Aeq,16h}$ 68 dB day • ~ $L_{Aeq,\ 8h}$ 63 dB night • L_{AFmax} not normally exceeding ~ 83 dB more than 10x per night
4	No trickle vents required. Consider noise ingress through other façade elements.	MVHR is a centralised system ducted to supply outlets in living rooms and bedrooms as well as to extracts in wet rooms. Guideline levels are shown in Table 3-4. The unit location is important for structure-borne and airborne noise. Consider ducted noise, particularly to bedrooms. Consider also crosstalk sound transmission via ducts. [Note 2]	With standard double glazing and no trickle vent: • ~ $L_{Aeq,16h}$ 62 dB day • ~ $L_{Aeq,\ 8h}$ 57 dB night • LAFmax not normally exceeding ~76 dB more than 10x per night With high performing acoustic glazing: • ~ $L_{Aeq,16h}$ 73 dB day • ~ $L_{Aeq,\ 8h}$ 68 dB night • LAFmax not normally exceeding ~ 90 dB more than 10x per night N.B. With secondary glazing higher sound insulation may be achieved.

Note 1 Refer to paragraphs B14 to B27 for the basis of calculated noise levels

Note 2 Hybrid ventilation strategies may involve mechanical supply and/or extract to specific habitable rooms, in which case those sources of noise should be considered.

The AVO Guide is not statutory guidance but is intended to build on the good practice guidance of ProPG.

World Health Organisation Guidelines for Community Noise

The WHO published guidance on the desirable levels of environmental noise in 2000. In Guidelines for Community Noise (13), the authors consider that the sleep disturbance criteria should be taken as an internal noise level of 30 dB $L_{Aeq,8hr}$. It is also suggested that internal L_{Amax} levels of 45 dB should be limited where possible.

The WHO document provides further guidance on the internal L_{Amax} criteria and suggests 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..."*

The guidelines also provide details on external noise levels that are likely to give rise to moderate and severe annoyance.

The noise criteria provided in the WHO guideline values are set at the level of the lowest adverse health effect. Noise that does not exceed the WHO guidelines values should be considered equivalent to the NPSE's definition of NOEL.

British Standard 8233:2014 – Guidance on sound insulation and noise reduction for buildings

British Standard (BS) 8233:2014 Guidance on sound insulation and noise reduction for buildings (3) provides guideline values for internal noise levels within several building types including residential dwellings.

Table A.3 shows the values for desirable indoor noise levels which are presented in BS 8233 and are based on the WHO guidelines and so should be regarded at NOEL. BS 8233 notes that where the development is necessary then a relaxation of 5 dB can be applied to still achieve reasonable internal noise levels. Therefore, should noise levels in Table A.3 be exceeded by less than 5 dB then this could be considered equivalent to LOAEL. A noise level greater than 5 dB of the noise levels in Table A.3 could be considered as SOAEL.

Table A.3: Indoor ambient noise levels for dwellings

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

BS 8233 states that guideline values may be set in terms of Sound Exposure Level (SEL) or $L_{Amax,F}$ for individual noise events that can cause sleep disturbance.

On noise in external amenity areas such as gardens and patios, the guidelines state 50 dB $L_{Aeq,T}$ should not be exceeded, with an upper guideline value of 55 dB $L_{Aeq,T}$. However, the guidance recognises that this may not be achievable in city and urban areas and that whilst the lowest practicable noise level should be achieved, external amenity areas that exceed the guidelines should not be prohibited.

BS 8233 provides guidance on calculating the sound insulation performance requirements for the external envelope or facade of a building where this is made up of a number of different elements.

The document also provides guidance on design criteria, building layout, construction, and control measures.

The Calculation of Road Traffic Noise

Calculation of Road Traffic Noise (CRTN) (8) is a technical memorandum produced by the Welsh Office in 1988. The document contains procedures for measuring and calculating noise from road traffic.

The document is used to assess entitlement under The Noise Insulation Regulations as well as providing guidance for more general applications such as environmental impact assessments and noise assessments used to inform planning applications.

Appendix B – Calibration Certificates

NTi AUDIO

Manufacturer Calibration Certificate

The sound level meter submitted for testing successfully completed the periodic tests of IEC 61672-3. All tests are traceable in accordance with ISO/IEC 17025.

This model of sound level meter submitted for periodic testing successfully completed the applicable pattern-evaluation tests given in IEC 61672-2. The pattern approval certificate is available at www.nti-audio.com/XL2.

Sound Level Meter

Manufacturer	NTi Audio		
Type	XL2-TA	S/N	A2A-15954-E0
Firmware	V4.21		
Reference Level Range	mid		
Microphone Model	M2230		
Preamplifier	MA220	S/N	8335
Microphone Capsule	MC230A	S/N	A16830
Performance class	Class 1		
Customer Inventory Nr.			

Customer

Goodhand Acoustics Ltd
Flat 4, St Augustines Apartments
1a Florence Road
Brighton
BN1 6BB

Date 11 June 2021

Certificate UK-21-045

Results **PASSED**
(for detailed report see next pages)

Operator [redacted]
David Young

NTi Audio UK Ltd • Office 33C Julians Road • Stevenage
Hertfordshire, SG1 3ES, UK • uk@nti-audio.com

Certificate: UK-21-045

Measurement equipment

Test System

Model	NTi Audio FX100, S/No. 11095
Last Calibration	27 October 2020
Cal Certificate	FX100 Cal #6585
Next Calibration	27 October 2021

Reference Microphone

Model	M2230 S/N #9565, Mic Capsule MC230A S/No. #A19844
Last Calibration	08 January 2021
Cal Certificate	44204-9565-M2230
Next Calibration	08 January 2022

Sound Calibrator

Model	Norsonic 1255 S/No. #125525354
Reference Level	114.18 dB
Calibration Frequency	1000 Hz
Last Calibration	05 January 2021
Cal Certificate	#36701
Next Calibration	05 January 2023

Environmental conditions

Temperature	24.5 °C
Humidity	54 %
Pressure	1009 hPa

Notes

- This calibration certificate documents the traceability to national standards, which realize the units of measurement according to the international Systems of Units (SI).
- The user is obliged to have the object recalibrated at appropriate intervals.
- This calibration certificate may not be reproduced other than in full except with the permission of the issuing laboratory. Calibration certificates without signature are not valid.
- All limits listed in this report are acceptance limits in accordance with IEC61672.
- The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with the regulations of the GUM.

NTi AUDIO

Certificate: UK-21-045

1. Indication at the calibration check frequency

The indication of the sound level meter at the calibration check frequency is checked by application of the sound calibrator and adjusted, if necessary, to indicate the required sound level for the environmental conditions under which the tests are performed. All levels in [dB].

Sensitivity before calibration	Sensitivity after calibration	Meas level	Limit -	Limit +	Uncert.	Status
37.1 mV/Pa	37.1 mV/Pa	114.2	113.18	115.18	0.2	Passed

2. Self-generated noise

2.1 Microphone cartridge installed

The self-generated noise is measured in the most-sensitive level range as a time-averaged sound pressure level with frequency-weighting A and an averaging time of 30 seconds. All levels in [dB].

Weighting	Meas level	Limit +	Uncert.	Status
A	18.0	18.0	0.1	Passed

2.2 Microphone cartridge replaced by the capsule replacement NTI-K65-15

The self-generated noise is measured in the most-sensitive level range as a time-averaged sound pressure level for all frequency-weightings and an averaging time of 30 seconds. All levels in [dB] referenced to S = 42 mV/Pa.

Weighting	Meas level	Limit +	Uncert.	Status
A	9.4	13.0	0.1	Passed
C	13.7	16.0	0.1	Passed
Z	20.2	24.0	0.1	Passed

3. Acoustic signal tests of a frequency weighting

The frequency weighting is tested for frequency-weighting A, using an acoustic test facility. The sound level meter is set to a fast time-weighted sound level in the reference level range. All levels in [dB].

Freq. [Hz]	Gen. level	Meas level	Dev	Limit -	Limit +	Uncert.	Status
125	69.8	70.1	0.3	-1.0	1.0	0.4	Passed
250	77.4	77.5	0.1	-1.0	1.0	0.4	Passed
500	82.8	82.7	-0.1	-1.0	1.0	0.4	Passed
1000	86.0	86.1	0.1	-0.7	0.7	0.4	Passed
2000	87.2	87.2	0.0	-1.0	1.0	0.4	Passed
4000	87.0	86.9	-0.1	-1.0	1.0	0.4	Passed
8000	84.9	84.9	0.0	-2.5	1.5	0.4	Passed

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4. Electric signal tests of frequency weightings

Frequency weightings are determined relative to the response at 1 kHz using steady sinusoidal electrical input signals. The sound level meter is set to display F-time-weighted sound level in the reference level range. All available frequency weightings provided in the sound level meter are verified. All levels in [dB].

4.1 A-Weighting

Freq. [Hz]	Gen. level	Meas level	Dev	Limit -	Limit +	Uncert.	Status
1000	80.0	80.0	0.0	-0.7	0.7	0.1	Passed
63	106.2	79.8	-0.2	-1.0	1.0	0.1	Passed
125	96.1	79.9	-0.1	-1.0	1.0	0.1	Passed
250	88.6	79.9	-0.1	-1.0	1.0	0.1	Passed
500	83.2	79.9	-0.1	-1.0	1.0	0.1	Passed
2000	78.8	80.0	0.0	-1.0	1.0	0.1	Passed
4000	79.0	79.9	-0.1	-1.0	1.0	0.1	Passed
8000	81.1	79.9	-0.1	-2.5	1.5	0.1	Passed
12500	84.3	79.8	-0.2	-2.5	1.5	0.1	Passed
16000	86.6	79.7	-0.3	-2.5	1.5	0.1	Passed

4.2 C-Weighting

Freq. [Hz]	Gen. level	Meas level	Dev	Limit -	Limit +	Uncert.	Status
1000	80.0	80.0	0.0	-0.7	0.7	0.1	Passed
63	80.8	79.8	-0.2	-1.0	1.0	0.1	Passed
125	80.2	79.9	-0.1	-1.0	1.0	0.1	Passed
250	80.0	79.9	-0.1	-1.0	1.0	0.1	Passed
500	80.0	80.0	0.0	-1.0	1.0	0.1	Passed
2000	80.2	80.0	0.0	-1.0	1.0	0.1	Passed
4000	80.8	79.9	-0.1	-1.0	1.0	0.1	Passed
8000	83.0	79.9	-0.1	-2.5	1.5	0.1	Passed
12500	86.2	79.8	-0.2	-2.5	1.5	0.1	Passed
16000	88.5	79.7	-0.3	-2.5	1.5	0.1	Passed

4.3 Z-Weighting

Freq. [Hz]	Gen. level	Meas level	Dev	Limit -	Limit +	Uncert.	Status
1000	80.0	80.0	0.0	-0.7	0.7	0.1	Passed
63	80.0	79.8	-0.2	-1.0	1.0	0.1	Passed
125	80.0	79.9	-0.1	-1.0	1.0	0.1	Passed
250	80.0	80.0	0.0	-1.0	1.0	0.1	Passed
500	80.0	80.0	0.0	-1.0	1.0	0.1	Passed
2000	80.0	80.0	0.0	-1.0	1.0	0.1	Passed
4000	80.0	79.9	-0.1	-1.0	1.0	0.1	Passed
8000	80.0	79.9	-0.1	-2.5	1.5	0.1	Passed
12500	80.0	79.9	-0.1	-2.5	1.5	0.1	Passed
16000	80.0	80.0	0.0	-2.5	1.5	0.1	Passed

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5. Frequency and time weightings at 1kHz

While injecting a constant steady signal at the reference frequency of 1 kHz the F-time-weighted sound level, S-time-weighted sound level and time-averaged sound level are verified with frequency weighting A. Additionally the F-time-weighted sound level for frequency weightings C and Z is measured. The first measurement serves as reference and differences in the reading with respect to this first one are determined. All levels in [dB].

Level	Exp level	Meas level	Dev	Limit -	Limit +	Uncert.	Status
LAF	114.0	114.0	0.0	-0.7	0.7	0.1	Passed
LAS	114.0	113.8	-0.2	-0.7	0.7	0.1	Passed
LAeq	114.0	114.0	0.0	-0.7	0.7	0.1	Passed
LCF	114.0	114.0	0.0	-0.7	0.7	0.1	Passed
LCeq	114.0	114.0	0.0	-0.7	0.7	0.1	Passed
LZF	114.0	114.0	0.0	-0.7	0.7	0.1	Passed
LZeq	114.0	114.0	0.0	-0.7	0.7	0.1	Passed

6. Level linearity on the reference level range

The level linearity on the reference level range is determined by applying steady sinusoidal electrical signals at a frequency of 8 kHz with the sound level meter set for frequency-weighting A and fast time-weighting. All levels in [dB].

Exp abs level	Meas. level	Abs dev	Abs Limit -	Abs Limit +	Exp rel level	Rel dev	Rel Limit -	Rel Limit +	Uncert.	Status
114.0	114.0	0.0	-0.8	0.8	0.0	0.0	-0.3	0.3	0.1	Passed
119.0	119.0	0.0	-0.8	0.8	119.0	0.0	-0.3	0.3	0.1	Passed
124.0	124.0	0.0	-0.8	0.8	124.0	0.0	-0.3	0.3	0.1	Passed
125.0	125.0	0.0	-0.8	0.8	125.0	0.0	-0.3	0.3	0.1	Passed
126.0	126.0	0.0	-0.8	0.8	126.0	0.0	-0.3	0.3	0.1	Passed
114.0	114.0	0.0	-0.8	0.8	0.0	0.0	-0.3	0.3	0.1	Passed
109.0	109.0	0.0	-0.8	0.8	109.0	0.0	-0.3	0.3	0.1	Passed
104.0	104.0	0.0	-0.8	0.8	104.0	0.0	-0.3	0.3	0.1	Passed
99.0	99.0	0.0	-0.8	0.8	99.0	0.0	-0.3	0.3	0.1	Passed
94.0	94.0	0.0	-0.8	0.8	94.0	0.0	-0.3	0.3	0.1	Passed
89.0	89.0	0.0	-0.8	0.8	89.0	0.0	-0.3	0.3	0.1	Passed
84.0	84.0	0.0	-0.8	0.8	84.0	0.0	-0.3	0.3	0.1	Passed
79.0	79.0	0.0	-0.8	0.8	79.0	0.0	-0.3	0.3	0.1	Passed
74.0	74.0	0.0	-0.8	0.8	74.0	0.0	-0.3	0.3	0.1	Passed
69.0	69.0	0.0	-0.8	0.8	69.0	0.0	-0.3	0.3	0.1	Passed
64.0	64.0	0.0	-0.8	0.8	64.0	0.0	-0.3	0.3	0.1	Passed
59.0	59.0	0.0	-0.8	0.8	59.0	0.0	-0.3	0.3	0.1	Passed
54.0	54.0	0.0	-0.8	0.8	54.0	0.0	-0.3	0.3	0.1	Passed
49.0	49.0	0.0	-0.8	0.8	49.0	0.0	-0.3	0.3	0.1	Passed
44.0	44.0	0.0	-0.8	0.8	44.0	0.0	-0.3	0.3	0.1	Passed
39.0	39.0	0.0	-0.8	0.8	39.0	0.0	-0.3	0.3	0.1	Passed
34.0	34.1	0.1	-0.8	0.8	34.0	0.1	-0.3	0.3	0.1	Passed
33.0	33.1	0.1	-0.8	0.8	33.1	0.0	-0.3	0.3	0.1	Passed
32.0	32.2	0.2	-0.8	0.8	32.1	0.1	-0.3	0.3	0.1	Passed
31.0	31.3	0.3	-0.8	0.8	31.2	0.1	-0.3	0.3	0.1	Passed

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7. Level linearity including the level range control

The test is performed with steady sinusoidal electrical input signals at a frequency of 1 kHz and with the sound level meter set for frequency weighting A and fast time weighting. With the input signal level kept constant, the indicated signal level is recorded for all level ranges where the applied signal level is displayed. All levels in [dB].

		Low Range		Mid Range		High Range			
Starting Range	Source level	Dev	Limit +/-	Dev	Limit +/-	Dev	Limit +/-	Uncert.	Status
Low	94	0.0	0.40	0.0	0.15	0.0	0.15	0.1	Passed
Mid	114			0.0	0.30	0.0	0.55	0.1	Passed
High	134					0.0	0.30	0.1	Passed
Low	29	0.1	0.30					0.1	Passed
Mid	36			0.1	0.30			0.1	Passed
High	58					0.1	0.30	0.1	Passed

8. Toneburst response

The response of the sound level meter to short-duration signals is tested on the reference level range with 4 kHz tonebursts that start and stop at zero crossings and are extracted from steady 4 kHz sinusoidal electrical input signals. The sound level meter is set for frequency weighting A. All levels in [dB].

The continuous signal level is 123 dB.

Burst signal	Burst duration [ms]	Exp level	Meas level	Dev	Limit -	Limit +	Uncert.	Status
LAF	200	122.0	122.0	0.0	-0.5	0.5	0.2	Passed
LAF	2	105.0	104.9	-0.1	-1.5	1.0	0.2	Passed
LAF	0.25	96.0	95.8	-0.2	-3.0	1.0	0.2	Passed
LAS	200	115.6	115.5	-0.1	-0.5	0.5	0.2	Passed
LAS	2	96.0	96.0	0.0	-3.0	1.0	0.2	Passed
LAeq10s	200	106.0	105.9	-0.1	-0.5	0.5	0.2	Passed
LAeq10s	2	86.0	85.9	-0.1	-0.5	0.5	0.2	Passed
LAeq10s	0.25	77.0	76.8	-0.2	-0.5	0.5	0.2	Passed

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9. C-weighted peak sound level

The sound level meter is tested on the least-sensitive level range with fast time weighting and C frequency weighting. The test signals are a single complete cycle of an 8 kHz sinusoid starting and stopping at zero crossings and positive and negative half cycles of a 500 Hz sinusoid that also start and stop at zero crossings. All levels in [dB].

Burst signal	Source level	Exp LCp-LCF	Meas LCp-LCF	Dev	Limit -	Limit +	Uncert.	Status
8kHz	129.0	3.4	2.2	-1.2	-2.0	2.0	0.2	Passed
500Hz +	132.0	2.4	2.2	-0.2	-1.0	1.0	0.2	Passed
500Hz -	132.0	2.4	2.2	-0.2	-1.0	1.0	0.2	Passed

10. Overload Indication

Overload indication is tested on the least-sensitive level range with the sound level meter set to A-weighted, time-averaged sound level. Positive and negative one-half-cycle sinusoidal electrical signals at a frequency of 4 kHz are used. All levels in [dB].

Start level	OV +	OV -	Dev	Limit -	Limit +	Uncert.	Status
138.1	140.3	140.3	0.0	-1.5	1.5	0.3	Passed

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AcSoft
Noise, Vibration & Air Quality

CALIBRATION CERTIFICATE

Date of issue: 21-02-2023 **Certificate No:** 1504568-1 **Page:** 1/3

INSTRUMENT DETAILS	Manufacturer:	**Larson Davis**	
	Model:	**CAL200**	
	Serial No.:	**10032**	
	Description:	Acoustical Calibrator accuracy class 1 with nominal level of 94 dB and 114 dB, and nominal frequency f_{n1} = 1000 Hz.	
CUSTOMER	Goodhand Acoustics		
ENVIRONMENTAL CONDITIONS	Temperature:	22.7	°C
	Humidity:	45.1	%
	Pressure:	101.34	kPa
DATE OF CALIBRATION	21-02-2023		
APPROVED BY	A. Pullinger		

AcSoft
Noise, Vibration & Air Quality

AcSoft Calibration | 11 Abbey Court
Fraser Road | Priory Business Park
MK44 3WH | Bedford
+44 (0) 1234 639550
www.acsoft.co.uk

This calibration was performed by AcSoft Calibration.
AcSoft Calibration is a trading name of AcSoft Ltd, 11 Abbey Court, Fraser Road, Priory Business Park, Bedford, MK44 3WH
(AP 21/12/2022 Issue No. 2)

AcSoft
Noise, Vibration & Air Quality

CALIBRATION CERTIFICATE

Issued by AcSoft Calibration

Date of issue: 21-02-2023 **Certificate No:** 1504568-1 **Page:** 2/3

CALIBRATION RESULTS

The calibrator submitted for testing has successfully completed the Periodic tests of IEC 60942:2003 (BS EN 60942:2003) (Annex B), for class 1 sound calibrators, for the environmental conditions under which the tests were performed.

The results are presented on page 3 of this certificate (including measurement uncertainty).

REPORTED RESULTS

The results contained in this Certificate refer only to the measurements made at the time of test for the instrument detailed above. These results do not reflect the instrument's ability to maintain calibration.

COMMENTS

The measured SPL was 0.38 dB high at both the 94 dB and 114 dB settings prior to adjustment and final calibration.

NOTES

1. *The information appearing on this certificate has been compiled specifically for this instrument. This calibration certificate is produced with traceable and advanced equipment which permit comprehensive quality assurance verification of all data supplied herein.*
2. *The measurements in this document are traceable to GUM (Central Office of Measures), Poland*
3. *This calibration certificate shall not be reproduced except in full, without written permission from AcSoft Ltd.*

MEASUREMENT TRACEABILITY

The instrument under test was calibrated using the following equipment.

Description	Manufacturer	Model	Serial Number
Pistonphone	GRAS	42AP	236167
Acoustical Calibrator	Svantek	SV30A	83782
Sound & Vibration Analyser	Svantek	SV912AE	15909
Digital Multimeter	Keithley	2015THD	1065133
Reference Microphone	GRAS	40AG	235709
Thermo-Barometer	LAB-EL	LB-706B	912

AcSoft
Noise, Vibration & Air Quality

CALIBRATION CERTIFICATE

Issued by AcSoft Calibration

Date of issue: 21-02-2023 **Certificate No:** 1504568-1 **Page:** 3/3

CALIBRATION RESULTS Calibration results are as follows:

SPL

	Measured Level	Deviation From Nominal	Uncertainty	Tolerance (dB)	
	dB	dB	dB	class 1	class 2
1	**94.06**	0.06	0.15	±0.25	±0.4
2	**114.06**	0.06			

Frequency

	Measured Frequency	Deviation From Nominal	Uncertainty	Tolerance (%)	
	Hz	Hz	Hz	class 1	class 2
1	**1000.56**	0.56	0.1	±0.7 (±7Hz)	±1.7 (±17Hz)
2	**1000.55**	0.55			

THD+N

	Measured Distortion	Uncertainty	Tolerance (%)	
	%	%	class 1	class 2
1	**0.28**	0.1	2.5	3.0
2	**0.32**			

This calibration was performed by AcSoft Calibration.
AcSoft Calibration is a trading name of AcSoft Ltd, 11 Abbey Court, Fraser Road, Priory Business Park, Bedford, MK44 3WH
(AP 21/12/2022 Issue No. 2)

Appendix C – Noise Survey Sheet - North Facade

Goodhand Acoustics
Gemini House | 136-140 Old Shoreham Road
Brighton | BN3 7BD | 01273 915 910

Project name:	3291 - 44 Brighton Road, Lancing
Location:	44 Brighton Road, Lancing
Start Date/Time:	17/07/2023 21:28 hrs
End Date/Time:	31/07/2023 17:38 hrs
Survey personnel:	Daniel Goodhand

Instrumentation used:

Sound Level Meter ID:	XL2, SNo. A2A-15471-E0	Calibration Date:	14/07/2022
Microphone ID:	NTi Audio M2230, SNo. 7937	Calibrator ID:	LD CAL200 10032
Calibration at start:	114.0 dB ref 114.0 dB	Calibration at end:	114.1 dB ref 114.0 dB

Microphone Setup:

Method of installation:	Pole	Location relative to development:	North Building Facade
Horizontal from road:	3.4	Microphone height:	3.5
Façade/freefield:	Freefield		

Weather conditions (start):

Wind speed:	< 5 m/s	Precipitation:	none
Wind direction:	-	Ground conditions:	dry
Temperature:	20 deg C	Other notes:	-

Weather conditions (end):

Wind speed:	7 m/s	Precipitation:	rain
Wind direction:	southwest	Ground conditions:	wet
Temperature:	17 deg C	Other notes:	Data excluded where weather affected results

Survey Location

The microphone was mounted on a pole at 3.5 m height overlooking Brighton Road on the boundary of the property.

Sound Sources:

Road traffic noise is dominant. There was a significant contribution from emergancy sirens and high speed vehicles. Construction noise was auidible from the next door site; however, where this significantly affected the results it was excluded.

Appendix D – BS 8233 Calculation Sheets

Project No:	**3291**
Client:	**Mark Kamis**
Site:	**44 Brighton Road, Lancing**
Room:	**Living Area**
Room Description:	**Overlooking Brighton Road**
Sound Level:	**North Building Facade - Day, LAeq**
Day/night:	**Day**
Sound Level Unit:	**LAeq**

BS 8233 / BS 12354-3 - Calculation Sheet

Data used in the calculation of the sound level inside the room

Term	Description	Single figure rating and notes	Octave band centre frequency Hz					A-weighted free-field level
			125	250	500	1000	2000	
LAeq,ff	Road		65	63	61	64	60	67
$D_{n,e}$	Ventilation located away from noise sources	Dn,e,w + Ctr = 0 dB						
R_{wi}	33.2SIL (18AR) 4 Thermal	Rw + Ctr = 31 dB	22	24	35	46	55	
R_{ew}	Cavity wall (PIR)	Rw + Ctr = 46 dB	38	39	47	56	65	
R_{rr}	-	Rw + Ctr = 0 dB						
A	Absorption of room with a reverberation time of 0.5 s for a room with a volume of 168 m^3	Estimated	36	47	54	54	54	
Terms that are not frequency dependant								
Term	**Derivation**		**Value (m^2)**					
S_f	Façade area (including window)		10.6					
S_r	Roof area (exposed side)		0.0					
S_{wi}	Window area		3.2					
S_{ew}	S_f - S_{wi}		7.4					
S_{rr}	Area of ceiling (only if exposed)		0.0					
S	S_f + S_{rr}		10.6					
A_0	Given in BS EN 20140-2		10					
Note: The expected precision of this calculation is +/- 2 dB								

The calculation

Term from equation (1)	Reverence letter of result	Octave band centre frequency Hz				
		125	250	500	1000	2000
LAeq,ff	A	65	63	61	64	60
$D_{n,e}$						
(A_0/S) x 10^(-$D_{n,e}$/10)	B					
A-weighted level contribution from B						
R_{wi}		21.9	24	35.2	46.4	54.6
(S_{wi}/S) x 10^(-R_{wi}/10)	C	0.001 95	0.001 20	0.000 09	0.000 01	0.000 00
A-weighted level contribution from C		**19**	**22**	**14**	**8**	**-3**
R_{ew}		38	39	47	56	65
(S_{ew}/S) x 10^(-R_{ew}/10)	D	0.000 11	0.000 09	0.000 01	0.000 00	0.000 00
A-weighted level contribution from D		**7**	**10**	**5**	**2**	**-9**
R_{rr}						
(S_{rr}/S) x 10^(-R_{rr}/10)	E					
A-weighted level contribution from E						
10 x log (B + C + D + E)	F	-26.9	-28.9	-39.8	-50.6	-59.0
A (*furnished*)		36	47	54	54	54
10 x log(S/A)	G	-5.3	-6.5	-7.1	-7.1	-7.1
LAeq,2	A + F + G + 3	**35.5**	**30.5**	**17.5**	**9.1**	**-3.0**
A-weighting dB		-16	-9	-3	0	1
LAeq,2 + A-weighting	LAeq,125 etc.	**19.4**	**21.9**	**14.3**	**9.1**	**-1.8**

$L_{Aeq,2}$ is obtained by combining these values by logarithmic addition

A-weighted level in the room LAeq,2 is	**24.4 dB**
Internal noise levels meet guidelines.	

Author: Daniel Goodhand

Project No:	**3291**
Client:	**Mark Kamis**
Site:	**44 Brighton Road, Lancing**
Room:	**Bedroom 1**
Room Description:	**Overlooking Brighton Road**
Sound Level:	**North Building Facade - Day, LAeq**
Day/night:	**Day**
Sound Level Unit:	**LAeq**

BS 8233 / BS 12354-3 - Calculation Sheet

Data used in the calculation of the sound level inside the room

Term	Description	Single figure rating and notes	Octave band centre frequency Hz					A-weighted free-field level
			125	250	500	1000	2000	
LAeq,ff	Road		65	63	61	64	60	67
$D_{n,e}$	sources	Dn,e,w + Ctr = 0 dB						
R_{wi}	33.2SIL (18AR) 4 Thermal	Rw + Ctr = 31 dB	22	24	35	46	55	
R_{ew}	Cavity wall (PIR)	Rw + Ctr = 46 dB	38	39	47	56	65	
R_{rr}	Tiled roof	Rw + Ctr = 49 dB	38	45	51	54	54	
A	Absorption of room with a reverberation time of 0.5 s for a room with a volume of 44 m^3	Estimated	9	12	14	14	14	

Terms that are not frequency dependant

Term	Derivation	Value (m^2)
S_f	Façade area (including window)	1.7
S_r	Roof area (exposed side)	44.0
S_{wi}	Window area	1.7
S_{ew}	$S_f - S_{wi}$	0.0
S_{rr}	Area of ceiling (only if exposed)	44.0
S	$S_f + S_{rr}$	45.7
A_0	Given in BS EN 20140-2	10

Note: The expected precision of this calculation is +/- 2 dB

The calculation

Term from equation (1)	Reverence letter of result	Octave band centre frequency Hz				
		125	250	500	1000	2000
LAeq,ff	A	65	63	61	64	60
$D_{n,e}$						
$(A_0/S) \times 10^{(-D_{n,e}/10)}$	B					
A-weighted level contribution from B						
R_{wi}		21.9	24	35.2	46.4	54.6
$(S_{wi}/S) \times 10^{(-R_{wi}/10)}$	C	0.000 24	0.000 15	0.000 01	0.000 00	0.000 00
A-weighted level contribution from C		**22**	**25**	**17**	**11**	**0**
R_{ew}		38	39	47	56	65
$(S_{ew}/S) \times 10^{(-R_{ew}/10)}$	D					
A-weighted level contribution from D						
10 x log (B + C + D + E)	F	-34.1	-37.5	-47.3	-53.3	-54.0
A (*furnished*)		9	12	14	14	14
10 x log(S/A)	G	6.8	5.7	5.1	5.1	5.1
LAeq,2	A + F + G + 3	**40.5**	**34.0**	**22.1**	**18.5**	**14.1**
A-weighting dB		-16	-9	-3	0	1
LAeq,2 + A-weighting	LAeq,125 etc.	**24.4**	**25.4**	**18.9**	**18.5**	**15.3**

$L_{Aeq,2}$ is obtained by combining these values by logarithmic addition

A-weighted level in the room LAeq,2 is	**29.1 dB**
Internal noise levels meet guidelines.	

Author: Daniel Goodhand
Checked:

Project No:	**3291**
Client:	**Mark Kamis**
Site:	**44 Brighton Road, Lancing**
Room:	**Bedroom 1**
Room Description:	**Overlooking Brighton Road**
Sound Level:	**North Building Facade - Night, LAeq**
Day/night:	**Night**
Sound Level Unit:	**LAeq**

BS 8233 / BS 12354-3 - Calculation Sheet

Data used in the calculation of the sound level inside the room

Term	Description	Single figure rating and notes	Octave band centre frequency Hz					A-weighted free-field level
			125	250	500	1000	2000	
LAeq,ff	Road		57	57	55	58	54	61
$D_{n,e}$	sources	Dn,e,w + Ctr = 0 dB						
R_{wi}	33.2SIL (18AR) 4 Thermal	Rw + Ctr = 31 dB	22	24	35	46	55	
R_{ew}	Cavity wall (PIR)	Rw + Ctr = 46 dB	38	39	47	56	65	
R_{rr}	Tiled roof	Rw + Ctr = 49 dB	38	45	51	54	54	
A	Absorption of room with a reverberation time of 0.5 s for a room with a volume of 44 m^3	Estimated	9	12	14	14	14	

Terms that are not frequency dependant

Term	Derivation	Value (m^2)
S_f	Façade area (including window)	1.7
S_r	Roof area (exposed side)	44.0
S_{wi}	Window area	1.7
S_{ew}	$S_f - S_{wi}$	0.0
S_{rr}	Area of ceiling (only if exposed)	44.0
S	$S_f + S_{rr}$	45.7
A_0	Given in BS EN 20140-2	10

Note: The expected precision of this calculation is +/- 2 dB

The calculation

Term from equation (1)	Reverence letter of result	Octave band centre frequency Hz				
		125	250	500	1000	2000
LAeq,ff	A	57	57	55	58	54
$D_{n,e}$						
$(A_0/S) \times 10^{(-D_{n,e}/10)}$	B					
A-weighted level contribution from B						
R_{wi}		21.9	24	35.2	46.4	54.6
$(S_{wi}/S) \times 10^{(-R_{wi}/10)}$	C	0.000 24	0.000 15	0.000 01	0.000 00	0.000 00
A-weighted level contribution from C		**15**	**18**	**10**	**5**	**-6**
R_{ew}		38	39	47	56	65
$(S_{ew}/S) \times 10^{(-R_{ew}/10)}$	D					
A-weighted level contribution from D						
10 x log (B + C + D + E)	F	-34.1	-37.5	-47.3	-53.3	-54.0
A (*furnished*)		9	12	14	14	14
10 x log(S/A)	G	6.8	5.7	5.1	5.1	5.1
LAeq,2	A + F + G + 3	**33.1**	**27.8**	**15.9**	**12.7**	**8.1**
A-weighting dB		-16	-9	-3	0	1
LAeq,2 + A-weighting	LAeq,125 etc.	**17.0**	**19.2**	**12.7**	**12.7**	**9.3**

$L_{Aeq,2}$ is obtained by combining these values by logarithmic addition

A-weighted level in the room LAeq,2 is	**22.5 dB**
Internal noise levels meet guidelines.	

Author: Daniel Goodhand
Checked:

Project No:	**3291**
Client:	**Mark Kamis**
Site:	**44 Brighton Road, Lancing**
Room:	**Bedroom 1**
Room Description:	**Overlooking Brighton Road**
Sound Level:	**North Building Facade - Night, LAmax**
Day/night:	**Night**
Sound Level Unit:	**LAmax**

BS 8233 / BS 12354-3 - Calculation Sheet

Data used in the calculation of the sound level inside the room

Term	Description	Single figure rating and notes	Octave band centre frequency Hz					A-weighted free-field level
			125	250	500	1000	2000	
LAmax,ff	Road		76	76	75	77	73	80
$D_{n,e}$	Ventilation located away from noise sources	Dn,e,w + Ctr = 0 dB						
R_{wi}	33.2SIL (18AR) 4 Thermal	Rw + Ctr = 31 dB	22	24	35	46	55	
R_{ew}	Cavity wall (PIR)	Rw + Ctr = 46 dB	38	39	47	56	65	
R_{rr}	Tiled roof	Rw + Ctr = 49 dB	38	45	51	54	54	
A	Absorption of room with a reverberation time of 0.5 s for a room with a volume of 44 m^3	Estimated	9	12	14	14	14	

Terms that are not frequency dependant

Term	Derivation	Value (m^2)
S_f	Façade area (including window)	1.7
S_r	Roof area (exposed side)	44.0
S_{wi}	Window area	1.7
S_{ew}	S_f - S_{wi}	0.0
S_{rr}	Area of ceiling (only if exposed)	44.0
S	S_f + S_{rr}	45.7
A_0	Given in BS EN 20140-2	10

Note: The expected precision of this calculation is +/- 2 dB

The calculation

Term from equation (1)	Reverence letter of result	Octave band centre frequency Hz				
		125	250	500	1000	2000
LAmax,ff	A	76	76	75	77	73
$D_{n,e}$						
(A_0/S) x 10^(-$D_{n,e}$/10)	B					
A-weighted level contribution from B						
R_{wi}		21.9	24	35.2	46.4	54.6
(S_{wi}/S) x 10^(-R_{wi}/10)	C	0.000 24	0.000 15	0.000 01	0.000 00	0.000 00
A-weighted level contribution from C		**33**	**38**	**31**	**25**	**13**
R_{ew}		38	39	47	56	65
(S_{ew}/S) x 10^(-R_{ew}/10)	D					
A-weighted level contribution from D						
10 x log (B + C + D + E)	F	-34.1	-37.5	-47.3	-53.3	-54.0
A (*furnished*)		9	12	14	14	14
10 x log(S/A)	G	6.8	5.7	5.1	5.1	5.1
LAmax,2	A + F + G + 3	**51.4**	**47.2**	**36.2**	**32.0**	**26.7**
A-weighting dB		-16	-9	-3	0	1
LAmax,2 + A-weighting	LAmax,125 etc.	**35.3**	**38.6**	**33.0**	**32.0**	**27.9**

$L_{Aeq,2}$ is obtained by combining these values by logarithmic addition

A-weighted level in the room LAmax,2 is 41.7 dB
Individual noise events within ProPG guideline values.

Author: Daniel Goodhand
Checked:

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