Acoustic Associates Sussex Ltd

Discharge of Planning Condition.

Site: **1-3 Ham Road, Shoreham by Sea. BN43 6PA.**
Client: **Gareth Chalmers**

Report by: Scott Castle BSc (Hons) CEnvH, MCIEH PGDip: Acoustics MIOA

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Issue 1

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Issue 1	26/04/2022	

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Acoustic Associates Sussex Ltd.

1 Introduction and Executive Summary

Acoustic Associates have been appointed to undertake an acoustic assessment to support a discharge of planning condition. Specifically, a planning condition requires an assessment of the soundscape in accordance with BS8233:2014.

Standards and guidance referenced for this assessment include:

- BS8233 (Sound insulation and noise reduction for buildings) 2014

External sound pressure levels were measured between 8th to 13th April 2022 with two long term class one sound level meters at positions representative of the front and rear elevations of 1-3 Ham Road, Shoreham. The arithmetic average of the measured daytime sound pressure levels were identified as 60dB $L_{Aeq,\ 16\ hours}$ (daytime) and 51dB $L_{Aeq,8\ hours}$ (night time) for Ham Road elevation and 51dB $L_{Aeq,\ 16\ hours}$ (daytime) and 46dB $L_{Aeq,8\ hours}$ (night time) for the Rear Station Road elevation.

The noisier elevation is that of Ham Road which is consistent with passing road traffic as well as buses.

The measurement period deliberately included a weekend and was undertaken in good weather conditions suitable for environmental monitoring. Condition 3 of AWDM/2172/21 required an assessment of the soundscape against table 4 values in BS8233:2014 which has been undertaken. A scheme of glazing and ventilation has been presented which protects future occupants from the external soundscape and uses standard thermal double glazing and through wall acoustic vents which exceed the requirements of Building Regulations Approved Document F in terms of ventilation.

Sufficient detail has been presented to allow the local planning authority to discharge condition 3 of AWDM/2172/21.

2 Context, Noise Criteria & Noise Assessment Methodology

2.1 Context

Planning consent has been granted by Adur and Worthing District Council under AWDM/2172/21 for a Change of Use from Chiropractors (Use Class D1) to 1no. 3 bedroom dwelling with new rooflight also being added onto the Western roof elevation. Condition 3 of the decision notice requires as follows:

"3. 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, railway and commercial noise and an allied scheme prepared to protect the habitable rooms from excess noise in relation to British Standard BS 8233: 2014: Guidance. The approved assessment and mitigation scheme shall be implemented prior to first occupation of the dwelling and retained thereafter."

2.2 Location and Site Setting

The approved dwelling has a dual aspect with bedrooms facing Ham Road as well as the railway station to the rear. The site is detached and has alleyways either side of the dwelling. To the West of the site is an MOT garage "Perkins and Robins Garage". The garage operates 08:30 to 17:00 Monday to Friday only without any weekend working.

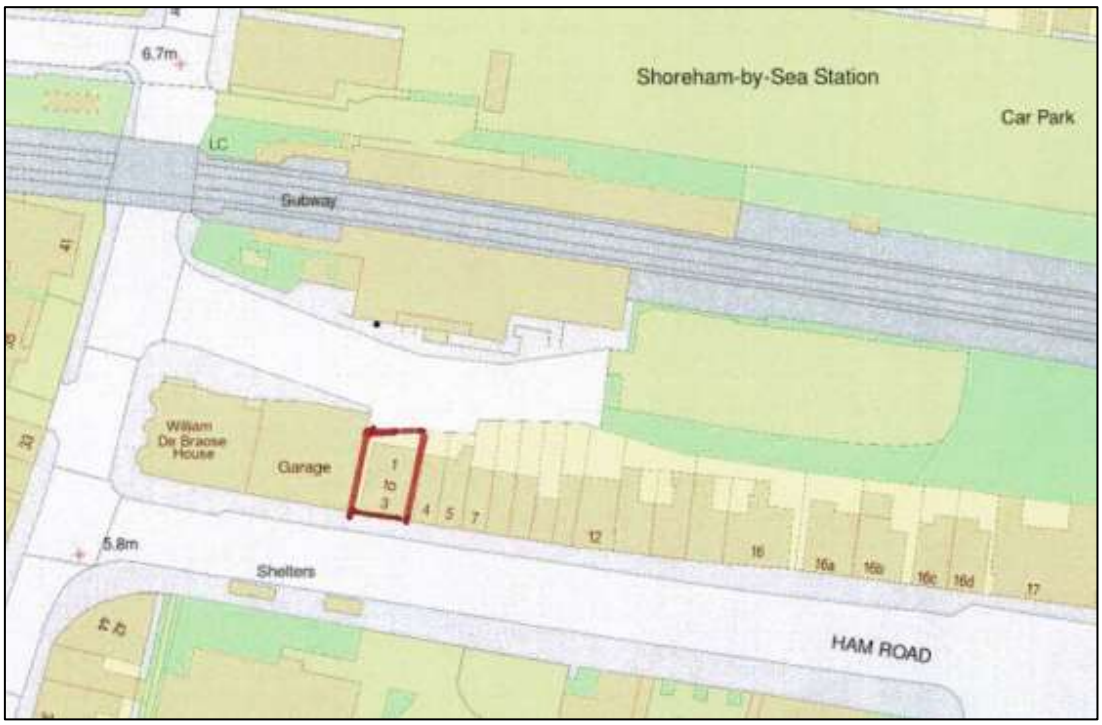

Figure 1. Site Location

2.3 Applicable Criteria

It is noted that condition 3 specifically references BS8233:2014 which is reproduced below. Table 4 of BS8233:2014 provides the following guideline values for internal sound pressure levels:

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 Criteria

2.4 Methodology and Approach

Given that bedrooms are located to the front and rear of the site, it is necessary to be able to measure and quantify the impact at both locations. Security is an additional consideration when reviewing how and where to locate sound level meters to avoid theft, tampering or vandalism.

Two class one sound level meters were placed at the rear bedroom window (on a monopole) and also towards the front of the property protruded above the side gate. Given that the front sound level meter was located just behind the front façade, an additional sound level meter was used to calculate the difference between the two meters. Both were in façade conditions and provided the adjustment necessary for the Ham Road elevation. Both sound level meters had their clocks synchronised allowing a like for like comparison.

With sound levels known at the front and rear, rigorous calculations may be undertaken to determine the appropriate glazing and/or ventilation to protect the future occupants. It will not therefore be necessary to generate a noise model.

3 Sound Survey Baseline Conditions & Results

Two class 1 sound level meters were left at the site at representative location**s**, based on consented site plans from the Adur and Worthing website. A sound survey was carried between Friday 8th April 2022 and Wednesday 13th April 2022. The duration of the survey deliberately covered a weekend to ensure that the soundscape was properly understood. The details of the locations are shown below. The rationale for two sound level meters was to understand the different soundscape with the train station located to the rear as well as Ham Road and associated traffic and bus stops located to the front. The survey positions are listed as rear (North) and front (South) for ease of reference.

3.1 Sound Survey Details

The survey details are noted in Figure 2 below with the images seen in Figure 3 below.

Survey(s) carried out by	Scott Castle BSc (Hons) Env Health, MCIEH CEnvH PGDip Acoustics MIOA
Equipment Used (Rear)	01dB Black Solo 3.5m above ground level (Unattended)-Facade
Equipment Used (Front)	Castle Svantek Mirus, 2.3m above ground level (unattended)- Facade
Equipment Used (Front)	Norsonic 118 – Tripod Mounted at 1.5m (Attended)- Facade
Equipment Used	01dB Calibrator (CAL21) – Serial Number 50241778
Duration	8th April 2022 to 13th April 2022

Figure 2. Survey Details

The sound level meters were all calibrated before and after commencing the noise measurements (@94dB with no drift). The 01dB Black Solo was on 1 second resolution and was post processed through dBTrait, whereas the Castle Svantek Mirus logged sound pressure levels at a 1 minute resolution. Both surveys were considered to be façade measurements and will be corrected to freefield measurements for the remainder of the report.



Figure 3. Locations of the Sound Level Meters

3.2 Measured External Sound Pressure Levels

Figures 4 and 6 below present the measured external sound pressure levels on a day by day basis. These are the daily logarithmic averages for the daytime and night time periods. An arithmetic average has been applied at the bottom of the table. As stated, the data has been corrected to freefield values. A correction has also been applied for the front sound level meter, as this was just short of the façade edge, as there was no secure location.

3.2.1 Rear Location

Rear -Station Road			
Logarithmically Averaged Day and Night time Periods (External - Freefield)-dB(A)			
$L_{Aeq,\ 16\ hour-\ 07:00-23:00}$		$L_{Aeq,\ 8\ hour\ 23:00-07:00}$	
Day 1	51.2	Night 1	48.4
Day 2	50.6	Night 2	45.1
Day 3	51.9	Night 3	45.2
Day 4	51.3	Night 4	45.2
Day 5	51.1	Night 5	47.7
Arithmetic Average	**51.2**	**Arithmetic Average**	**46.3**

Figure 4. Measured Sound Pressure Levels -REAR

3.2.2 Front Location

For the front location, it was noted that the only secure position was for the sound level meter to be set back slightly from the front façade and to protrude above the gate. To determine the difference in sound pressure levels, a ten-minute measurement was also taken at the façade to determine what adjustment to the data might be required. The attended and unattended position can be seen in Figure 3 above.

The clocks of the sound level meters were synchronised to ensure a like for like comparison.

For the same time period, the following sound pressure levels were noted:

Review of Ham Road Long Term vs Short Term Measurements - Both Façade Conditions				
Time From	**Time To**	**Gate- $L_{Aeq,\ 5minutes}$**	**Front Façade- $L_{Aeq,\ 5minutes}$**	**dB Difference**
08:05	08:10	56.1	61	4.9
08:10	08:15	55.5	60.1	4.6

Figure 5. Attended Vs Long Term Data

With the measurement position being closer to the road traffic sound source (ie Ham Road), the soundscape will increase by 5dB. It is however necessary to convert the measured data set which was façade into a freefield dataset with the subtraction of 3dB. The adjustment factor is therefore to add 5dB to the received sound pressure levels, but to then subtract 3, meaning in practice, an increase of 2dB for the measured dataset to ensure that sound pressure levels were representative of the front of the 1-3 Ham Road property. The following figures are therefore representative of a freefield soundscape for the Ham Road Elevation.

Front - Ham Road			
Logarithmically Averaged Day and Night time Periods (External - Freefield)-dB(A)			
$L_{Aeq, 16 hour- 07:00-23:00}$		**$L_{Aeq, 8 hour 23:00-07:00}$**	
Day 1	60.6	Night 1	52.1
Day 2	58.2	Night 2	50.6
Day 3	60.3	Night 3	50.7
Day 4	61.2	Night 4	51.2
Day 5	60.5	Night 5	51.5
Arithmetic Average	**60.1**	**Arithmetic Average**	**51.2**

Figure 6. Measured Sound Pressure Levels -FRONT

3.2.3 Side Location

It is apparent that a side dormer window (East elevation) exists at first floor and due to the location, ie oversailing the neighbours alleyway, this was not capable of being measured. A calculation may therefore be made using a 10log relationship from Ham Road to account for the 4.4m from the front façade. This would account for a 6.4dB correction from the front façade, ie front elevation is 60dB $L_{Aeq, 16 hour}$, therefore 54dB $L_{Aeq, 16 hour}$ and 45dB $L_{Aeq,8 hour}$.

4 Opening Windows

An assessment may be made to determine if windows are capable of being opened for natural ventilation for the future occupants. Figures 7 to 9 below detail $L_{Aeq,16 hour}$ and $L_{Aeq, 8 hours}$. In short, it is evident that whilst future occupants retain the freedom to open windows, the practice of doing so is likely to cause internal sound pressure levels to be above BS8233:2014 values.

Assessment of whether windows may be opened for background ventilation (FRONT-HAM ROAD)						
Location	**Description and Room (Area)**	**Highest Predicted Daytime External Sound Pressure Level ($L_{Aeq, 16\ hour}$)**	**Open Window (-13dB)**	**BS8233:2014 Daytime Criterion**	**Openable Windows (Yes/No)**	**Rigorous Calculation Required - Yes/No**
Front	Lounge (Ground Floor)	60	47	35dB $L_{Aeq,16\ hour}$	NO	YES
Front	Bedroom (First Floor)	60	47	35dB $L_{Aeq,16\ hour}$	NO	YES
Location	**Description and Room (Area)**	**Highest Predicted Night Time External Sound Pressure Level ($L_{Aeq, 16\ hour}$)**	**Open Window (-13dB)**	**BS8233:2014 Night Time Criterion**	**Openable Windows (Yes/No)**	**Rigorous Calculation Required - Yes/No**
Front	Lounge (Ground Floor)	51	38	30dB $L_{Aeq,8\ hour}$	NO	YES
Front	Bedroom (First Floor)	51	38	30dB $L_{Aeq,8\ hour}$	NO	YES

Figure 7. Assessment of Openable Windows - Ham Road (FRONT)

Assessment of whether windows may be opened for background ventilation (REAR - STATION ROAD)						
Location	**Description and Room (Area)**	**Highest Predicted Daytime External Sound Pressure Level ($L_{Aeq, 16\ hour}$)**	**Open Window (-13dB)**	**BS8233:2014 Daytime Criterion**	**Openable Windows (Yes/No)**	**Rigorous Calculation Required - Yes/No**
Rear	Kitchen (Ground Floor)	51	38	35dB $L_{Aeq,16\ hour}$	NO	YES
Rear	Bedroom (First Floor)	51	38	35dB $L_{Aeq,16\ hour}$	NO	YES
Location	**Description and Room (Area)**	**Highest Predicted Night Time External Sound Pressure Level ($L_{Aeq, 16\ hour}$)**	**Open Window (-13dB)**	**BS8233:2014 Night Time Criterion**	**Openable Windows (Yes/No)**	**Rigorous Calculation Required - Yes/No**
Rear	Kitchen (Ground Floor)	46	33	N/A	N/A	N/A
Rear	Bedroom (First Floor)	46	33	30dB $L_{Aeq,8\ hour}$	NO	YES

Figure 8. Assessment of Openable Windows - Station Road (REAR)

Assessment of whether windows may be opened for background ventilation (SIDE- STATION ROAD)						
Location	**Description and Room (Area)**	**Highest Predicted Daytime External Sound Pressure Level ($L_{Aeq, 16\ hour}$)**	**Open Window (-13dB)**	**BS8233:2014 Daytime Criterion**	**Openable Windows (Yes/No)**	**Rigorous Calculation Required - Yes/No**
Side	Bedroom (First Floor)	54	41	35dB $L_{Aeq,16\ hour}$	NO	YES
Location	**Description and Room (Area)**	**Highest Predicted Night Time External Sound Pressure Level ($L_{Aeq, 16\ hour}$)**	**Open Window (-13dB)**	**BS8233:2014 Night Time Criterion**	**Openable Windows (Yes/No)**	**Rigorous Calculation Required - Yes/No**
Side	Bedroom (First Floor)	45	32	30dB $L_{Aeq,8\ hour}$	NO	YES

Figure 9. Assessment of Openable Windows - Station Road (SIDE)

5 Required Sound Reduction Index or SRI

The required Sound Reduction Index or SRI has taken account of the worst case measured daytime and night time values within the front and rear measurement datasets and is presented in Figure 10 below.

Review of SRI Requirements for Habitable Rooms					
Room Type and Orientation	Predicted Freefield External		SRI Day	SRI Night	SRI to be Applied
	Worst Case Day	Worst Case Night			
Front (Ham Road)					
Lounge (Ground Floor)	61	52	26	22	26
Bedroom (First Floor)	61	52	26	22	26
Side (Eastern Façade)					
Bedroom (First Floor-Side)	55	46	20	16	20
Rear (Station Side)					
Kitchen (Ground Floor)	52	N/A	17	N/A	17
Bedroom (First Floor)	52	48	17	18	18
Measured Extenal Sound Pressure Levels are freefield and dB(A)					

Figure 10. SRI Requirements

It is noted that the front, ie Ham Road has the higher sound pressure levels and requires the greater degree of protection for future occupants. Whilst the Sound Reduction Index is a simplistic account of the degree of attenuation required from outside to inside, the rigorous calculation process takes this one step further and considers the ratio of glazing to façade as well as additional building components.

6 Rigorous Calculations

The BS8233 “Rigorous Calculation” has been used to predict the sound insulation provided by the building envelope (Calculation detailed in BS8233 (Annex G.2). The below calculations have been completed to demonstrate how the required SRI can be achieved. Rather than a simplistic outside to inside subtraction, a rigorous calculation calculates the ratio of the glazed area to the facades to provide a greater degree of certainty as to the internal sound pressure levels achieved and accordingly the SRI.

6.1 Rigorous Calculation Inputs

The consented room dimensions have been taken from scaled architect drawings on the Adur and Worthing planning website.

The Walls are standard brick/block cavity construction

The roof, which is entered as tiles on felt, pitched roof with 100mm of mineral wool on a plasterboard ceiling (in reality, a greater thickness of mineral wool will be provided).

6.2 Non Habitable Rooms

Window W3 provides light to a first floor landing and is capable of using standard Pilkington thermal double glazing, ie 4\12\4.

6.3 Small Rooflight

A new small rooflight measuring approximately 0.25m^2 is noted on the Western roof slope. Given the height, this is likely to be toughened or laminated glass and should not be less than the specifications shown below in Figure 11.

6.4 Rigorous Calculations Summary (Habitable Rooms)

The rigorous calculations can be seen in Appendix A, however for brevity are summarised here. It is noted that these use standard thermal double glazing (4/12/4) with through wall acoustic vents proving air flow in exceedance of the 8000mm^2 free space required by Building Regulations Approved Document F. For bedrooms a Rytons acoustic passive through the wall vent (AAC125HP) has been applied with a freespace of 8500mm^2, whereas for larger rooms, a Titon 9800mm^2 passive through the wall vent has been applied.

Summary of Rigorous Calculations							
Client Window Ref	Room Type and Orientation	Worst Case Daytime-	SRI Required	Window	Ventilator	Internal Sound Pressure Level	SRI Achieved of Building Envelope
Front (Ham Road)							
W1	Lounge (Ground Floor)	61	26	4\12\4	Titon (9800m^2)	35	27
W2	Bedroom (First Floor)	61	26	4\12\4	Rytons AAC125HP Look Ryt-8500mm^2	31	30
Side (Eastern Façade)							
W6	Bedroom (First Floor)	55	20	4\12\4	Rytons AAC125HP Look Ryt-8500mm^2	24	31
Rear (Station Side)							
W5	Kitchen (Ground Floor)	52	18	4\12\4	Titon (9800m2)	20	32
W4	Bedroom (First Floor)	52	18	4\12\4	Rytons AAC125HP Look Ryt-8500mm^2	22	31
Measured Extenal Sound Pressure Levels are freefield and dB(A)							

Figure 11. Rigorous Calculations Summary

The relatively low SRI of windows W1 on the Ham Road is accounted for by the fact that there is a significant amount of glazing to façade. Any front door selected for the W1 element must be equal to, or greater than the specification provided for the windows section.

7 Recommendations

7.1 Glazing

From the rigorous calculations carried out it is apparent that the property is capable of being constructed with standard thermal double glazing. Whilst Pilkington 4/12/4 glazing has been applied in the calculations, should alternative glazing providers be approached, it is the $R_{traffic}$ metric which must be compared to ensure a like for like comparison.

The $R_{traffic}$ for 4/12/4 glazing is 25dB(A).

7.2 Ventilation

Figures 7-9 above detail that open windows may not be entirely relied upon to provide background ventilation to the property. Whilst it is a future occupant's choice to open windows, the practice of opening the will cause the internal Table 4 values in BS8233:2014 to be exceeded.

For this reason, large passive through the wall vents have been recommended and these have been reviewed as part of the rigorous calculations. These have a large free area of 9800mm^2 in terms of air flow for larger rooms and 8500mm^2 for bedrooms. It is strongly recommended that the client discuss this with their M+E consultant to ensure compliance with Building Regulations - Approved Document F for ventilation.

For reference, the Titon vents when open have a $D_{n,ew}$ of 42dB and the Ryton Vents, 43dB $D_{n,ew.}$ It is critical when reviewing vents that the manufacturer's test data is used with the vents open and not closed.



Figure 12. Rytons Through Wall Acoustic Ventilator

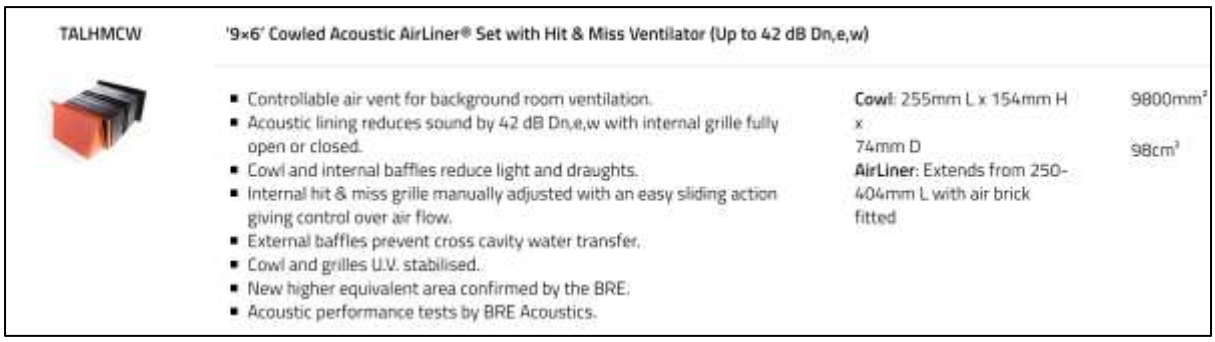

Figure 13. Titon Through The Wall Acoustic Ventilator

8 Conclusion

External sound pressure levels were measured between 8th to 13th April 2022 with two long term class one sound level meters at positions representative of the front and rear elevations of 1-3 Ham Road, Shoreham. The arithmetic average of the measured daytime sound pressure levels were identified as 60dB $L_{Aeq,\ 16\ hours}$ (daytime) and 51dB $L_{Aeq,8\ hours}$ (night time) for Ham Road elevation and 51dB $L_{Aeq,\ 16\ hours}$ (daytime) and 46dB $L_{Aeq,8\ hours}$ (night time) for the Rear Station Road elevation.

The noisier elevation is that of Ham Road which is consistent with passing road traffic as well as buses.

The measurement period deliberately included a weekend and was undertaken in good weather conditions suitable for environmental monitoring. Condition 3 of AWDM/2172/21 required an assessment of the soundscape against table 4 values in BS8233:2014 which has been undertaken. A scheme of glazing and ventilation has been presented which protects future occupants from the external soundscape and uses standard thermal double glazing and through wall acoustic vents which exceed the requirements of Building Regulations Approved Document F in terms of ventilation.

Sufficient detail has been presented to allow the local planning authority to discharge condition 3 of AWDM/2172/21.

9 Appendix A - Rigorous Calculations – Worked Examples

9.1 Ham Road – First Floor Bedroom

Non Frequency Dependent Variables		
Term	**Derivation**	**Value**
A_o	Given in BS EN 20140-10 = 10 (m^2)	10
S_f	Total Facade Area (m^2)	29.3
S_{wi}	Window Area (m^2)	2.3
S_{ew}	External Wall Area (m^2)	27.03
S_{rr}	Ceiling Area (m^2)	15.3
S	Total Area sound enters the room (m^2)	44.6

Key for Table Below	
R_{wi}	Sound Reduction of Window (Octave)
R_{ew}	Sound Reduction Index of External Wall (Octav
R_{rr}	Sound Reduction Index of Roof/Ceiling (Octav
A	Equivalent Absorbtion Area of Rx Room
$D_{n,e}$	Insulation of Trickle Vent (BS EN 20140-10)

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
$D_{n,e}$	Rytons AAC125HP Look Ryt-8500mm2	42	37	34	43	57	64
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}	Tile on Felt, Pitched Roof, 100mm mineral wool on plasterboard ceiling	43	43	43	43	43	43
A	Equivalent Absorbtion Area of Room (Copied from BS8233)	11.00	14.00	16.00	16.00	15.00	15.00

BS8233 Calculation Details						
	Octave Band Centre Frequency					
Term From Equation Below	**125**	**250**	**500**	**1000**	**2000**	**4000**
$L_{eq,ff}$	63	59	57	57	54	47
Ao/S . 10^(-Dn,e/10)	1.41E-05	4.47E-05	8.93E-05	1.12E-05	4.47E-07	8.93E-08
Swi/S . 10^(-Rwi/10)	0.000205	0.000516	0.000163	1.63E-05	8.17E-06	1.63E-05
Sew/S . 10^(-Rew/10)	4.81E-05	7.63E-05	2.41E-05	3.82E-06	6.06E-07	1.92E-07
Srr/S . 10^(-Rrr/10)	1.72E-05	1.72E-05	1.72E-05	1.72E-05	1.72E-05	1.72E-05
10log10(S/A)+3	9.079422	8.032068	7.452149	7.452149	7.732436	7.732436
Leq,2	36.62456	35.18733	29.13059	21.31513	15.95174	10.01927
A-Weighting	-16.1	-8.6	-3.2	0	1.2	1
A-Weighted Leq	**20.52456**	**26.58733**	**25.93059**	**21.31513**	**17.15174**	**11.01927**

A-Weigted Level Outside	**61**
BS8233 Predicted Internal A-Weigted Level	**31**
Prediced Building Envelope SRI	**30**

First Floor Front Bedroom- Ham Road

BS8233 Calculation can be seen below:

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

9.2 Ham Road- Ground Floor Lounge

Non Frequency Dependent Variables		
Term	Derivation	Value
A_o	Given in BS EN 20140-10 = 10 (m^2)	10
S_f	Total Facade Area (m^2)	31.4
S_{wi}	Window Area (m^2)	8.1
S_{ew}	External Wall Area (m^2)	23.3
S_{rr}	Ceiling Area (m^2)	0.0001
S	Total Area sound enters the room (m^2)	31.4

Key for Table Below	
R_{wi}	Sound Reduction of Window (Octave)
R_{ew}	Sound Reduction Index of External Wall (Octav
R_{rr}	Sound Reduction Index of Roof/Ceiling (Octave
A	Equivalent Absorbtion Area of Rx Room
$D_{n,e}$	Insulation of Trickle Vent (BS EN 20140-10)

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 (9800m2)	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}	100mm flat concrete roof (230 kg/m2)	52	52	52	52	52	52
A	Equivalent Absorbtion Area of Room (Copied from BS8233)	11.00	14.00	16.00	16.00	15.00	15.00

BS8233 Calculation Details						
	Octave Band Centre Frequency					
Term From Equation Below	125	250	500	1000	2000	4000
$L_{eq,ff}$	63	59	57	57	54	47
Ao/S . 10^(-Dn,e/10)	4.01E-05	0.000101	8E-05	2.53E-05	3.18E-06	6.35E-07
Swi/S . 10^(-Rwi/10)	0.001027	0.00258	0.000816	8.16E-05	4.09E-05	8.16E-05
Sew/S . 10^(-Rew/10)	5.89E-05	9.34E-05	2.95E-05	4.68E-06	7.42E-07	2.35E-07
Srr/S . 10^(-Rrr/10)	2.01E-11	2.01E-11	2.01E-11	2.01E-11	2.01E-11	2.01E-11
10log10(S/A)+3	7.55537	6.508016	5.928097	5.928097	6.208384	6.208384
Leq,2	41.07075	39.93868	32.59085	23.40294	16.72223	12.37002
A-Weighting	-16.1	-8.6	-3.2	0	1.2	1
A-Weighted Leq	**24.97075**	**31.33868**	**29.39085**	**23.40294**	**17.92223**	**13.37002**

A-Weigted Level Outside	**61**
BS8233 Predicted Internal A-Weigted Level	**35**
Prediced Building Envelope SRI	**27**

Lounge - Ground Floor- Front

BS8233 Calculation can be seen below:

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

9.3 Bedroom – Side Elevation (First Floor)

Non Frequency Dependent Variables		
Term	Derivation	Value
A_o	Given in BS EN 20140-10 = 10 (m^2)	10
S_f	Total Facade Area (m^2)	7.7
S_{wi}	Window Area (m^2)	2.2
S_{ew}	External Wall Area (m^2)	5.5
S_{rr}	Ceiling Area (m^2)	10.5
S	Total Area sound enters the room (m^2)	18.2

Key for Table Below	
R_{wi}	Sound Reduction of Window (Octave)
R_{ew}	Sound Reduction Index of External Wall (Octav
R_{rr}	Sound Reduction Index of Roof/Ceiling (Octav
A	Equivalent Absorbtion Area of Rx Room
$D_{n,e}$	Insulation of Trickle Vent (BS EN 20140-10)

Frequency Dependent Variables							
		Octave Band Centre Frequency					
Term	Description	125	250	500	1000	2000	4000
$L_{eq,ff}$	Free-Field External Noise Level	57	53	51	51	48	41
$D_{n,e}$	Rytons AAC125HP Look Ryt-8500mm2	42	37	34	43	57	64
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}	Tile on Felt, Pitched Roof, 100mm mineral wool on plasterboard ceiling	43	43	43	43	43	43
A	Equivalent Absorbtion Area of Room (Copied from BS8233)	11.00	14.00	16.00	16.00	15.00	15.00

BS8233 Calculation Details						
	Octave Band Centre Frequency					
Term From Equation Below	125	250	500	1000	2000	4000
$L_{eq,ff}$	57	53	51	51	48	41
Ao/S . 10^(-Dn,e/10)	3.47E-05	0.00011	0.000219	2.75E-05	1.1E-06	2.19E-07
Swi/S . 10^(-Rwi/10)	0.000481	0.001209	0.000382	3.82E-05	1.92E-05	3.82E-05
Sew/S . 10^(-Rew/10)	2.4E-05	3.8E-05	1.2E-05	1.91E-06	3.02E-07	9.56E-08
Srr/S . 10^(-Rrr/10)	2.89E-05	2.89E-05	2.89E-05	2.89E-05	2.89E-05	2.89E-05
10log10(S/A)+3	5.186787	4.139434	3.559514	3.559514	3.839801	3.839801
Leq,2	29.7365	28.55512	22.63445	14.40859	8.783325	3.129897
A-Weighting	-16.1	-8.6	-3.2	0	1.2	1
A-Weighted Leq	**13.6365**	**19.95512**	**19.43445**	**14.40859**	**9.983325**	**4.129897**

A-Weigted Level Outside	**55**
BS8233 Predicted Internal A-Weigted Level	**24**
Prediced Building Envelope SRI	**31**

First Floor SIDE Bedroom

BS8233 Calculation can be seen below:

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

9.4 Rear Kitchen – Ground Floor

Non Frequency Dependent Variables		
Term	Derivation	Value
A_o	Given in BS EN 20140-10 = 10 (m^2)	10
S_f	Total Facade Area (m^2)	24
S_{wi}	Window Area (m^2)	1.44
S_{ew}	External Wall Area (m^2)	22.6
S_{rr}	Ceiling Area (m^2)	0.00001
S	Total Area sound enters the room (m^2)	24

Key for Table Below	
R_{wi}	Sound Reduction of Window (Octave)
R_{ew}	Sound Reduction Index of External Wall (Octav
R_{rr}	Sound Reduction Index of Roof/Ceiling (Octave
A	Equivalent Absorbtion Area of Rx Room
$D_{n,e}$	Insulation of Trickle Vent (BS EN 20140-10)

Frequency Dependent Variables							
		Octave Band Centre Frequency					
Term	Description	125	250	500	1000	2000	4000
$L_{eq,ff}$	Free-Field External Noise Level	54	50	48	48	45	38
$D_{n,e}$	Titon (9800m2)	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}	No Roof	100	100	100	100	100	100
A	Equivalent Absorbtion Area of Room (Copied from BS8233)	11.00	14.00	16.00	16.00	15.00	15.00

BS8233 Calculation Details						
	Octave Band Centre Frequency					
Term From Equation Below	125	250	500	1000	2000	4000
$L_{eq,ff}$	54	50	48	48	45	38
Ao/S . 10^(-Dn,e/10)	5.25E-05	0.000132	0.000105	3.31E-05	4.17E-06	8.31E-07
Swi/S . 10^(-Rwi/10)	0.000239	0.0006	0.00019	1.9E-05	9.51E-06	1.9E-05
Sew/S . 10^(-Rew/10)	7.48E-05	0.000119	3.75E-05	5.94E-06	9.42E-07	2.98E-07
Srr/S . 10^(-Rrr/10)	4.17E-17	4.17E-17	4.17E-17	4.17E-17	4.17E-17	4.17E-17
10log10(S/A)+3	6.388186	5.340832	4.760913	4.760913	5.0412	5.0412
Leq,2	26.02441	24.63661	17.97082	10.39611	1.689988	-3.92623
A-Weighting	-16.1	-8.6	-3.2	0	1.2	1
A-Weighted Leq	**9.924406**	**16.03661**	**14.77082**	**10.39611**	**2.889988**	**-2.92623**

A-Weigted Level Outside	**52**
BS8233 Predicted Internal A-Weigted Level	**20**
Prediced Building Envelope SRI	**32**

Ground Floor Rear Kitchen

BS8233 Calculation can be seen below:

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

9.5 Rear First Floor Bedroom

Non Frequency Dependent Variables		
Term	Derivation	Value
A_o	Given in BS EN 20140-10 = 10 (m^2)	10
S_f	Total Facade Area (m^2)	18.96
S_{wi}	Window Area (m^2)	2.47
S_{ew}	External Wall Area (m^2)	16.5
S_{rr}	Ceiling Area (m^2)	11.8
S	Total Area sound enters the room (m^2)	30.7

Key for Table Below	
R_{wi}	Sound Reduction of Window (Octave)
R_{ew}	Sound Reduction Index of External Wall (Octav
R_{rr}	Sound Reduction Index of Roof/Ceiling (Octav
A	Equivalent Absorbtion Area of Rx Room
$D_{n,e}$	Insulation of Trickle Vent (BS EN 20140-10)

Frequency Dependent Variables							
		Octave Band Centre Frequency					
Term	Description	125	250	500	1000	2000	4000
$L_{eq,ff}$	Free-Field External Noise Level	54	50	48	48	45	38
$D_{n,e}$	Rytons AAC125HP Look Ryt	42	37	34	43	57	64
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}	Tile on Felt, Pitched Roof, 100mm mineral wool on plasterboard ceiling	43	43	43	43	43	43
A	Equivalent Absorbtion Area of Room (Copied from BS8233)	11.00	14.00	16.00	16.00	15.00	15.00

BS8233 Calculation Details						
	Octave Band Centre Frequency					
Term From Equation Below	125	250	500	1000	2000	4000
$L_{eq,ff}$	54	50	48	48	45	38
Ao/S . 10^(-Dn,e/10)	2.06E-05	6.5E-05	0.00013	1.63E-05	6.5E-07	1.3E-07
Swi/S . 10^(-Rwi/10)	0.00032	0.000805	0.000254	2.54E-05	1.28E-05	2.54E-05
Sew/S . 10^(-Rew/10)	4.27E-05	6.77E-05	2.14E-05	3.39E-06	5.37E-07	1.7E-07
Srr/S . 10^(-Rrr/10)	1.93E-05	1.93E-05	1.93E-05	1.93E-05	1.93E-05	1.93E-05
10log10(S/A)+3	7.457457	6.410103	5.830184	5.830184	6.110471	6.110471
Leq,2	27.50845	26.21686	20.11163	11.92058	6.322202	0.64317
A-Weighting	-16.1	-8.6	-3.2	0	1.2	1
A-Weighted Leq	**11.40845**	**17.61686**	**16.91163**	**11.92058**	**7.522202**	**1.64317**

A-Weigted Level Outside	**52**
BS8233 Predicted Internal A-Weigted Level	**22**
Prediced Building Envelope SRI	**31**

First Floor REAR Bedroom- STATION

BS8233 Calculation can be seen below:

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