



ACOUSTIC CONSULTANTS LTD

Proposed Hotel
The Butler, Chatham Street, Reading

Noise Impact Assessment

Reference: 6863/PP/BL

April 2018



Proposed Hotel
The Butler, Chatham Street, Reading

Noise Impact Assessment

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1. Introduction

Oxford Architects appointed Acoustic Consultants Limited to carry out a site noise monitoring survey to support a planning application for conversion of an existing pub and tire changing garage into hotel at The Butler, Chatham Street, Reading.

The purpose of this assessment is to address the noise climate affecting the proposed hotel conversion, specifically road traffic and commercial noise.

The noise impact assessment has been undertaken in accordance with the guidance in the National Planning Policy Framework (NPPF), Noise Policy Statement for England (NPSE), National Planning Practice Guidance (NPPG), British Standard 4142:2014 (BS4142) and British Standard 8233:2104 (BS8233).

The author of this report is an Associate Member of the Institute of Acoustics with 3 years' experience within the field and as such is considered suitably qualified to undertake a noise impact assessment.

The report is based upon noise level data measured on the development site and reasonable assumptions. This report limits itself to addressing solely on the noise aspects as included in this report and is intended for planning purposes only.

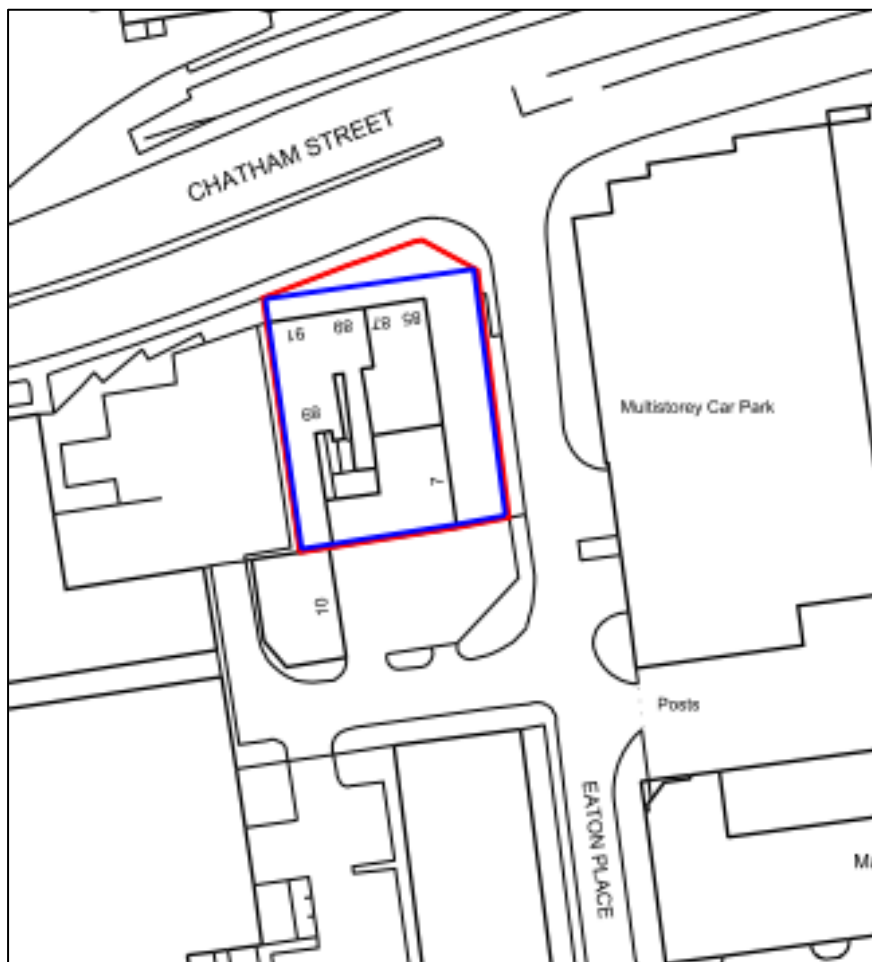


2. The Site

The site is located at The Butler, Chatham Street, Reading. The proposal is to convert part of the existing pub and tire changing garage into a hotel.

The site is in a mixed residential and commercial area: to the east is a multi-storey carpark, and commercial properties to the west and south. Directly to the north of the site is Chatham Street (A329). The main source of noise affecting the site is road traffic along Chatham Street A329 with some contribution from Eaton Place.

Figure 1: Site Location Plan





3. Planning and Noise

3.1. National Planning Policy Framework

The National Planning Policy Framework (NPPF) was published in March 2012 and replaces the withdrawn Planning Policy Guidance Document 24 entitled 'Planning and Noise'. Section 11 entitled 'Conserving and enhancing the natural environment' addresses noise as a requirement of planning.

Paragraph 109 states:

"109. The planning system should contribute to and enhance the natural and local environment by:

- *preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability."*

Paragraph 123 states:

"123. Planning policies and decisions should aim to:

- *avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;*
- *mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions;*
- *recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established; and*
- *identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason."*

The document does not prescribe any assessment methodology or criteria to assess the adverse effect of noise.



3.2. Noise Policy Statement for England

The NPPF refers to the Noise Policy Statement for England (NPSE). This was published in March 2010 and aims to provide clarity regarding current policies and practices to enable noise management decisions to be made within the wider context, at the most appropriate level, in a cost-effective manner and in a timely fashion and applies to all forms of noise including environmental noise, neighbour noise and neighbourhood noise.

The NPSE sets out the long term vision of Government noise policy. This long term vision is supported by three noise policy aims as follows:

“Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

- *avoid significant adverse impacts on health and quality of life;*
- *mitigate and minimise adverse impacts on health and quality of life; and*
- *where possible, contribute to the improvement of health and quality of life.”*

The NPSE introduces the concept of “Significant adverse” and “Adverse” impacts of noise which relate to the noise policy aims. These are applied as follows:

NOEL – No Observed Effect Level

This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.

LOAEL – Lowest Observed Adverse Effect Level

This is the level above which adverse effects on health and quality of life can be detected.

SOAEL – Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur.

The Noise Policy Statement for England (NPSE) states that noise levels above the Lowest Observed Adverse Effect Level are acceptable in planning where reduced to a minimum.



With regard to where there is potential for noise impact it states the following in relation to the second noise policy aim:

"The second aim of the NPSE refers to the situation where the impact lies somewhere between LOAEL and SOAEL. It requires that all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development (paragraph 1.8). This does not mean that such adverse effects cannot occur."

The NPSE does not provide any assessment criteria for the noted effect levels and each case must be considered on its merits. The NPSE does, however, emphasise that in dealing with noise Local Planning Authorities are required to take a balanced approach in considering the benefits of development as against any adverse effects which arise. Paragraph 2.18 of the NPSE is particularly relevant in this respect and states:

"There is a need to integrate consideration of the economic and social benefits of the activity or policy under examination with proper consideration of the adverse environmental effects, including the impact of noise on health and quality of life. This should avoid noise being treated in isolation in any particular situation, i.e. not focusing solely on the noise impact without taking into account other related factors."

The planning need is outside the scope of noise and acoustics and will need to be addressed by others.

3.3. National Planning Practice Guidance, Noise

The National Planning Practice Guidance (NPPG) on noise referred to here is based on the current version (January 2015) as provided on the Planning Guidance Website. It states that *"Noise needs to be considered when new developments may create additional noise and when new developments would be sensitive to the prevailing acoustic environment."*

It provides generic guidance on how to determine the noise impact and what factors could be a concern.

It includes the option types to mitigate any adverse effects of noise stating that there are four broad types of mitigation. These are engineering, layout, using planning conditions or obligations and noise insulation.



Paragraph 5 of the NPPG provides a table identifying the effect level and examples of effect relating to the impact effect levels provided in the NPSE. The table is duplicated below:

Table 1: NPPG Noise – Perception of Effect Levels

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
		Lowest Observed Adverse Effect Level	
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
		Significant Observed Adverse Effect Level	
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

The table does not provide any objective assessment which equates to the noted effect levels however the NPPG identifies that where noise is audible it is not necessarily intrusive. The effect and impact on people is based primarily on the level of noise.



4. Assessment Methodology

4.1. British Standard 8233:2014

Internal Ambient Noise Levels

British Standard 8233:2014 entitled "Guidance on sound insulation and noise reduction for buildings" came into effect on 28th February 2014.

Section 7.7.2 Table 4 of the British Standard 8233:2014 provides internal ambient noise levels for dwellings from noise sources 'without a specific character'. The British Standard guideline states that noise levels should not exceed those as noted in Table 2 of the British Standard and this is summarised below:

Table 2: Table 2 of the British Standard 8233:2014 Internal Noise Criteria

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

Maximum Noise Levels

Section 7.7.2 Note 4 of the British Standard states "Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$ depending on the character and number of events per night. Sporadic noise events could require separate values".

The new British Standard provides no definitive criteria for maximum noise levels from individual events ($L_{Amax,F}$). Section 3.4 of the "Guidelines for Community Noise" published by the World Health Organisation in 1999 (WHO 1999) states "For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 L_{Amax} more than 10-15 times per night (Vallet & Verbey 1991)".

As such it would be considered acceptable if the maximum noise level from individual events do not exceed 45 dB $L_{Amax(F)}$ no more than 10 to 15 times during the night-time period.



5. Noise Monitoring

Long term unattended noise survey was conducted between 11:55 hours on the 15th September 2017 and 12:35 hours on the 19th September 2017 at two monitoring locations; and a short term attended noise survey between 12:00 hours and 12:30 hours on the 19th September 2017. The survey was undertaken in accordance with British Standard 7445.

5.1. Equipment

Sound Pressure Levels were measured using a Sound Level Meter with a half-inch condenser microphone, using the 'fast' setting. The equipment is checked regularly using a Quality System meeting the requirements of British Standard EN ISO/IEC 17025:2005 and in accordance with British Standard EN 10012:2003 and traceable to the National Standards.

This equipment was checked and calibrated as noted below and the certificates are available for inspect upon request. Table 2 provides the equipment and calibration status.

Table 3: Equipment and Calibration Status

Equipment Description / Manufacturer / Type	Serial number	Date of calibration	Calibration Certification Number
Sound Level Meter, Cirrus Research, CR:171C	G079832	19/06/2017	250282
Calibrator, Cirrus Research, CR:515	80569	05/05/2017	112613
Microphone, Cirrus Research, MK224	209563D	16/04/2017	112614
Sound Level Meter, Cirrus Research, CR:171C	G071684	26/06/2017	250502
Calibrator, Cirrus Research, CR:515	73217	13/09/2016	107762
Microphone, Cirrus Research, MK224	606369B	23/06/2017	112732

The measurement system was checked before and after use with the noted calibrator, and no drift exceeding 0.2 dB was detected.



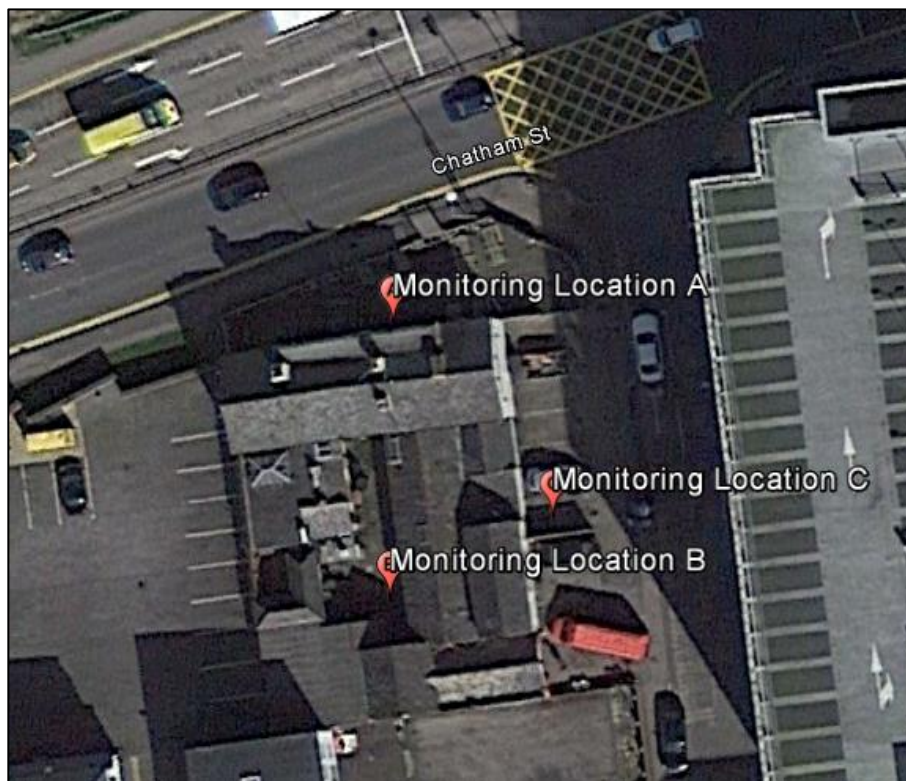
5.2. Weather Conditions

During the noise survey the weather conditions were windy on Friday (15th September 2017) and Saturday (16th September 2017) but dry and calm on Sunday night (17th September 2017) through Tuesday (19th September 2017) with a wind speed less than 5 metre per second. The highest temperature is up to 22 degrees Celsius and lowest is 14 degrees Celsius. The weather conditions on 15th to 16th September are expected to have affected the measured data and has been omitted but on 17th to 19th September the weather conditions are not expected to have affected the measurement and has been used for the assessment.

5.3. Monitoring Procedure

The long term noise monitoring exercise was undertaken at the monitoring location A and B and short term monitoring at location C marked on the figure below. At monitoring location A the microphone was placed outside first floor window in a façade position. At monitoring location B the microphone was placed on a tripod 1.5m above ground within the courtyard in a façade position. At monitoring location C, the microphone was placed on a tripod 1.5m above ground in a façade position. All monitoring locations are marked on the figure below.

Figure 2: Monitoring locations



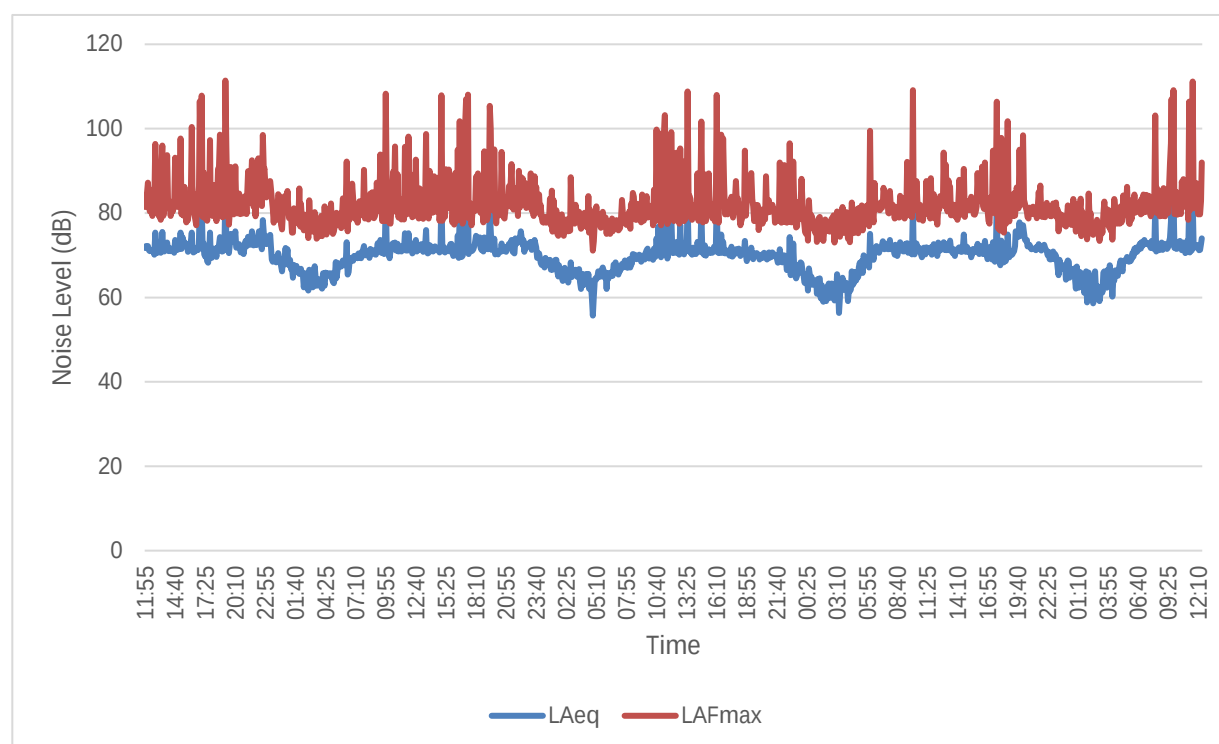


5.4. Measured Noise Levels

Location A

The main noise source affecting the monitoring location was road traffic noise from Chatham Street (A329). During the attended periods, no significant noise was audible from the commercial premises in the area. Chart 1 below provides the measured noise level over the measurement period.

Chart 1: Measured noise levels (façade level)



From the measured data, we have determined the following façade level octave band design 'daytime' and 'night-time' equivalent noise levels, and maximum noise levels at the monitoring location:

Table 4: Measured Octave Band Design Noise Levels (free-field level)

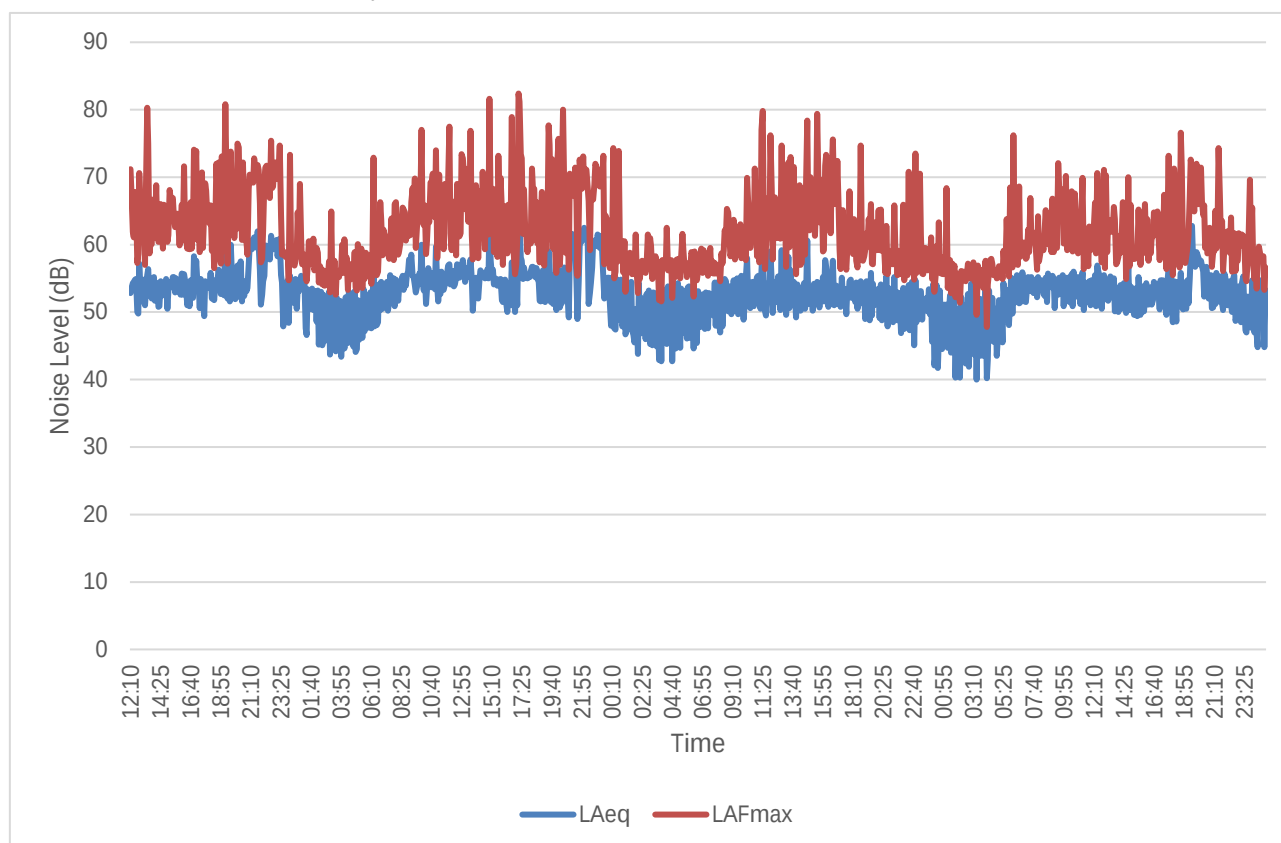
Parameter	63	125	250	500	1000	2000	4000	8000	dB(A)
Day $L_{eq,(16hr)}$	73	67	65	63	66	63	56	47	69
Night $L_{eq,(8hr)}$	65	59	58	58	61	58	51	42	64
Night $L_{max(F)}$	78	73	73	75	74	72	67	59	79



Location B

The main noise source affecting the monitoring location was road traffic noise from Chatham Street (A329). During the attended periods, no significant noise was audible from the commercial premises in the area. Chart 2 below provides the measured noise level over the measurement period.

Chart 2: Measured noise levels (façade level)



From the measured data, we have determined the following façade level octave band design 'daytime' and 'night-time' equivalent noise levels, and maximum noise levels at the monitoring location:

Table 5: Measured Octave Band Design Noise Levels (free-field level)

Parameter	63	125	250	500	1000	2000	4000	8000	dB(A)
Day $L_{eq,(16hr)}$	41	45	55	52	49	45	38	35	54
Night $L_{eq,(8hr)}$	37	42	54	49	45	40	31	21	51
Night $L_{max(F)}$	78	73	73	75	74	72	67	59	79



Location C

The main noise source affecting the monitoring location was road traffic noise from Chatham Street (A329) and Eaton Place. During the attended periods, no significant noise was audible from the commercial premises in the area. The measured noise level are as follows:

Table 6: Measured Noise Levels (free-field level)

Date and Time	L _{Aeq} (15mins) dB	L _{A10} (15mins) dB	L _{AFmax} dB
19/09/2017 11:30	65	64	92
19/09/2017 11:45	62	65	79
19/09/2017 12:00	61	64	74
19/09/2017 12:15	61	64	79



6. Noise Modelling

To determine the noise levels across the site, a noise modelling exercise has been undertaken within the noise modelling software CadnaA by Datakustik.

6.1. Noise modelling Methodology

The model allows for the prediction of noise levels to be undertaken for a high number of receiver locations and different noise emission scenarios. The modelling software calculates noise levels based on the inputted noise emission values, source and receiver locations, and primarily distance, barrier and ground attenuation. Calculations are undertaken using the methodology of the Calculation of Road Traffic Noise (CRTN).

The noise emission data and model setting parameters are as given in the table below.

Table 7: CadnaA Parameters

Parameter	Comments
Topography of the Site	Flat
Building Heights	Google Earth
Barriers	None
Night-time Receiver locations	Worst case location assumed to be 1.5 and 4.5 m from ground, this is a free-field level
Daytime Receiver Locations	Worst case location assumed to be 1.5 m and 4.5 m from ground, this is a free-field level
Reflections	Reflections calculated via the methodology of CRTN and not mirror sources
Ground Absorption	Ground fully reflective

6.2. Verification Model

A verification model has been created to ensure the measured and predicted 'daytime' and 'night-time' equivalent noise levels, and maximum noise levels at monitoring locations are comparable. This model is available upon request.

6.3. Noise Modelling Results

The proposed building is added into the verification model to determine the noise level at each façade.

The figures below show the predicted equivalent daytime $L_{Aeq(16 \text{ hours})}$ noise level, which is assessed on the worst case floors. The night-time $L_{Aeq(8 \text{ hours})}$ equivalent noise level and night-time maximum noise level L_{Amax} are assessed at first floor height (where 'night-time rooms' are located).

Figure 3: Predicted Daytime Equivalent Noise Level $L_{Aeq(16 \text{ hours})}$ at the Proposed Dwellings

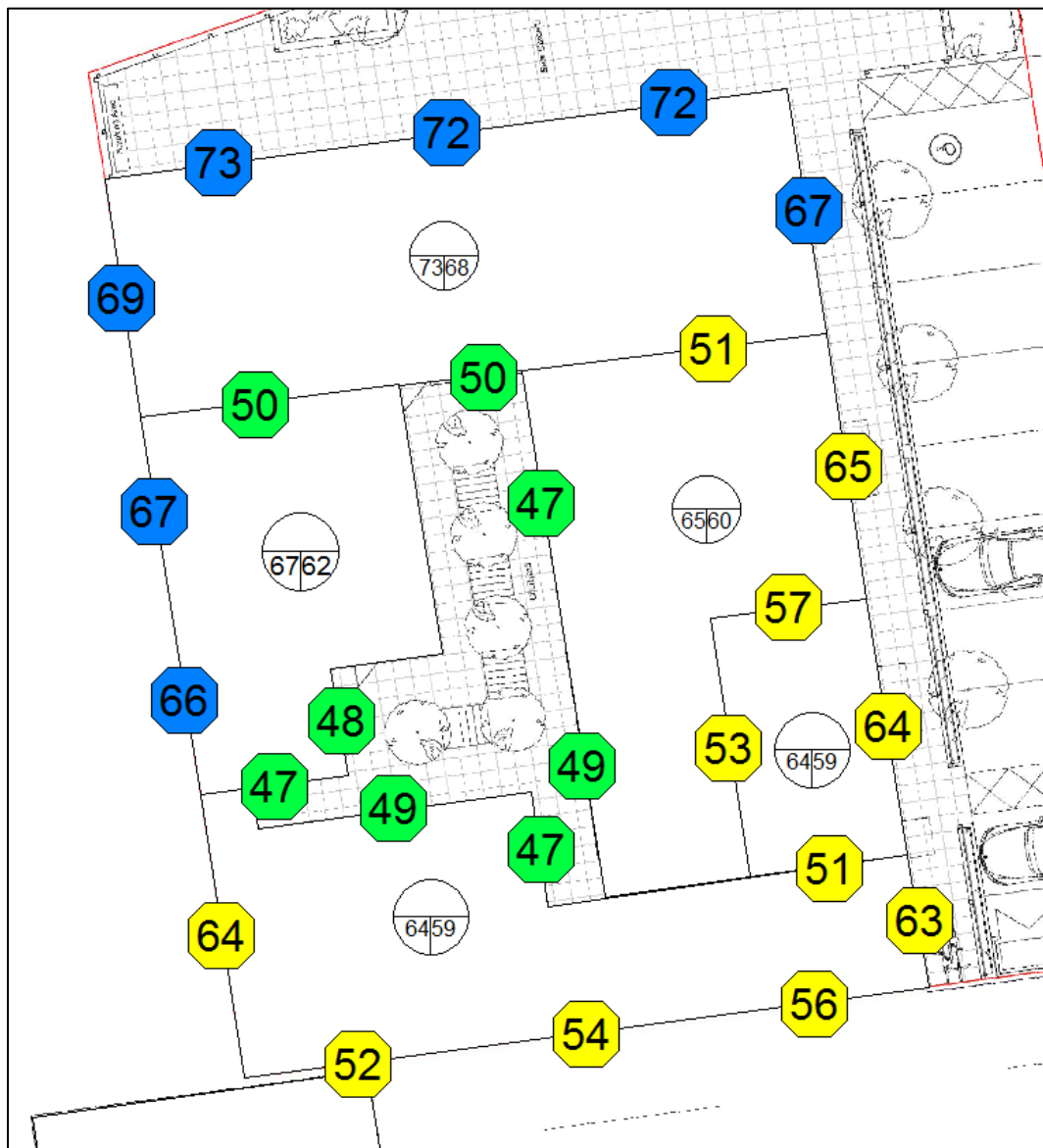




Figure 4: Predicted Night-time Equivalent Noise Levels $L_{Aeq}(8 \text{ hours})$ at the Proposed Dwellings

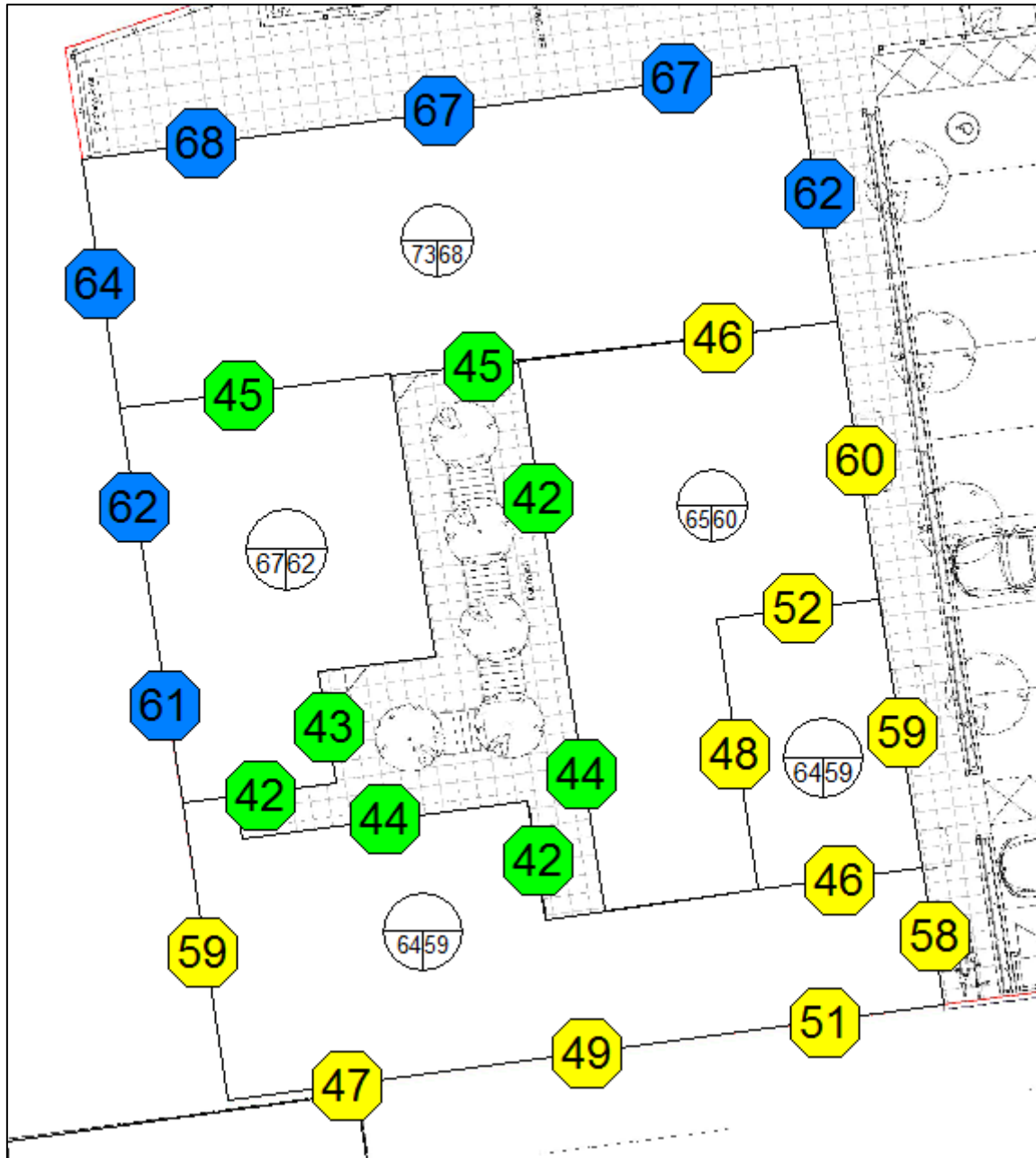
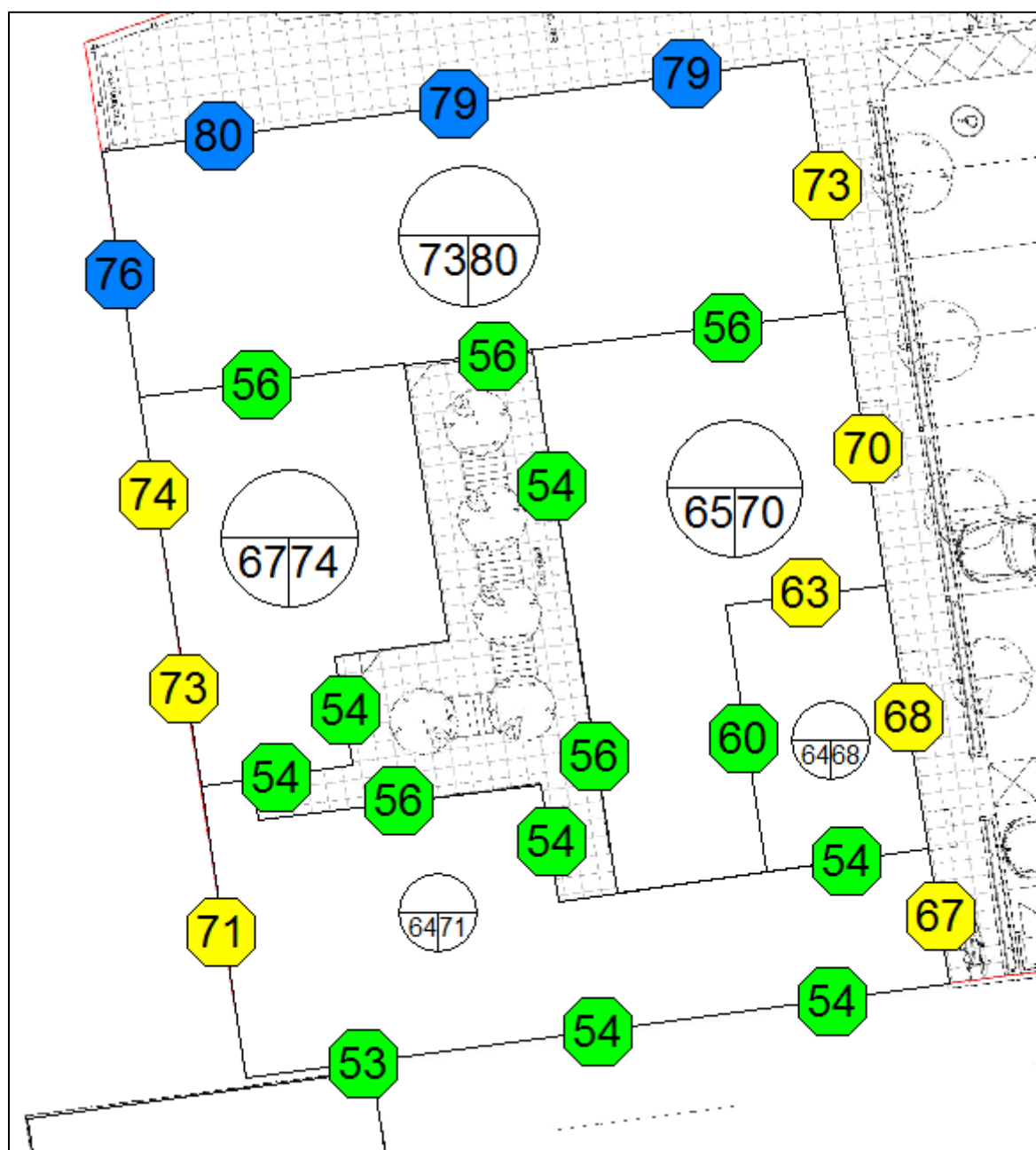




Figure 5: Predicted Night-time Maximum Noise Levels L_{Amax} at the Proposed Dwellings





7. Road Traffic Noise Mitigation Measures

In accordance with the design guidance in British Standard 8233:2014, it will be necessary to design the building fabric of the residential properties to control the equivalent noise level and maximum noise levels internally.

The octave band free-field design equivalent noise levels and maximum noise levels used to determine the internal noise levels within the residential rooms of the development are taken from the measured noise spectra noted above.

Internal ambient noise level prediction calculations have been carried out using the measured $L_{eq,T}$ and L_{max} sound level spectra noted above. The internal ambient noise levels have been predicted in accordance with the method of Annex G.2 of British Standard 8233:2014. The predicted internal noise levels are those which would be expected in a typically furnished room having a standardised reverberation time of 0.5 seconds.

The façades (including walls, windows, doors and roof) of the habitable rooms are exposed to noise from road traffic and they will require specific noise mitigation measures.

We advise that building elements, having the sound insulation performances noted below, be incorporated into the design of the façades including the windows, doors, floor, and the building roof. In doing so, it is predicted that the criteria of British Standard 8233:2014 will be met.

7.1. External Wall

It is our understanding that the existing wall comprises of solid brickwork wall with at least 480 kilograms per metre squared. With this construction, the wall is expected to achieve the following minimum sound reduction indices:

Table 8: Sound Reduction Indices of the Existing External Wall

Octave Band (Hz)	125	250	500	1000	2000	4000
Sound reduction indices (dB)	42	45	49	54	57	57



7.2. Roof Construction

The existing roof construction is a traditional pitched roof. To control external noise, the roof should be upgraded to the following:

- External skin of tiles or slates (minimum density of at least 20 Kg/m²).
- On battens on Roof joists.
- Roof Void with at least 100 millimetres thick of mineral fibre
- Independent two skins of 12.5mm plasterboard ceiling (density at least 20 Kg/m²).

This roof is expected to achieve the following minimum sound reduction indices:

Table 9: Required Minimum Sound Reduction Indices of the Roof

Frequency (Hz)	125	250	500	1k	2k	4k
SRI (dB)	40	51	58	67	72	75

7.3. Windows and Roof Lights

Windows and Roof Lights - Bedrooms 2, 3, 4 and 5

All windows on the bedrooms stated above will need to achieve the following sound reduction indices:

Table 10: Required Minimum Sound Reduction Indices of Windows

Octave Band (Hz)	125	250	500	1000	2000	4000
Sound reduction indices (dB)	27	29	36	41	42	52

This equates to a sound reduction rating of 40 dB Rw.

This can be achieved by 10 millimetre glass, a 12 millimetre cavity, and 6.4 millimetre laminated glass glazing specification.



Roof Light - Bedroom 6 and 7

Bedroom 6 and 7 roof lights will need to achieve the following sound reduction indices:

Table 11: Required Minimum Sound Reduction Indices of Windows

Octave Band (Hz)	125	250	500	1000	2000	4000
Sound reduction indices (dB)	20	19	29	38	36	45

This equates to a sound reduction rating of 33 dB Rw.

This can be achieved by 6 millimetre glass, a 12 millimetre cavity, and 6 millimetre glass glazing specification.

Windows and Roof Lights - Bedrooms 9-16

In accordance to WHO (World Health Organisation) guidance, a partially open window provides approximately 15 decibels of sound reduction. With the predicted noise level at the façade within the courtyard, the predicted noise level is low enough to naturally ventilate the bedrooms with open windows and still achieve the BS8233 criteria. There is no specific window specification needed for these window openings.

However, we recommend that the window opening of bedrooms 3, 5 and 7 should at least comprise of 4 millimetre glass, a 12 millimetre cavity and 4 millimetre glass.

From the data supplied by Saint Gobain this achieves the following sound reduction indices:

Table 12: Recommend Sound Reduction Indices of Windows

Octave Band (Hz)	125	250	500	1000	2000	4000
Sound reduction indices (dB)	27	29	36	41	42	52

This equates to a sound reduction rating of 31 dB Rw.



Roof light – Bedroom 8

The roof lights within the bedroom stated above will need to achieve the following sound reduction indices:

Table 13: Required Minimum Sound Reduction Indices of Roof lights

Octave Band (Hz)	125	250	500	1000	2000	4000
Sound reduction indices (dB)	20	19	29	38	36	45

This equates to a sound reduction rating of 33 dB Rw.

This can be achieved by 6 millimetre glass, a 12 millimetre cavity, and 6 millimetre glass glazing specification.

7.4. Doors

Bedrooms 2-5

All doors opening on the east elevation will need to achieve the following sound reduction indices:

Table 15: Required Minimum Sound Reduction Indices of Doors

Octave Band (Hz)	125	250	500	1000	2000	4000
Sound reduction indices (dB)	26	28	33	33	38	38

Door that typically achieve the above sound reduction indices are well-sealed, solid core doors with a density of at least 40 kilograms per metre squared.

Doors within the Courtyard

The predicted noise level within the courtyard is low enough to not need specific mitigation measures. However, we recommend installing a well-sealed, solid core door with a density of at least 20 kilograms per metre squared.



7.5. Ventilation Provisions

Bedrooms 9-16

The predicted noise level at the windows opening into the noted bedrooms is low enough to naturally ventilate rooms with open windows.

All other Bedrooms

All other bedrooms will need to be ventilated via attenuated means. This could comprise of in wall vents, roof vents or window fitted acoustic trickle vents.

The vents will need to achieve the following element normalised level difference ($D_{n,e}$) in the open position.

Table 16: Ventilation Octave Band Element Normalised Level Difference $D_{n,e}$

Frequency (Hz)	125	250	500	1k	2k	4k
$D_{n,e}$, dB	37	37	36	47	49	55

This would equate to a weighted element normalised level difference ($D_{n,e,w}$) in the open position of 44 dB. The supplier should provide test data confirming that the above Weighted Element Normalised Level Difference $D_{n,e,w}$ is achievable with the vent in the open position.

7.6. Effect of Mitigation Measures

With the noted building fabric construction, and suitable ventilation provisions, the predicted internal noise levels achieve the criteria of British Standard 8233:2014 of 35 dB L_{Aeq} (16 hour) in the daytime rooms; and 30 dB L_{Aeq} (8 hour), 45 dB $L_{Amax}(fast)$ within the night-time rooms.

As such we would consider that external noise is suitably controlled and below the LOAEL of the NPPG.



8. Limitations

The report limits itself to addressing solely on the road traffic noise aspects as included in this report. We provide advice only in relation to noise and acoustics. It is recommended that appropriate expert advice is sought on all the ramifications (e.g. CDM, structural, condensation, fire, legal, etc.) associated with any proposals in this report or as advised and concerning the appointment.

The report has been prepared in good faith, with all reasonable skill and care, based on information provided or available at the time of its preparation and within the scope of work agreement with the Client. We disclaim any responsibility to the Client and others in respect of any matters outside the scope of the above.

The report is provided for the sole use of the named Client and is confidential to them and their professional advisors. No responsibility is accepted to other parties.

It should be noted that noise predictions are based on the current information as we understand it and on the performances noted in this report. Any modification to these parameters can alter the predicted level. All predictions are in any event subject to a degree of tolerance of normally plus or minus three decibels. If this tolerance is not acceptable, then it would be necessary to consider further measures.



9. Summary and Conclusions

Oxford Architects appointed Acoustic Consultants Limited to carry out a site noise monitoring survey to support a planning application for the proposed hotel conversion at The Butler, Chatham Street, Reading.

The purpose of this assessment is to address the road traffic noise affecting the proposed scheme.

The noise impact assessment has been undertaken in accordance with the guidance in the National Planning Policy Framework (NPPF), Noise Policy Statement for England (NPSE), National Planning Practice Guidance (NPPG), and British Standard 8233:2104 (BS8233).

With the noted building fabric construction, and suitable ventilation provisions, the predicted internal noise levels achieve the criteria of British Standard 8233:2014 of 35 dB L_{Aeq} (16 hour) in the daytime rooms; and 30 dB L_{Aeq} (8 hour), 45 dB $L_{Amax}(fast)$ within the night-time rooms.

As such we would consider that external noise is suitably controlled and below the LOAEL of the NPPG.

Further, if the mitigation measures outlined within the above document are adopted fully we see no reason why the proposed use class suggested (C1 Hotel) cannot be fully supported through the planning process.



Appendix 1 – Calculation for Worse Case Room (Bedroom 2)

Reverberation Time Calculation									
Room Dimensions				Room Volume		0.16*Volume			
Room Height (m)	2.6			36.556		5.84896			
Length (m)	3.7								
Width (m)	3.8								
Absorption Coefficient	Hz	Hz	Hz	Hz	Hz	Hz	Hz	Hz	m ²
per octave band	63	125	250	500	1000	2000	4000	8000	Area
Standard Carpet Tiles	0.05	0.05	0.05	0.10	0.20	0.45	0.65	0.65	14.1
	0.7	0.7	0.7	1.4	2.8	6.3	9.1	9.1	-
Suspended plasterboard ceiling	0.20	0.20	0.15	0.10	0.05	0.05	0.05	0.05	14.1
	2.8	2.8	2.1	1.4	0.7	0.7	0.7	0.7	-
Wall:Plastered wall	0.02	0.02	0.03	0.04	0.04	0.05	0.05	0.06	35.6
	0.7	0.7	1.1	1.4	1.4	1.8	1.8	2.1	-
Window:Glazing	0.10	0.10	0.06	0.04	0.03	0.02	0.02	0.02	1.4
	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	-
Doors:Solid Timber	0.14	0.14	0.10	0.06	0.08	0.10	0.10	0.10	2.0
	0.3	0.3	0.2	0.1	0.2	0.2	0.2	0.2	
							TOTAL	AREA	67.1
Total sound absorbtion (sq.m)	4.7	4.7	4.2	4.4	5.1	9.0	11.8	12.2	
Frequency	63	125	250	500	1000	2000	4000	8000	T _{mf}
Reverberation Time	1.26	1.26	1.40	1.33	1.14	0.65	0.49	0.48	1.0

Predicted Free Field Level at Façade

Octave Band	63	125	250	500	1000	2000	4000	8000	dBa
Day, L _{Aeq} (16 hour)	69	63	61	59	62	59	52	43	65
Night L _{Aeq} (8hour)	61	55	54	54	57	54	47	38	60
Night-time L _{Amax} (fast)	69	64	64	66	65	63	58	50	70

Internal Ambient Noise Level Calculation

External Element		63	125	250	500	1000	2000	4000	8000
SF X V75 / SFSA C75 (open)	D _{ne}	30	37	37	36	47	49	55	61
	Number of	1							
		0.000438596	8.75115E-05	8.75115E-05	0.00011017	8.75115E-06	5.5216E-06	1.38696E-06	3.4839E-07
Window:Double Glazed: 10/12/6.4		22	27	29	36	41	42	52	50
	Area	4							
		0.000968575	0.00030629	0.000193256	3.85597E-05	1.21936E-05	9.68575E-06	9.68575E-07	1.53509E-06
Plastered solid brickwork (480 kg/m2)		37	42	45	49	54	57	57	57
	Area	5							
		4.63811E-05	1.4667E-05	7.35091E-06	2.92645E-06	9.25425E-07	4.63811E-07	4.63811E-07	4.63811E-07
Roof		30	40	51	58	67	72	75	65
	Area	12							
		0.000526316	5.26316E-05	4.18067E-06	8.34154E-07	1.05014E-07	3.32083E-08	1.66436E-08	1.66436E-07
Solid-core 40kg/m2 well sealed		21	26	28	33	33	38	38	38
	Area	2							
		0.000696779	0.000220341	0.000139026	4.39638E-05	4.39638E-05	1.39026E-05	1.39026E-05	1.39026E-05

Noise Level Including Vent

Calculations for results

Sum	0.002676647	0.000681441	0.000431325	0.000196455	6.5939E-05	2.96069E-05	1.67386E-05	1.64163E-05
10log sum	-25.72408835	-31.6657158	-33.6519547	-37.0673799	-41.8085753	-45.2860644	-47.7628177	-47.8472483
10log S/A	6.904632152	6.904632152	7.382989873	7.132993432	6.469210351	4.019201763	2.842604781	2.714184138

Leq2	Day	53.2	41.2	37.7	32.1	29.7	20.7	10.1	0.9	35
	Night	45.2	33.2	30.7	27.1	24.7	15.7	5.1	-4.1	29
	Max	53.2	42.2	40.7	39.1	32.7	24.7	16.1	7.9	39



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