Environmental Noise Assessment

Project No: PA114

Report Ref: LG0709163NR

Issue Date: 18th October 2016

Land Adjacent to Tenford Lane, Tean, Staffordshire

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1. Summary

1.1. Proposal

It is proposed to develop residential dwellings on land adjacent to Tenford Lane, Tean, Staffordshire, close to Tenford Dog Kennels

1.2. Reason for Assessment

The local planning authority has requested a noise assessment due to the site being within proximity of dog kennels.

1.3. Planning Conditions & Criteria

For desirable internal and external noise levels to be maintained, given in BS8233:2014 as:

- 35dB L_{Aeq} within living rooms (07:00 – 23:00)
- 30dB L_{Aeq} within bedrooms (23:00 – 07:00)
- 45dB L_{Amax} should not be regularly exceeded within bedrooms (23:00 – 07:00)
- <55dB $L_{Aeq,16hr}$ within external amenity spaces

1.4. Assessment Standards & Justification

'BS8233:2014 – Guidance on sound insulation and noise reduction for buildings' is a recognised standard for noise sensitive developments within proximity of aircraft noise. The standard gives a rigorous calculation method for determining interior noise levels based on measured environmental noise levels and typical façade specifications.

'WHO Guidelines for Community Noise, 1999' gives recommended internal noise level and gives comment on guideline noise levels based on annoyance, speech ineligibility, disturbance of information extraction, sleep disturbance and hearing impairment.

'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. The noise emitting from the Golf Club would emanate from a point source.

1.5. Measurements

In order to assess noise emissions, attended noise measurements were undertaken over a 3-hour daytime period on 6th October 2016 between 13:31-16:21 and a 1-hour night-time period on 7th October between 1:06-2:02.

Noise Measurement Summary				
Measurement	**Date**	**Period**	**LAeq (dB)**	**LAFmax (dB)**
M1	6th October 2016	Day (3hr)	**55.8**	**77.3**
M1	7th October 2016	Night (1hr)	**47.4**	**68.5**

1.6. Noise Assessment Outcome

It is determined that by using the mitigation as specified below for the building façade, the outcome summarised in the following table is achieved. This is based on the assumption that all windows are closed:

Internal Space	**Noise Parameter**	**Internal Noise Level**	**Within Desired Criteria**
Living Room	Daytime $L_{Aeq,\ 16hr}$	27.7	**Yes**
Bedroom	Night-time $L_{Aeq,\ 8hr}$	19.9	**Yes**
Bedroom	Night-time L_{AFmax}	40.3	**Yes**
External Space	**Noise Parameter**	**External Noise Level**	**Within Desired Criteria**
Amenity Space	Daytime $L_{Aeq,\ 16hr}$	41.9	**Yes**

External amenity noise levels based on the installation of acoustic fencing

1.7. Mitigation Recommendations

1.7.1. Façade Specifications within 170m of kennels

Living Rooms – 4/12/4mm glazing and heat recovery system
Bedrooms (Facing West, North and/or South) – 10/12/6mm glazing and heat recovery system
Bedrooms (Facing East) - 4/12/4mm glazing and heat recovery system

1.7.2. Façade Specifications outside of 170m from the kennels

Living Rooms and Bedrooms – 4/12/4mm glazing and hit & miss trickle ventilators

1.8. Site & Measurement Location

Measurement Location

Site Location

2. Environmental Noise Survey

2.1. Source Under Investigation

Primary noise sources identified onsite were from dogs barking from Tenford Kennels to the West and vehicle traffic from Tenford Lane to the South. Secondary noise sources were from birdsong and light aircraft.

Daytime and night-time noise measurements have been carried out on 6th and 7th October 2016

3.1. Measurement location

Noise levels were measured at the Western extent of the site, as close as possible to Tenford kennels

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**.

3.4.1. Measurement Results

Measurements were taken in October which is not representative of peak times of operation for the dog kennels. It was difficult to assess the number of dogs currently housed in kennels however it can be assumed that the kennels will most likely be close to full capacity during the summer months. Assuming the worst-case scenario of the kennels having the capacity to double the number of dogs during peak months a 3dB penalty correction can be applied to all noise levels measured.

Results of measurements are as follows:

Measured Noise Levels 6th-7th October 2016

	$L_{Aeq,\,T}$ (dB)	L_{AFmax} (dB)
Daytime (M1)	**55.8**	**77.3**
Night-time (M2)	**47.4**	**68.5**
Capacity Correction (M1)	**58.8**	**80.3**
Capacity Correction (M2)	**50.4**	**71.5**

4. BS8233:2014 Noise Assessment

4.1. Criteria

The target outcome for the assessment is for desirable internal and external noise levels to be maintained, given in BS8233:2014 as:

- 35dB L_{Aeq} within living rooms (07:00 – 23:00)
- 30dB L_{Aeq} within bedrooms (23:00 – 07:00)
- 45dB L_{Amax} should not be regularly exceeded within living rooms (23:00 – 07:00)
- <55dB $L_{Aeq,16hr}$ within external amenity spaces

4.2. External Noise Analysis

Measured noise levels are shown graphically in **Appendix E.** Both day and night-time measurements are dominated by noise emanating from the adjacent kennels as L_{Aeq} and L_{Afmax} levels follow a similar pattern. The dogs were asleep during night-time measurements until approximately 01:45 when they were woken, accounting for the sudden increase in measured L_{Aeq} and L_{Afmax} levels. During day-time measurements dogs were barking consistently throughout measurements.

4.4. 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

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

4.5. Daytime Internal Noise Levels

Considering the insulation with the addition of 4/12/4mm glazing and hit & miss trickle ventilation, daytime environmental noise would be reduced from 58.8 dB $L_{Aeq,\ 3hr}$ to interior levels of **27.7 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.

The assumed standard of construction would place the internal levels in living rooms as below 35dB $L_{Aeq,\ 16hr}$, therefore within the desirable criteria.

4.6. Night-time Internal Noise Levels

Considering the insulation with the addition of 4/12/4mm glazing and hit & miss trickle ventilators, night-time environmental noise in bedrooms would be reduced from 50.4 dB $L_{Aeq,\ 1hr}$ to interior levels of **19.9dB $L_{Aeq,\ 8hr}$**

BS8233:2014 suggests a desirable guideline of 30dB $L_{Aeq,\ 8hr}$ for sleeping conditions, with an acceptable limit of 35dB $L_{Aeq,\ 8hr}$.

The above standard of construction would place the internal continuous levels in bedrooms as below 30dB $L_{Aeq, 16hr}$

4.7. Maximum internal Noise Levels

Internal noise levels will be calculated in accordance with BS EN 12354:-3:2000 based on measured maxima, as these maxima will emanate from a point source (i.e. a dog barking). Calculations of internal maxima levels are calculated within the sound insulation modelling software Insul™ (Marshall Day Acoustics).

Considering the insulations with the addition of 4/12/4mm glazing and hit & miss trickle ventilators, night-time maximum individual noise events due to dogs barking will be reduced from 80.3 dB L_{Afmax} to **40.3dB L_{Afmax}**

For night-time maximum individual noise events due to dogs barking, internal levels will be reduced from 71.5dB L_{Afmax} to **32.4dB L_{Afmax}.**

The desirable limit of BS8233:2014 suggests Individual noise events (Measured with fast time-weighted Maximum) should not normally exceed 45dB L_{AFmax} (as in BS8233:1999).

The above standard of construction would place internal maximum noise level as below 45dB L_{AFmax}, therefore in the desirable category.

Discussion: Although it is demonstrated that desirable internal noise levels can be maintained, due to the dogs barking being the most prominent noise source on site and above the ambient noise level, the noise of dogs barking will likely be audible within the proposed dwellings.

4.8. Assessment of Internal Noise Impact

4.8.1. Impact of dog barking intermittency

Due to the cyclic nature of measurements resulting from dogs barking intermittently calculations will be made for night-time noise break-in during periods where the dogs are quiet. This will be compared to the break-in due to dog noise levels in attempt to assess the impact of intermittent dog barking.

Noise levels during periods when the dogs in the kennels were quiet were measured between 14:35-15:25 in the day-time and 01:08-01:31 at night.

The following table shows the difference in noise levels from periods where dogs are barking to periods to where they are quiet. Calculations are made assuming all windows are shut:

	Overall Internal Noise Levels	Internal Noise Level when dogs quiet	Difference
Day, dB L_{Aeq}	27.7	16.0	11.7
Night, dB L_{Aeq}	19.9	8.2	11.7
Max (Night), dB L_{Afmax}	32.4	23.0	9.4

The differences between overall internal noise levels and internal noise levels during periods where dogs are quiet are high, suggesting barking will be very noticeable in the dwellings proposed to be built close to the kennels. Overall internal noise levels are still within desirable criteria as stated in

BS8233:2014, but it should be highlighted that the intermittency of the dog barking will be noticeable and audible.

4.8.2. Effect of Open Windows

Good internal noise levels in the dwellings proposed to be built closest to the kennels are likely to be **highly reliant** on windows being closed. BS8233:2014 states that a 15dB attenuation can be applied to measured noise levels to represent internal noise levels when windows are open, however this is assuming road traffic noise. The attenuation due to road traffic noise is based upon the assumption that the noise is emanating from a line source, in the case of this report the noise emanating from dogs barking is more likely to have a more severe impact on susceptibility, therefore a 12dB attenuation is assumed.

The following table shows the levels internal noise will be when windows are open:

	Open Window Corrected Measurements	Difference from BS8233 criteria
Day, dB L_{Aeq}	46.8	11.8
Night, dB L_{Aeq}	38.4	8.4
Max (Night), dB L_{Afmax}	59.5	14.5

The following line source distance correction can be used to determine the minimum distance at which internal noise levels of the proposed dwellings will be at acceptable BS8233:2014 levels with windows opened:

$$L_{A2} = L_{A1} + 10\log (r_1 / r_2)$$

(Where L_{A2} is the BS8233 criteria level, L_{A1} is the measured level corrected for open window attenuation (-12dB), r_1 is the distance between noise source and measurement location and r_2 is the distance between the respective noise source and the location at which desirable internal noise levels can be met with windows opened)

Re-arrangement of the formula gives:

$$r_2 = r_1 / 10\text{^}((L_{A2} - L_{A1})/10)$$

Noise levels were measured approximately 10m away from the kennels.

For day-time levels measured the minimum distance will be

$$r_2 = 10/ 10\text{^}((35 - 46.8)/10)$$

$$r_2 = 90.8\text{m}$$

The following table shows the minimum distances for the day, night and max measured levels using a similar calculation as above:

	Desirable Level, dB $L_{Aeq,AFmax}$	Minimum Distance, m
Day, dB L_{Aeq}	35	90.8
Night, dB L_{Aeq}	30	41.5
Max (Night), dB L_{Afmax}	45	169.1

Considering the worst case measurement of night-time maxima due to dogs barking, the proposed dwellings located within 170m of the dog kennels will not be able to achieve BS8233 internal noise levels with their windows being open, therefore any dwelling to be built within 170m of the kennels would be reliant on having windows shut to achieve desirable internal noise levels.

4.9. Further Mitigation

4.9.1. Mechanical Ventilation

It is recommended for dwellings within 170m of the kennels utilise a mechanical ventilation system in order to maintain appropriate temperature levels in the summer months. The proposed dwellings representing areas where BS8233:2014 internal noise level criteria are unachievable are shown within the vicinity of the yellow boundary shown in **Appendix H.**

4.9.2 Bedroom Window Locations

Where possible, and most importantly on dwellings situated directly adjacent the kennels, bedroom windows should not face west and should ideally be easterly facing. This will obscure the line of sight between the bedroom windows and kennels, thus providing a further attenuation of noise emissions from the dog kennels.

4.9.3 Increased Glazing Specification on Dwellings Closest to Kennels

It is recommended that all western, northern and southern windows on dwellings situated closest to the kennels, as shown in **Appendix I**, are increased to a minimum specification of 10/12/6mm double glazing. Although it has been demonstrated that 4/12/4mm double glazing suffices for desirable internal noise levels, the noise impact of dogs barking will be higher at dwellings located closest to the kennels, therefore an increased specification should be used.

4.10. 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 $L_{Aeq,16hr}$.

External noise levels across the full daytime period (07:00 – 23:00) were measured and as **58.8 dB $L_{Aeq,16hr}$,** which is 8.8 dB above the desirable criteria and 3.8dB above the acceptable criteria.

It is recommended to install an acoustic fence around amenity areas close to Tenford kennels in order to reduce dog barking noise emissions to acceptable levels in garden areas. A 2m high acoustic fence is recommended.

A Maekawa calculation shown in **Appendix J** demonstrates that a reduction of 16.9dB is achievable with the installation of a 2m high acoustic fence for a receiver in a worst case scenario location (shown in **Appendix I**). This will reduce noise levels within amenity spaces to **41.9dB $L_{Aeq, 16hr}$,** thus reducing emissions from the dog kennels to desirable levels. It is realistic to assume that the façades of the dwellings closest to the kennels, along with the acoustic fence installation and general distance attenuation, will reduce noise emissions to acceptable levels in amenity spaces located further East from the first linear block of dwellings closest to the kennels.

The fence should meet the following criteria in order to achieve the required attenuation:

- Be a minimum density of 33kgm^{-2}.
- Be lined with a porous material, such as rockwool, to prevent sound buildup
- Have no gaps, cracks or fissures within the construct.
- Must be sufficiently solid to ensure sound waves that pass through the barrier are significantly quieter compared to sound waves that diffract over the barrier.
- Be placed as close as possible to the site boundary.

Peak Acoustic recommends Jakoustic *PLUS* fencing in order to attain the necessary barrier reductions, specifications are shown in **Appendix K.**

5. 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 $L_{Aeq, 16hr}$	27.7	'Desirable'
Bedroom	Night-time $L_{Aeq, 8hr}$	19.9	'Desirable'
Bedroom	Night-time L_{AFmax}	40.3	'Desirable'
External Space	**Noise Parameter**	**External Noise Level**	**BS8233 Classification**
Amenity Area	Daytime $L_{Aeq, 16hr}$	41.9	'Desirable'

APPENDIX A - Measurement Details

Measurement	Kit	Start Date	Start Time	End Date	End Time
M1	A3	06/10/16	13:31	06/10/16	16:21
M2	A3	07/10/16	01:06	07/10/16	02:02

APPENDIX B - Equipment Details

Kit	Equipment	Make	Model	Class	Serial Number
A3	Sound Meter	Svantek	958	1	40305
A3	Pre-Amp	Svantek	SV12L	1	41651
A3	Calibrator	Svantek	SV31	1	32507

APPENDIX C - Meteorology Details

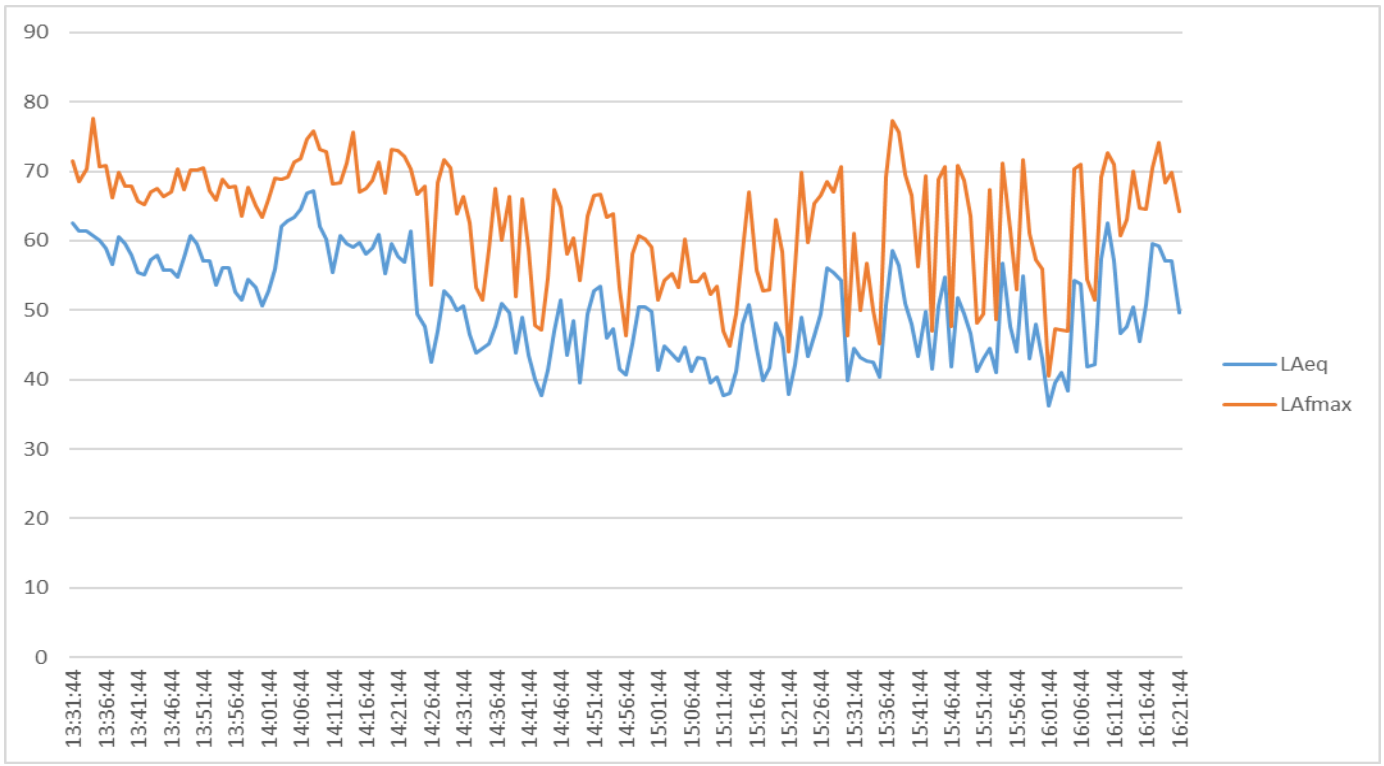
Measurement	Temp C	Wind Speed m/s	Wind Direction	Humidity %	Precipitation mm	Cloud Cover (Oktas)
M1	14	4.8	ENE	58	0.0	2/8
M2	10	3.3	N	79	0.0	Unidentifiable

APPENDIX D - Calibration Details

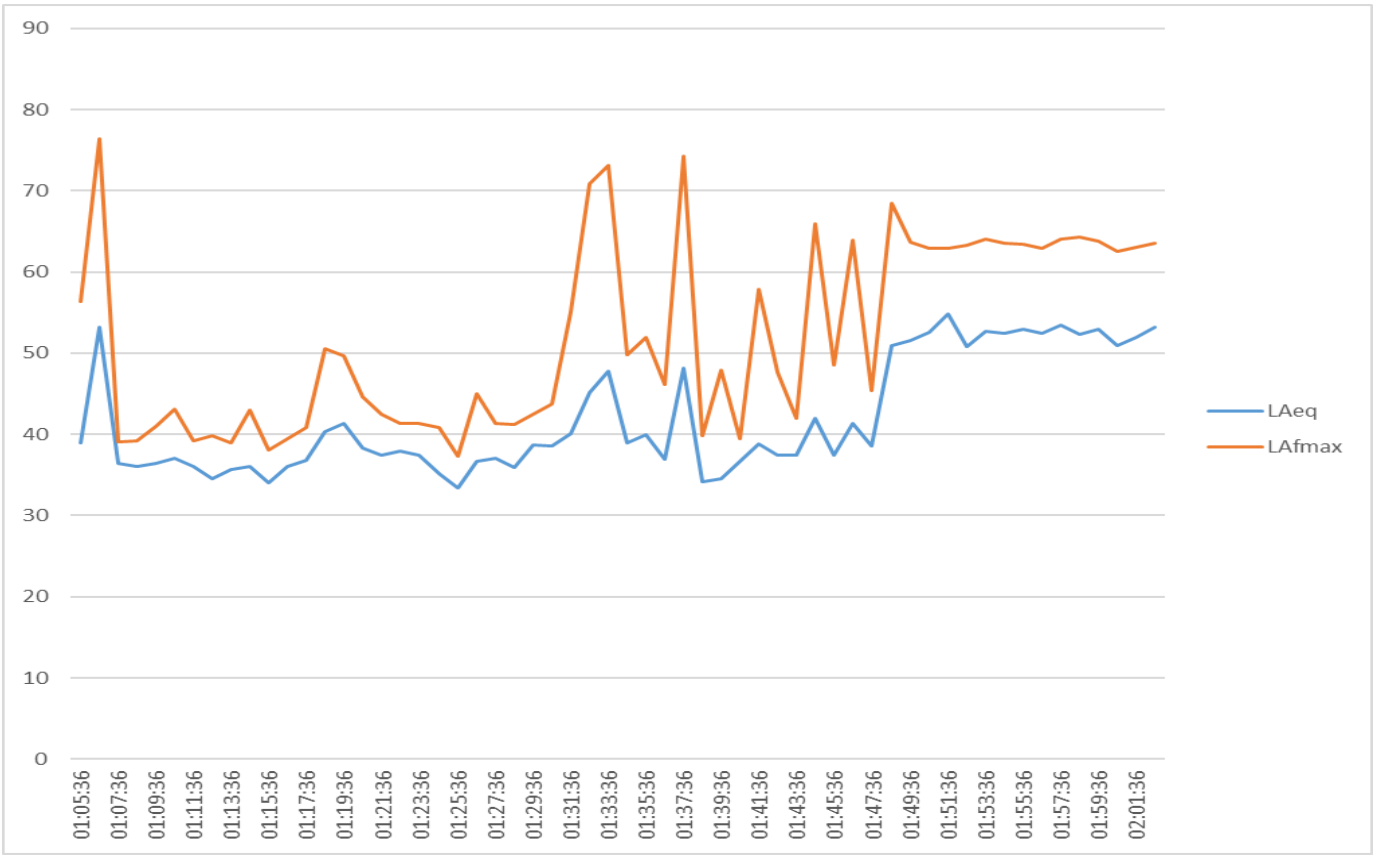
Measurement	Calibrator Ref Level (dB)	Level Before (dB)	Deviation Before (dB)	Level After (dB)	Deviation After (dB)
M1	114.0	113.53	0.47	113.44	0.56
M2	114.0	113.44	0.56	113.44	0.56

APPENDIX E – Noise Survey Results

Day-time environmental noise measurements, 6th October 2016



Night-time environmental noise measurements, 7th October 2016



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. Typical room sizes are taken from BS8233 as:

- Living room 5m x 4m x 2.4m
- Bedroom 3m x 4m x 2.4m

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
- Passive through-wall vents
- 4/12/4mm double glazing
- 10/12/6mm double 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 4/12/4mm glazing, dB (R_w)

Frequency Band (Hz)	125	250	500	1000	2000
R_w of Glazing	24	20	25	34	37

Sound Reduction Index of 10/12/6mm glazing, dB (R_w)

Frequency Band (Hz)	125	250	500	1000	2000
R_w of Glazing	26	27	34	40	38

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	47.3	43.6	54.7	52.7	45.3
Dne	34	27	37	35	34
Rwi	24	20	25	34	37
Rew	41	45	45	54	58
Rrr	27	37	43	48	52
A	16	16	16	16	16
Sf	9.6		S	10	
Sw1	1.8		A0	10	
Sew	7.8				
Srr	20.0				

	125	250	500	1000	2000
A	47	44	55	53	45
B	0.00041	0.00208	0.00021	0.00033	0.00041
C	0.00075	0.00188	0.00059	0.00007	0.00004
D	0.00006	0.00003	0.00003	0.00000	0.00000
E	0.00017	0.00007	0.00007	0.00001	0.00000
F	-28.56620	-23.93084	-30.49469	-33.81348	-33.40373
G	-2.12188	-2.12188	-2.12188	-2.12188	-2.12188
leq2	19.6	20.5	25.1	19.8	12.8
A weight	-16	-9	-3	0	1
LAeq2	3.6	11.5	22.1	19.8	13.8
Leq2 (SN)	28.1				
LAeq2 (SN)	24.7				

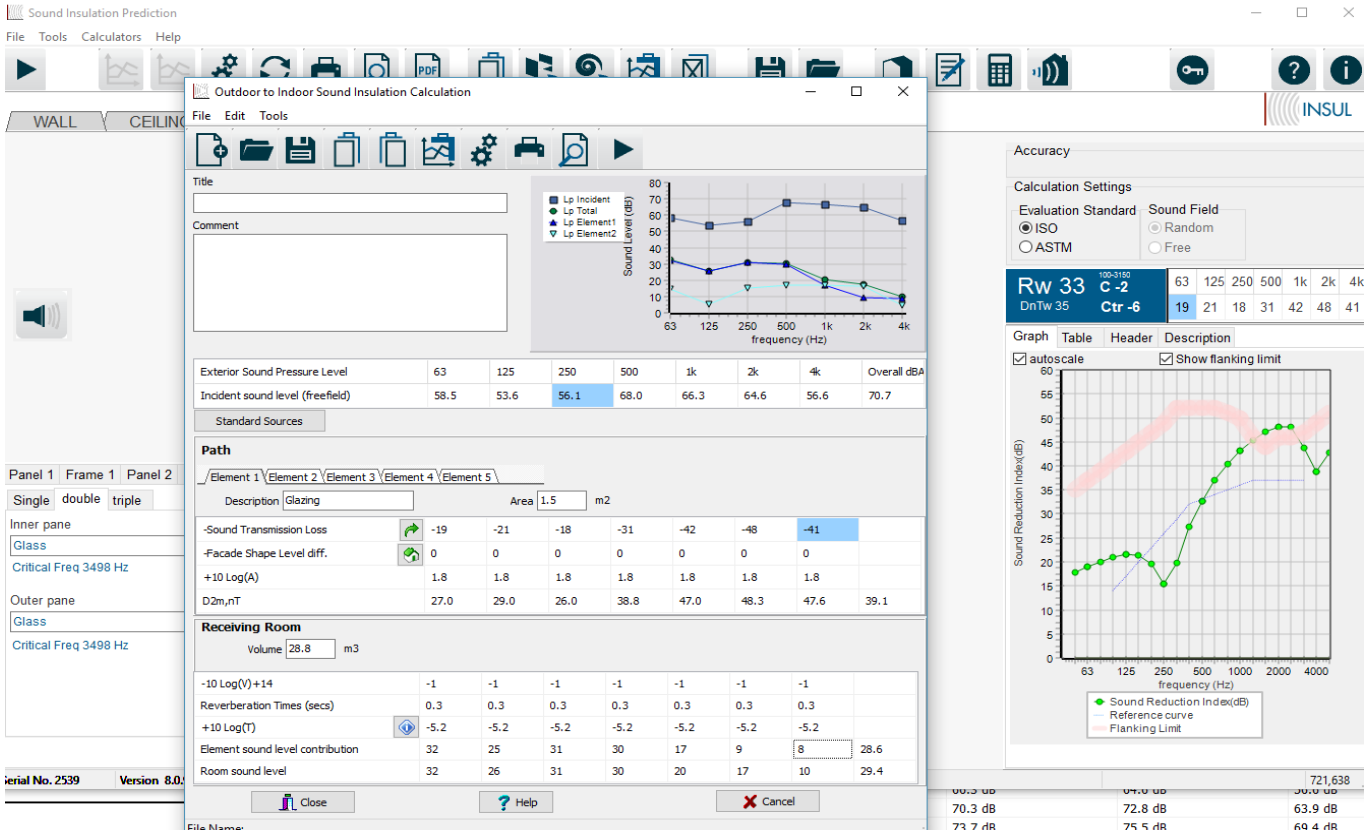
BS8233 Rigorous Design Calculation – Internal Night-time Noise

	125	250	500	1000	2000
Leq1	51.8	50.9	50.2	52.5	50.9
Dne	42	43	43	49	64
Rwi	20	19	29	38	34
Rew	41	45	45	54	58
Rrr	27	37	43	48	52
A	16	16	16	16	16
Sf	9.6		S	10	
Sw1	1.5		A0	10	
Sew	8.1				
Srr	12.0				

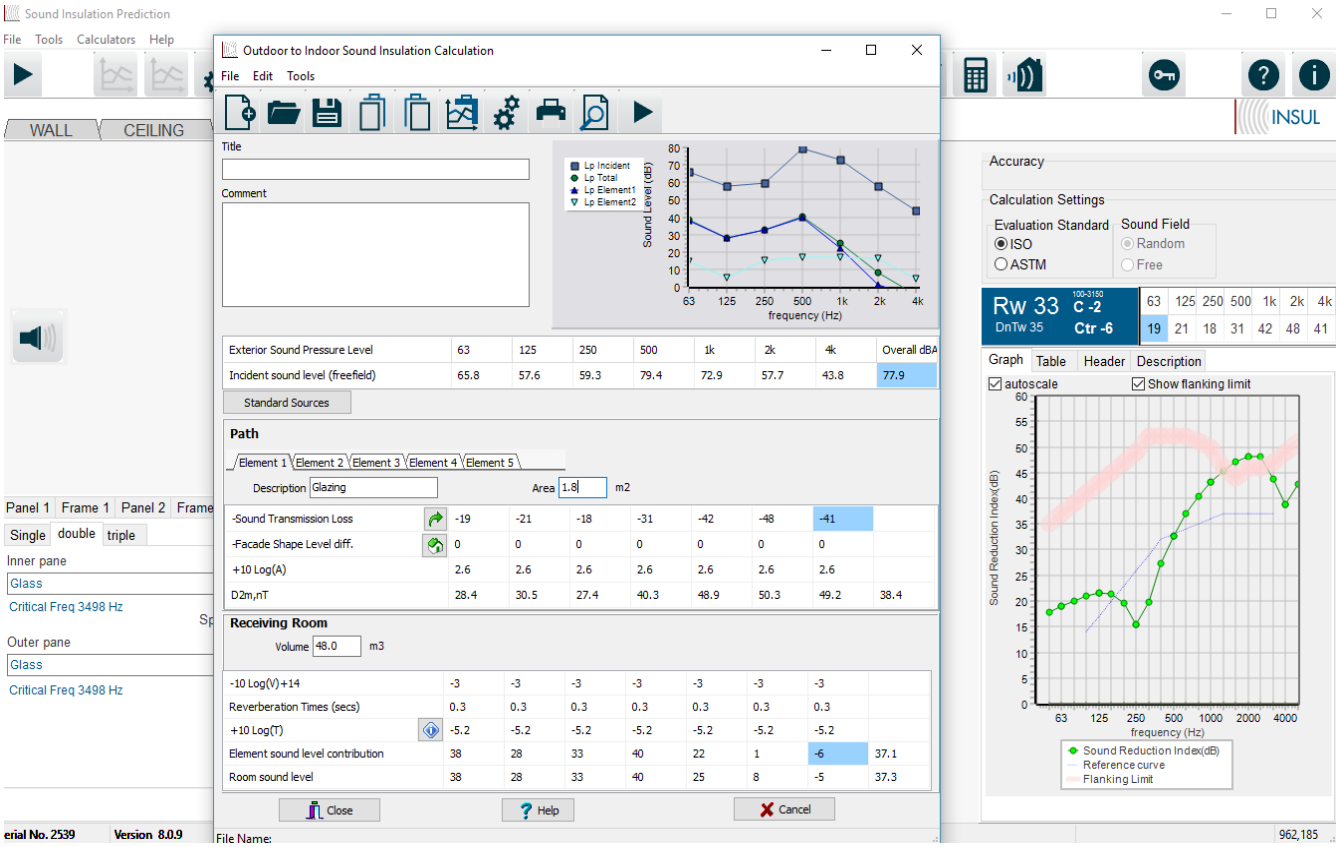
	125	250	500	1000	2000
A	37	39	48	44	33
B	0.00041	0.00208	0.00021	0.00033	0.00041
C	0.00062	0.00156	0.00049	0.00006	0.00003
D	0.00007	0.00003	0.00003	0.00000	0.00000
E	0.00010	0.00004	0.00004	0.00000	0.00000
F	-29.19716	-24.30965	-31.14551	-33.98001	-33.47571
G	-2.12188	-2.12188	-2.12188	-2.12188	-2.12188
leq2	9.1	15.2	18.1	10.5	0.3
A weight	-16	-9	-3	0	1
LAeq2	-6.9	6.2	15.1	10.5	1.3
Leq2 (SN)	20.7				
LAeq2 (SN)	16.9				

APPENDIX H – Insul™ Calculations of internal maxima levels

Night-time maxima



Day-time maxima



Appendix I – Proposed development plan, with recommendations

Boundary for dwellings to have mechanical ventilation installation

10/12/6mm double glazing required

2m Acoustic fence recommendation

Worst case receiver location for barrier attenuation calculation

Appendix J – Barrier attenuation calculations

Frequency (Hz)	31.5	63	125	250	500	1000	2000	4000	8000
Wavelength (m)	10.889	5.444	2.744	1.372	0.686	0.343	0.172	0.086	0.043
Fresnel No.	0.094	0.189	0.375	0.749	1.498	2.997	5.993	11.986	23.972
Δbarrier (dB)	6.9	8.3	10.2	12.5	15.2	18.0	20.9	23.9	26.8
LAeq source noise (dB)	**13.3**	**25.2**	**31.2**	**35.0**	**51.5**	**52.7**	**46.5**	**39.5**	**37.1**
Attenuated Level	6.4	16.9	21.0	22.5	36.3	34.7	25.6	15.6	10.3
Insertion Loss	16.9								
Path Difference (m)	**0.5139**								
Source Height (m)	1								
Receiver Height (m)	6.8								
Barrier Height (m)	2.2								

Appendix K – Acoustic Fence specifications

Jakoustic PLUS

Acoustic Fencing | Jacksons Security

Jacksons Fencing
Stowting Common | Ashford | TN25 6BN
www.jacksons-security.co.uk
+44 (0) 1233 750 393

Jacksons
Quality that lasts
Fencing & Access Solutions

Applications

✓ Residential ✓ Commercial ✓ Medium Risk ✓ Schools ✓ Sports Venues

An absorptive layer, covered with a plastic membrane is incorporated on one side of the boards to futher reduce noise by an average of 4dB.

Distance from noise source	2.0m fence	2.5m fence	3.0m fence
	Noise reduction		
5m	17.6dB	20.5dB	21.4dB
10m	14.3dB	17.5dB	18.1dB
15m	14.3dB	16.5dB	16.9dB
20m	13.2dB	15.9dB	16.4dB

Features

- Up to 32dB reduction in noise*
- Can accommodate changes in level or profile
- Unique timber tuning forks
- Additional absorptive layer covered by a protective membrane

*Jakoustic barrier certified laboratory results:
Rating according to BS EN 1793 - 2:1998
Category = B3
BS EN 1793-1:1998
Category = A3
Laboratory sound reduction 32dB
Supperficial mass 33 kg/m2

25 YEARS GUARANTEE

Reflective