Environmental Noise Assessment

Project No: PA73

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Land at Reddish Lane, Whaley Bridge, High Peak, SK23 7FY

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1. Summary

1.1. Proposal

It is proposed to develop a residential dwelling at land off Reddish Lane, Whaley Bridge, High Peak, SK23 7FY.

1.2. Reason for Assessment

The proposed dwelling will be in close proximity of a multi-use game area (MUGA). An assessment has been requested to determine the likely noise impact of the MUGA and for mitigation measures through façade sound insulation (glazing and ventilation) and acoustic fencing to be studied.

1.3. Planning Conditions & Criteria

Desirable noise limits for residential dwellings are set out in BS8233:2014, however these are based upon on anonymous noise sources, such as road traffic. Noise emissions from the MUGA will be from a defined source, therefore a -3dB target reduction has been applied to give stricter noise criteria. Noise targets are therefore defined as:

- 32dB $L_{Aeq,16hr}$ within living rooms (07:00 – 23:00)
- 27dB $L_{Aeq,8hr}$ within bedrooms (23:00 – 07:00)
- 42dB L_{Amax} should not be regularly exceeded within bedrooms (23:00 – 07:00)
- 47dB $L_{Aeq,16hr}$ within external residential amenity spaces

1.4. Assessment Standards & Justification

'BS8233:2014 – Guidance on sound insulation and noise reduction for buildings' is a recognised standard for assessing and mitigating environmental noise levels upon a proposed noise sensitive development. The standard gives a rigorous calculation method for determining interior noise levels based on measured environmental noise levels, however it is noted the rigorous calculation omits the usage for point noise sources, such as raised voices.

'BS EN 12354-3:2000 – Estimation of acoustic performance in buildings from the performance of elements - Airborne sound insulation against outdoor sound' allows internal noise levels to be derived from point sources situated externally from the building façade.

1.5. Measurements

In order to assess noise emissions, noise measurements were undertaken over a 24-hour period from 8th – 9th August 2016. The results of the measurements are tabulated below:

Measurement Summary				
Measurement	**Date**	**Period**	**LAeq (dB)**	**LAFmax (dB)**
M1	8th –9th August 2016	Day (16hr)	**48.8**	N/A
M1	8th – 9th August 2016	Night (8hr)	**36.8**	**64.8**

1.6. Noise Assessment Outcome

It is determined that by using mitigation as specified below for the building façade, the outcome summarised in the following table is achieved.

Internal Space	Noise Parameter	Internal Noise Level	Within Desired Criteria
Living Room	Daytime $L_{Aeq, 16hr}$	25.6	Yes
Bedroom	Night-time $L_{Aeq, 8hr}$	14.7	Yes
Bedroom	Night-time L_{AFmax}	32.0	Yes
External Space	**Noise Parameter**	**External Noise Level**	**Within Desired Criteria**
Amenity Space	Daytime $L_{Aeq, 16hr}$	46.7	Yes

1.7. Mitigation Recommendations

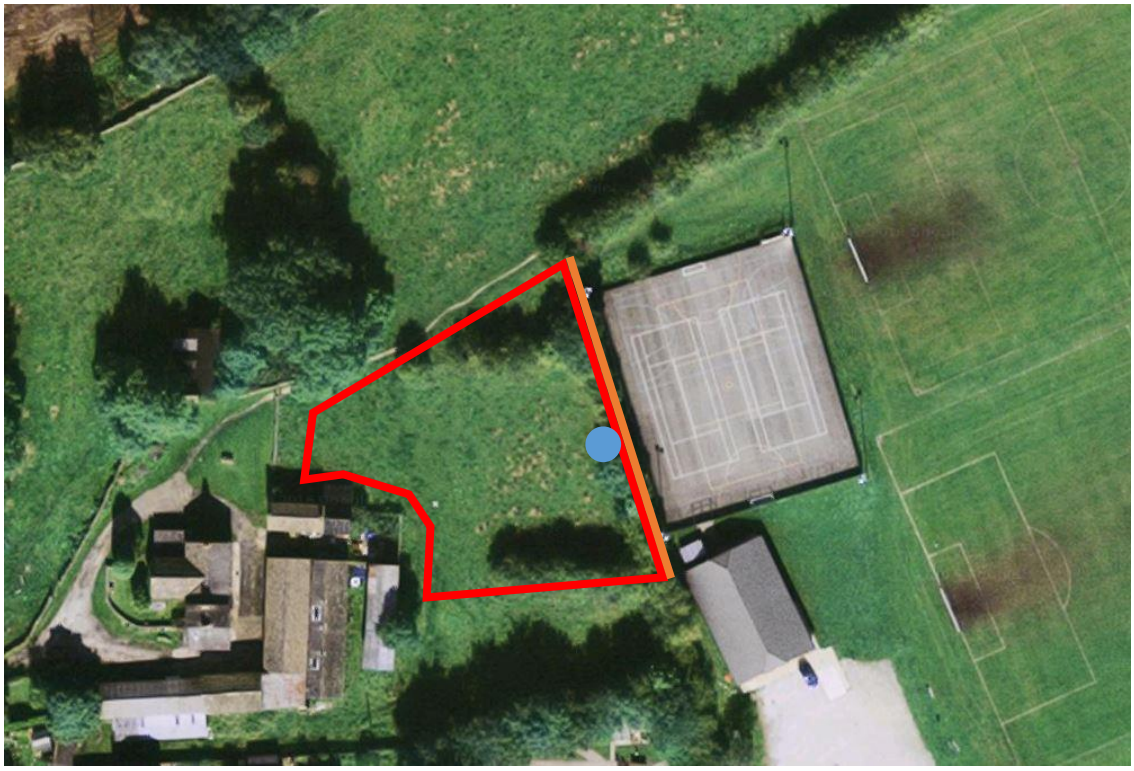
1.7.1 Façade Specifications

Living Rooms – 6/12/6mm glazing and hit & miss trickle ventilators
Bedrooms – 6/12/6mm glazing and hit & miss trickle ventilators

1.7.2 Acoustic Fencing

If desirable noise levels in external amenity areas are to be maintained when the Multi-Use Game Area is in use, it is recommended to install 2m high acoustic fencing along the eastern border of the plot.

1.8. Site & Measurement Location



Measurement location
Site location
Recommended acoustic fence

2. Environmental Noise Survey

2.1. Source Under Investigation

Primary noise sources identified onsite were users of the MUGA during operational hours, birdsong and dog walkers. Secondary noises sources included occasional vehicles accessing Reddish Barns.

3. Survey Measurements

Daytime and night-time noise measurements have been carried out on 8th – 9th August 2016.

3.1. Measurement location

Noise levels were measured at a height of 1.5m from the ground at the eastern boundary of the plot.

3.2. Weather Conditions

Weather conditions were deemed acceptable for environmental noise measurements; detailed weather conditions are given in **Appendix C**.

3.3. Measurement Equipment

Measurement equipment used complies with accuracy requirements for common environmental noise measurement standards. A detailed equipment list is given in **Appendix B** with calibration information in **Appendix D**.

3.4. Measurement Results

The results from the measurement intervals are summarised in the tables below. Full measurement details and information can be found in **Appendix E**.

Results of measurements are as follows:

Measured Levels 8th – 9th August 2016, SK23 7FY

	$L_{Aeq,\ T}$ (dB)	L_{AFmax} (dB)
Daytime (M1)	**48.8**	-
Night-time (M1)	**36.8**	**64.8**

4. BS8233:2014 Noise Assessment

4.1. Criteria

The noise target is that internal noise levels are to be within the 'desirable' criteria, outlined in BS8233:2014, however these limits are based upon anonymous noise. Noise emissions from the MUGA will be from a defined source, therefore a -3dB target reduction has been applied to give stricter noise criteria. Noise targets are therefore defined as:

- 32dB $L_{Aeq,16hr}$ within living rooms (07:00 – 23:00)
- 27dB $L_{Aeq,8hr}$ within bedrooms (23:00 – 07:00)
- 42dB L_{Amax} should not be regularly exceeded within living rooms (23:00 – 07:00)
- 47dB $L_{Aeq,16hr}$ within external residential amenity spaces

4.2. External Noise Analysis

Measured noise levels are shown graphically in **Appendix E** and are typical of a rural noise climate. The results shown on the graph demonstrate an increase in noise levels during the hours when the Multi-Use Game Area is in use between 17.00 and 21:00.

4.3. Internal Noise Levels – Assumed Insulation

Internal noise levels have been calculated in order to demonstrate that the proposed development can achieve suitable internal noise levels inside rooms, when appropriate glazing and ventilation systems are used.

In order to describe the likely internal exposure to environmental noise at the site, Peak Acoustics, Ltd. use suggested data from BS8233:2014 on standard construction. This will include all elements of the exposed living room and bedroom façades closest to the noise sources.

Assumed window sizes have been adjusted based on the available plans of the proposed development, which show that the front and rear façades of the dwelling are comprised wholly of glazing.

A summary of assumed construction details is provided within **Appendix F.**

4.4. Daytime Internal Noise Levels

4.4.1. BS8233 Calculation of Daytime Internal Noise Levels

Considering the insulation with the addition of 6/12/6mm glazing and hit & miss trickle ventilation, daytime environmental noise would be reduced from 48.8 dB $L_{Aeq,\ 16hr}$ to interior levels of **25.6 dB $L_{Aeq,\ 16hr}$.**

The desirable limit of BS8233:2014 suggests a guideline of 35dB $L_{Aeq,\ 16hr}$ for resting conditions, and up to 40dB considered acceptable for necessary developments. With stricter noise criteria in place to reflect non-anonymous noise, the desirable limit is 32dB $L_{Aeq,\ 16hr}$.

The assumed standard of construction would place the internal levels in living rooms as below 32dB $L_{Aeq,\ 16hr}$, therefore within the desired criteria.

4.4.2 Effect of Multi-Use Game Area on Daytime Internal Noise Levels

4.4.2.1 Maximum Individual Noise Events

Noise arising from the Multi Use Game Area has been assessed using similar criteria to that of the night-time noise assessment of BS8233:2014. The target outcome is, therefore, that maximum individual noise events should not exceed 45 dB L_{Afmax} . Individual noise events are likely to occur frequently whilst the facility is in use, and are therefore deemed to be a good indicator of the adverse impact of the MUGA on the residents of the proposed dwelling.

Interior sound levels have been calculated according to BS12354-3, using acoustic software (Insul ™ - Marshall Day Acoustics) to model the front façade of the proposed dwelling with the addition of 6/12/6mm glazing and hit & miss trickle ventilators. Insul calculations are shown in **Appendix H** and are subject to a +3 dB correction factor accounting for the error margin of the prediction software. By analysing the octave band data obtained from the measurements, noise levels of two individual

maxima noise events have been identified and utilised in the calculations. Measured levels have been distance corrected to the frontal façade of the dwelling using the following point source distance attenuation.

$$L_2 = L_1 + 20\log (r_1/r_2)$$

$$L_2 = L_1 + 20\log (3/12)$$

(Where L_1 is the measured level, L_2 is the distance corrected level, r_1 is the distance between the measurement position and the noise source, r_2 is the distance between the noise source and the noise sensitive receptor)

Calculated interior noise levels are shown below:

Noise Data	Measured External Noise Level, **dB L_{Afmax}**	Distance Corrected level, Façade, **dB L_{Afmax}**	Target Criterion, **dB L_{Afmax}**	Interior Noise Level, **dB L_{Afmax}**
Football Kick	**78.3**	**66.3**	**45.0**	**44.1**
Voices	**82.8**	**70.8**	**45.0**	**43.7**

Note: Noise data for football kick and voices taken at 19:03 and 19:48 respectively.

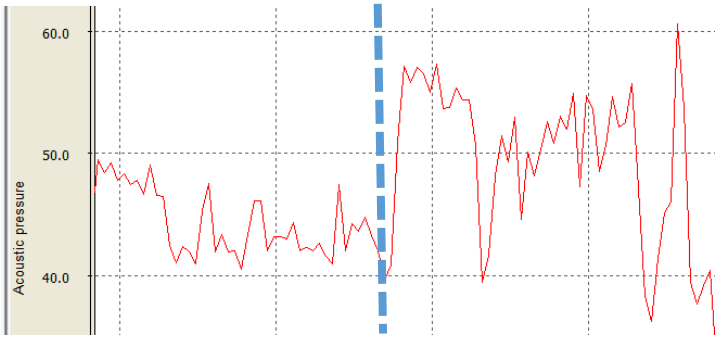
4.4.2.2 Continuous Noise

The effect of continuous noise from the Multi-Use Game Area has also been taken into account. Line-source distance attenuation ($L_2 = L_1 + 10\log (r_1/r_2)$) has been used to calculate levels at the façade of the dwelling as continuous noise from the MUGA emanates from a widespread area. Calculation of continuous noise using acoustic modelling of the building façade demonstrates that levels of 23.2 dB $L_{Aeq,\ 4hr}$ are achieved with the recommended specification in place:

Noise Data	Measured Exterior Noise Level, **dB $L_{Aeq,\ 4hr}$**	Distance Corrected level, Façade, **dB $L_{Aeq,\ 4hr}$**	Target Criterion, **dB $L_{Aeq,\ 4hr}$**	Interior Noise Level, **dB $L_{Aeq,\ 4hr}$**
MUGA Activity Period, 4 hours	**53.1**	**47.1**	**32.0**	**23.2**

Note: Noise data taken from approximately 17:00 – 21:00.

The graph of noise levels over time show that ambient noise levels increase by approximately 10 dB when activity is taking place, as demonstrated in the section of the graph shown below:



Noise Levels, dB L_{Aeq}, 13:40 – 21:00, 8th August 2016

This indicates that whilst desirable interior noise levels are maintained during time when the MUGA is in use, noise arising from these activities is likely to be distinguishable against the ambient noise.

4.5. Night-time Internal Noise Levels

Considering the insulation with the addition of 6/12/6mm glazing and hit & miss trickle ventilation, night-time environmental noise in bedrooms would be reduced from 36.8 dB $L_{Aeq,\ 8hr}$ to interior levels of **14.7 dB $L_{Aeq,\ 8hr}$** with maximum individual noise events reduced from 64.8 dB L_{AFmax} to **32.0 dB L_{AFmax}**.

BS8233:2014 suggests a desirable guideline of 30dB $L_{Aeq,\ 8hr}$ for sleeping conditions, with an acceptable limit of 35dB $L_{Aeq,\ 8hr}$. Individual noise events (Measured with fast time-weighted Maximum) should not normally exceed 45dB L_{AFmax} (as in BS8233:1999). With stricter noise criteria in place to reflect non-anonymous noise, the desirable limit is 27dB $L_{Aeq,\ 16hr}$ with individual noise events not exceeding 42 dB L_{AFmax}.

The above standard of construction would place the internal continuous levels in bedrooms as below 27dB $L_{Aeq,\ 16hr}$ and maximum noise level as below 42dB L_{AFmax}, therefore in the desirable category.

4.6. External Amenity Space Noise Levels

BS8233:2014 provides a desirable guideline of 50dB $L_{Aeq,16hr}$ for external amenity spaces and an acceptable guideline of 55dB $L_{Aeq,16hr}$. With stricter noise criteria in place to reflect non-anonymous noise, the desirable limit is 47 dB $L_{Aeq,16hr}$.

External noise levels across the full daytime period (07:00 – 23:00) were measured and corrected as **46.7 dB $L_{Aeq,16hr}$**, which is 0.3 dB within the desirable criteria.

4.6.1 Effect of Multi-Use Game Area on External Amenity Space Noise Levels

External, daytime noise levels arising from activities within the MUGA specifically were measured and corrected as **49.6 dB $L_{Aeq,4hr}$**, which is 2.6 dB above the desired criteria. If desirable noise levels in external amenity spaces are to be maintained whilst activities within the MUGA are taking place, mitigation is therefore required in the form of acoustic fencing.

Two-metre acoustic fencing (such as Jacksons *Jakacoustic Plus)* is typically quoted as achieving >13 dB sound attenuation, however 5 dB is often more realistic in practice. 5 dB attenuation is considered as a worst-case scenario by assuming a path difference of zero between the noise source and the receiver, as shown using the barrier calculation below:

$$A_{barrier} = 10\log(3+20N)\ dB$$

$$A_{barrier} = 10\log(3+20x0)\ dB$$

$$\mathbf{A_{barrier} = 5\ dB\ R_W}$$

(Where $N=2 \times \delta/\lambda$, δ = Path Difference, λ = Wavelength)

With the addition of acoustic fencing along the eastern boundary of the plot, noise levels arising from activities within the MUGA are reduced to **44.6 dB $L_{Aeq,4hr}$**, which is 0.4 dB within the desirable criteria.

4.7. BS8233:2014 Effect Level and Exposure Outcomes

A summary of internal noise levels and their respective BS8233 classifications can be found below:

Internal Space	Noise Parameter	Internal Noise Level	BS8233 Classification
Living Room	Daytime $L_{Aeq, 16hr}$	25.6	'Desirable'
Bedroom	Night-time $L_{Aeq, 8hr}$	14.7	'Desirable'
Bedroom	Night-time L_{AFmax}	32.0	'Desirable'
External Space	**Noise Parameter**	**External Noise Level**	**BS8233 Classification**
Amenity Area	Daytime $L_{Aeq, 16hr}$	46.7	'Desirable'

APPENDIX A - Measurement Details

Measurement	Kit	Start Date	Start Time	End Date	End Time
M1	A2	08/08/16	13:52	09/08/16	12:30

APPENDIX B - Equipment Details

Kit	Equipment	Make	Model	Class	Serial Number
A2	Sound Meter	Svantek	971	1	40305
A2	Pre-Amp	Svantek	SV18	1	41651
A2	Calibrator	Svantek	SV31	1	32507

APPENDIX C - Meteorology Details

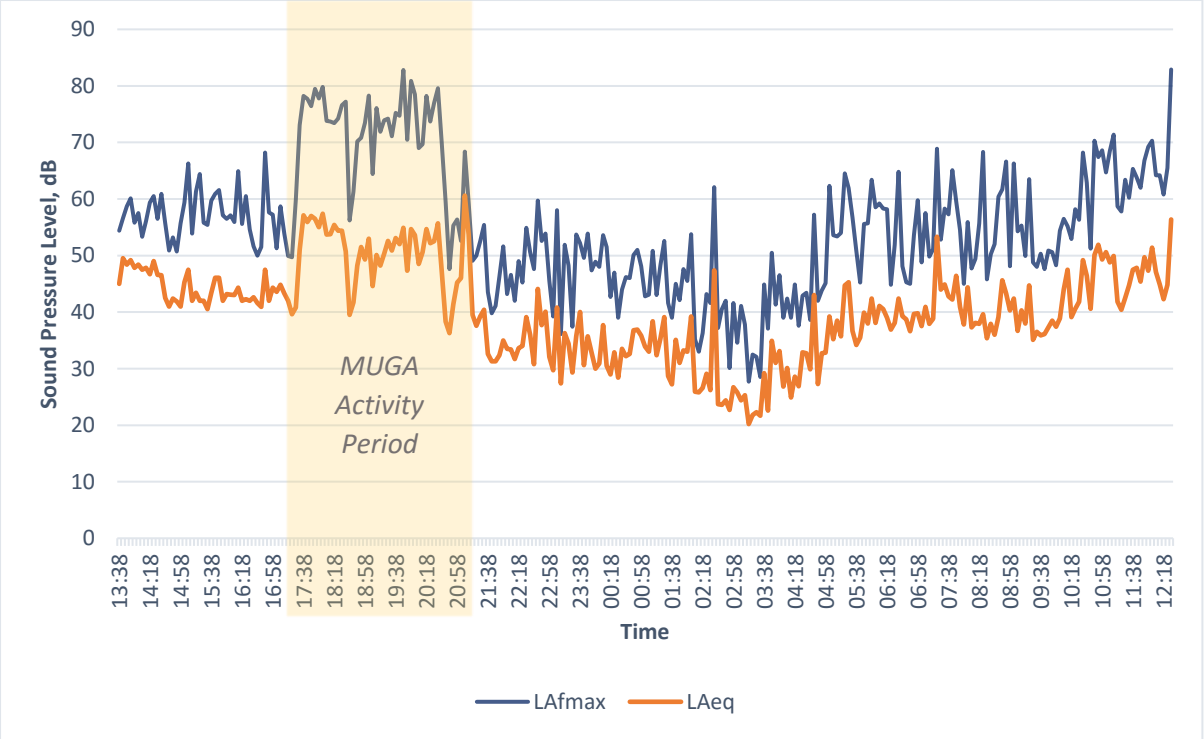
Measurement	Temp C	Wind Speed m/s	Wind Direction	Humidity %	Precipitation mm	Cloud Cover (Oktas)
M1	15	3.3	SW	66	1.8	6/8

APPENDIX D - Calibration Details

Measurement	Calibrator Ref Level (dB)	Level Before (dB)	Deviation Before (dB)	Level After (dB)	Deviation After (dB)
M1	113.0	112.51	0.49	112.41	0.59

APPENDIX E – Noise Survey Results

Environmental Noise Measurements, 8th – 9th August 2016, Measurement M1



APPENDIX F – Assumed Construction Details

Values are given according to two key areas covered by BS8233:2014, which are listed as the following:

- Living rooms between hours of 07:00 and 23:00;
- Bedrooms between hours of 23:00 and 07:00.

For the purposes of this assessment, daytime levels are assessed in living room spaces, night-time levels are assessed in bedrooms. Sizes are adjusted based on plans of the proposed dwelling available, and are therefore given as:

- Living room 5m x 5m x 3m
- Bedroom 5m x 5m x 3m

The building envelope is assumed as having standard construction, with façade materials and elements, such as:

- External wall, concrete block & brickwork leaves with >75mm cavity
- Pitched roof with mineral wool and plaster ceiling
- Hit & Miss Trickle Ventilators
- 6/12/6mm glazing

The following are Sound Reduction Indices of the specifications identified previously:

Sound Reduction Index of the external wall, dB (R_w)

Frequency Band (Hz)	125	250	500	1000	2000
R_w of External wall	41	45	45	54	58

Sound Reduction Index of the roof, dB (R_w)

Frequency Band (Hz)	125	250	500	1000	2000
R_w of Roof	27	37	43	48	52

Sound Reduction Index of 6/12/6mm glazing, dB (R_w)

Frequency Band (Hz)	125	250	500	1000	2000
R_w of Glazing	20	19	29	38	34

Level Difference ($D_{n,e}$), dB of hit & miss trickle ventilators

Frequency Band (Hz)	125	250	500	1000	2000
$D_{n,e}$ of Ventilation	34	27	37	35	34

This report determines values based on the assumption that ventilation is **NOT from open windows**, but from auxiliary methods of external ventilation, in this case hit & miss trickle ventilators.

Summary calculations are made following the BS8233:2014 Rigorous Design Calculation shown in **Appendix G**.

APPENDIX G – Attenuation Calculation Sheets

BS8233 Rigorous Design Calculation – Internal Daytime Noise

	125	250	500	1000	2000
Leq1	51.8	44.1	44	44.5	41
Dne	34	27	37	35	34
Rwi	20	19	29	38	34
Rew	20	19	29	38	34
Rrr	27	37	43	48	52
A	24	24	24	24	24
Sf	15.0		S	15	
Sw1	15.0		A0	10	
Sew	0.0				
Srr	25.0				

	125	250	500	1000	2000
A	52	44	44	45	41
B	0.00027	0.00133	0.00013	0.00021	0.00027
C	0.01000	0.01259	0.00126	0.00016	0.00040
D	0.00000	0.00000	0.00000	0.00000	0.00000
E	0.01667	0.02098	0.00210	0.00026	0.00066
F	-15.69730	-14.57156	-24.57156	-31.98283	-28.77121
G	-2.12188	-2.12188	-2.12188	-2.12188	-2.12188
leq2	37.0	30.4	20.3	13.4	13.1
A weight	-16	-9	-3	0	1
LAeq2	21.0	21.4	17.3	13.4	14.1
Leq2 (SN)	38.0				
LAeq2 (SN)	25.6				

BS8233 Rigorous Design Calculation – Internal Night-time Noise

	125	250	500	1000	2000
Leq1	41.6	37.5	34.1	30.6	26
Dne	34	27	37	35	34
Rwi	20	19	29	38	34
Rew	20	19	29	38	34
Rrr	27	37	43	48	52
A	41	41	41	41	41
Sf	15.0		S	15	
Sw1	15.0		A0	10	
Sew	0.0				
Srr	25.0				

	125	250	500	1000	2000
A	42	38	34	31	26
B	0.00027	0.00133	0.00013	0.00021	0.00027
C	0.01000	0.01259	0.00126	0.00016	0.00040
D	0.00000	0.00000	0.00000	0.00000	0.00000
E	0.01667	0.02098	0.00210	0.00026	0.00066
F	-15.69730	-14.57156	-24.57156	-31.98283	-28.77121
G	-4.34036	-4.34036	-4.34036	-4.34036	-4.34036
leq2	24.6	21.6	8.2	-2.7	-4.1
A weight	-16	-9	-3	0	1
LAeq2	8.6	12.6	5.2	-2.7	-3.1
Leq2 (SN)	26.4				
LAeq2 (SN)	14.7				

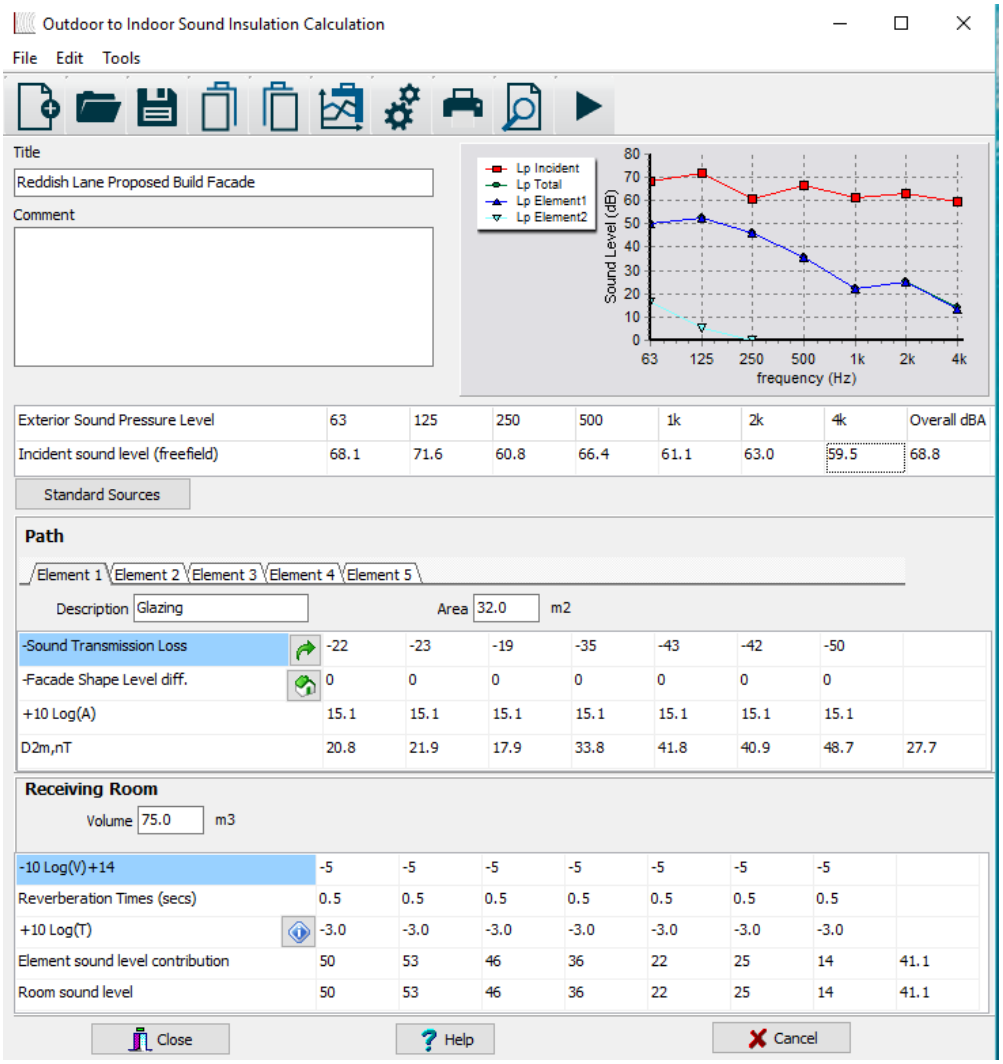
BS8233 Rigorous Design Calculation – Internal Night-time Noise, Maxima

	125	250	500	1000	2000
Leq1	53.2	53.8	52.4	52.6	55
Dne	34	27	37	35	34
Rwi	20	19	29	38	34
Rew	20	19	29	38	34
Rrr	27	37	43	48	52
A	41	41	41	41	41
Sf	15.0		S	15	
Sw1	15.0		A0	10	
Sew	0.0				
Srr	25.0				

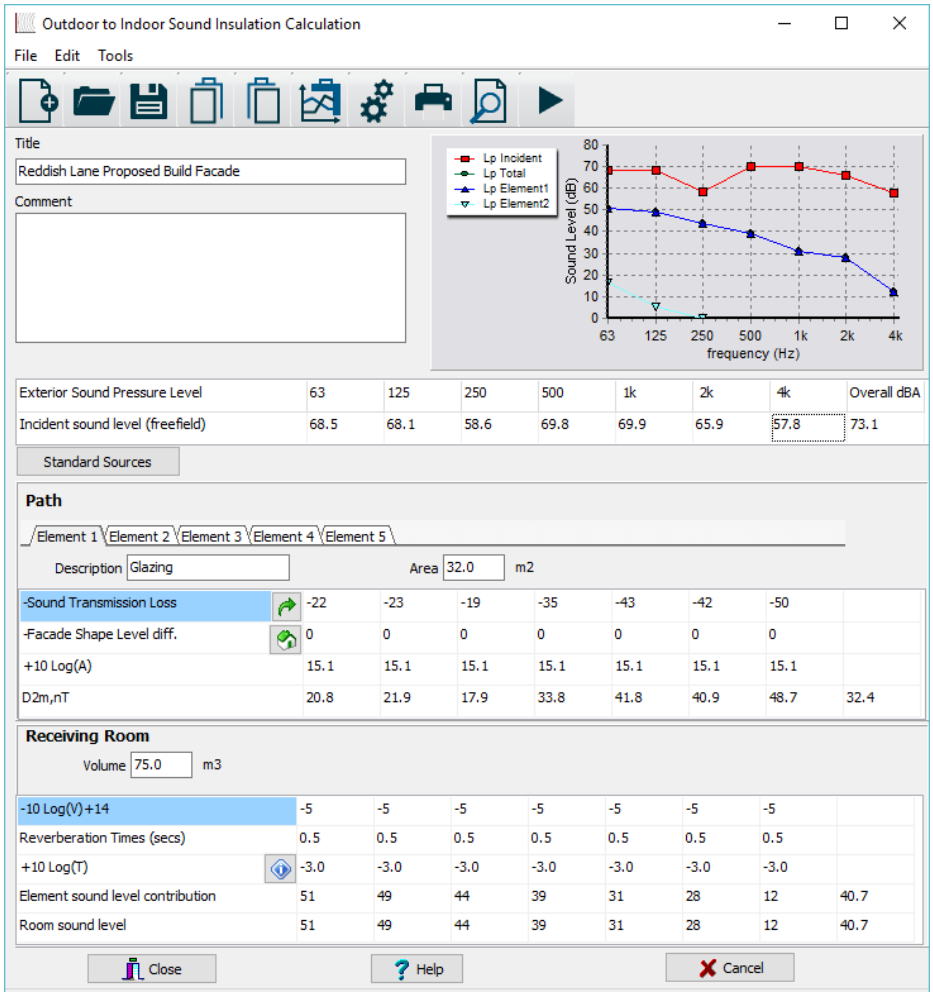
	125	250	500	1000	2000
A	53	54	52	53	55
B	0.00027	0.00133	0.00013	0.00021	0.00027
C	0.01000	0.01259	0.00126	0.00016	0.00040
D	0.00000	0.00000	0.00000	0.00000	0.00000
E	0.01667	0.02098	0.00210	0.00026	0.00066
F	-15.69730	-14.57156	-24.57156	-31.98283	-28.77121
G	-4.34036	-4.34036	-4.34036	-4.34036	-4.34036
leq2	36.2	37.9	26.5	19.3	24.9
A weight	-16	-9	-3	0	1
LAeq2	20.2	28.9	23.5	19.3	25.9
Leq2 (SN)	40.5				
LAeq2 (SN)	32.0				

APPENDIX H – Insul Calculations

Exterior to interior sound level calculations, Maxima (Ball Kick)



Exterior to interior sound level calculations, Maxima (Ball Kick)



Exterior to interior sound level calculations, LAeq 4hr, MUGA Activity period