Noise survey and
Façade acoustic design strategy
Prince Consort Road, Hebburn

Report Number:	**4825.1**
Version:	**A**
Date:	**2nd June 2015**
Prepared by:	**Felix Larrieu MSc AMIOA**
Checked by:	**Adam Cooke MSc MIOA**

Apex Acoustics Limited
Design Works
William Street
Gateshead
NE10 0JP

Tel: 0191 423 6272
www.apexacoustics.co.uk

Prepared for:
Terry Smith
Tyne & Wear LGV
Smith's Yard
Abbotsford Road
Felling, Gateshead
NE10 0EX

1. Revision register

Version	Changes from previous version	Issued by	Date

2. Contents

3. Summary

3.1 This report has been prepared in support of a Planning Application for a residential development at Prince Consort Road, Hebburn.

3.2 Noise levels affecting the proposed development have been measured during the day and night, and the façade noise impact calculated.

3.3 Measured noise levels are used to determine the potential façade sound insulation treatments to meet the internal noise level requirements of the Local Planning Authority.

3.4 A set of minimum glazing and ventilation strategy options, interpreted from Approved Document F (AD-F), is proposed as shown in Table 1.

Glazing / mm	Trickle ventilator	Potential ventilation strategy
4-16-4 Double glazing	Standard slot vents, e.g. Greenwoods 4000L	AD-F System 1, Background ventilators and intermittent extract fans
	Not required	AD-F System 4, mechanical supply and extract with heat recovery (MVHR)

Table 1: Summary of minimum façade sound insulation treatment

3.5 A limit of 26 dB(A) in bedrooms and 32 dB(A) in living rooms is suggested for mechanical services noise.

4. Introduction

4.1 A residential development consisting of 8 houses is proposed at Prince Consort Road, Hebburn.

4.2 The site location is shown in Figure 1.

4.3 Apex Acoustics has been commissioned to undertake a noise survey and provide advice on the sound insulation of the façade to achieve the internal levels required by the Local Planning Authority.

4.4 The purpose of this report is to identify the usual acoustic design parameters of the Local Environmental Health Department, and the manner in which internal noise levels may be achieved in practice.

4.5 This assessment is based on measurements of noise sources around the site, room and window dimensions on the architects' plans and assumptions about room conditions, with glazing and ventilation strategy options proposed in this report.

4.6 Internal noise transmission and the sound insulation requirements of the Building Regulations are not considered in this report.

Figure 1: Site location and measurement position

5. Guidance and acceptable levels

5.1 Table 4 of BS 8233, Reference 1, defines guideline upper limits for internal ambient noise levels in dwellings for steady external noise sources, as shown in Table 2.

Activity	Location	Guideline upper limit, $L_{Aeq,T}$ / dB	
		07:00 to 23:00	23:00 to 07:00
Resting	Living rooms	35	-
Dining	Dining room/area	40	-
Sleeping (daytime resting)	Bedroom	35	30

Table 2: Guideline indoor ambient noise levels defined in BS 8233

5.2 The guidelines set in BS 8233 are proposed to be adopted for this development.

6. Noise sources and measurements

6.1 Measurements of the existing noise environment were made using the guidance of BS 7445, Reference 2.

6.2 Measurements were made during a 24 hours period at the position indicated in Figure 1.

6.3 Measurements were made with the microphone located at 4 m above ground level, away from other reflecting surfaces, such that they are considered to be free field.

6.4 The equipment used is listed in Table 3.

Equipment	Model	Serial no.
Sound Level Meter	NTi XL2	A2A-05832-E0
Calibrator	Larson Davis Cal 200	9462

Table 3: Equipment used

6.5 Both meter and calibrator have current calibration certificates traceable to national standards.

6.6 Measurements were made on the 26th May 2015. According to the Met Office the temperature was around 17°C; the average wind speed measured was 4 m/s.

6.7 The noise sources affecting the proposed development during the daytime were among distant traffic road, birds and wind in the trees. No industrial noise was audible throughout the measurement period.

6.8 The time history of the $L_{Aeq,\ 1\ sec}$ recorded is shown in Figure 2. The grey shaded area represents the night time.

6.9 Measurement in progress can be seen in Figure 3.

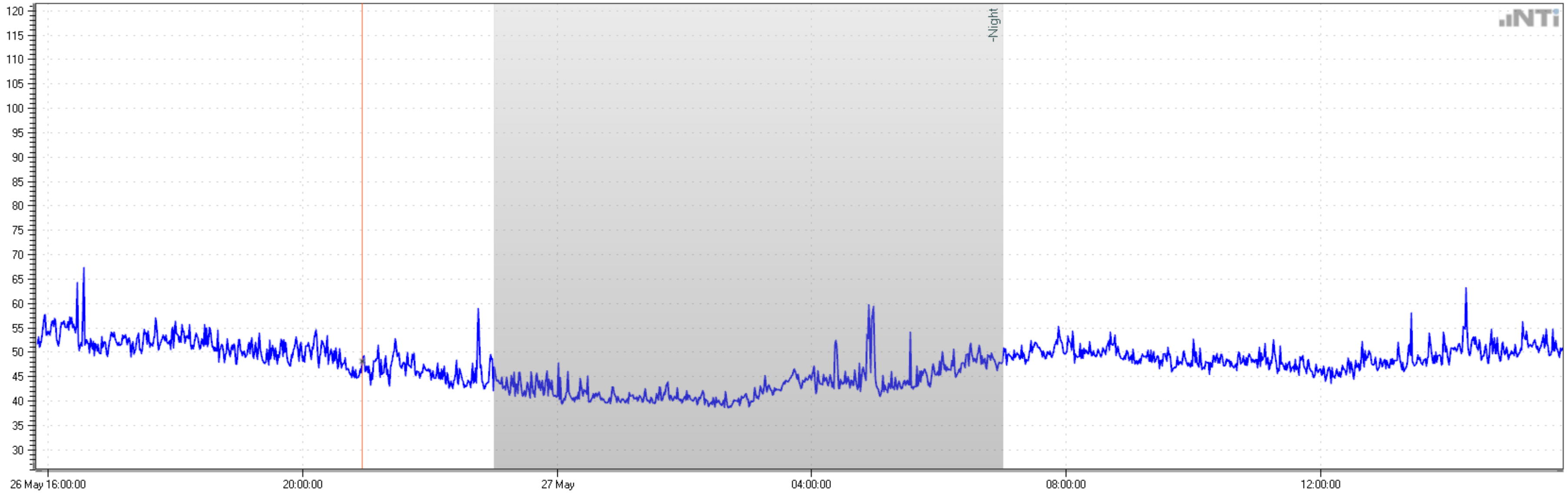

Figure 2: $L_{Aeq,\,1\,sec}$ between 26/05 and 27/05

Figure 3: Measurements in progress

6.10 **Results**

6.11 The measured noise levels are shown in Table 4.

Period	$L_{Aeq,T}$ / dB(A)	Octave Band Centre Frequency / Hz						
		63	125	250	500	1000	2000	4000
Day	**51**	34	37	41	45	47	43	37
Night	**45**	25	29	34	38	40	39	36

Table 4: Measured A-weighted noise levels

7. Facade noise calculations

7.1 As the measurements were taken at the position of the proposed façade, they are taken to be representative of the likely noise levels affecting the building once constructed.

7.2 This is a prudent assumption, as the proposed building, once constructed, will act as a noise barrier to some of the road traffic noise currently affecting the measurement position. However, the difference is likely to be small, and using the measured data directly represents a prudent practice.

7.3 The calculation method for façade sound insulation is in accordance with BS 8233 and the principles of BS EN 12354-3, Reference 3, as described in Appendix 1.

7.4 **Ventilation strategy**

7.5 The proposed development will be required to meet Part F of the Building Regulations, with regard to ventilation provision, as described in Approved Document F (AD-F), Reference 4.

7.6 For AD-F System 1, Background ventilators and intermittent extract fans, is considered using Greenwoods 4000L through frame slot vents. Up to 10 vents are permissible per room. The manufacturer's data for the element normalised level difference, $D_{n,e,}$ have been used in the calculations.

7.7 AD-F System 3, Continuous mechanical extract (MEV), could also be used with an appropriate through-frame slot vent.

7.8 Should AD-F System 4, Continuous mechanical supply and extract with heat recovery (MVHR), be implemented, trickle vents are not required.

7.9 It should be emphasised that the above is not intended to constitute a ventilation strategy design, which is the responsibility of the mechanical engineers. Assumptions regarding the ventilation strategy are required in order to carry out the acoustic assessment.

7.10 Once the ventilation strategy is established, if the details vary from those described above, the proposed details should be reassessed for acoustic performance.

7.11 **Reverberation time**

7.12 From ISO 140-4, Reference 7, the reverberation time is typically 0.5 seconds across the relevant frequency range for a furnished living room. This value is used for both living rooms and bedrooms.

7.13 **Dimensions and unit descriptions**

7.14 The room and window dimensions are taken from the architect's plans and elevations, Reference 8.

7.15 **Glazing**

7.16 The acoustic performance of the proposed glazing listed in the summary table is taken from Pilkington, Reference 9.

7.17 Opening windows may be acceptable to provide purge ventilation; all opening lights should be well fitted with compressible seals.

7.18 **Rooms most exposed to noise ingress**

7.19 Calculations are carried out for those rooms most exposed to noise ingress as the worst cases. If these have sufficient sound insulation to meet the internal level criteria, noise levels in less exposed but similarly protected rooms will be lower and therefore also comply with the Local Authority requirements.

7.20 The most exposed rooms are those with the largest ratio of window area to room volume, as well as those closest and most exposed to the noise sources.

7.21 A summary of the calculated internal levels is shown in Table 5.

Dwelling description	**Calculated internal level, $L_{Aeq, T}$ / dB**		**Full calculation**
	Daytime	**Night time**	
Master Bedroom	31	25	Table 6
Bedroom 4	31	24	Table 7

Table 5: Summary of calculated worst case internal noise levels

7.22 As night time noise levels are measured to be more than 5 dB below the daytime noise levels, the façade sound insulation design for bedrooms is limited by the daytime noise level upper limit of 35 dB(A).

8. Noise aspects of mechanical services design

8.1 The potential for noise issues from mechanical services is discussed in Appendix 2.

8.2 A limit of 26 dB(A) in bedrooms and 32 dB(A) in living rooms is suggested, following the default design guidance of BS EN 15251, Reference 10, for mechanical services noise when ventilating at the minimum low rate in accordance with AD-F.

8.3 The mechanical services noise limits are both to prevent the total noise from all sources exceeding the limits identified, and to prevent mechanical services noise causing annoyance that may result in occupants curtailing the operation of the ventilation system as described in Problems in residential design for ventilation and noise, Reference 5.

8.4 It is suggested that the specification includes a requirement for commissioning measurements of noise from the mechanical services, to ensure that the contractor pays sufficient attention to the design and construction requirements to meet this limit.

8.5 Measurements of mechanical services noise should be made in accordance with the Association of Noise Consultants Guidelines, Reference 6.

9. Conclusion

9.1 Noise levels affecting the proposed development have been measured and the highest noise impact calculated.

9.2 On the basis of the measurements, assumptions and details in this report, it is calculated that the minimum façade sound insulation provision as shown in the summary table is required.

10. References

1. BS 8233: 2014, Guidance on sound insulation and noise reduction for buildings.
2. BS 7445: 2003, Description and measurement of environmental noise. Guide to quantities and procedures
3. .BS EN 12354-3:2000, Building Acoustics – Estimation of acoustic performance of buildings from the performance of elements – Part 3: Airborne sound insulation against outdoor sound.
4. Approved Document F 2010 Edition, The Building Regulations 2000.
5. Harvie-Clark, J. and Siddall, M. Problems in residential design for ventilation and noise, Proc. Institute of Acoustics 2013; 35 (1): 74-87
6. ANC Guidelines: Noise Measurement in Buildings, Part 1: Noise from Building Services, Association of Noise Consultants, 2011
7. BS EN ISO 140-4: 1998 Acoustics – Measurement of sound insulation in buildings and of building elements – Part 4: Field measurements of airborne sound insulation between rooms.
8. BW Architecture Drawings No. 1425-04, 05, 06, 08, 03
9. Pilkington Glass technical data sheet
10. BS EN 15251: 2007, Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics

11. Appendix 1: Calculation of façade noise ingress

11.1 The noise level in a room due to sound penetrating a façade element may be calculated according to BS EN 12354-3 and BS 8233 from:

$$L_2 = L_{1,in} - R + 10 \times Log\left(\frac{S}{V}\right) + 10 \times Log(T) + 11$$

Equation 1.

Where:

- L_2 = noise level in room due to sound through façade portion of area S and mean sound reduction index R, dB
- L_1, in = external free-field noise level at the position of the façade, dB.
- R = sound reduction index of portion, dB
- S = area of façade portion, m^2.
- V = room volume, m^3
- T = reverberation time, s.

11.2 For small façade components, such as ventilators, the noise level in a room may be calculated according to the same standards as above from:

$$L_2 = L_{1,in} - D_{n,e} - 10 \times Log(V) + 10 \times Log(T) + 21$$

Equation 2.

Where:

- $D_{n,e}$ = element-normalised sound level difference of the ventilator.

Other components have the same meaning as above.

11.3 The sound reduction of the masonry portion of the facade is much higher than that of the glazing and ventilation provision. Therefore noise penetration through the masonry is disregarded as insignificant compared to noise penetration through the glazing and ventilation provision.

11.4 The noise penetration through the vents and the glazing is calculated as above and then combined in each frequency band to give an overall internal level from the external sources by these routes. Calculations are carried out in five octave bands as indicated in BS 8233.

Master Bedroom (Bedroom 3)	
Volume, V /m^3	44.6
Window area, S /m^2	14.2
Reverberation Time, T /s	0.5
Number of vents required	10

Octave centre frequency	**dB(A)**	**125 Hz**	**250 Hz**	**500 Hz**	**1 kHz**	**2 kHz**
Daytime freefield Noise, L_{1in} /dB(A)	**51**	**37**	**41**	**45**	**47**	**43**
4-16-4		24	20	25	35	38
Equation 1, L_2 /dB(A)	**27**	16	24	23	15	8
Greenwoods 4000 L /Dn,e		39	36	34	31	34
Equation 2, L_2 /dB(A)	**29**	10	17	22	27	20
Combined noise through window and vent/ dB(A)	**31**					

Octave centre frequency	**dB(A)**	**125 Hz**	**250 Hz**	**500 Hz**	**1 kHz**	**2 kHz**
Night time freefield Noise, L_{1in} /dB(A)	**44**	29	34	38	40	39
4-16-4		24	20	25	35	38
Equation 1, L_2 /dB(A)	**20**	8	17	16	8	4
Greenwoods 4000 L /Dn,e		39	36	34	31	34
Equation 2, L_2 /dB(A)	**23**	2	10	15	20	16
Combined noise through window and vent/ dB(A)	**25**					

Table 6: Calculations for Master Bedroom (Bedroom 3)

Bedroom 4	
Volume, V /m^3	34.3
Window area, S /m^2	1.9
Reverberation Time, T /s	0.5
Number of vents required	10

Octave centre frequency	**dB(A)**	**125 Hz**	**250 Hz**	**500 Hz**	**1 kHz**	**2 kHz**
Daytime freefield Noise, L_{1in} /dB(A)	**51**	**37**	**41**	**45**	**47**	**43**
4-16-4		24	20	25	35	38
Equation 1, L_2 /dB(A)	**19**	8	16	15	7	0
Greenwoods 4000 L /Dn,e		39	36	34	31	34
Equation 2, L_2 /dB(A)	**30**	11	18	23	28	21
Combined noise through window and vent/ dB(A)	**31**					

Octave centre frequency	**dB(A)**	**125 Hz**	**250 Hz**	**500 Hz**	**1 kHz**	**2 kHz**
Night time freefield Noise, L_{1in} /dB(A)	**44**	29	34	38	40	39
4-16-4		24	20	25	35	38
Equation 1, L_2 /dB(A)	**13**	0	10	8	1	-3
Greenwoods 4000 L /Dn,e		39	36	34	31	34
Equation 2, L_2 /dB(A)	**24**	3	11	16	21	17
Combined noise through window and vent/ dB(A)	**24**					

Table 7: Calculations for Bedroom 4

12. Appendix 2: Mechanical ventilation systems

12.1 **Noise ducted from the MVHR unit**

12.2 Noise from mechanical ventilation systems is not currently regulated under the Building Regulations.

12.3 There is no association of the ventilation condition, in accordance with Approved Document F, that should be provided while the noise level limits are achieved.

12.4 Problems with the dissociation of ventilation condition and noise level are discussed by Harvie-Clark and Siddall, Reference 5.

12.5 There is guidance in Approved Document F (AD-F) that noise from mechanical services should not exceed 30 dB(A) in bedrooms and living rooms, and not exceed a limit of 35 dB(A) in kitchens, when ventilating at the minimum low rate according to AD-F.

12.6 On the basis of the literature review presented by Harvie-Clark and Siddall, it is suggested that these limits are too high, and cause annoyance in a significant proportion of people. Annoyance can result in occupants curtailing the operation of the ventilation system. Such action leads to inadequate ventilation resulting in poor air quality, which is well correlated with a range of adverse health effects, as described in Reference 5.

12.7 Tolerance to domestic MVHR system noise has not yet been investigated in the UK; however, it is suggested that appropriate noise level limits associated with the minimum low ventilation rate may be taken from the default design values of BS EN 15251, Reference 10.

12.8 These values are 26 dB(A) in bedrooms, and 32 dB(A) in living rooms.

12.9 It is suggested that the client include a requirement for commissioning measurements of MVHR noise to ensure that these levels are met in practice. Measurements should be made according to the Association of Noise Consultants Guidelines.

12.10 There is currently considered to be insufficient understanding of appropriate noise limits during the minimum high ventilation rate (boost condition), and therefore limits for this condition are not proposed.

12.11 **Noise implications of other design issues**

12.12 As well as ducted noise from the MVHR unit, there is potential for ventilation systems which are not well designed to develop a negative noise impact. For example, locating the unit on a light-weight wall, or in the loft directly over bedrooms may be inappropriate and lead to an adverse noise impact.

12.13 If the filters are not regularly changed, the fan may increase in effort to counteract the additional flow resistance, resulting in higher noise levels. The unit should therefore be in a place that facilitates its operation and maintenance.

12.14 **Cross-talk between rooms**

12.15 Where there are ducts between rooms, there is potential for noise transmission between them; this is generally undesirable for the residents, but is not currently regulated. It is suggested that the level of cross-talk between rooms is limited such that $D_{ne,w} \geq 45$ dB.

12.16 Distribution systems that utilise single ducts from a plenum to each vent typically overcome the requirement for cross-talk attenuators.

12.17 **Purge ventilation and over heating**

12.18 Overheating has traditionally been controlled by the use of purge ventilation; over heating is not controlled under the Building Regulations, and there is no universally accepted definition, although it is understood that the revised CIBSE Guide A, due to be published shortly, will adopt the overheating criteria of BS EN 15251.

12.19 Utilising open windows to provide purge ventilation during the night time is unlikely to be compatible with undisturbed sleep, and is therefore undesirable.

12.20 As a means of sufficient ventilation for air quality purposes that is compatible with maintaining the façade sound insulation is proposed in this report, it is suggested that the designers give sufficient attention to preventing overheating such that purge ventilation is not required during the night time period.