

Acoustic Associates Sussex Ltd

Discharge of Planning Condition

Site: 1 Spencer Street, Bognor Regis, PO21 1AP

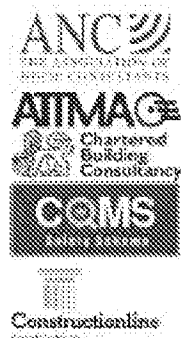
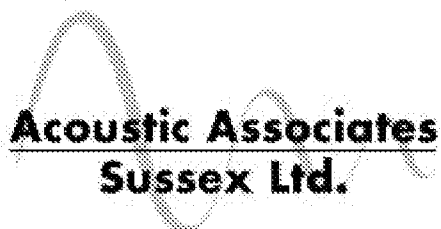
Client : Hurston Estates (NE) Limited

Report by: David Kendal BA (Hons), Tech IOA

Date: 29/03/2022

Project: J3370

Issue 1



Sound Insulation Testing - Acoustic Design of Buildings - BS4142 - PPQ24 - Schools Acoustics BS693 -
Vibration - Expert Witness Testimony - Noise at Work - Air Tightness Testing - Auditorium Acoustics

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Checked by: George Orton BEng (Hons) MIOA

Issue 1	29/03/2022	Original Issue
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1 Introduction and Executive Summary

Acoustic Associates have been appointed to undertake an acoustic assessment to support a discharge of condition for the client. A two-storey office has been granted planning permission by Arun District Council to create two studio flats, on the ground and first floor respectively. An assessment is therefore required of the soundscape to protect the future occupants.

Standards and guidance referenced for this assessment include:

- BS8233 (Sound insulation and noise reduction for buildings) 2014
- ISO9613 (Attenuation of sound during propagation outdoors) 1996

A sound survey was carried out between Thursday 3rd to Wednesday 9th March 2022 using a long-term class 1 sound level meter. The sound level meter was protruded at first floor level out of the window due to a lack of any secure positions externally and measured an arithmetic average of 53dB $L_{Aeq, 16 \text{ hour}}$ for the daytime and 46dB $L_{Aeq, 8 \text{ hour}}$ for the night time period.

A computer noise model was generated to replicate 1 Spencer Street and calibrated based on the measured noise levels. The noise model then predicted freefield external sound pressure levels for windows on different facades. The levels predicted for the day and night-time periods have been assessed in terms of Table 4 BS8233:2014 values as per the requirements of condition 3 of BR/277/21/PL.

BS8233:2014 Rigorous Calculations were then carried out to assess the performance of the new glazing proposed for the studio flats. The rigorous calculations which considered the ratio of glazing to façade determined that standard thermal double glazing will be sufficient and it is recommended that passive through the wall vents be installed to ensure that sufficient air changes are achieved.

- New glazing to achieve a minimum of $R_w+C_{tr}=25\text{dB}$ (R_w+C_{tr} can also be stated as $R_{traffic}$)
- Acoustic vents to achieve a minimum of $D_{n,E,w}=42\text{dB}$

The report has therefore identified a suitable scheme of works to protect future occupants from external sound sources allowing the local planning authority to discharge condition 3 of BR/277/21/PL.

2 Context, Noise Criteria & Noise Assessment Methodology

2.1 Context

A planning application has been approved for a change of use in order to convert the existing office space (ground and first floors) into two self-contained flats (ground and first floor). This requires consideration of how traffic and other contributing sound sources might impact the proposed development. The office is situated on Spencer Street (PO21 1AP), which runs parallel to Bognor Regis train station. It is understood from the client that there is an intention to replace the existing windows.

The condition referenced in decision notice from Arun District Council relating to the soundscape and acoustics is as follows;

“3. Prior to commencement the applicant shall provide the local planning authority with a scheme to demonstrate that the internal sound pressure levels inside the flats achieve Table 4 conditions laid down in BS8233:2014. The approved measures shall be implemented during construction and thereafter be maintained in accordance with the approved details”.

2.2 Location and Plans

The location of the existing office is seen in Figure 1 below with the consented floorplans detailed in Figure 2. The two dwellings have kitchen and bathroom areas with the living area having a dual façade, i.e., windows to the front and side. The front north-western façade of the first floor currently has no windows, however a three-pane window is to be introduced. Similarly, the ground floor façade will be upgraded with an increased window area. There are currently no windows being added to the northeast elevation as indicated in the current plans.

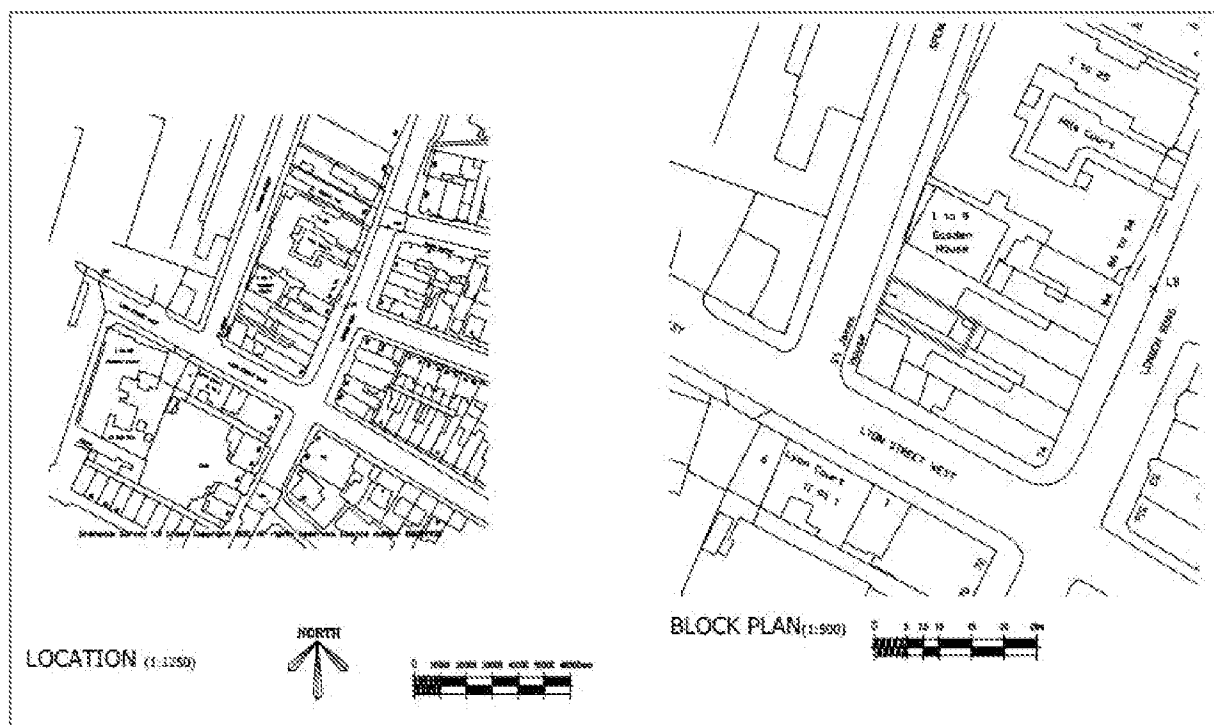


Figure 1. Location of proposed development



Figure 2. Elevations of consented dwellings

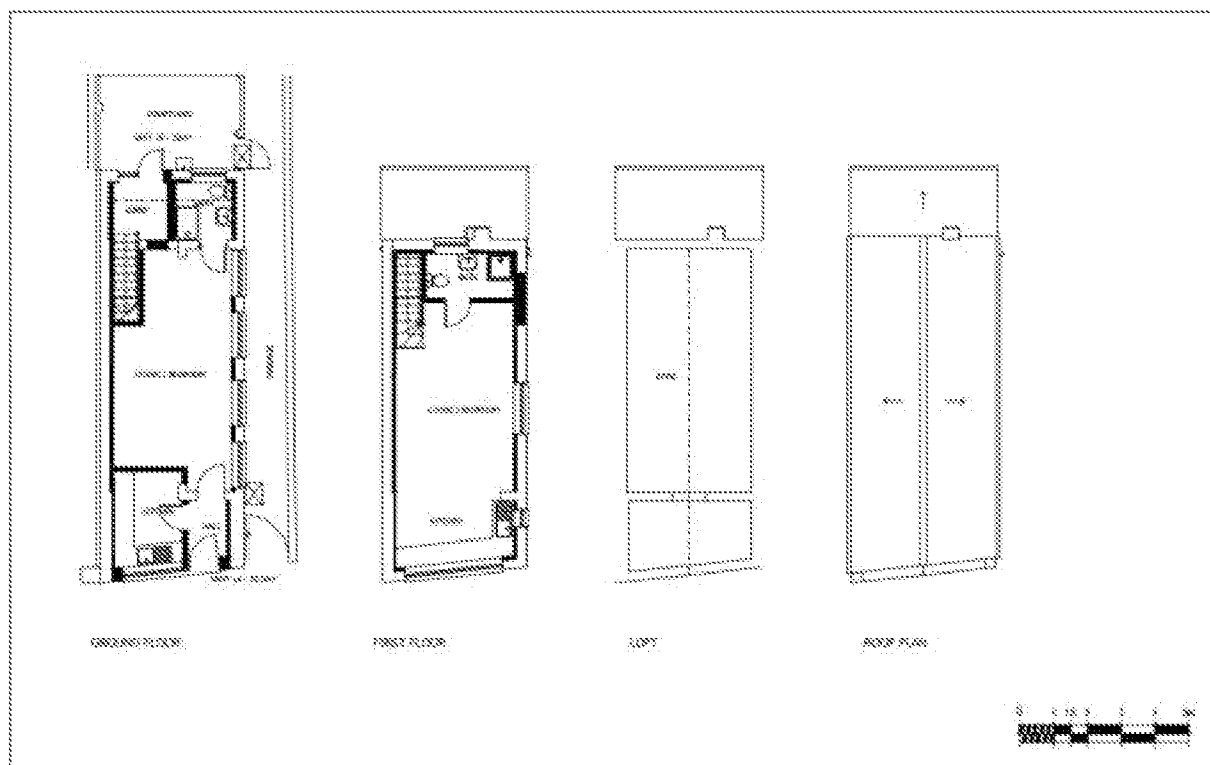


Figure 3. Floor plan of consented dwellings

2.3 Relevant Assessment Criteria

The relevant assessment criterion used is BS8233:2014. Table 4 values presented below reflects conditions for continuous and anonymous sound sources.

Activity	Location	Time period of day	
		07:00-23:00	23:00-07:00
Resting	Living Rooms	35dB $L_{Aeq,16hour}$	-
Dining	Dining Room/Area	40dB $L_{Aeq,16hour}$	-
Sleeping (daytime resting)	Bedroom	35dB $L_{Aeq,16hour}$	30dB $L_{Aeq,8hour}$

Table 1. BS8233:2014 Table 4 Criteria

2.4 Methodology and Approach

To ensure that sufficient information is presented to the client, the following approach has been applied:

1. Measure sound pressure levels as close to the front of the property as possible to determine the impact of noise produced by traffic generated by the nearby road.
2. Construct a computer noise model to calibrate and predict the likely sound pressure levels around the consented property.
3. Carry out a rigorous calculation to determine the level of performance needed to attenuate road traffic noise for a living space.

3 Sound Survey Baseline Conditions & Results

A sound survey was carried out between the 3rd of March 2022 and 10th March 2022 to assess ambient sound pressure levels as close as possible to Spencer Street. The time period selected was the first complete 3 days and 4 nights. Due to the survey location measuring sound pressure levels in façade conditions, 3dB has been subtracted to ensure calculations were representative of free field conditions.

3.1 Sound Survey Details

Survey(s) carried out by	David Kendal BA (Hons), Tech IOA
Equipment Used	01dB SIP95 – Serial No. 10492 Norsonic Sound Calibrator type 1251 S/N 30974
Location	4.2m above ground level
Duration	3 rd March 2022 to 9 th March 2022

Table 2. Survey equipment with specifications

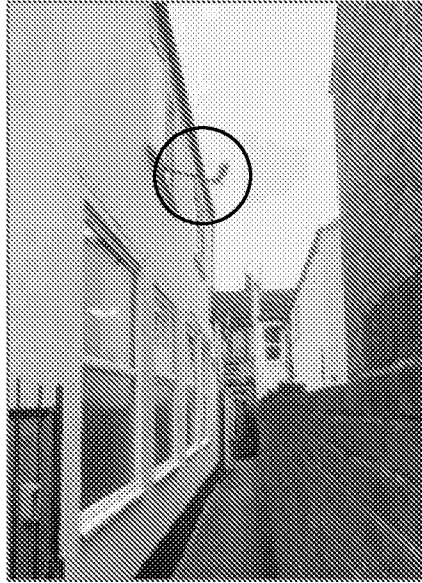


Figure 4. Survey Equipment

The sound level meter was calibrated to 114dB at 1000Hz before and after commencing the noise measurements with no drift. All measurements were taken with the time base set to record 1-minute intervals and used a fast time weighting. All measurements were taken with the microphone located in facade conditions at the southwestern façade of 1 Spencer Street. The microphone was positioned 0.85m outside of the closest window to the road. The window was selected due to the fact that it was the closest openable window to Spencer Street.

3.2 Measured External Sound Pressure Levels

Table 3 below details the daytime and night time sound pressure levels measured at the external survey location. As stated, these have been converted to freefield conditions.

Logarithmically Averaged Day and Night Periods (External-Freefield) dB(A)			
L _{Aeq,16hour} (07:00-23:00)		L _{Aeq,8hour} (23:00-07:00)	
Day 1	53.4	Night 1	45.6
Day 2	55.6	Night 2	44.6
Day 3	50.6	Night 2	46.6
-	-	Night 4	47.4
Arithmetic Average	53.2dB	Arithmetic Average	46.0 dB

Table 3. Measured Sound Pressure Levels

4 Noise Modelling Software

In order to see how noise varies at different positions around the proposed development it is possible to produce a noise contour map.

A computer noise model has been completed using the computer package IMMI. The survey data and drawings of the consented development have been used to complete the noise models. IMMI faithfully implements the propagation method of ISO-9613:1996; Acoustics – Attenuation of sound during propagation outdoors [2]. A survey reception point was added (in the same location as the survey microphone) to allow the calibration of the noise sources (road traffic noise from Spencer Street and Lyon Street).

Consented drawings from the client were used to construct 1 Spencer Street at the relevant building heights etc. Reception points were added into the model at different heights representative of where the windows will be located. The noise model can be seen below with labelled receptor points. The model introduces a line source creating representative sound pressure levels measured at the survey reception point. The survey position is noted in the model as 'Survey and 1st Side'. As can be seen the predicted sound pressure levels at this reception point match the arithmetic average of the day and night time survey results shown in Table 3.

The noise model is beneficial in being able to predict freefield A weighted dB(A) sound pressure levels around the consented property, from which the sound reduction index and rigorous calculations may be derived. The results box also presents both the daytime and night time sound pressure levels at the relevant receptor positions.

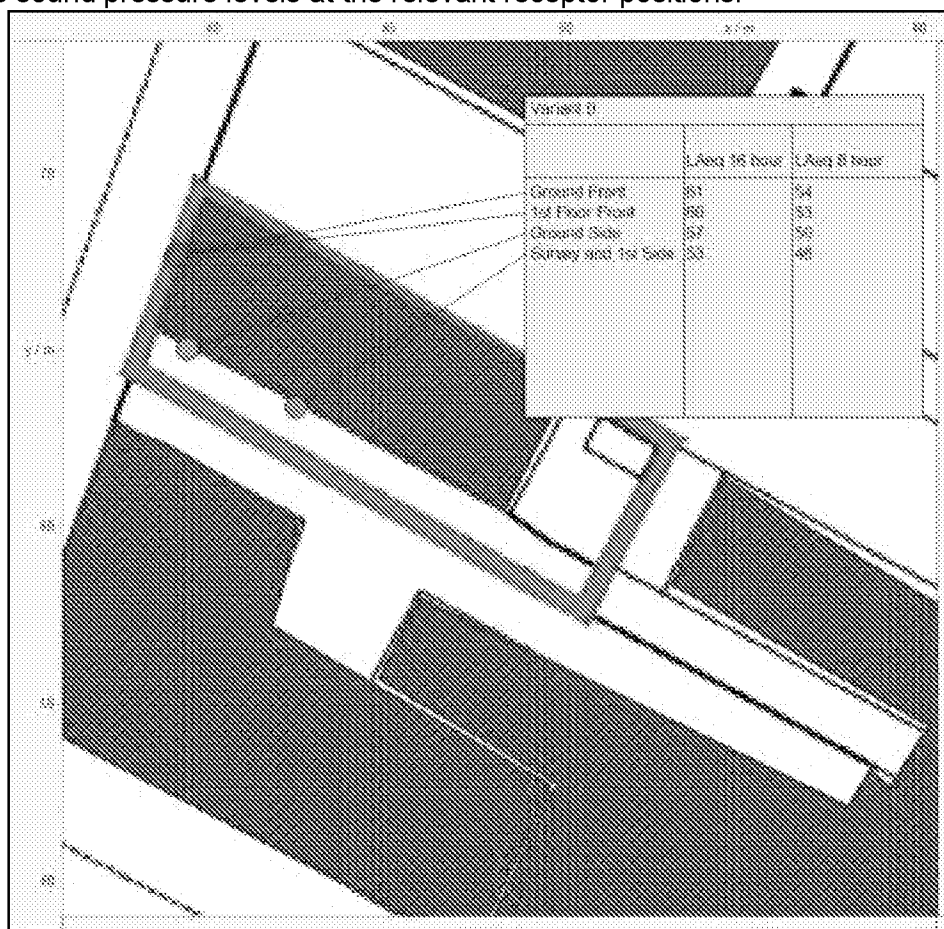


Figure 5. IMMI model prediction of free field levels at the façade

5 Assessment of Opening Windows

An assessment may be made to determine if windows are capable of being opened to provide ventilation for the future occupants. The assessment uses the industry standard of 13dB for the attenuation of sound energy passing through a partially open window from a freefield source to an internal space. As can be seen in Table 4 below, if windows are opened, the Table 4 criteria within BS8233:2014 will be exceeded and occupants may not rely on open windows for background ventilation. An alternative form of ventilation is therefore required.

Assessment of Open Windows				
Location	Day - L _{Aeq,16 hour}	Daytime Open Window	Night- L _{Aeq, 8 hour}	Night Time Open Window
Front				
Ground Floor	61	48	54	41
First Floor	60	47	53	40
Side				
Ground Floor	57	44	50	37
First Floor	53	40	46	33
All predictions are in dB(A)				

Table 4. Assessment of Windows Being Opened.

Residents do however retain the freedom to open windows at will and there are no restrictions placed on purge ventilation, where for example windows might be opened to air burnt toast odours or painting fumes, albeit these are typically shorter periods.

5 Required Sound Reduction Index (SRI)

The Sound Reduction Index or SRI, is the level of attenuation of sound energy required to achieve the required criteria stated in the planning condition reference.

The BS8233:2014 noise criteria will be used to specify the noise mitigation measures for all habitable rooms. The maximum internal noise level for each area is as follows:

- Bedrooms 30dBA L_{Aeq, 8 hour}
- Bedroom 35dB L_{Aeq, 16 hour}
- Lounges 35dBA L_{Aeq, 16 hour}
- Kitchens 40dBA L_{Aeq, 16 hour}

In this case, the main living areas are studio flats so act as bedrooms and lounges. As the daytime noise level is 6dB higher than the night-time levels, if the daytime criteria are achieved, by default the night-time criterion will also be achieved. The required sound reduction for each room has been detailed below:

Room	Floor	Ext Level Day	Required Sound Reduction
Ground Floor Flat Kitchen	Ground	61	21
Ground Floor Living Area	Ground	57	22
First Floor Living Area	First	60	25

Table 5. Predicted Sound Reduction Index Required for each room

Whilst the SRI is a simplistic assessment of the reduction needed in terms of sound pressure levels from outside to inside, a rigorous calculation may be carried out which determines the same, but pays attention to the ratio of glazed areas in the façade and any ventilation mechanisms to assess the likely sound energy which will enter the room space.

5.1 Rigorous Calculations

Using the predicted free field sound pressure levels from Table 5 above, it is possible to use a rigorous calculation as per G.2 of BS8233:2014 ^[3]. The calculation takes into account how the glazing size and façade size, and any other transmission routes such as through ceilings or ventilation grills to identify the likely internal sound pressure levels. Whilst Table 6 below is a summary, the worked examples are detailed in the Appendix.

Pilkington Standard thermal double glazing of 4/12/4 has been used in the assessment, albeit the R_{traffic} rating of the required glazing will be provided to the client to allow comparisons between other glazing providers. It is essential that only the R_{traffic} metric is used to compare glazing specifications as this ensures a like for like comparison.

In presenting the rigorous calculations, it is noted that the kitchen at the ground floor studio flat is in fact separate from the lounge/living space, although this is not the case for the first-floor studio flat. For the latter, the glazed areas have been summed and compared against the worst-case façade of 60dB $L_{\text{Aeq, 16 hour}}$.

Spectral noise levels were predicted based on the overall sound pressure level predicted by the noise model and based on the C_{tr} traffic noise curve in ISO document 717-1 ^[4], due to the main sound source being road traffic along Spencer Street and Lyon Street. The rigorous calculation method was taken from British Standard Publication 8233 ^[5].

Given the combined living and bedroom area for the first floor, a larger freespace vent has been applied (Titon, 9800mm²). This is a through the wall passive acoustic ventilator. Through the wall ventilators were also applied for the ground floor kitchen and separate living/bedroom areas.

As can be seen in Table 6 below, with standard thermal double glazing and through the wall acoustic ventilators, the highest sound reduction index (25dB) has been exceeded, with all internal sound pressure levels predicted to be below 35dB $L_{\text{Aeq, 16 hour}}$. It follows that if the daytime sound pressure levels achieve the Table 4 BS8233:2014 values, then the night time values are also achieved by virtue that they are approximately 6dB lower.

The client's M+E consultant should be asked to review the assumptions made and consider if the proposed ventilators provide the required air changes for the properties. It should be noted that the final ventilation solution decided upon by the client must achieve the required SRI detailed in the report.

Façade	Room	Glazing	Ventilation	Predicted Sound Pressure Level Outside*	Predicted Internal Sound Pressure Level (dBA)	Predicted Sound Reduction Index (SRI)
Front	Ground Floor Flat Kitchen	4-12-4	Titon - 9800mm ²	61	32	29
Front	Ground Floor Living Area	4-12-4	Titon - 9800mm ²	57	31	26
Front	First Floor Living Area	4-12-4	Titon - 9800mm ²	60	32	28

Table 6. Rigorous calculation summary using 4/12/4 glazing and passive through wall ventilators.

5.1 Recommendations

Recommendations are based upon the minimum specification needed for attenuation of road traffic noise. The client reserves the right to select any other manufacturers products with like for like or improved performance.

To achieve the planning application criteria the performance for new windows and associated ventilators will be as follows:

- New glazing to achieve a minimum of $R_w+C_{tr}=25\text{dB}$ (R_w+C_{tr} may also be stated as $R_{traffic}$)
- Trickle vents to achieve a minimum of $D_{n,E,w}=42\text{dB}$

6 Uncertainty

Measures have been taken to minimise uncertainty in the data collection and report writing process. These are as follows:

- The sound level meter used was calibrated on site at both the site set up as well as the decommissioning of the equipment to ensure that it was operating as intended. No significant drift was noted.
- The data collected from the survey spanned over three days and four nights.

7 Conclusion

Acoustic Associates have been appointed to undertake an acoustic assessment to assist with the discharge of a planning condition imposed on a decision notice for 1 Spencer Street, Bognor Regis. The planning allows for a change of use from offices to two studio flats located at ground and first floors.

A sound survey was carried out between Thursday 3rd to Wednesday 9th March 2022 using a long-term class 1 sound level meter. The sound level meter was protruded at first floor level out of the window due to a lack of any secure positions externally and measured an arithmetic average of 53dB $L_{Aeq, 16 \text{ hour}}$ for the daytime and 46dB $L_{Aeq, 8 \text{ hour}}$ for the night time period.

A computer noise model was generated to replicate 1 Spencer Street and calibrated based on the measured noise levels. The noise model then predicted freefield external sound pressure levels for windows on different facades. The levels predicted for the day and night-time periods have been assessed in terms of Table 4 BS8233:2014 values as per the requirements of condition 3 of BR/277/21/PL.

BS8233:2014 Rigorous Calculations were then carried out to assess the performance of the new glazing proposed for the studio flats. The rigorous calculations which considered the ratio of glazing to façade determined that standard thermal double glazing will be sufficient and it is recommended that passive through the wall vents be installed to ensure that sufficient air changes are achieved.

- New glazing to achieve a minimum of $R_w+C_{tr}=25\text{dB}$ (R_w+C_{tr} can also be stated as $R_{traffic}$)
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The report has therefore identified a suitable scheme of works to protect future occupants from external sound sources allowing the local planning authority to discharge condition 3 of BR/277/21/PL.

8 Appendix A – BS8233 Rigorous Calculations

The key for Tables 1,2 and 3 is as follows.

R_{wi} Sound Reduction of Window (Octave)

R_{ew} Sound Reduction Index of External Wall (Octave)

R_{rr} Sound Reduction Index of Roof/Ceiling (Octave)

A Equivalent Absorption Area of R_x Room

$D_{n,e}$ Insulation of Trickle Vent (BS EN 20140-10)

The calculation for the A-weighted level inside of a room at each frequency band is as follows.

$$L_{eq,2} \approx L_{eq,ff} + 10 \log_{10} \left(\frac{A_0}{S} 10^{\frac{-D_{n,e}}{10}} + \frac{S_{wi}}{S} 10^{\frac{-R_{wi}}{10}} + \frac{S_{ew}}{S} 10^{\frac{-R_{ew}}{10}} + \frac{S_{rr}}{S} 10^{\frac{-R_{rr}}{10}} \right) + 10 \log_{10} \left(\frac{S}{A} \right) + 3$$

8.1 Ground Floor Kitchen

Non-Frequency Dependent Variables		
Term	Derivation	Area
A_o	Given in BS EN 20140-10 = 10	10 m ²
S_f	Total Facade Area	12.42
S_{wi}	Window Area	4.5 m ²
S_{ew}	External Wall Area	7.92 m ²
S	Total Area sound enters the room	12.421 m ²

Frequency Dependent Variables		Octave Band Centre Frequency					
Term	Description	125	250	500	1000	2000	4000
$L_{eq,ff}$	Free-Field External Noise Level	63	59	57	57	54	47
$D_{n,e}$	Titon 9800mm ²	39	35	36	41	50	57
R_{wi}	4_12_4	24	20	25	35	38	35
R_{ew}	Cavity Masonry (Brick Cavity with Insulation lightweight block)	41	39	44	52	60	65
R_{rr}	Tiles on felt, pitched roof, 100mm mineral wool on lath and plaster ceiling	51	51	51	51	51	51
A	Equivalent Absorption Area of Room (Copied from BS8233)	11.00	14.00	16.00	16.00	15.00	15.00

A-Weighted Level Outside	61
BS8233 Predicted Internal A-Weighted Level	32
Predicted Building Envelope SRI	29

Table A1 Rigorous calculation for Ground Floor Living Area

8.2 Ground Floor Living Space

Non-Frequency Dependent Variables		
Term	Derivation	Area
A_o	Given in BS EN 20140-10 = 10	10 m ²
S_f	Total Facade Area	45.29 m ²
S_{wi}	Window Area	8.8 m ²
S_{ew}	External Wall Area	36.49 m ²
S	Total Area sound enters the room	45.289 m ²

Frequency Dependent Variables							
Term	Description	Octave Band Centre Frequency					
		125	250	500	1000	2000	4000
$L_{eq,ff}$	Free-Field External Noise Level	59	55	53	53	50	43
$D_{n,e}$	Titon-9800mm ²	39	35	36	41	50	57
R_{wi}	4_12_4	24	20	25	35	38	35
R_{ew}	Cavity Masonry (Brick Cavity with Insulation lightweight block)	41	39	44	52	60	65
R_{rr}	Tiles on felt, pitched roof, 100mm mineral wool on lath and plaster ceiling	51	51	51	51	51	51
A	Equivalent Absorption Area of Room (Copied from BS8233)	11.00	14.00	16.00	16.00	15.00	15.00

A-Weighted Level Outside	57
BS8233 Predicted Internal A-Weighted Level	31
Predicted Building Envelope SRI	26

Table A2 Ground floor living area with new glazing with trickle ventilation prediction of 24dB SRI

8.3 First Floor Living Space

Non-Frequency Dependent Variables		
Term	Derivation	Value
A _o	Given in BS EN 20140-10 = 10	10m ²
S _f	Total Facade Area	45.70m ²
S _{wi}	Window Area	5.74m ²
S _{ew}	External Wall Area	39.96m ²
S	Total Area sound enters the room	45.697m ²

Frequency Dependent Variables			Octave Band Centre Frequency				
Term	Description	125	250	500	1000	2000	4000
L _{eq,ff}	Free-Field External Noise Level	62	58	56	56	53	46
D _{n,e}	Titon (9800mm ²)	39	35	36	41	50	57
R _{wi}	4_12_4	24	20	25	35	38	35
R _{ew}	Cavity Masonry (Brick Cavity with Insulation lightweight block)	41	39	44	52	60	65
R _{ir}	Tiles on felt, pitched roof, 100mm mineral wool on lath and plaster ceiling	51	51	51	51	51	51
A	Equivalent Absorption Area of Room (Copied from BS8233)	11.00	14.00	16.00	16.00	15.00	15.00

A-Weighted Level Outside	60
BS8233 Predicted Internal A-Weighted Level	32
Predicted Building Envelope SRI	28

Table A3 Rigorous calculation for First Floor Living Area

9 References

- [1] BS 8233:2014 (2014). Table 4. Indoor ambient noise levels for dwellings. 7.7.2 Internal ambient noise levels for dwellings. *Guidance on sound insulation and noise reduction for buildings*. p.24. from BSI Standards Publication
- [2] ISO 9613-2:1996 (1996). Part 2: General Method of Calculation. *Acoustics - Attenuation of sound during propagation outdoors*. p.p.1-17. from International Standard Publication from International Standard Publication
- [3] BS 8233:2014 (2014). Calculation Methods. G.2. Typical design problem: More rigorous calculation. *Guidance on sound insulation and noise reduction for buildings*. p.65. from BSI Standards Publication
- [4] BS 717-1:2020 (2020). 4.5 Calculation of spectrum adaptation terms. 4. *Procedure for evaluating single-number quantities. Acoustics – Rating of sound insulation in buildings and building elements*. p.p.8-9. from BSI Standards Publication
- [5] BS 8233:2014 (2014). Calculation Methods. G.2. Typical design problem: More rigorous calculation. *Guidance on sound insulation and noise reduction for buildings*. p.65. from BSI Standards Publication
- [6] Pro PG Planning & Noise (2017). Stage 2: Noise Element 2 – Internal Noise Level Guidelines. *Professional Guidance on Planning & Noise – New Residential Development*. p.p.12.13. from Acoustic & Noise Consultants