soundtesting
acoustic consultancy & air leakage specialists

Environmental Noise Survey Report

7 Warwick Court
Holborn
London
WC1R 5DJ

Date of Survey: Saturday 22nd August & Sunday 23rd August 2015

Date of Report: Tuesday 25th August 2015

Reference: 7338E Rev 2

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1.0 General Information

1.1 Site Address

7 Warwick Court
Holborn
London
WC1R 5DJ

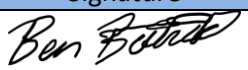
1.2 Client Instructing Survey

Marek Wojciechowki Architects
66-68 Margaret Street
London
W1W 8SR

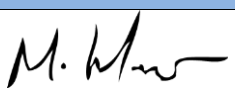
1.3 Date of Noise Survey

Saturday 22nd August & Sunday 23rd August 2015

1.4 Survey Consultant

	Name	Position	Signature	Date
Prepared by	Ben Bielicki BSc AMIOA	Acoustic Engineer		03/09/15
For and on behalf of: Soundtesting.co.uk Ltd				

1.5 Report Approval

	Name	Position	Signature	Date
Report Approval	Martin Hamer AMIOA	Acoustic Engineer		03/09/15
For and on behalf of: Soundtesting.co.uk Ltd				

2.0 Introduction

It is proposed to convert existing offices at 7 Warwick Court, a Grade II listed building located in the London Borough of Camden, into four residential dwellings spread across five floors. Marek Wojciechowski Architects have requested a noise survey in order to assess the impact of external noise sources on the new development, and in addition, the impact of noise from proposed plant on neighbouring properties. We are informed by Marek Wojciechowki Architects that it's likely that four air conditioning units will be located on the roof and one in the lightwell.

2.1 An Environmental Noise Assessment

Soundtesting.co.uk Ltd carried out an environmental noise assessment in order to evaluate the noise impact of the new air conditioning units on the nearest noise sensitive dwellings and surrounding area. Background noise levels were measured at the rear of 7 Warwick Court over a twenty-four hour period in order to evaluate the existing noise climate. The background levels measured on Saturday 22nd August & Sunday 23rd August 2015 at 7 Warwick Court will be used to assess the new plant.

This report will show the noise impact from the new plant on the nearest noise sensitive dwellings. Reference will also be made to the guidance contained within BS4142:2014, *Methods for rating and assessing industrial and commercial sound*.

The report will also state the measured noise levels between Saturday 22nd August & Sunday 23rd August 2015 at the front and rear of the building, and will refer to guidance contained within BS8233:2014, Sound Insulation and Noise Reduction for Buildings and WHO Community Noise Guidelines for recommended internal noise levels within living spaces.

At the time of the survey there was an active building site next door to the development; therefore to avoid any additional noise, the survey was carried out over the weekend. We were informed there would be no mechanical operations during the measurement period.

3.0 Assumptions & Limitations

a. All suggested specifications require a good level of workmanship and for materials to be installed as the manufacture intends. Any poor workmanship may lead to weaknesses in the sound attenuation provided at the building façade.
b. The report assumes that the noise levels measured on site during the environmental noise survey are typical of the site.
c. It is believed that drawings and information supplied by Marek Wojciechowki Architects are up to date and correct.
d. The report assumes that the technical data supplied by Mitsubishi is correct.
e. At the time of writing this report, it was our understanding that Marek Wojciechowki Architects had not yet decided on the specific locations of the air conditioning units.

4.0 Criteria

The criteria listed below are taken from associated relevant guidance documents, all of which should be considered for the internal and external noise levels.

4.1 BS4142:2014 Method for Rating and Assessing Industrial and Commercial Sound

This British Standard describes methods for rating and assessing sound of an industrial and/or commercial nature.

The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background level and the context in which it occurs.

a) Typically, the greater this difference, the greater the magnitude of the impact.
b) A difference of around +10dB or more is likely to be an indication of significant adverse impact, depending on context.
c) A difference of around +5dB is likely to be an indication of an adverse impact, depending on context.
d) The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or significant impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on context.

4.2 BS8233:2014 Sound Insulation and Noise Reduction for Buildings

BS 8233:2014 Sound Insulation and Noise Reduction for Buildings – Code of Practice suggests the following noise levels:-

Table 1: BS 8233:2014 Recommended Internal Noise Levels

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living Room	35 dB $L_{Aeq,16hour}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16hour}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$

Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline may be set in terms of SEL or L_{AFmax} depending on the character and number of events per night. Sporadic noise events could require separate values.

4.3 WHO Community Noise Guidelines

Table 2: A summary of the guidance noise levels can be found below:

Specific Environment	Critical Health Effect (s)	L_{Aeq} (dB)	Time base (hours)	L_{AFmax} (dB)
Outdoor living area	Serious annoyance, daytime and evening	55	16	-
	Moderate annoyance, daytime evening	50	16	-
Dwelling, indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	16	-
Inside bedrooms	Sleep disturbance, night-time	30	8	45
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	8	60

Table 2 – (ref: WHO Community Noise Guidelines)

4.4 Criteria Summary

The sound pressure levels of the new air conditioning units will be compared to the existing measured background noise levels in order to identify any potential noise problems. All recommendations will be made in order to meet the criteria of BS4142:2014.

The measured $L_{Aeq,T}$ levels between 07:00 on Saturday 22nd August & 07:00 on Sunday 23rd August 2015 will be compared to BS8233:2014 and WHO Community Noise Guidelines in order to assess the internal noise levels within bedrooms and living rooms during this period.

5.0 Site Description

The front of the building faces southwest on to Warwick Court, which is a pedestrianised street that runs in a northerly direction, perpendicular to High Holborn A40.

The rear façade is in close proximity with the rear of the buildings situated on Fulwood Place.

The building consists of five stories, with offices on the ground floor. The building also has a basement level. At the time of the survey, the first to third floors were unoccupied.

It is understood that four of the new air conditioning units are to be installed on the roof and one within the internal lightwell.

During site attendance, subjectively the dominant noise source at the rear was mainly existing air conditioning units on neighbouring buildings, as well as frequent aircraft noise. At the front of the building some distant traffic noise was also audible, such as car horns and occasional sirens.

At the time of the survey, some construction work was being carried out on a nearby building.

6.0 Noise Measurement Procedure

Personnel Present

Martin Hamer AMIOA

Ben Bielicki BSc AMIOA

6.1 Survey Equipment Used

Table 3

Manufacturer	Model	Serial No.	Description
Rion	NL52	01032413	Real Time Analyser Sound Level Meter
Rion	NA28	00211583	Real Time Analyser Sound Level Meter
Rion	NC74	35125832	Calibrator

Calibration

The sound level meter was calibrated with the field calibrator, to a level of 94.0 dB @ 1 kHz, prior to the commencement and on the completion of the survey in accordance to the manufacturer's instructions. No significant drift in calibration was observed. The meters used during the survey are precision grade class 1.

Calibration certificates are available by request.

6.2 Weather Conditions

During the measurement period; the sky was clear and sunny, with high temperatures around 27^0C during the daytime and 21^oC at night. Wind speed was around 4.5ms^{-1} blowing in a north-westerly direction, both during the day and night.

6.3 Noise Measurement Procedure

The sound level meters were set to measure L_{A90}, L_{Aeq} and L_{AFmax} in 5 minute periods, as well as A-weighted 1:1 and 1:3 octave spectrum analysis in order to identify any tonal characteristics of the noise.

Data charts can be found in the appendix.

Position 1

A microphone was positioned on the second floor at the rear façade of the development. The microphone was set on a pole 1m from the façade and approximately 8m from the ground.

Measurements were carried out in $L_{Aeq,\ 5minute}$ periods.

Position 2

A microphone was positioned on the first floor at the front façade of the development. The microphone was set on a pole 1m from the façade and approximately 5m from the pavement surface.

Measurements were carried out in $L_{Aeq,\ 5minute}$ periods.

WAV audio recordings were made in order to identify sound events that exceeded 75dB.

7.0 BS8233:2014 Assessment

Analysis of measured data, predictions of internal noise and glazing recommendations.

7.1 Measurement Analysis

Table 4 presents the measured results as a quick comparison in order to analyse the results.

Table 4: Comparison Chart

Monitoring position	Time Period	Time Base T (hours)	$L_{Aeq,T}$ (dB)	L_{AFmax} (dB)	L_{A90} (dB)	L_{A10} (dB)
1	Daytime	16	53.8	-	44.1	49.5
1	Night time	8	43.8	43.4 – 61.2	42.8	44.3
2	Daytime	16	68.6	-	49.0	61.3
2	Night time	8	52.2	58.2 – 73.6	46.2	55.4

Position 1 L_{AFmax} Night time (23:00 – 07:00)

At position 1; the L_{AFmax} measured during the night time period (23:00-07:00) has been analysed. It is noted that the maximum measured L_{AFmax} is 61.2dB, which occurs at 05:55. L_{AFmax} 60dB was exceeded only once during the night time period, and 50.0dB was exceeded sixteen times.

Position 2 L_{AFmax} Night time (23:00 – 07:00)

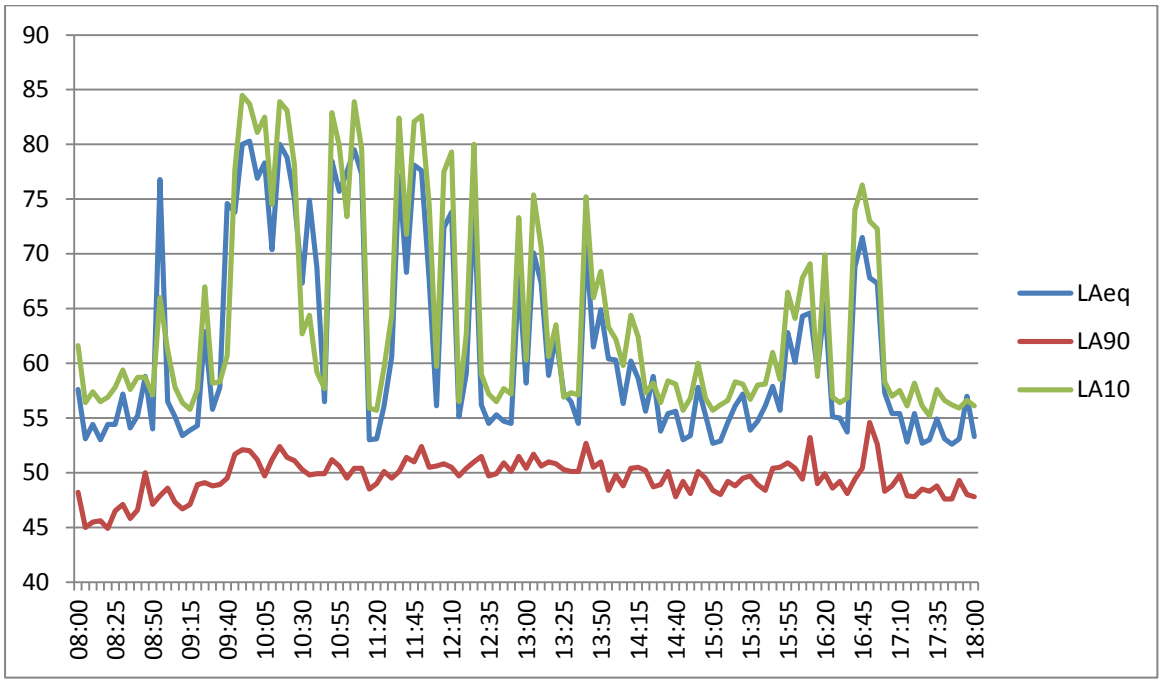
At position 2; the L_{AFmax} measured during the night time period (23:00-07:00) has been analysed. It is noted that the maximum measured L_{AFmax} is 73.6dB, which occurs at 03:30. L_{AFmax} 70dB is exceeded only once during the night time period, and 60.0dB is exceeded ninety one times.

There are no WAV audio file recordings for the night time as 75dB was not exceeded during this period.

Daytime Audio WAV File Recordings

It has been observed there are high levels of noise activity between the hours of approximately 09:00 and 17:00 at both measurement positions. The WAV file audio recordings during this period demonstrate there was use of what sounds like an electric saw. The following chart shows the high levels during this period.

Position 2 levels between 08:00 and 18:00



7.2 Recommendations

The external noise measurements in Table: 5 have been used as the starting point of the calculations of the predicted internal noise levels, within the flats.

We understand that Marek Wojciechowki Architects are planning to retain the existing single glazing and intend to install a secondary glazing.

7.3 Internal Bedrooms and Living Rooms/Kitchens on the Front and Rear Façades

Based on the $L_{Aeq,T}$ and $L_{AFmax,T}$, measurements between 07:00 on Saturday 22nd August & 07:00 on Sunday 23rd August 2015; the existing glazing, assumed to be 4mm single glazed units, will provide the necessary attenuation to achieve the requirements for BS8233:2014 and WHO Community Noise Guidelines.

Passive ventilation is not required as mechanical ventilation and air conditioning is to be installed.

7.4 Notes on Ventilation

The glazing and ventilation suggestions have been calculated assuming the window is tightly closed. However it must be noted that windows are suggested to be openable to provide rapid or purge ventilation or means of escape.

7.5 Calculation Methodology

The BRE Building Envelope Insulation calculator has been used for all noise break-in calculations.

In order to calculate the glazing recommendations, the values have had a façade correction of 3dB applied in order to adjust the measurement so that it is comparable to a free-field sound pressure level.

The calculations and predicted levels are based on the external façade being 200mm solid brick.

INSUL modelling software by Marshall Day Acoustics has been used to model the brick wall elements used in the calculations. A correction of 3dB has been applied to allow for margin of error.

The calculations have been made for ground floor bedroom 1 and second floor living room/kitchen, on the front façade; and for ground floor bedroom 2, on the rear façade. All room dimensions are based on drawings provided by Marek Wojciechowski Architects.

The calculations assume bedrooms and living rooms have a reverberation time of Rt 0.5s.

The predictions also have been calculated assuming the windows are tightly closed.

7.6 Building Elements

Table 5: Table Showing Expected Performance of Existing Glazing and Walls

Element	Description[#]	$R_w/D_{n,e,w}$ (dB)	Octave Centre Frequencies (Hz) SRI / $D_{n,e}$ (dB)					
			125	250	500	1k	2k	4k
Glazing	4mm Single Glazing (BRE)	-	20	22	28	32	33	-
Wall	200mm Solid Brick (INSUL)	54	38	42	50	58	64	68

Table 6: Expected Performance after Recommended Glazing & Ventilation

Measurement Position		Measured External		Predicted Internal	
		Average $L_{Aeq,T}$ (dB)	L_{AFmax} (dB)	$L_{Aeq,T}$ (dB)	L_{AFmax} (dB)
Front Façade, Ground Floor, Bedroom I	Daytime	68.6	-	26.6	-
	Night time	52.2	-	17.9	-
	L_{AFmax}	-	73.6	-	42.6
Rear Façade, Ground Floor, Bedroom II	Daytime	53.8	-	18.3	-
	Night time	43.8	-	9.5	-
	L_{AFmax}	-	61.2	-	27.6
Front Façade, Second Floor, Living Room/Kitchen	Daytime	68.8	-	26.3	-

8.0 BS4142:2014 Assessment

Analysis in accordance with BS4142:2014

8.1 Background Levels

Table 7 Daytime Values of $L_{A90, 1hour}$

Time	Saturday 22nd $L_{A90, 1hour}$ (dB)
07:00 – 08:00	43.3
08:00 – 09:00	43.5
09:00 – 10:00	43.9
10:00 – 11:00	44.4
11:00 – 12:00	44.1
12:00 – 13:00	44.7
13:00 – 14:00	44.4
14:00 – 15:00	44.5
15:00 – 16:00	44.0
16:00 – 17:00	44.2
17:00 – 18:00	44.3
18:00 – 19:00	43.5
19:00 – 20:00	43.5
20:00 – 21:00	43.7
21:00 – 22:00	45.0
22:00 – 23:00	44.3

Table 7 shows the $L_{A90, 1hour}$ background measurements taken during the 16 hour daytime period on Saturday 22nd August 2015 and shows the lowest L_{A90} to be 43dB.

Table 8: Night Time Mode Values of $L_{A90, 15 minute}$

$L_{A90,15minute}$ (dB)	41	42	43	44	45
Number of Occurrences	2	15	5	6	4

Table 8 shows the frequency of the $L_{A90, 15 minute}$ values in single figures and demonstrates that $L_{A90,15minute}$ 42dB is actually the mode which occurs 15 times, and the lowest L_{A90} 41dB only occurs twice. Therefore $L_{A90,15minute}$ 42dB will be used for the purposes of the BS4142 assessment.

Table 9: Selected L_{A90} measured values at the rear of the building

Monitoring position	Time Period	Time Base T (L_{A90})	Time	Mode	L_{A90} (dBA)
Position 1	Daytime	1 hour	07:00 – 08:00	-	43
Position 1	Night time	15 minutes	-	15	42

The selected L_{A90} can be used to compare with the acoustic data for the air conditioning units.

8.2 Acoustic Data of Air Conditioning Units

Table 10: Sound Pressure Levels of Intended Air Conditioning Units

Type	Operation	Sound Pressure Level (dBA)	Sound Power Level (dBA)
Mitsubishi MXZ-3D54VA2	Heating	53	64
	Cooling	50	
Mitsubishi MXZ4D72VA	Heating	53	64
	Cooling	50	

It is understood that the AC units will be used for both heating and cooling.

8.3 Assessment of the Mitsubishi Air Conditioning Units

As the air conditioning unit locations are currently unknown, the following calculations have been carried out without any distance attenuation. The calculations assume that the air conditioning units are standing freely on the roof surface and not against walls or any other reflecting surfaces.

Table 11 shows the calculated sound pressure levels of the air conditioning Units compared to L_{A90} background when heating.

Table 11: Results Demonstrating the Current Noise Levels of the Units Operating on Heating

	Mitsubishi MXZ-3D54VA2		Mitsubishi MXZ4D72VA	
	Daytime	Night Time	Daytime	Night Time
Sound Pressure Level (dBA)	53	53	53	53
Acoustic Feature Correction for Tonal Characteristics	+5	+5	+5	+5
Rating Level (dBA)	58	58	58	58
Background Level L_{A90} (dBA) – 3dB façade correction	40	39	40	39
Excess of Rating Level over Background.	18	19	18	19

Table 11 demonstrates that when any given unit is heating; the rating level will be at least 18dB over the daytime background level and at least 19dB over the night time background level.

Table 12: Demonstrating Noise Levels when Multiple Air Conditioning Units are in Operation

	Total of 4 x Air Conditioning Units	
	Daytime	Night Time
Sound Pressure Level (dBA) for a total of 4 x AC Units	59	59
Acoustic Feature Correction for Tonal Characteristics	+5	+5
Rating Level (dBA)	64	64
Background Level L_{A90} (dBA) – 3dB façade correction	40	39
Excess of Rating Level over Background.	24	25

Table 12 demonstrates that when all four air conditioning units are in operation on the roof, the rating level will be at least 24dB over the daytime background level and at least 25dB over the night time background level.

8.4 Analysis Summary

The results demonstrate that when a single air conditioning unit is in operation, there is a difference of +18dB or more above background and when up to four multiple units are in operation, there is a difference of +24dB or more above background, therefore it is "likely to be an indication of significant adverse impact".

8.5 Recommendations

In order to reduce the net noise level of the new Mitsubishi air conditioning units; an acoustic enclosure should be installed around each unit.

Tables 13 and 14 demonstrate the difference between the rating level and background level when acoustic enclosures have been installed to the new Mitsubishi units. The calculations have been carried out using an Environlite ELV1.125ASHP Acoustic Enclosure; providing an overall transmission loss of 26dB.

Table 13: Results Demonstrating the Current Noise Levels of a Single Air Conditioning Unit Compared to BS4142:2014 after an Acoustic Enclosure Has Been Installed.

	Mitsubishi MXZ-3D54VA2		Mitsubishi MXZ4D72VA	
	Daytime	Night Time	Daytime	Night Time
Sound Pressure Level (dBA)	53	53	53	53
Acoustic Feature Correction for Tonal Characteristics	+5	+5	+5	+5
Enclosure Attenuation	-26	-26	-26	-26
Rating Level (dBA)	32	32	32	32
Background Level L_{A90} (dBA) – 3dB façade correction	40	39	40	39
Excess of Rating Level over Background.	-8	-7	-8	-7

Table 14: Results Demonstrating the Current Noise Levels for a Total of Four Air Conditioning Units Compared to BS4142:2014 after an Acoustic Enclosure Has Been Installed.

	Total of 4 x Air Conditioning Units	
	Daytime	Night Time
Sound Pressure Level (dBA)	59	59
Acoustic Feature Correction for Tonal Characteristics	+5	+5
Enclosure Attenuation	-26	-26
Rating Level (dBA)	38	38
Background Level L_{A90} (dBA) – 3dB façade correction	40	39
Excess of Rating Level over Background.	-2	-1

It should be noted that the calculations for the Mitsubishi MXZ-3D54VA2 and Mitsubishi MXZ4D72VA air conditioning units demonstrate that, when an acoustic enclosure is in operation, "this is an indication of the specific sound source having a low impact", in accordance with BS4142:2014.

8.6 Context

It should be noted that this assessment has been based on a weekend background level and not during an average working day. It's probable that during a 'working' day the background levels are higher and therefore reducing the difference between the Specific Level and Background Level.

There has been a +5dB acoustic feature correction for tonal characteristics applied to the calculations. Third octave data cannot be provided by Mitsubishi and in our experience air conditioning units can show tonal characteristics, therefore 5dB has been added to demonstrate worst case, however, if a model of the same specification can be measured; third octave measurements may prove otherwise.

8.7 Uncertainty

While every endeavour has been taken to ensure the accuracy of measurements and subsequent calculations, all acoustic measurements and assessments are subject to a degree of uncertainty.

9.0 Conclusions

If the recommendations are followed, the external noise levels from the Mitsubishi MXZ-3D54VA2 and Mitsubishi MXZ4D72VA air conditioning units; when a total of four units are in operation; will provide rating levels at the nearest noise sensitive receptors more than 1dBA below the current worst case day time background noise level. “Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact”, in accordance with BS4142:2014.

The suggested glazing in the recommendations section demonstrates that the predicted internal noise levels described in BS8233:2014 and WHO Noise Guidelines can be achieved for all bedrooms and living rooms.

10.0 References

BS4142:2014 Methods for rating and assessing industrial and commercial sound

BS8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings

World Health Organisation Guidelines for Community Noise: 1999

BS 7445-1: 2003 Description and measurement of environmental noise – Part 1: Guide to quantities and procedures

www.google.co.uk/maps

10.1 Drawing References

P_01 Demolition & Proposed Ground Floor Plan

P_02 Demolition & Proposed Basement Plan

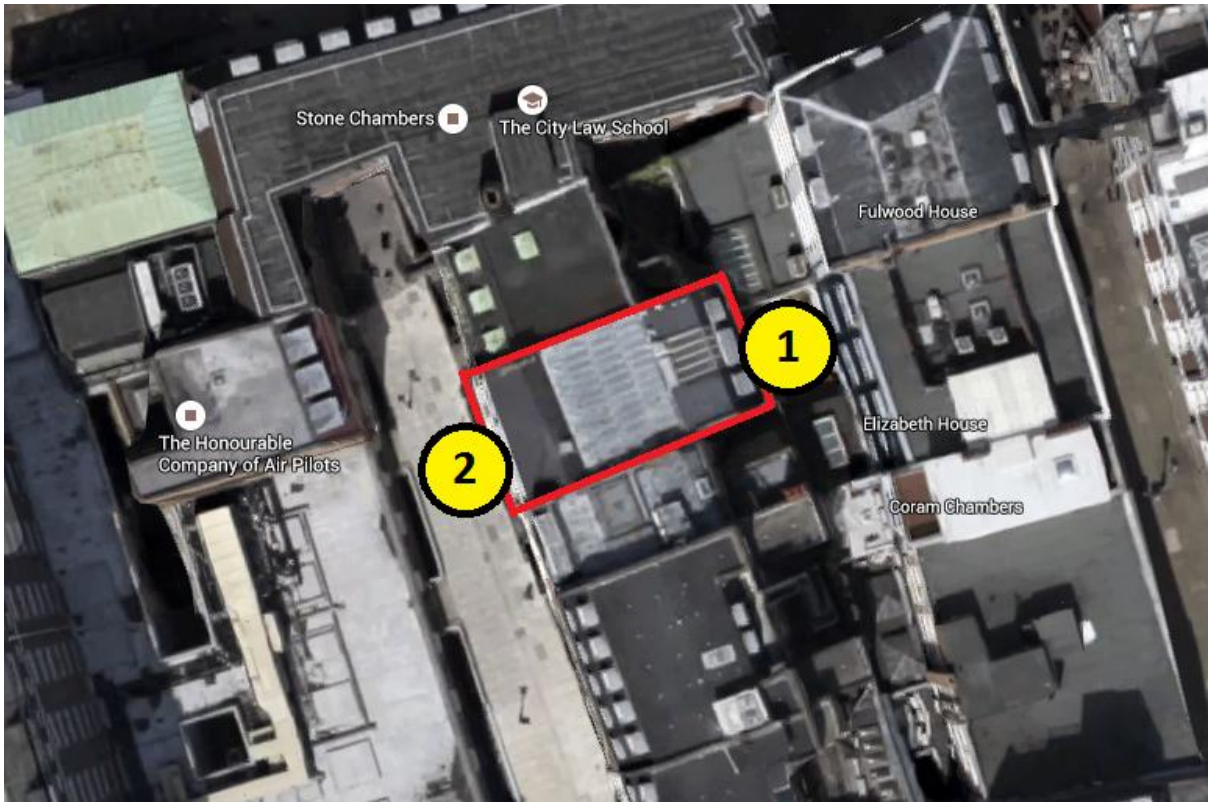
P_03 Demolition & Proposed First Floor Plan

P_04 Demolition & Proposed Second Floor Plan

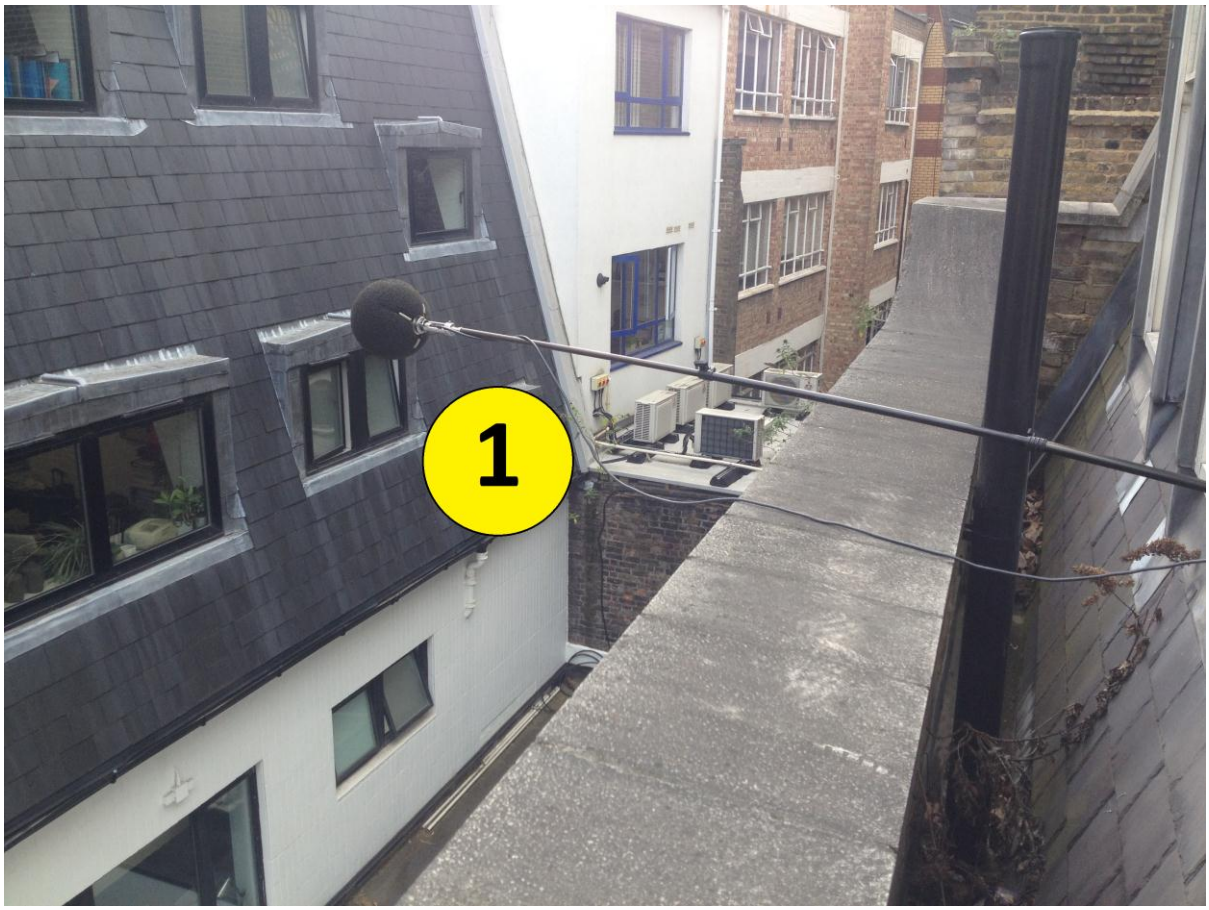
P_05 Demolition & Proposed Third Floor Plan

Appendix

Aerial View of 7 Warwick Court Showing Measurement Positions



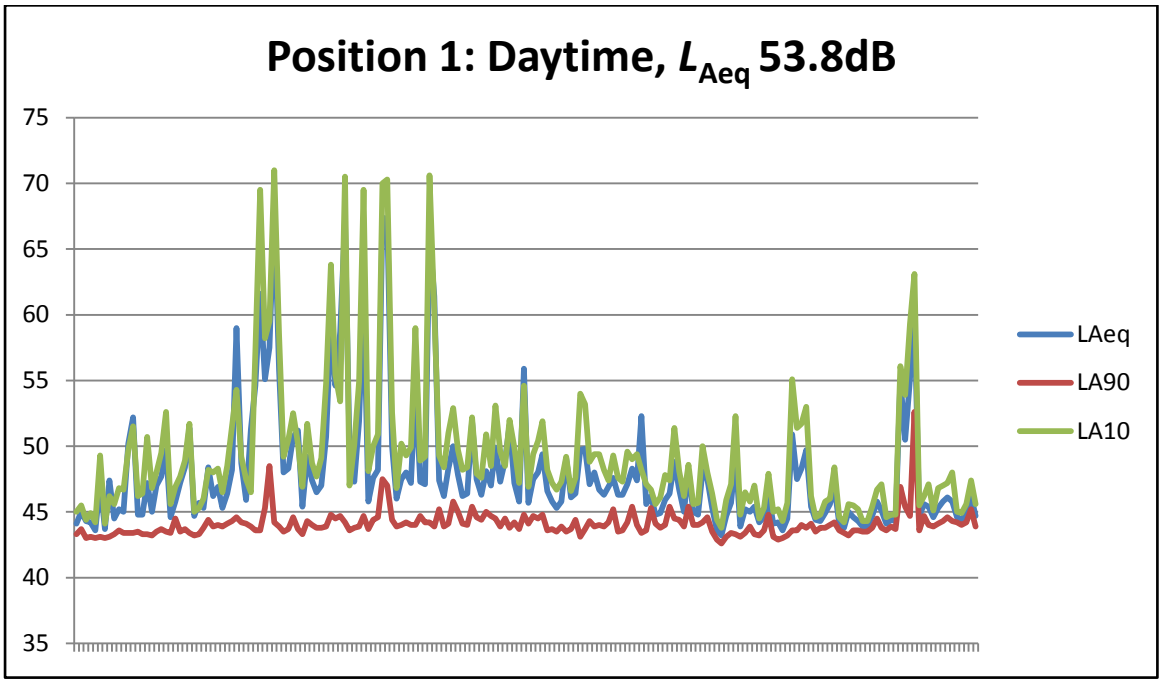
Measurement Position 1 – Rear Façade, Showing Plant on Nearby Buildings

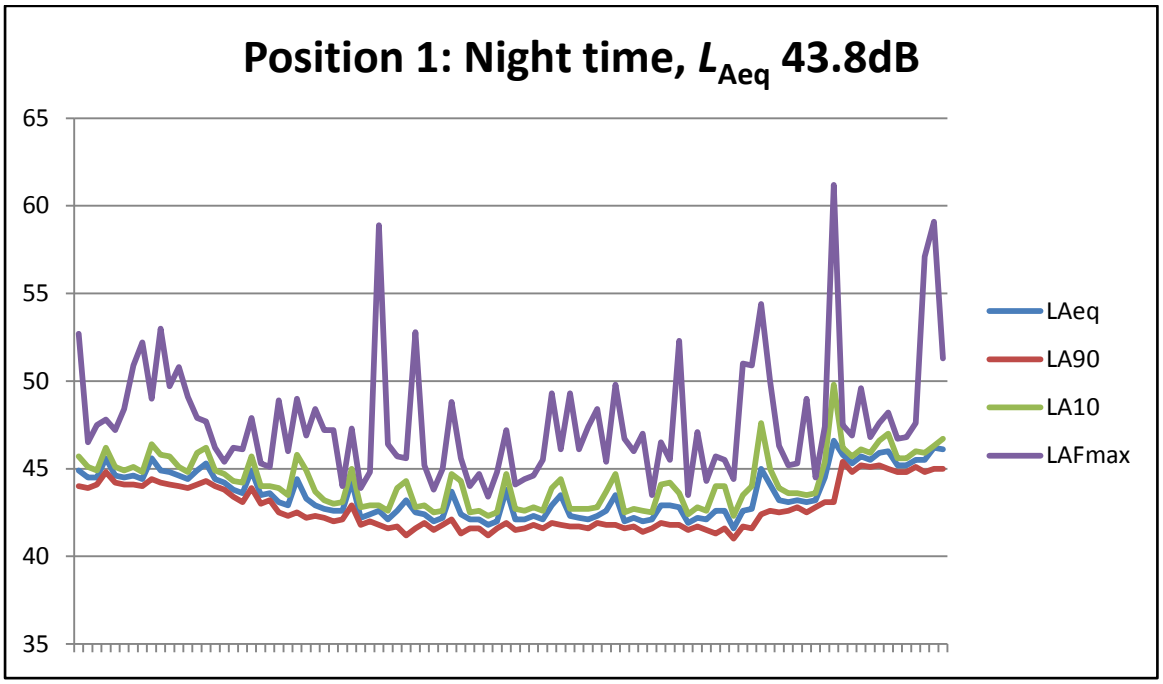


Measurement Position 2 – First Floor, Front Façade

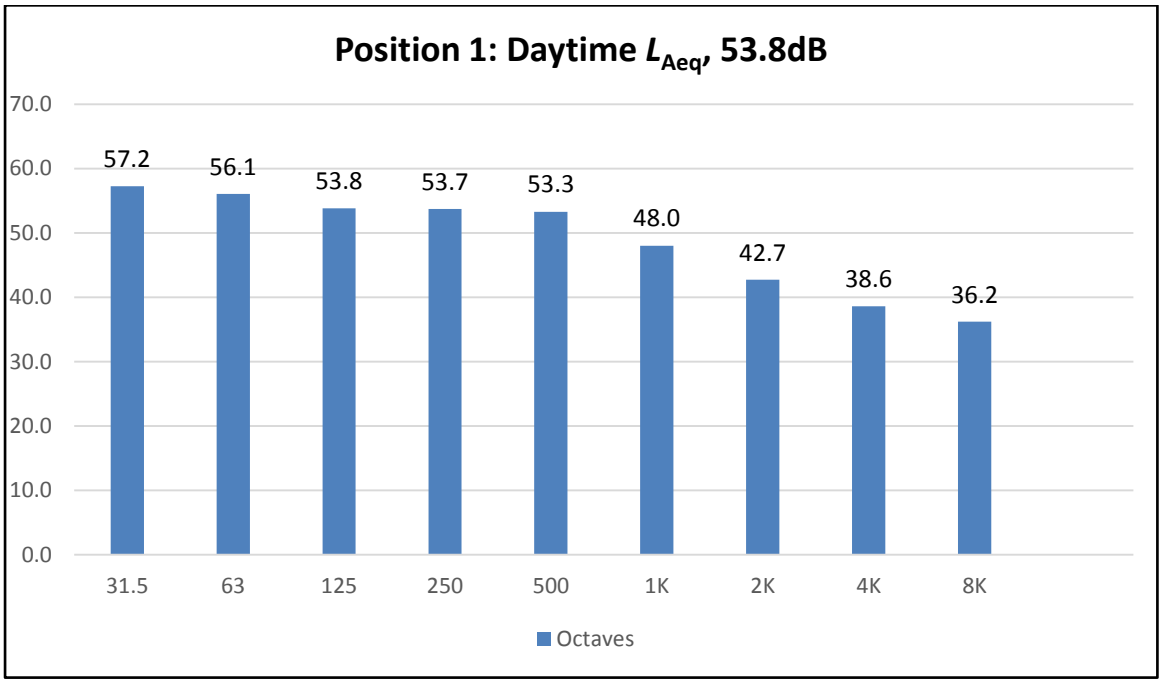
Measurement Position 2 – Showing Plant on Neighbouring Building at Front Façade

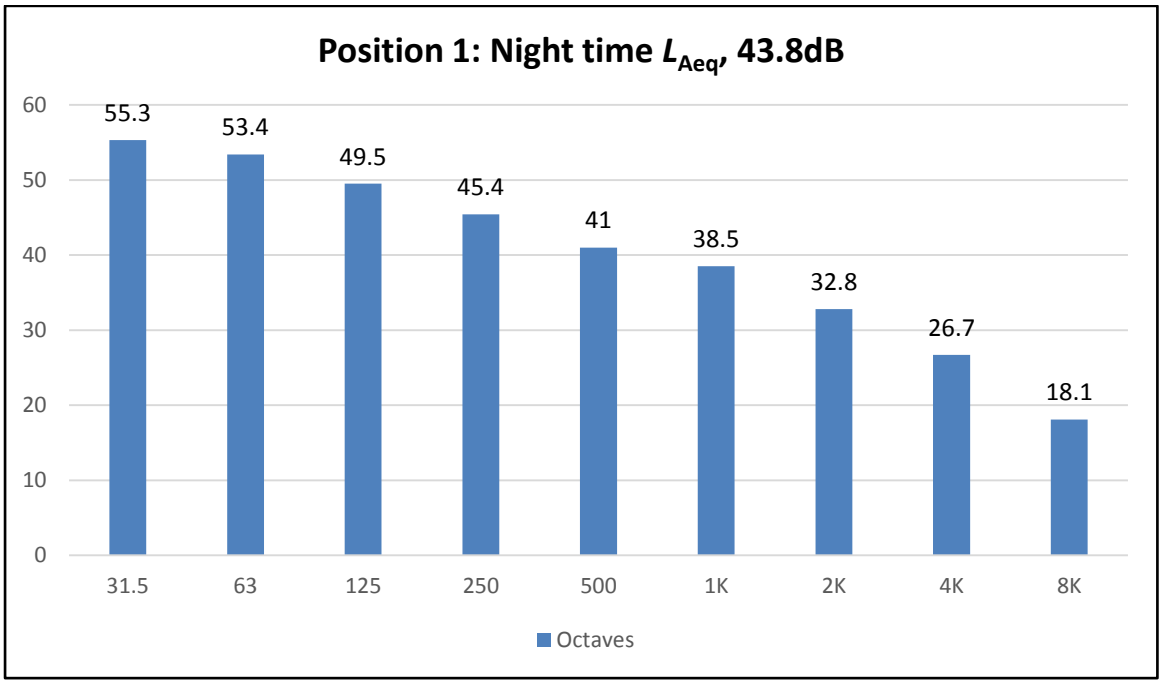
Measurement Results

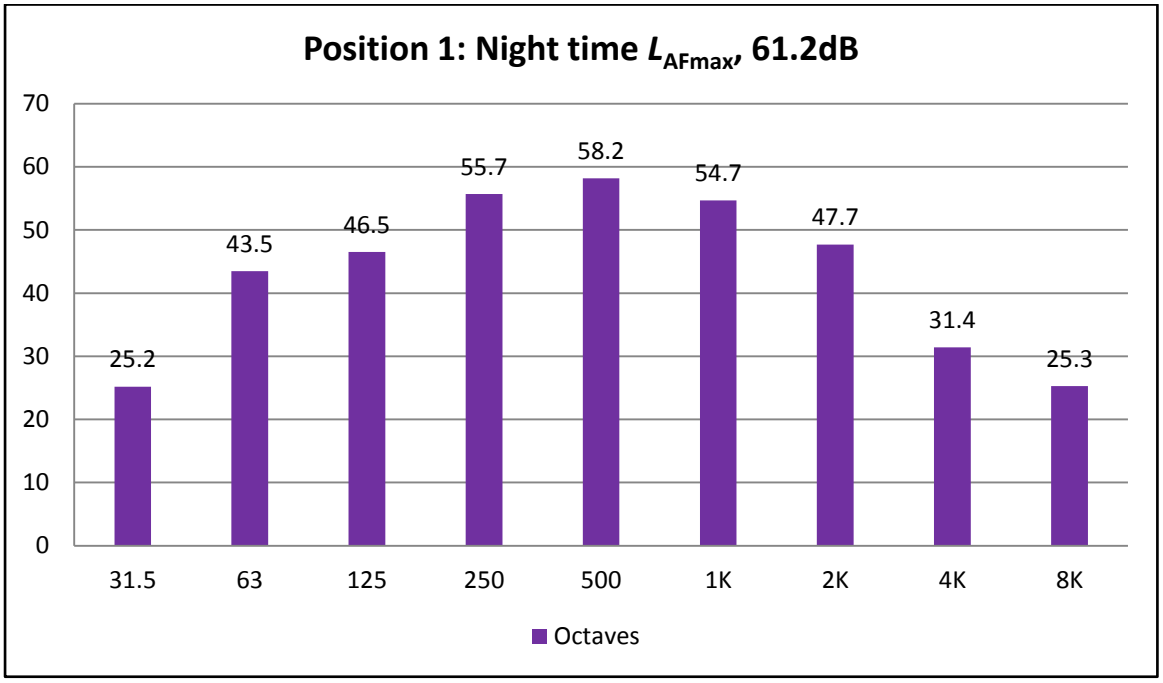


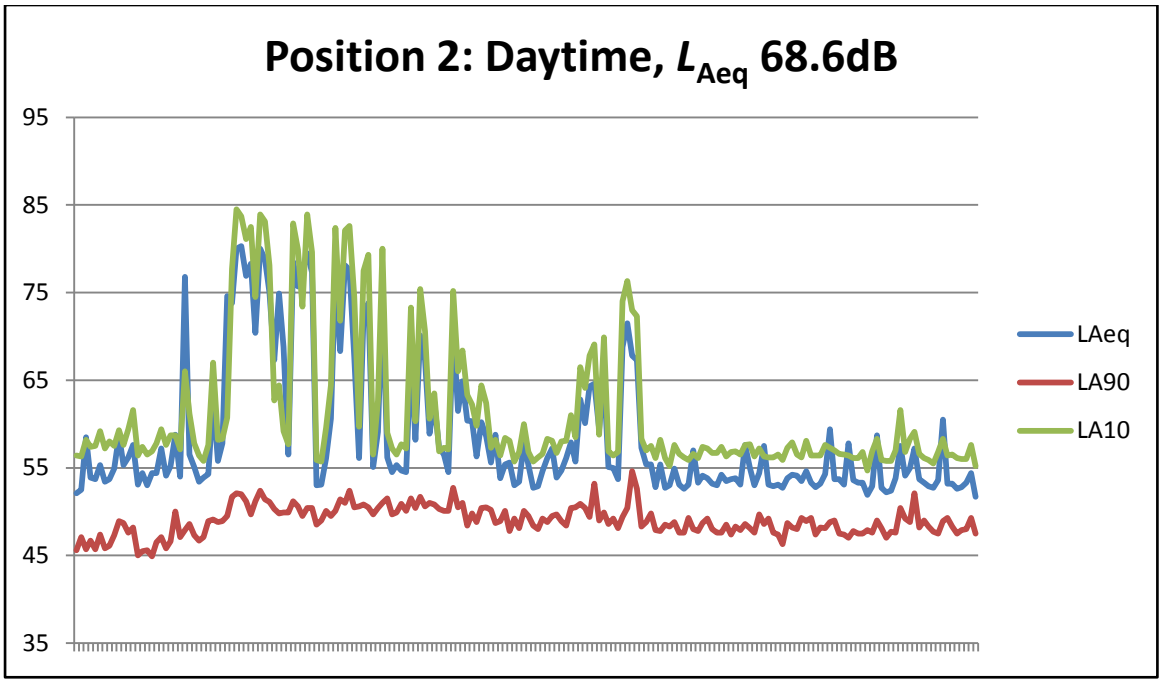


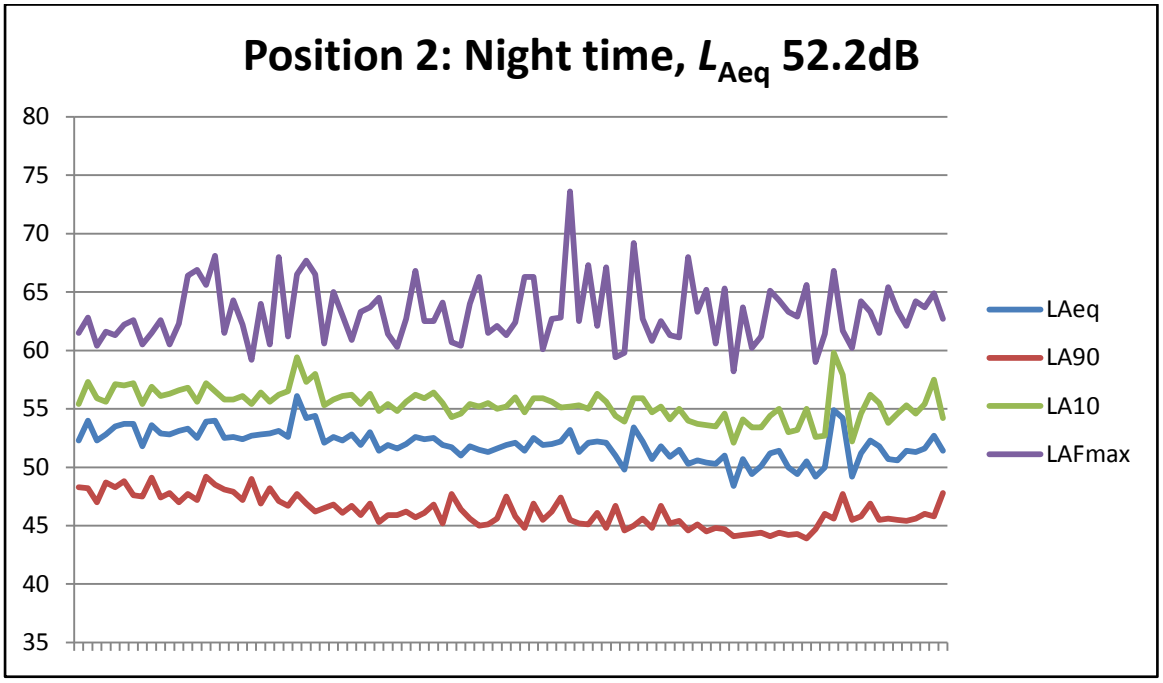
Un-weighted 1:1 Octave Results



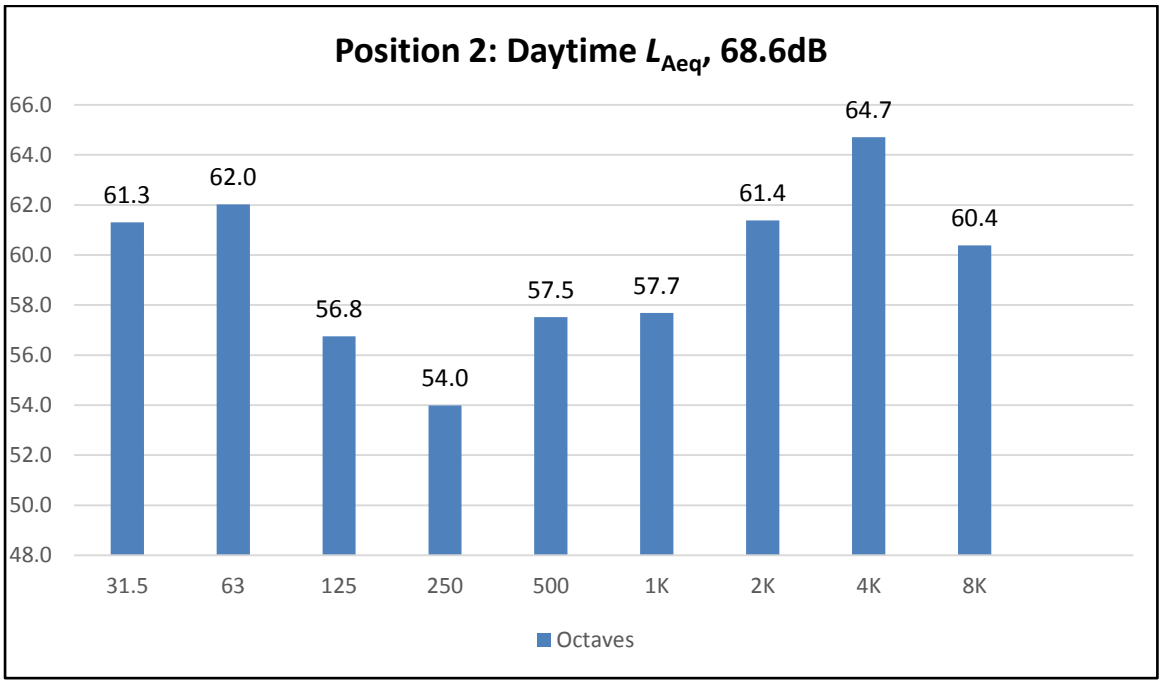


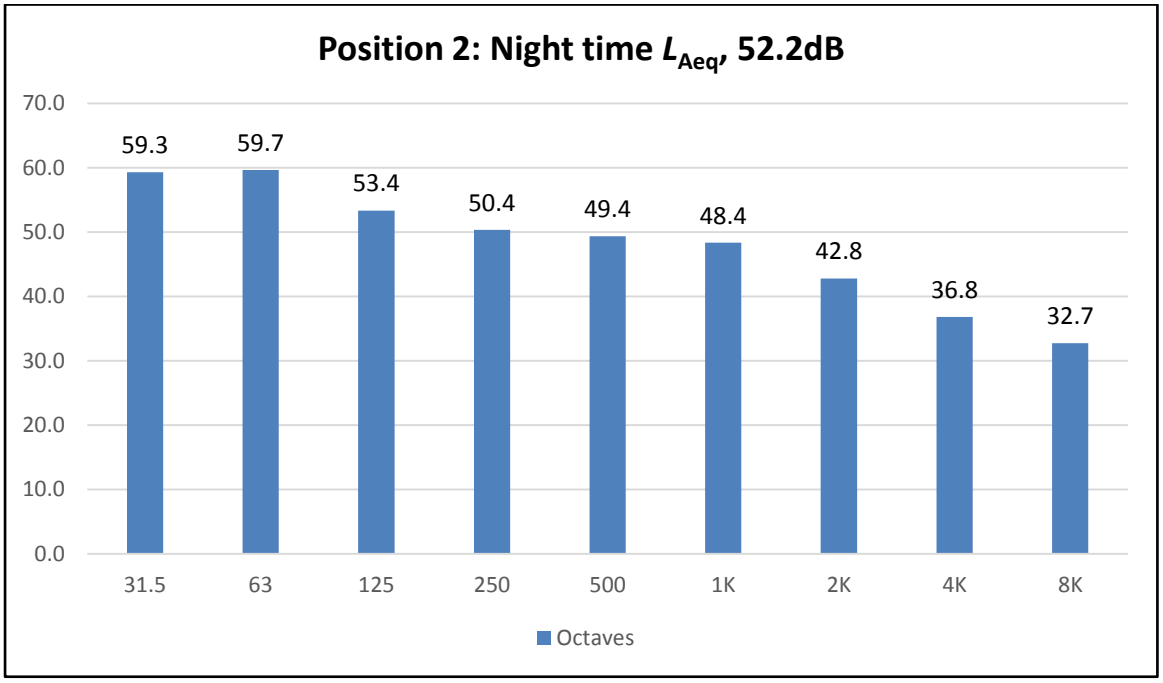

Position 1: Night time L_{AFmax}, 61.2dB
70
60
50
40
30
20
10
0
25.2
43.5
46.5
55.7
58.2
54.7
47.7
31.4
25.3
31.5
63
125
250
500
1K
2K
4K
8K
Octaves

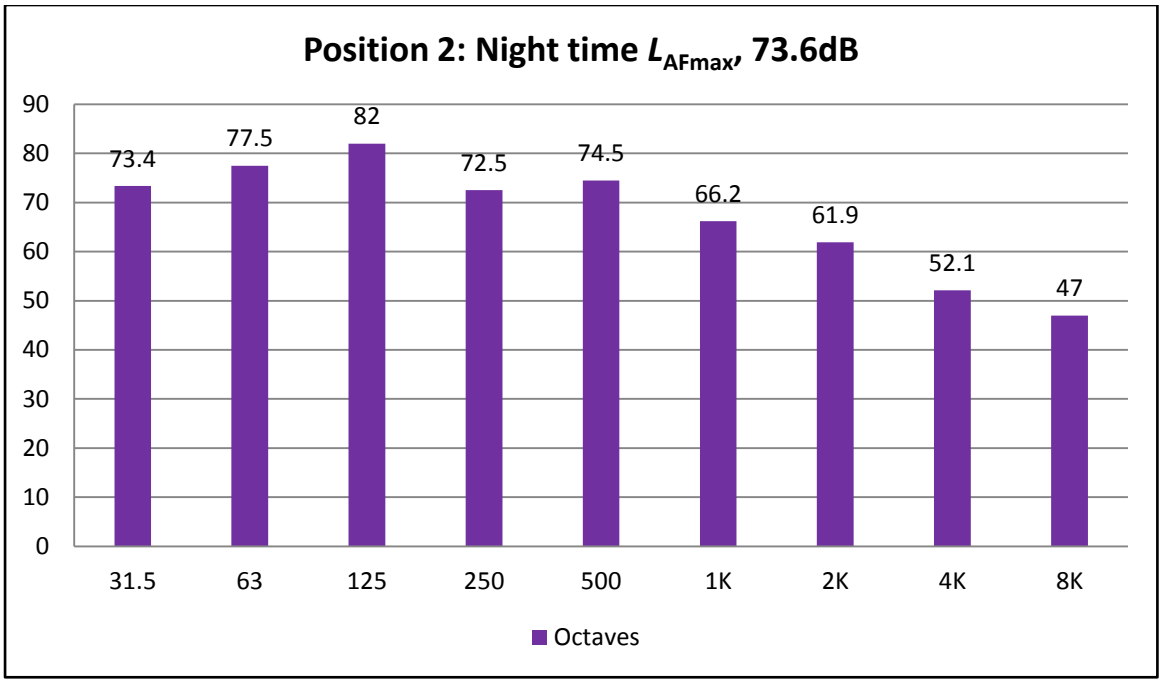

Position 2: Daytime, L_{Aeq} 68.6dB
95
85
75
65
55
45
35
LAeq
LA90
LA10



Un-weighted 1:1 Octave Results







More detailed measured data is available on request.

Acoustic Modelling of 200mm Solid Brick Wall

Sound Insulation Prediction (v7.0.6)

- Key No. 2522

Margin of error is generally within Rw +/- 3 dB

Job Name:

Job No.: Page No.: Notes:

Date: 6 Aug 14 Initials:martinhamer

File Name: insul.ixl

Rw 54 dB
C -1 dB
C_{tr} -5 dB

System description

Panel 1 Outer layer: 1 x 200.0 mm Brick- (m=320.0 kg/m2, fc=137 Hz, Damping=0.00) Profile

frequency (Hz)	TL(dB)	TL(dB)
50	39	
63	40	39
80	38	
100	39	
125	37	38
160	38	
200	40	
250	43	42
315	45	
400	48	
500	50	50
630	53	
800	56	
1000	59	58
1250	61	
1600	62	
2000	64	64
2500	65	
3150	67	
4000	69	68
5000	70