Acoustic Associates Sussex Ltd

Discharge of Planning Condition – Railway Noise and Vibration Assessment.

Site: **46 Victoria Road, Southwick. BN42 4DH**
Client: **3D and M Homes Limited**

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

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Issue 1

Acoustic Associates Sussex Ltd.

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Issue 1	08/12/2021	Original Issue

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Acoustic Associates Sussex Ltd.

1 Introduction

Acoustic Associates have been appointed to undertake a railway noise assessment to support a discharge of planning condition. A planning inspector allowed an appeal for the demolition of the existing property and the erection of a 3 bedroom detached two storey house.

Standards and guidance referenced for this assessment include:

- Calculation of Railway Noise 1995
- World Health Organisation (WHO) - Guidelines for Community Noise 1999
- BS8233 (Sound insulation and noise reduction for buildings) 2014
- ProPG2017: Planning & Noise – New Residential Development.
- Acoustics Ventilation and Overheating Guidance, January 2020
- Sussex Planning Noise Advice Document dated March 2021
- BS6472-1:2008 - Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting.

Railway noise levels were measured during a typical rush hour period over a 4-hour duration with a class 1 sound level meter on Friday 3rd December 2021. Vibration levels were also measured for the same time (15:00-19:00 hours). Predictions were made from the measured train passes to identify likely daytime and night time sound pressure levels ($L_{Aeq,\ 16\ hour}$ and $L_{Aeq,\ 8\ hour}$), and additionally vibration values in VDV for day and night and for both the ground floor slab and first floor level of the property.

The predicted freefield daytime and night time sound pressure level at the nearest bedroom(3) is 52dB $L_{Aeq,16\ hour}$ and 46dB $L_{Aeq,\ 8\ hour}$. With standard thermal double glazing (4\12\4 or R_{RAIL} of 28dB) and trickle vents applied, a rigorous calculation predicts an internal sound pressure level of 22dB $L_{Aeq,\ 16\ hours}$ and a Sound Reduction Index (SRI) of 30dB. The SRI is sufficient to protect against night time L_{Amax} events.

Vibration levels were also predicted for both the ground floor and first floor using two different methods in BS6472:2008 (Methods 1 and 2). The outcome being that there is a low probability of adverse comment to the future occupants.

The planning condition (3) required a railway noise and vibration assessment to be undertaken and mitigation measures to protect the dwelling. This has been undertaken with information presented on both noise and vibration. Sufficient detail has been presented to allow the local planning authority to discharge condition 3 of the planning inspectors decision notice.

2 Context, Noise Criteria, Noise Assessment Methodology and Planning Policy

2.1 Context and Location

Adur and Worthing Council refused a planning application (AWDM/0880/20) for the demolition of an existing bungalow dwelling and the erection of a new two storey detached three-bedroom dwelling. The application was refused by the Council, albeit, not on noise grounds. The decision was appealed and a planning inspector determined the appeal allowing the development, with conditions attached on 9th April 2021.

Condition 3 of APP/Y3805/W/20/3261845 requires as follows:

"No works hereby permitted above slab level shall be carried out until a scheme for protecting the dwelling from noise and vibration from the railway has been submitted to and approved by the Local Planning Authority. All works which form part of the scheme shall be completed before the dwelling is occupied."

This report therefore provides an assessment of noise and vibration levels and any associated mitigation measures with a view to allowing the local planning authority (LPA) to discharge condition 3.

The property location and footprint can be seen below in Figure 1 with the railway located approximately 16m to the South. The railway is on an embankment and runs from East to West. To the East is Southwick Station and to the West, Shoreham by Sea with the line being the London to Portsmouth South Eastern line which runs via Brighton. As per the requirements of the condition, the development has not progressed past slab level.

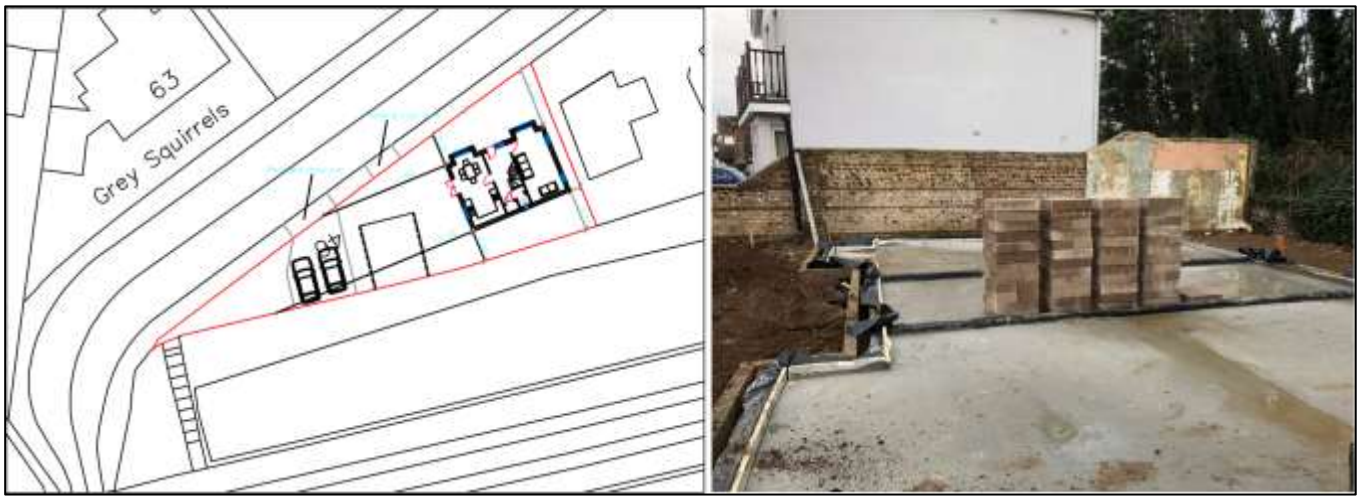

Figure 1. Approved Site

Residential properties already exist to the North of the railway line, as shown in the annotated google earth image below (Figure 2).



Figure 2. Existing Properties Adjacent to Railway Line

2.2 Consented Floor Plans

The approved floor plans can be seen below and the images are orientated North. Good acoustic design has therefore minimised any fenestration for habitable rooms on the rear façade, with only two toilet windows located on the South façade. Note that the first-floor bedroom is off set on the Western façade.

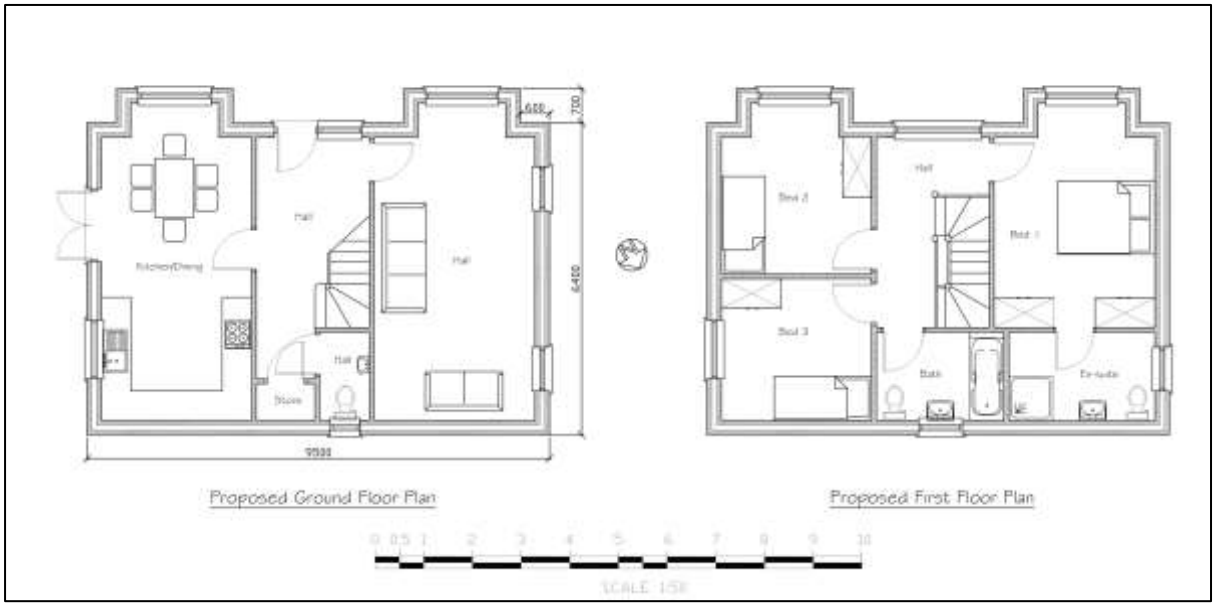

Figure 3. Consented Ground and First Floor Layouts

2.3 Soundscape

The soundscape at the site consisted of birdsong, gull noise, occasional passing vehicles on Victoria Road and aviation noise from low level aircraft and helicopters. Passing trains were also noted which varied in their speed as not all trains stop at either Southwick or Shoreham by Sea stations. The conditions for the survey were very still with little wind and ideal for environmental noise monitoring.

2.4 ProPG2017

Planning guidance (ProPG2017) relates to new residential development and airborne transportation noise, which includes exposure to road traffic, railway and aviation noise. Whilst ProPG, 2017 generally mirrors the requirements of BS8233:2014 and the World Health Organisation Guidelines, 1999, it goes further in setting a limit for inside bedrooms for L_{Amax} events and specifically, no more than 10 L_{Amax} events per night time period above 45dB(A).

The internal bedroom L_{Amax} values will be used in accordance with ProPG2017. An initial site risk assessment and acoustic design statement are not being provided as due planning process has already consented the dwelling.

2.5 BS8233:2014 Noise Criteria

Table 4 of BS8233:2014 provides the following guideline values:

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

2.6 BS6472-1:2008 - Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting

In homes, adverse comment about building vibrations is likely when the vibration levels to which occupants are exposed are only slightly above thresholds of perception. When the appropriately-weighted vibration measurements or predictions have been used to derive the VDV for either 16h (daytime) or 8h (night-time) at the relevant places of interest, their significance in terms of human response for people in those places can be derived from the table below which has been taken from BS6472:2008.

Place & Time	*Low probability of adverse comment[1] $ms^{-1.75}$*	*Adverse comment possible $ms^{-1.75}$*	*Adverse comment Probable[2] $ms^{-1.75}$*
Residential Building 16h Day	0.2 - 0.4	0.4 - 0.8	0.8 - 1.6
Residential Building 8h Night	0.1 - 0.2	0.2 - 0.4	0.4 - 0.8

Table 2. BS6472 Criteria

2.7 ANC Guidelines for Measurement & Assessment of Ground borne Vibration

These guidelines, published in 2012 aim to provide additional guidance in relation to all aspects of vibration monitoring and assessment in line with BS6472, BS7385 and BS5228. Its aim is to provide interpretation and useful practical methods to assist the assessor in real-terms.

Where possible, this assessment has followed these guidelines.

2.8 Rail Noise Measurement and Prediction Methodology

The noise levels for the day and night time periods have been predicted, using on site measurements, rather than measuring constantly for 24 hrs or more. The predictions have been made using the following information:

- Current timetable data which details the number of passenger trains that pass by the site (between Shoreham and Southwick stations).
- Train Sound Exposure Levels (SELs) were measured on site during the daytime. These individual measurements were then grouped into train types based on train length and direction.

The individual SEL measurements have been averaged for each train type and direction in order to create a "typical" sound exposure level (SEL) for each train type.

The above methodology is in accordance with Calculation of Rail Noise 1995 which states the following in section 43 paragraph 2 and 3.

"In order to determine the $L_{Aeq,16h}$ or $L_{Aeq,8h}$ noise level it may be necessary to carry out SEL noise measurements of each train pass-by over the full time period of interest. Exceptions to this may occur when the train mix and speed of individual train types remain reasonably constant over the relevant time period. For this situation, it is acceptable to measure a representative sample of individual train pass bys of each train type running on each track and determine an arithmetic mean value for the SEL for each case."

In paragraph 3, CRN goes on to say that having established by measurement the mean values for the SELs of each train type operating on the railway, the day and the night time noise levels ($L_{Aeq,16hr}$ and $L_{Aeq,8hr}$) should be calculated using a formula that is also stated in CRN. The SEL to $L_{Aeq,day/night}$ formula is detailed below and implemented in section 4.

[1] Below these ranges adverse comment is not expected.

[2] Above these ranges adverse comment is very likely.

For each train type: $\mathbf{L_{Aeq}}$ **= SEL – 10Log T + 10Log N**

- *N = no. of events in period (For each train type based upon timetable information*
- *T = no. of seconds in period (57600 seconds for the day and 28800 for the night)*

In order to sample all types of train that travel on the particular line the survey was deliberately conducted over a duration that covered a busy and a quiet period of train operation (15:00 to 19:00 hours). Conducting the sampling in this way considers the fact that rail companies will try to match train type with demand.

It should be noted that a train SEL measured in the daytime is likely to be marginally higher than if an identical train SEL was measured at night time. This is due to the fact that in the daytime the background noise levels are generally higher than at night time and during the train SEL measurement background noise will be "captured" as well as the train noise.

2.9 Non-Passenger Train Activity

The effect of noise from freight train activity is sometimes difficult to assess due to the irregularity of freight operations and the non-existence of any useful timetable information.

These may well be occasional leaf clearing or maintenance trains that operate during the day or night-time period. These trains will be seasonal/infrequent and it is very unlikely that there would be several in a week let alone more than one in any night time hour.

Because of the infrequency of such events, it has not been possible to carry out measurements of the rail traffic noise associated with them.

It should be borne in mind that such trains pass the site only on an occasional basis, as the need arises. Therefore, it would not normally be the case that planning decisions would hinge upon such irregular events.

3 Sound Survey Baseline Conditions & Results

An attended rail noise survey was carried out between 15:00 hours and 19:00 hours on Friday 3rd December 2021. The 4-hour survey was consistent with the methodology applied in the calculation of railway noise and the duration was designed to cover the evening rush hour period. The planning decision notice was clear in that it was railway noise which was to be quantified and not environmental noise.

The survey location was not secure, and the vibration survey equipment was not capable of being secured on site, so used the same 4-hour period of measured train passes. The sound level meter was set up in freefield conditions at a location representative of the nearest bedroom window which was 1.8m from the South West corner of the building footprint. The sound level meter was calibrated before and after the measurements were taken at 94dB at 1000Hz without any drift having occurred.

The vibration equipment was set up on the southern side of the concrete slab and in line with good practice, a weather station was installed. All three pieces of equipment can be seen in Figure 4 below.

3.1 Sound Survey Details

Survey(s) carried out by	Scott Castle BSc(Hons) Env Health, MCIEH CEnvH PGDip Acoustics MIOA
Equipment Used	Norsonic 118 (C) – Class 1 sound Level Meter - Serial No. 31540
Location	TQ23864/05085 and pole mounted at 2.1m above ground floor level
Duration	15:00 hours to 19:10 hours

Table 3. Survey Equipment - Sound

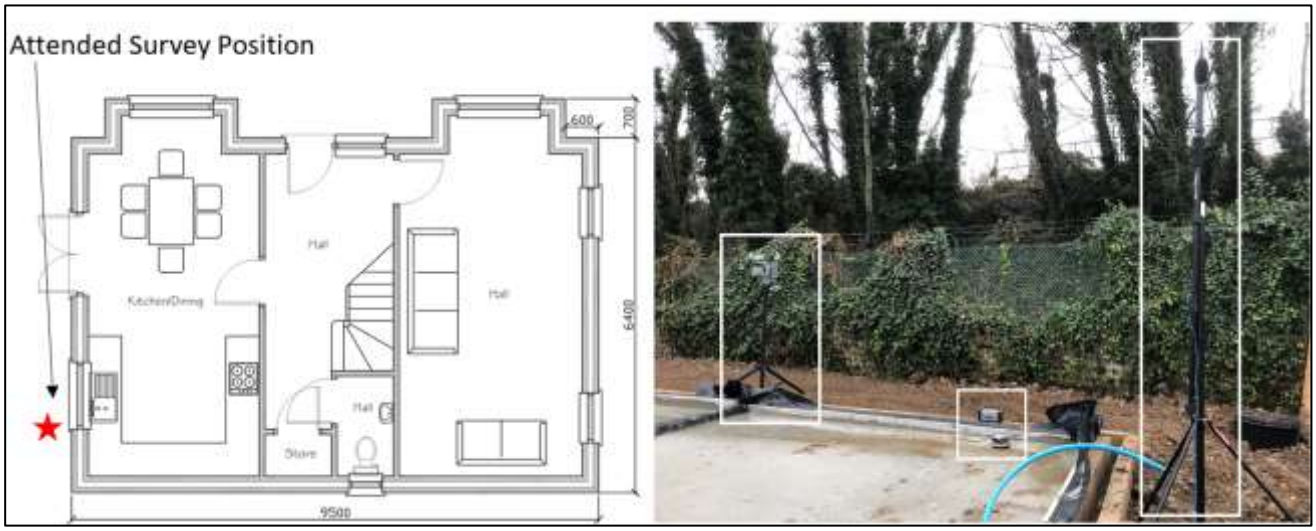

Figure 4. Location of Survey Equipment

Figure 4 above shows the weather station, the vibration meter and the sound level meter all highlighted.

3.2 Weather Conditions

As detailed in Figure 5 below the windspeeds were very low indeed creating ideal conditions for environmental noise monitoring. Conditions were dry and cold (7.5 to 10 degrees).

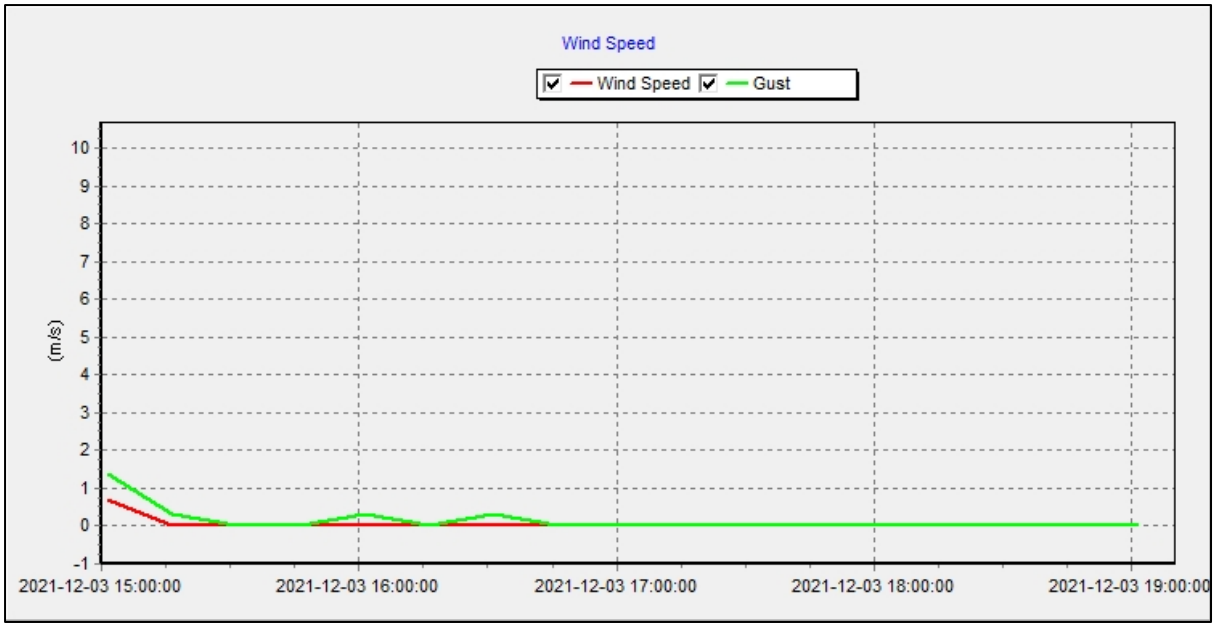

Figure 5. Wind Speeds Recorded for the Survey Duration

4 Railway Noise Levels at Measurement Position

4.1 Noise Survey Results

There were 34 measured train passes during the survey period, consistent with the timetabling schedule.

4.2 Train Timetable

The train time calculated and assessed against was valid from 6th September 2021 to Saturday 11th December 2021. The worst-case 24-hour period was used as follows.

Train Type	Number of Trains			
	East		West	
	Day	Night	Day	Night
South Eastern	138	17	125	11
Total				291

Figure 6. Busiest Timetable Period

Eastbound			Westbound		
Coaches	Passes	Percentage	Coaches	Passes	Percentage
3	6	33	3	5	31
4	6	33	4	4	25
6	1	6	6	1	6
8	4	22	8	4	25
10	0	0	10	1	6
12	1	6	12	1	6

Figure 7. Coach Types as a percentage of measured train passes

Train Type	Number of Trains			
	East		West	
	Day	Night	Day	Night
3 Coach	46.0	5.7	39.1	3.4
4 Coach	46.0	5.7	31.3	2.8
6 Coach	7.7	0.9	7.8	0.7
8 Coach	30.7	3.8	31.3	2.8
10 Coach	0.0	0.0	7.8	0.7
12 Coach	7.7	0.9	7.8	0.7

Figure 8. Predicted Coach Types as per the Scheduled Sept to December 2021 Timetable

4.3 Converting Sound Exposure Levels (SEL) to L_{Aeq} Levels (Measurement Position)

In paragraph 3 CRN states that having established, by measurement, the mean values for the SELs of each train type operating on the railway, the day and the night time noise levels ($L_{Aeq,16hr}$ and $L_{Aeq,8h}$) can be calculated. The day and the night time period noise level relating to each train type can be calculated using the following formula

Train Type $L_{Aeq,\ day/night}$ = SEL – 10Log T + 10Log N

- *N = no. of events in period (For each train type based upon timetable information*
- *Day = 07:00-:23:00hrs & Night = 23:00-07:00hrs*
- *T = no. of seconds in period (57600 seconds for the day and 28800 for the night)*

4.4 Train Type – Day/Night Noise Levels

The East and West train types and contributions for carriage length and daytime and night time periods are shown in Figure 9 below.

Train Type	dB(A) Contribution from Train Types and Direction			
	East		West	
	Day	Night	Day	Night
3 Coach	46.0	39.9	40.3	32.8
4 Coach	43.0	36.9	41.3	28.8
6 Coach	38.2	32.2	32.3	24.8
8 Coach	45.3	39.2	41.3	33.8
10 Coach	0.0	0.0	39.3	31.8
12 Coach	41.2	35.2	39.3	31.8

Figure 9. dB(A) Contributions Predicted from Carriage Length, Direction and Daytime and Night Time Periods.

4.5 Total Noise Level at Measurement Position

The noise levels detailed above can be added together (logarithmically) to show the total received daytime and night time noise levels at the measurement position for all trains in both directions.

For the daytime period this would be $10*\log (10^{5.06}+10^{4.75}) = 52.3$ dB(A)

For the night time period this would be $10*\log (10^{4.45}+10^{3.92})= 45.6$ dB(A)

Rounded, this equates to

- $L_{Aeq,07:00-23:00}$ ***= 52 dB(A)***
- $L_{Aeq,23:00-07:00}$ ***= 46 dB(A)***

4.6 Predicted Noise Levels and Corrections

Given that railway noise is being assessed, it is appropriate to consider whether the same protection is afforded from thermal double glazing (4/12/4) as opposed to road traffic noise. PPG24, albeit withdrawn, still includes relevant detail concerning railway noise. Table 1 in Annex 6 shows that for electric locomotives, double glazing is likely to provide 36dB(A) difference between outside and inside levels. This is further reinforced in Pilkington Glass data sheets dated 2007 which state that $R_{RAIL} = R_{TRA}+3$. Therefore, the protection afforded for thermal double glazing for this particular assessment is 36dB(A).

When using an SEL formula, there is no requirement for on time corrections, as this is already incorporated within the calculations.

4.7 Window/Room Assessment

4.7.1 Continuous Noise Level – $L_{Aeq, 16\ hour}$ and $L_{Aeq, 8\ hour}$

As previously stated, good acoustic design has been applied to minimise any windows on the Southern façade closest to the railway line. The only exception to this being the bathroom windows which are not considered to be a habitable room.

A rigorous calculation can be applied to determine the glazing, and/or ventilation types required for the nearest rear bedroom (Bedroom 3). The freefield predicted sound pressure level for the daytime period is 52dB $L_{Aeq, 16\ hour}$. The construction is a brick/cavity blockwork and the façade size is 14.07m^2. The window size is 1.44m^2 making the remaining façade area 12.63m^2. The ceiling area is 8.99m^2 and the ceiling finish is a slate tile finish on a felt roof with 100mm mineral wool and plasterboard ceiling. A standard trickle vent has been applied for ventilation purposes.

The rigorous calculation, as advocated by annex G2 of BS8233:2014 has been calculated as follows:

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)	14.07
S_{wi}	Window Area (m^2)	1.44
S_{ew}	External Wall Area (m^2)	12.63
S_{rr}	Ceiling Area (m^2)	8.99
S	Total Area sound enters the room (m^2)	23.06

Key for Table Below	
R_{wi}	Sound Reduction of Window (Octave)
R_{ew}	Sound Reduction Index of External Wall (Octa
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
$D_{n,e}$	Typical Trickle Vent	34	34	34	34	34	34
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)	0.000173	0.000173	0.000173	0.000173	0.000173	0.000173
Swi/S . 10^(-Rwi/10)	0.000249	0.000624	0.000197	1.97E-05	9.9E-06	1.97E-05
Sew/S . 10^(-Rew/10)	4.35E-05	6.9E-05	2.18E-05	3.46E-06	5.48E-07	1.73E-07
Srr/S . 10^(-Rrr/10)	1.95E-05	1.95E-05	1.95E-05	1.95E-05	1.95E-05	1.95E-05
10log10(S/A)+3	6.214666	5.167313	4.587393	4.587393	4.86768	4.86768
Leq,2	27.06568	24.63963	18.73061	15.91948	12.93457	6.133065
A-Weighting	-16.1	-8.6	-3.2	0	1.2	1
A-Weighted Leq	**10.96568**	**16.03963**	**15.53061**	**15.91948**	**14.13457**	**7.133065**

A-Weigted Level Outside	**52**
BS8233 Predicted Internal A-Weigted Level	**22**
Prediced Building Envelope SRI	**30**

First Floor Rear Bedroom

BS8233 Calculation can be seen below:

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

Figure 10. Rigorous Calculation of First Floor Rear Bedroom

The calculation shows that with a standard thermal double-glazed window (4/12/4) applied, the Sound Reduction Index of the façade is predicted to be 30dB. The internal predicted sound pressure level is 22dB which is comfortably below the daytime requirement of 35dB $L_{Aeq,\ 16\ hour}$.

4.7.2 L_{Amax} Event Assessment

In line with the requirements of the ProPG2017 guidance, the L_{Amax} events inside a bedroom should not exceed 45dB L_{Amax} more than 10 times a night. Reviewing the worst-case night period timetable, it would suggest that there are 28 train passes during the 8 hour overnight period. These are not continuous and relate to the early part of the night and the latter part of the morning period.

The following L_{Amax} events were taken from the measured train passes, with a worst case max of 72dB $L_{Amax,T}$. Therefore, the minimum SRI needed would be 72-45, which equals 27dB SRI. From 4.7.1 above, it is predicted that the SRI of the building façade is 30dB, which exceeds the lower SRI.

As a worst case scenario, even if 28 trains passed with 72dB $L_{Amax,T}$, these would still be below the 10 events per night, (28 occurrences of 42dB $L_{Amax,T}$), indicating compliance with ProPG2017.

Assessment of L_{Amax} Events		
Carriage Number	**East**	**West**
3	72	64
4	68.4	61
6	70	61
8	71	65
10	0	70
12	71	64

Figure 11. L_{Amax} Event Assessment

4.7.3 Bedroom Summary

The calculations demonstrate that standard thermal double glazing with a configuration of 4/12/4 will be sufficient for the bedroom. As previously stated, a correction is applied to the metric to allow other glazing manufacturers to be approached. The value for comparison is R_{Rail} which is calculated as $R_{traffic}$ +3.

For example, Pilkington glass having a configuration of 4/12/4 has an Rtraffic of 25. The R_{Rail} for comparative purposes would therefore be R_{Rail} of 28dB.

4.7.4 Overheating Assessment For Worst Case Room

A level 1 overheating risk assessment was undertaken and is presented below in Figure 12. It must be recognised that this is the worst case closest habitable window, with other rooms having greater distance and attenuation (via the building form itself) from the railway line.

The result is stated as "*The use of opening windows as the primary means of mitigating overheating is not likely to result in an adverse effect*" and accordingly, a level 2 assessment is not required.

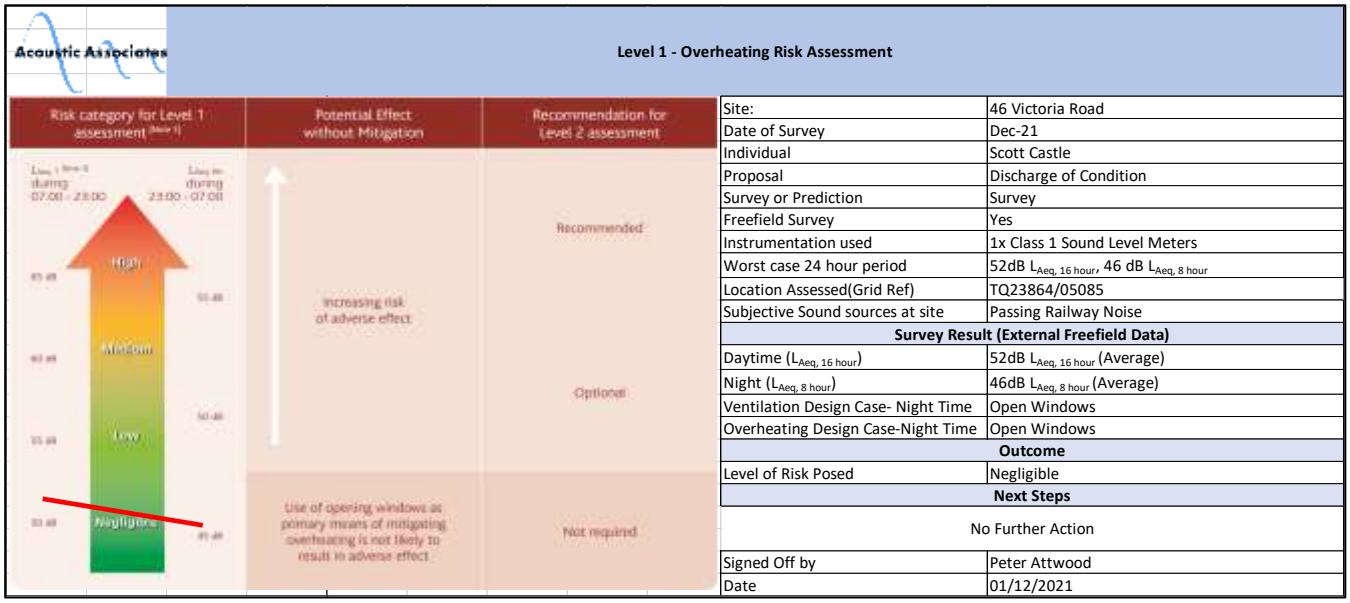

Figure 12. Level 1 Overheating Assessment

5 Vibration Assessment

A vibration survey was carried out between the 14:52 to 19:12 hours to measure ground-borne vibration levels associated with the adjacent railway lines to the South of the site.

An Omnidots SWARM vibration monitor was used which has 4G connectivity and the results were downloaded from the online platform for the period of the survey. BS6472:2008, Part 1 states that *the effect of building vibration on the people within is assessed by finding the appropriate vibration dose. Present knowledge shows that this type of vibration is best evaluated with the Vibration Dose Value or VDV*.

5.1 Survey Equipment

Vibration Transducer	
Survey(s) carried out by	Scott Castle BSc(Hons) Env Health, MCIEH CEnvH PGDip Acoustics MIOA
Equipment Used	Omnidots SWARM vibration meter
Duration of Survey	14:52 to 19:12 hours, 3rd December 2021
Height	0.0m

Table 4. Survey Equipment Details- Vibration

The accelerometer can be seen below in Figure 13 mounted on the concrete slab. The battery/power unit and GPS is seen mounted on the exterior brick course. The sensor recorded measurements in VDV every 30 seconds.



Figure 13. Vibration Meter

5.2 Vibration Results

As previously stated, it was not possible to leave the vibration monitor in situ, so two methods from BS6472:2008 have been applied to predict the daytime and night time vibration levels in VDV.

5.2.1 BS6472:2008-Part 1 – Method 1

$$(1) \qquad \mathrm{VDV}_{\mathrm{b/d,day/night}} = \left(\int_0^T a^4(t)dt \right)^{0.25}$$

Where:

$\mathrm{VDV}_{\mathrm{b/d,day/night}}$ is the vibration dose value (in $\mathrm{m \cdot s^{-1.75}}$);

$a(t)$ is the frequency-weighted acceleration (in $\mathrm{m \cdot s^{-2}}$), using W_{b} or W_{d} as appropriate;

T is the total period of the day or night (in s) during which vibration can occur.

Daytime Period with trains (ie 16 hour)= 960 minutes.

Sample Period, 206.5 minutes of vibration measurement data.

- VDV for whole survey Day = 0.021183287, Night = 0.021183287
- Ground floor Slab – Day = 0.031105068, Night = 0.021994604

For the upper floor, a worst-case resonance is applied using an increase of 13dB which equates to an increase of acceleration of 4.5 times.

- First Floor Day = 0.1
- First Floor Night = 0.1

5.2.2 Comparison with BS6472:2008

From Figure 14 below, it is seen that using method 1, the results are below those where there is a low probability of adverse comment for both day and night and for both ground floor and first floor residential occupation.

Place & Time	***Low probability of adverse comment[3] $ms^{-1.75}$***	***Adverse comment possible $ms^{-1.75}$***	***Adverse comment Probable[4] $ms^{-1.75}$***
Residential Building 16h Day	0.2 - 0.4	0.4 - 0.8	0.8 - 1.6
Residential Building 8h Night	0.1 - 0.2	0.2 - 0.4	0.4 - 0.8

Figure 14. BS6472:2008 Assessment Criteria Table

5.2.3 BS6472:2008-Part 1, Method 2

Method 2 uses a worst-case measured event/VDV value and applies this to all of the trains for both daytime and night time periods. The highest VDV rating was for an 8 carriage west bound train at 18:41 hours.

$$(2) \qquad \mathrm{VDV}_{\mathrm{b/d,day}} = \left(\frac{t_{\mathrm{day}}}{t_{\tau}}\right)^{0.25} \times \mathrm{VDV}_{\mathrm{b/d},\tau}$$

Where: t_{day} is the duration of exposure per day (s).

If, during any assessment period, there is a total of N vibration episodes of various durations t_n each with a vibration dose value of $\mathrm{VDV}_{\mathrm{b/d},t_n}$, the total vibration dose value for the day or night period is given by equation 3.

Therefore – Highest VDV =0.013958727

Daytime Predicted Number of Trains - 263

Night time Predicted Number of Trains-28

- VDV Day at ground floor slab = 0.05621274
- VDV Night at ground floor slab = 0.032109632

[3] Below these ranges adverse comment is not expected.

[4] Above these ranges adverse comment is very likely.

For the upper floor, a worst-case resonance is applied using an increase of 13dB which equates to an increase of acceleration of 4.5 times.

- First Floor Day = 0.3
- First Floor Night = 0.1

As per Figure 14 above, the VDV values even assuming all trains which passed the site had the vibration energy associated with the singular 8 coach Westbound train, this still falls into the category of low probability of adverse comment.

5.3 Vibration Summary

Having reviewed the measured data obtained during the attended survey period, vibration is not deemed to be a concern at the application site. The criteria assessed against remains consistent with the requirements in the Planning Noise Advice Document Sussex, dated March 2021 and vibration is specifically referenced in section 3.4

6 Discussion

6.1 Railway Noise

The predictions made from the measured train passes predict the daytime railway noise as being 52dB $L_{Aeq,\ 16\ hour}$ and 46dB $L_{Aeq,\ 8\ hour}$ for the night time period. Because these were measured at the location of the worst-case bedroom window on the Western façade, no corrections are required.

Other bedroom windows are located further away from the sound source (ie the railway) and the building form will also act as a barrier in shielding the two first floor bedrooms which overlook Victoria Road.

Given the noise levels predicted, standard thermal double glazing (R_{RAIL} 28dB(A)) will be sufficient to protect future occupants against both L_{Aeq} and L_{Amax} events from the passing trains. The calculations were made with standard trickle vents fitted and a level 1 overheating assessment indicates that future occupants are capable of opening windows to mitigate against overheating without adverse effects.

Should windows be opened, the industry standard is to apply a 13dB loss from external freefield sound pressure levels to internal sound pressure levels as the sound energy passes through a partially open window. An open window at the worst case and closest first floor bedroom would therefore account for a daytime sound pressure level of 39dB $L_{Aeq,16\ hour}$ and for 33dB $L_{Aeq,\ 8\ hour}$ for night time. Note 7 from 7.7.2 of BS8233:2014 states that levels up to 5dB above the table 4 values can still provide reasonable internal conditions. This approach is also mirrored in ProPG2017 (Section 2.30).

If greater ventilation above and beyond a trickle vent was required to provide background ventilation, then a passive through the wall ventilator may be considered. The types of unit differ in their free area (mm^2) and depend on the size of the space being served, but for a bedroom a ventilator of 2500mm^2 is more than sufficient. A greenwood AWV39 through the wall passive ventilator would provide 20dB $L_{Aeq,16\ hour}$ internally, and an SRI of 32dB.

6.2 Railway Vibration

The measurements taken from site and the subsequent predictions made in line with BS6472:2008 (Part 1) and the Planning Noise Advice Document Sussex (March 21) identify a low probability of adverse comment both at the ground floor slab and first floor level of the residential property. Mitigation measures are not required.

7 Conclusion

Railway noise levels were measured during a typical rush hour period over a 4-hour duration with a class 1 sound level meter on Friday 3rd December 2021. Vibration levels were also measured for the same time (15:00-19:00 hours). Predictions were made from the measured train passes to identify likely daytime and night time sound pressure levels ($L_{Aeq,\ 16\ hour}$ and $L_{Aeq,\ 8\ hour}$), and additionally vibration values in VDV for day and night and for both the ground floor slab and first floor level of the property.

The predicted freefield daytime and night time sound pressure level at the nearest bedroom (3) is 52dB $L_{Aeq,16\ hour}$ and 46dB $L_{Aeq,\ 8\ hour}$. With standard thermal double glazing (4\12\4 or R_{RAIL} of 28dB) and trickle vents applied, a rigorous calculation predicts an internal sound pressure level of 22dB $L_{Aeq,\ 16\ hours}$ and a Sound Reduction Index (SRI) of 30dB. The SRI is sufficient to protect against night time L_{Amax} events.

Vibration levels were also predicted for both the ground floor and first floor using two different methods in BS6472:2008 (Methods 1 and 2). The outcome being that there is a low probability of adverse comment to the future occupants.

The planning condition (3) required a railway noise and vibration assessment to be undertaken and mitigation measures to protect the dwelling. This has been undertaken with information presented on both noise and vibration. Sufficient detail has been presented to allow the local planning authority to discharge condition 3 of the planning inspectors decision notice.