Assessment of the Existing Noise Climate in the Vicinity of the Proposed New Residential Dwellings at the Lower Gate Site in Paddock, Huddersfield

Report Prepared for:

D2M3 Yorkshire Ltd
Brackenwood
Hebers Ghyll Drive
Ilkley
LS29 9QQ

Report Prepared By:

Robert Smith

Report Reference: DRUK/ACC/RS/JWBLLH/2576.1

Date: 22nd June 2017

✉ ***Druk*** Limited, 87 St Albans Road, Halifax, HX3 0ND
☎ 01422 330 621 / 07917 727 901
rsmith@druklimited.co.uk
www.druklimited.co.uk
Registered in England: 06380955

Contents

1.0 Summary

Planning permission is being sought to permit the construction of up to 17 new residential houses and flats on a parcel of land on Lower Gate in Paddock, Huddersfield.

In support of the application process, noise surveys have been conducted to characterise the existing noise climate in the immediate vicinity of the proposed residential dwellings. Using the existing noise climate data obtained from the surveys, calculations have been performed to provide an indication of the likely internal noise levels within the proposed new residential houses and flats, resulting from external noise break-in.

The noise climate in the vicinity of the proposed residential development on Lower Gate in Paddock, Huddersfield, was regarded as being essentially sub-urban in character with Lower Gate itself being an intermittently busy road. During both the afternoon and night time periods the principal contributor to the ambient noise climate was road traffic noise, with private cars and buses representing the dominant classes of vehicles.

Additional noise sources again included the sound of the leaves on the trees surrounding the proposed development site rustling in the breeze, a number of train movements on the railway lines to the south, distant emergency vehicle sirens and the sound of occasional aircraft overflights.

Combining the measured noise levels obtained from the surveys with the sound insulation provided by the proposed dwelling envelopes, it has been demonstrated that the calculated internal noise levels within the proposed dwellings would comply with the adopted design guide values from BS 8233:2014 with respect to the L_{Aeq}, and L_{Amax} parameters. As a consequence, it is suggested that the sound insulation provided by the proposed building envelope components, highlighted in this report, would be sufficient to control the ‘break-in’ of external noise to the proposed dwellings without the need for the incorporation of any additional sound attenuation measures. In addition it is suggested that the noise climate in the principal amenity space, the back gardens of proposed house types A and C, would comply with the design guide value contained within BS 8233:2014 for external amenity areas.

Consequently it is suggested that the existing noise climate in the vicinity of the proposed dwellings on Lower Gate in Paddock, Huddersfield should not be regarded as an impediment to the granting of planning permission.

Report Prepared by:

R Smith.

....
Robert Smith

2.0 Introduction

Planning permission is being sought to permit the construction of up to 17 new residential houses and flats on a parcel of land on Lower Gate in Paddock, Huddersfield.

In support of the application process, noise surveys have been conducted to characterise the existing noise climate in the immediate vicinity of the proposed residential dwellings. Using the existing noise climate data obtained from the surveys, calculations have been performed to provide an indication of the likely internal noise climate within the proposed new residential dwellings, resulting from external noise break-in.

3.0 Site Description

The proposed development site would be located on a parcel of land on Lower Gate in Paddock, Huddersfield (figure 1 below and image 1 overleaf). To the north of the proposed development site are the existing residential dwellings on Lower Gate (photograph 1 overleaf). To the east of the proposed development site is the existing Metrodent commercial building (photograph 2 overleaf) and the west of the proposed development site is the existing residential dwelling at 109 Lower Gate (photograph 3 overleaf). Approximately 35 metres to the south of what would be the rear façades of the proposed dwellings are the existing railway lines.

Photograph 1. Proposed development site (edged in red), Lower gate, Paddock, Huddersfield

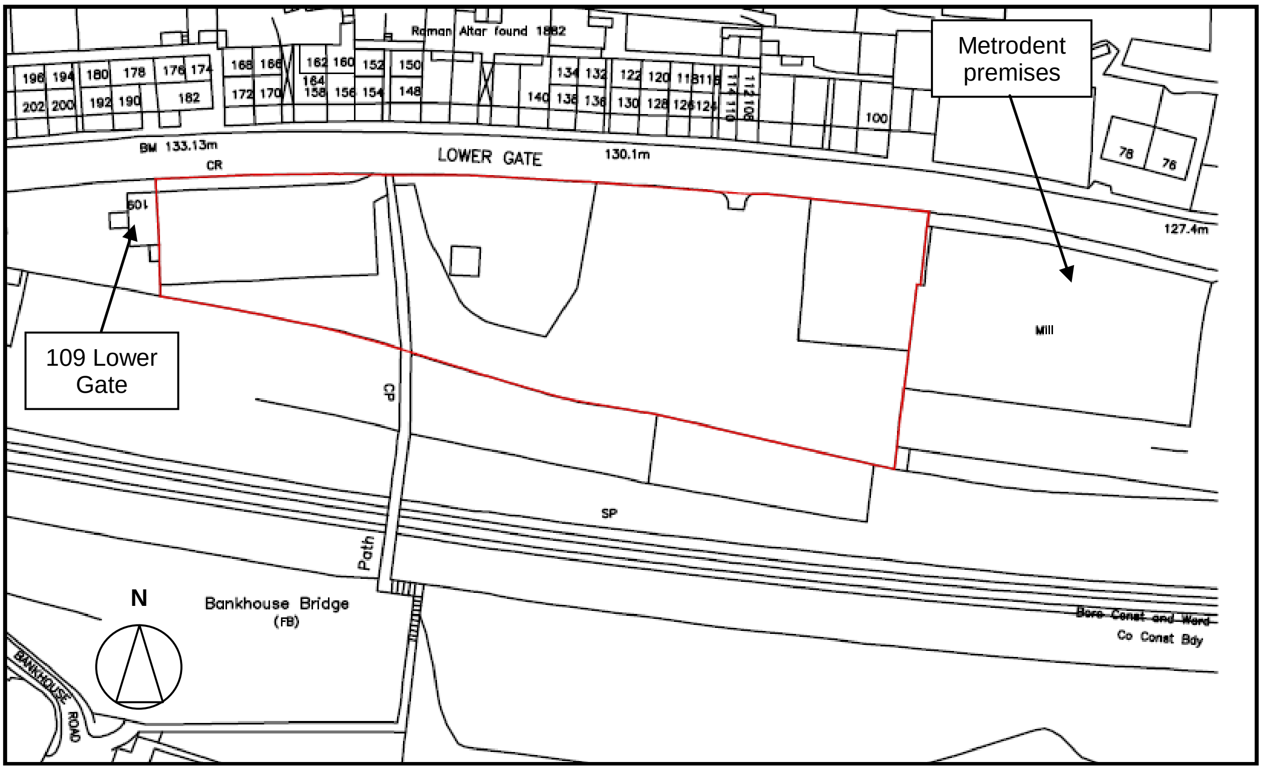


Image 1. Proposed development site, Lower Gate, Paddock

Source: Goolge images 2017

Photograph 1. Existing residential properties to the north of the proposed development site

Photograph 2. Metrodent premises to the east of the proposed development site

Photograph 3. Number 109 Lower Gate to the west of the proposed development site

4.0 Assessment Criteria

A pre-application discussion was held with the Local Planning Authority, Kirklees Council, to discuss various elements of the proposed development. Subsequent to this discussion a consultation response was received, on the 18th April 2017, from Kirklees Council's Pollution and Noise Control Team detailing a number of investigations that they deemed would be necessary with respect to the proposed development scheme. Included in this response was a requirement to assess the existing noise climate and evaluate what, if any, noise attenuation measures would be necessary to ensure that noise levels within the proposed dwellings and associated gardens would meet acceptable levels. The full wording of the requirement relating to noise is reproduced below.

> Noise
>
> Before development commences a report specifying the measures to be taken to protect the development from noise from rail/road traffic and nearby industry shall be submitted to and approved in writing by the LPA
>
> The report shall
>
> (i) Determine the existing noise climate
>
> (ii) Predict the noise climate in gardens (daytime), bedrooms (night-time) and other habitable rooms of the development (this is for housing think whether there would be alternative wording for other uses)
>
> (iii) Detail the proposed attenuation/design necessary to protect the amenity of the occupants of the new residences (including ventilation if required).
>
> Unless otherwise agreed in writing with the LPA the development shall not be occupied until all works specified in the approved report have been carried out in full and such works shall be thereafter retained.

In order to comply with the above requirements further discussions were held with Ms. Alexandra Garry, Senior Environmental Health Officer within Kirklees MBC's Pollution & Noise Control Team. Email Correspondence, reproduced in Appendix 1, with Ms. Garry identified a suitable measurement procedure and indicated that the existing noise climate and the potential effects this may have on the permitted dwellings, should be assessed with regarded to the guidance contained within British Standard (BS) 8233:2014 “Guidance on sound insulation and noise reduction for buildings”.

4.1 BS 8233:2014

BS 8233:2014 draws together research and best practice relating to building design, providing guidance to facilitate the development of buildings that have internal noise environments that are consistent with and appropriate for their intended use. The British Standard highlights methods for the control of noise from a number of sources including external noise and building services etc., as well as evaluating the effect that noise from these sources may have on the acoustics of the internal spaces.

With reference to the design guidance relating to the internal noise climate of residential dwellings, BS 8233:2014 summarises this guidance within table 4 of section 7.7.2. The main elements of this guidance is reproduced in table 1 overleaf.

Table 1. Indoor ambient noise levels for dwellings (reproduced from table 4 of BS8233:2014)

Activity	Location	0700 to 2300	2300 to 0700
Resting	Living room	35dB $L_{\text{Aeq, 16 hour}}$	-
Dining	Dining room/area	40dB $L_{\text{Aeq, 16 hour}}$	-
Sleeping (daytime resting)	Bedroom	35dB $L_{\text{Aeq, 16 hour}}$	30dB $L_{\text{Aeq, 8 hour}}$

Although the 2014 version of BS 8233 contains comprehensive guidance relating to desirable internal noise levels within habitable spaces in terms of the L_{Aeq} values over the day and night time periods, it does not contain an L_{Amax} standard for bedrooms at night. As a result reference will be made to the guidance contained within the earlier 1999 version of BS 8233. The L_{Amax} guidance from the 1999 version of BS8233 specifies a separate ‘reasonable’ standard in bedrooms at night, from individual noise events. To achieve this ‘reasonable’ standard BS 8233:1999 states in footnote (a) to table 5 that, "individual noise events (measured with the fast time-weighting) should not normally exceed 45 dB L_{Amax}". The 45dB L_{Amax} criterion is often considered as a stringent criterion particularly with respect to urban and sub-urban environments.

In addition to the internal noise design guidance, BS 8233:2014 also provides guidance on the external noise environment. In this situation BS8233:2014, at paragraph 7.7.3.2, states the following: “*For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise climate does not exceed 50dB $L_{Aeq,T}$ with an upper guideline value of 55dB $L_{Aeq,T}$ which would be acceptable in noisier environments*”.

With reference to the subsequent assessments of the likely internal noise climate within the permitted dwellings, all evaluations will be undertaken with respect to guidance contained within both versions of BS 8233. Despite this and with reference to both the versions of BS 8233, it must be remembered that the advice contained within these documents is design guidance and the suggested levels are *desirable*. It does not represent a set of rigid criteria, below which a development ‘passes’ and above which a development ‘fails’. For instance, with windows open, there can be very few developments outside the quietest of areas where the internal levels would not exceed at least some of the various criteria.

5.0 Survey Details

5.1 Survey Times and Personnel

The noise surveys, to evaluate the existing noise climate in the vicinity of the proposed development were undertaken between 2300 - 0100 hours on the 25th - 26th June 2017 and between 1530 - 1900 hours on the 3rd July 2017.

All measurements were fully attended for the duration and the surveys and were conducted by Mr. R Smith of Druk Limited.

5.2 Weather

Throughout the ambient noise surveys the weather conditions were as follows:

Night time, 25th - 26th June 2017

All surfaces were dry, the sky was overcast, the temperature was approximately 15°C, the wind speed was approximately 0.5m/s and the barometric pressure was 998mb.

Afternoon, 3rd July 2017

All surfaces were dry, cloud cover was approximately 30%, the temperature was approximately 20°C, the average wind speed was approximately 2.7m/s gusting to 4.7m/s and the barometric pressure was 1003mb.

5.3 Equipment

All the noise surveys and measurements were conducted using the equipment detailed in the table 2 below.

The sound level meter was field calibrated before, after and during the surveys as necessary, during which time no significant deviation in the calibrated level was observed.

Table 2. Equipment used during the ambient noise surveys

Equipment description	Manufacturer	Model number	Serial number
Sound level meter	NTI Audio	XL2-TA	A2A-10232-E
Microphone pre-amplifier	NTI Audio	MA220	5537
Microphone	NTI Audio	M2230	8636
Acoustic calibrator	Norsonic AS	Nor 1251	31522

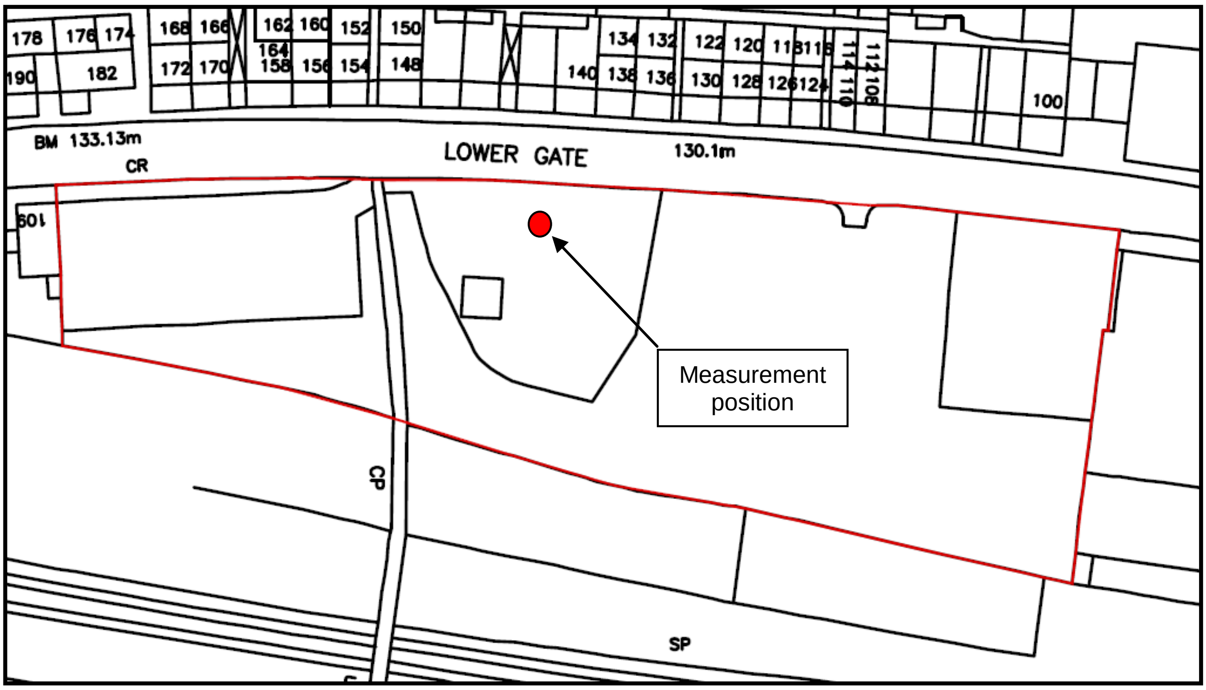
5.4 Measurement Procedure

As can be seen from image 1 above the proposed development site was, with one exception, covered with large mature trees which restricted access to the majority of the site. The only open area on the site was in front of a number of what appeared to be disused garages on what would be the Lower Gate elevation (photograph 4 overleaf). As a consequence it was only possible to obtain measurements of the existing noise climate from this one area of clear ground adjacent to Lower Gate itself. The approximate location of this single measurement position is detailed on figure 2 overleaf.

The sound level meter was tripod mounted such that the microphone was approximately 1.3 metres above ground level, at least 3 metres from any potentially reflecting surface and approximately 6 metres from the nearside carriageway. During both the day and night time surveys the measurement time interval was 15 minutes and all measurements were made with the ‘fast’ time weighting engaged.

Photograph 4. Clear area on the proposed development site

Figure 2. Approximate location of the measurement position



6.0 Noise Survey Results

The noise climate in the vicinity of the proposed development site on Lower Gate was regarded as being essentially sub-urban in character with Lower Gate itself being an intermittently busy road. The following paragraphs contain brief subjective descriptions of the noise sources noted during the survey periods.

6.1 Qualitative Assessment: Night time Period

During this period the principal contributor to the existing noise climate was road traffic on Lower Gate, which comprised mainly private cars, light vans and taxis. Additional noise sources noted during this period included the sound of the leaves on the trees surrounding the development site rustling in the breeze, a few train movements on the railways lines to the south of the proposed development site, a few pedestrians talking as they walked along Lower Gate, baring dogs and the sound of wildlife rustling in the undergrowth behind the measurement position.

6.2 Qualitative Assessment: Afternoon Period

Again the principal contributor to the ambient noise climate was road traffic noise on Lower Gate, with private cars and buses representing the dominant classes of vehicles. Throughout this period the volume of traffic on the road remained relatively steady with very little apparent variation in traffic volume during the measurement period.

Additional noise sources again included the sound of the leaves on the trees surrounding the proposed development site rustling in the breeze, a number of train movements on the railway lines to the south, distant emergency vehicle sirens and the sound of occasional aircraft overflights.

One other element to be considered during this period was the emission of noise from the Metrodent premises to the east of the proposed development site. By virtue of the relatively narrow pavements and the lack of other suitable measurement locations close to these premises, it was not possible to obtain quantitative measurements of the emission of noise from Metrodent. As a consequence two qualitative noise assessments were undertaken of the emission of noise from the Metrodent premises and these assessments were made between 1500 - 1530 hours on the 3rd July 2017 and between 1600 - 1630 hours on the 5th July 2017. During both of these periods it was not possible to hear any noise that was believed to emanate from the Metrodent premises above the remaining contributors to the existing noise climate.

6.3 Basic Results

As the measurements were obtained from a position that was closer to the nearside carriageway than the front façade of any of the proposed dwellings, the measured noise levels have been distance corrected assuming a conservative line source propagation correction. The distance corrected noise levels are summarised in terms of the L_{Aeq}, L_{Amax}, L_{A10} and L_{A90} parameters in tables 3 and 4 overleaf. Full measurement data are presented in tabular form in Appendix 1.

Table 3. Existing ambient noise levels (distance corrected), night time, Lower Gate

Start time	dB L_{Aeq}, (15 minutes)	dB L_{Amax}, (15 minutes)	dB L_{A10} (15minutes)	dB L_{A90}, (15 minutes)
2300	57	78	53	39
2315	59	78	61	38
2330	58	77	60	38
2345	55	72	59	38
0000	51	71	50	37
0015	56	74	57	38
0030	55	75	53	38
0045	57	75	60	38
Standard deviation	2.42	2.54	4.13	0.59

Table 4. Existing ambient noise levels (distance corrected), afternoon/evening, Lower Gate

Start time	dB L_{Aeq}, (15 minutes)	dB L_{Amax}, (15 minutes)	dB L_{A10} (15minutes)	dB L_{A90}, (15 minutes)
1530	60	74	62	50
1545	60	71	63	53
1600	60	76	62	49
1615	60	74	63	49
1630	60	74	63	49
1645	60	76	63	51
1700	59	72	62	49
1715	59	74	62	47
1730	60	77	63	50
1745	60	80	63	50
1800	60	74	63	48
1815	59	76	63	46
1830	59	71	62	45
1845	60	77	63	45
Standard deviation	0.46	2.41	0.37	2.36

As can be seen from the tables 3 and 4 the daytime noise climate was steadier, in terms of the L_{Aeq}, L_{A10}, and L_{A90} parameters, than the night time noise climate suggesting that the noise climate during this period was principally affected by a relatively dominant and constant noise source, in this case road traffic. With reference to the L_{Amax} levels, these demonstrate a greater degree of variability and were largely a consequence of vehicles travelling along Lower Gate.

7.0 Noise Transmission Calculations

Using the measured ambient noise levels from the afternoon and night-time measurement periods, calculations have been performed to assess the likely internal noise levels within the proposed new dwellings. All the assessments have been conducted with reference to the design guidance detailed in section 4.0 above.

The subsequent assessment of the potential internal noise levels within the proposed dwellings have been undertaken using the highest measured levels from the noise surveys and these levels are detailed in table 5 below. With reference to the proposed rooms on the rear elevations of the proposed dwellings, as these elevations will be effectively shielded from the principal noise source by the dwellings themselves, a conservative 10dB reduction in the measured noise levels has been assumed for these elevations only. This suggested reduction has been utilised in the subsequent calculations. Consequently the following assessments may be regarded as worst case situations which are unlikely to persist for all but short periods of time.

Table 5. Highest measured noise levels, Lower Gate

OBCF, Hz*	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**Overall, dB(A)**
Daytime, L_{Aeq}, (1545 - 1600 hours)	71	63	57	54	57	53	47	44	**60**
Night time, $L_{Aeq,}$ (2315 - 2330 hours)	65	59	56	54	56	51	45	39	**59**
Night time, $L_{Amax.}$ (2300 - 2315 hours)	85	83	78	75	73	65	60	56	**78**

The sound insulation provided by a building envelope is calculated from the sound insulation provided by the various façade elements, such as the glazing, external walls etc., and the areas they cover. In the majority of cases it is the glazing that can be considered as the ‘weak’ link acoustically, therefore increasing the sound insulation of the glazing will improve the overall sound insulation of the façade. The result of the calculations is a composite sound insulation value for the whole façade.

The assessments contained within the subsequent sections of this assessment report have been undertaken according to preliminary drawings, relating to both the proposed dwelling types and site layout, issued by Stott Thompson Architects of Halifax. These drawings are reproduced in Appendix 3 and detail three main dwellings types, namely: house type A - 4 bedroom house, house type C - 4 bedroom house and house type D - 2 bedroom apartment.

To facilitate the calculations to be made the following assumptions have been employed:

- The reverberation times within the habitable rooms will be 0.5 seconds.
- The floor to ceiling height will be approximately 2.4 metres.

7.1 Construction Specification

The building envelope constructional details described below and overleaf have been assumed for the purposes of the subsequent calculations.

External Walls

The external walls of the proposed dwellings will be of cavity masonry construction around 300mm thick and will comprise: an external brick leaf, a 75 - 100mm cavity filled with thermal insulation and a 100mm thick concrete block inner leaf lined with one layer of 12.5mm plasterboard on adhesive dabs. Test results for a similar construction suggest that external walls of this type should provide an overall sound insulation of around R_w 52dB, with the octave band sound insulation values being as detailed in table 6 below.

Table 6. External Wall**,** Octave Band Sound Insulation Values

OBCF, Hz*	**125**	**250**	**500**	**1k**	**2k**	**4k**	**Overall, R_w dB(A)**
Sound Insulation, dB	38	42	51	59	63	63	52

* Octave Band Centre Frequency

Glazing

The proposed dwelling glazing will be of the sealed unit type and will comprise the following nominal specification: 4mm pane - 16/20mm cavity - 4mm pane. Laboratory test data form Pilkington indicate that this configuration should provide a sound insulation value of 31dB R_w respectively when closed. The octave band sound insulation values are as detailed in table 7 below.

Alternative glazing configurations would be acceptable providing the sound insulation performances are at least equivalent to the specifications detailed in table 7 below.

Table 7. Glazing, octave band sound insulation values

OBCF, Hz*	**125**	**250**	**500**	**1k**	**2k**	**4k**	**Overall, R_w dB(A)**
4mm, 6 - 20mm, 4mm	24	20	25	35	38	35	**31**

* Octave Band Centre Frequency

Ventilation

It has been assumed that background ventilation in compliance with the requirements of Approved Document F will be provided by window frame mounted ventilators of the Greenwood EAR42W acoustic ventilator (or units offering equivalent sound insulation performance) type, with local mechanical extract ventilation being provided in areas of high humidity. Laboratory test data indicates that these ventilators should provide a sound insulation value of 42dB $D_{n,e,w}$ respectively in their open position. Details of the selected ventilator may be found in Appendix 4.

With reference to the ventilator selection, the specified unit has been employed primarily to ensure that the night time L_{Amax} levels within the proposed dwellings comply with the design values quoted in section 4. The octave band sound insulation values for the Greenwood EAR42W unit are detailed in table 8 below.

Table 8. Background ventilation**,** octave band sound insulation values

OBCF, Hz*	**125**	**250**	**500**	**1k**	**2k**	**4k**	**Overall, $D_{n,e,w}$ dB**
Greenwood EAR42W	33	39	39	43	50	53	**42**

* Octave Band Centre Frequency

Despite the above it is worth remembering that many local planning authorities are now requiring some form of ventilation strategy that facilitates the rapid ventilation of the internal spaces without necessitating the opening of windows. This is particularly the case where developments are planned within city centres or other higher noise environments. The intention is to provide occupants in higher noise environments with a choice of whether to ventilate the internal spaces by opening the windows or not. The implicit assumption is that ventilating the internal spaces by opening windows will inevitably permit the ingress of external noise.

One way to address the compromise that exists between adequately ventilating the internal spaces whilst ensuring the continuity of the façade sound insulation, is to provide the dwellings with mechanical ventilation. Where mechanical ventilation is to be provided it would be prudent to locate the intake and exhaust terminations of such systems on the quieter, rear, façades of the dwellings. Where this is not possible the exhaust and inlet terminations should be provided with suitable attenuators to minimise the ingress of external noise. Where duct attenuators are to be provided is it not uncommon to specify that they achieve similar sound insulation values to that provided by the windows and this would be recommended in this case. It would be prudent to engage an M & E contractor to undertake suitable assessments to evaluate the likely noise levels at the internal terminations resulting from losses through the attenuators, ductwork, end reflections etc.

The above comments accord with the advice given in note 5 to paragraph 7.7.2 of BS8233:2014, which states the following: "If relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation that does not compromise the facade insulation or the resulting noise level". It would however be prudent to discuss the ventilation requirements for the flats with the Local Planning Authority at the earliest possible opportunity.

7.2 Calculation Results

For the purposes of the calculations the highest measured noise levels detailed in table 5 above were used. The results of the break-in noise calculations are presented, with reference to the design guidance contained within section 4.0 above, in tables 9, 10 and 11 overleaf. With respect to the presentation of the results the calculations relating to the night time L_{Aeq} and L_{Amax} results are presented in the same columns with the L_{Amax} results being contained in brackets. Full data are available in Appendix 5.

Table 9. Calculated internal noise levels, house type A

Location	Design target, daytime, dB L_{Aeq}	Calculated level, daytime, dB L_{Aeq}	Design target, night time, dB L_{Aeq}	Calculated levels, night time, dB L_{Aeq} and (L_{Amax})
Kitchen/dining room	35	**31**	30 (45)	-
Living room	35	**24**	30 (45)	-
Bedroom 1	35	**22**	30 (45)	**18 (40)**
Bedroom 2	35	**29**	30 (45)	**27 (45)**
Bedroom 3	35	**28**	30 (45)	**26 (45)**
Bedroom 4	35	**22**	30 (45)	**19 (40)**

Table 10. Calculated internal noise levels, house type C

Location	Design target, daytime, dB L_{Aeq}	Calculated level, daytime, dB L_{Aeq}	Design target, night time, dB L_{Aeq}	Calculated levels, night time, dB L_{Aeq} and (L_{Amax})
Kitchen/dining room	35	**22**	30 (45)	-
Living room	35	**30**	30 (45)	-
Bedroom 1	35	**27**	30 (45)	**24 (45)**
Bedroom 2	35	**21**	30 (45)	**18 (40)**
Bedroom 3	35	**31**	30 (45)	**15 (37)**
Bedroom 4	35	**21**	30 (45)	**16 (37)**

Table 11. Calculated internal noise levels, house type D (2 beroom flats)

Location	Design target, daytime, dB L_{Aeq}	Calculated level, daytime, dB L_{Aeq}	Design target, night time, dB L_{Aeq}	Calculated levels, night time, dB L_{Aeq} and (L_{Amax})
Kitchen/dining/living room	35	**19**	30 (45)	-
Bedroom 1	35	**27**	30 (45)	**17 (38)**
Bedroom 2	35	**21**	30 (45)	**24 (45)**

As can be seen from tables 9 - 11 the calculated internal noise levels resulting from external noise break-in would not exceed either sets of design guidance contained within section 4 above. As such it is suggested that the sound insulation of the proposed building envelope components detailed above, would be sufficient to limit the ingress of external noise to the interior of the proposed dwellings without the need for any additional sound attenuation measures to be implemented.

7.3 External Amenity Areas

With reference to the external amenity areas appurtenant to the proposed dwellings, it is suggested that the rear gardens of house types A and C would be the principal external amenity spaces for the proposed dwellings. With reference to the likely effect that the existing noise climate may have on this area, it has been assumed that the measured noise levels obtained from the afternoon period will be the most appropriate with reference to this evaluation.

The obtained noise levels from the afternoon survey indicate that the highest measured level was 60dB $L_{Aeq\ (15\ mins)}$ with the mean value over the measurement period also being 60dB $L_{Aeq,T.}$ As the principal contributor to the existing noise climate was noise from vehicles on Lower Gate itself, the proposed dwellings themselves would be expected to provide a considerable degree of acoustic shielding to the garden areas directly behind the dwellings.

The principles contained within the Calculation of Road Traffic (CRTN) document, relating to the shielding provided by the proposed houses with a height of approximately 7.6 metres and assuming a receiver height of 1.4 metres, roughly equivalent to a seated person, were applied. The results of the assessment suggest that the calculated path difference (δ) would be around 2.0 metres. Applying the potential barrier corrections contained within Chart 9b of CRTN would suggest an attenuation of around 18dB would be possible. Applying this calculated reduction in noise level to both the highest and average measured levels obtained from the afternoon period, would see the resulting noise levels in the back gardens of the proposed houses reduced to around 42dB$L_{Aeq,T,}$ with reference to the noise from Lower Gate. Noise levels of this order would comply with the "*upper guideline value of 55dB $L_{Aeq,T}$*" detailed in 7.7.3.2 of BS 8233:2014.

8.0 Conclusion

The noise climate in the vicinity of the proposed residential development on Lower Gate in Paddock, Huddersfield, was regarded as being essentially sub-urban in character with Lower Gate itself being an intermittently busy road. During both the afternoon and night time periods the principal contributor to the ambient noise climate was road traffic noise, with private cars and buses representing the dominant classes of vehicles.

Additional noise sources again included the sound of the leaves on the trees surrounding the proposed development site rustling in the breeze, a number of train movements on the railway lines to the south, distant emergency vehicle sirens and the sound of occasional aircraft overflights.

Combining the measured noise levels obtained from the surveys with the sound insulation provided by the proposed dwelling envelopes, it has been demonstrated that the calculated internal noise levels within the proposed dwellings would comply with the adopted design guide values from BS 8233:2014 with respect to the L_{Aeq}, and L_{Amax} parameters. As a consequence, it is suggested that the sound insulation provided by the proposed building envelope components, highlighted in this report, would be sufficient to control the 'break-in' of external noise to the proposed dwellings without the need for the incorporation of any additional sound attenuation measures. In addition it is suggested that the noise climate in the principal amenity space, the back gardens of proposed house types A and C, would comply with the design guide value contained within BS 8233:2014 for external amenity areas.

Consequently it is suggested that the existing noise climate in the vicinity of the proposed dwellings on Lower Gate in Paddock, Huddersfield should not be regarded as an impediment to the granting of planning permission.

Appendix 1: Emails

From: Robert Smith [mailto:rsmith@druklimited.co.uk]
Sent: 12 June 2017 21:27
To: Alexandra Garry
Subject: Planning noise assessments

Dear Alexandra.

Many thanks for taking the time to discuss the two potential planning noise assessment procedures with me.

As discussed our proposals related to the planning permission granted under application 2014/46/93986/W – erection of two dwellings on Manchester Road in Slaithwaite and Lower Gate in Paddock, PNC reference WK/20176487. In both cases we propose to conduct the noise surveys between 1530 – 1900 hours and again between 2300 – 0100 hours. Where any significant late night entertainment or commercial noise sources are detected we will extend the night time period accordingly. In both cases the surveys will be conducted during the week.

With reference to the analysis, we will base this on complying with the design guidance contained within BS8233:2014 and the L_{Amax} guidance contained within BS8233:1999. Where necessary we will specify the necessary measures to ensure compliance with the design targets.

As discussed I would be most grateful if you could confirm whether or not these proposals are acceptable to you.

Regards,

Rob Smith

Druk Limited, 87 St Albans Road, Halifax, HX3 0ND
Tel: 01422 330 621/07917 727 901
rsmith@druklimited.co.uk
www.druklimited.co.uk
Registered in England: 06380955

From: Alexandra Garry [mailto:Alexandra.Garry@kirklees.gov.uk]
Sent: 13 June 2017 10:25
To: 'Robert Smith'
Subject: RE: Planning noise assessments

Thank you for your email Robert. To confirm I am happy with your proposals for both sites.

Regards

Alex

Alexandra Garry
Senior Environmental Health Officer
Pollution & Noise Control Team
T: 01484 221000 (Automated Switchboard ask for Alexandra Garry)
Lync: 70832

Appendix 2: Existing noise climate, measured levels

Lower Gate, Paddock											
Existing noise climate survey											
Distance corrected noise levels											
25th - 26th June 2017											
Octave Band Centre Frequency, Hz.	**dB(A)**	**31.5**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**16k**
2300											
L_{Aeq}	**57.1**	60.5	64.3	66.3	58.4	51.8	51.4	47.7	40.5	36.4	38.0
L_{max}	**77.5**	81.3	84.6	82.9	77.8	75.4	73.2	64.7	60.0	55.7	62.9
L_{10}	**53.0**	62.1	59.1	54.1	50.1	47.1	49.1	46.1	40.1	36.1	36.1
L_{90}	**39.4**	39.1	42.1	37.1	32.1	33.1	33.1	31.1	31.1	32.1	35.1
2315											
L_{Aeq}	**59.4**	60.6	64.9	58.8	55.6	53.7	56.5	51.5	45.1	39.3	38.8
L_{max}	**77.5**	80.8	88.6	78.4	77.3	73.0	73.5	68.4	64.7	60.2	62.0
L_{10}	**60.9**	63.1	62.1	57.1	57.1	54.1	58.1	54.1	44.1	37.1	36.1
L_{90}	**38.3**	38.1	39.1	35.1	32.1	31.1	31.1	30.1	30.1	32.1	35.1
2330											
L_{Aeq}	**57.8**	59.8	73.1	63.6	53.0	50.7	54.2	49.9	42.7	39.4	36.3
L_{max}	**77.3**	80.7	84.6	88.6	77.2	71.0	71.0	66.9	62.4	61.4	45.8
L_{10}	**59.7**	61.1	61.1	57.1	54.1	52.1	57.1	53.1	43.1	36.1	36.1
L_{90}	**38.3**	38.1	40.1	35.1	32.1	31.1	31.1	30.1	30.1	32.1	35.1
2345											
L_{Aeq}	**55.4**	55.3	55.1	49.0	48.7	48.3	53.0	48.5	38.9	34.3	36.0
L_{max}	**71.7**	76.8	72.3	66.1	65.8	63.5	69.7	64.1	55.0	47.0	38.3
L_{10}	**58.8**	57.1	58.1	52.1	53.1	52.1	56.1	52.1	42.1	35.1	35.1
L_{90}	**38.0**	38.1	39.1	35.1	31.1	30.1	30.1	30.1	30.1	32.1	35.1
0000											
L_{Aeq}	**51.3**	60.3	55.7	45.9	45.4	44.6	48.7	44.0	36.1	33.9	36.0
L_{max}	**71.2**	82.3	75.0	67.1	64.0	65.0	69.3	62.4	54.5	49.7	37.5
L_{10}	**50.1**	63.1	59.1	48.1	45.1	44.1	47.1	42.1	37.1	34.1	35.1
L_{90}	**37.3**	36.1	36.1	34.1	30.1	29.1	28.1	28.1	30.1	32.1	35.1
0015											
L_{Aeq}	**55.7**	52.9	55.7	48.9	49.5	48.9	53.5	48.0	39.2	34.3	36.0
L_{max}	**73.6**	72.6	73.1	67.3	69.2	68.9	71.4	64.2	56.0	48.9	39.6
L_{10}	**57.3**	55.1	57.1	51.1	51.1	50.1	55.1	50.1	40.1	34.1	35.1
L_{90}	**37.8**	37.1	38.1	34.1	31.1	30.1	30.1	29.1	30.1	32.1	35.1
0030											
L_{Aeq}	**54.7**	58.1	56.9	53.6	48.8	49.8	52.0	46.3	39.8	35.7	36.2
L_{max}	**74.9**	80.4	77.8	76.5	70.9	71.5	71.9	64.7	60.6	56.1	49.3
L_{10}	**52.6**	59.1	54.1	50.1	47.1	47.1	50.1	44.1	38.1	34.1	35.1
L_{90}	**38.3**	36.1	37.1	34.1	31.1	31.1	31.1	30.1	30.1	32.1	35.1
0045											
L_{Aeq}	**56.9**	56.1	58.4	53.9	50.6	50.1	54.6	49.3	40.8	35.4	36.0
L_{max}	**74.8**	76.0	76.8	75.9	69.9	68.2	73.1	64.8	56.5	50.9	40.8
L_{10}	**60.3**	57.1	61.1	55.1	54.1	53.1	58.1	53.1	43.1	36.1	35.1
L_{90}	**38.1**	36.1	36.1	33.1	31.1	31.1	31.1	29.1	30.1	32.1	35.1

Lower Gate, Paddock											
Existing noise climate survey											
Distance corrected noise levels											
3rd July 2017											
Octave Band Centre Frequency, Hz.	**dB(A)**	**31.5**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**16k**
1530											
L_{Aeq}	**59.9**	68.7	70.4	61.2	55.9	53.5	56.6	52.7	46.5	40.7	36.8
L_{max}	**74.3**	87.4	85.9	77.6	72.7	66.3	68.6	68.1	62.9	63.3	53.2
L_{10}	**62.0**	73.1	72.1	64.1	57.1	56.1	59.1	54.1	47.1	42.1	36.1
L_{90}	**49.9**	54.1	56.1	48.1	46.1	44.1	46.1	43.1	38.1	34.1	35.1
1545											
L_{Aeq}	**60.2**	70.1	71.4	63.1	56.6	54.5	56.6	52.7	46.7	43.8	36.5
L_{max}	**71.2**	87.1	87.9	78.2	67.5	65.1	63.8	62.5	59.3	64.1	41.3
L_{10}	**62.6**	72.1	74.1	65.1	59.1	56.1	59.1	55.1	49.1	43.1	37.1
L_{90}	**52.7**	56.1	60.1	53.1	50.1	47.1	49.1	45.1	40.1	35.1	35.1
1600											
L_{Aeq}	**60.0**	67.4	70.7	64.3	55.9	53.8	56.7	52.1	45.1	40.7	36.5
L_{max}	**75.5**	88.0	91.2	85.7	72.2	70.6	69.1	65.3	60.8	63.1	50.8
L_{10}	**62.2**	70.1	72.1	64.1	57.1	56.1	59.1	55.1	47.1	41.1	36.1
L_{90}	**48.6**	53.1	55.1	48.1	44.1	43.1	45.1	41.1	36.1	33.1	35.1
1615											
L_{Aeq}	**59.9**	67.1	68.6	60.3	55.0	53.6	57.1	52.4	44.9	39.0	36.5
L_{max}	**73.7**	86.4	87.1	78.1	74.2	69.3	67.8	65.0	62.0	60.6	45.3
L_{10}	**62.7**	70.1	71.1	62.1	57.1	56.1	60.1	55.1	47.1	40.1	36.1
L_{90}	**49.0**	52.1	54.1	47.1	44.1	43.1	46.1	41.1	36.1	33.1	35.1
1630											
L_{Aeq}	**59.7**	68.1	68.1	61.7	55.6	53.4	56.7	52.1	44.6	39.6	36.6
L_{max}	**74.2**	87.3	85.8	80.5	72.4	67.7	68.2	67.7	62.3	59.5	52.5
L_{10}	**62.7**	70.1	71.1	63.1	57.1	56.1	60.1	55.1	47.1	40.1	36.1
L_{90}	**49.1**	53.1	55.1	48.1	44.1	43.1	46.1	41.1	36.1	33.1	35.1
1645											
L_{Aeq}	**60.2**	67.8	70.2	63.1	55.6	53.6	57.2	52.6	45.2	39.4	36.6
L_{max}	**76.4**	85.8	91.2	86.9	73.1	68.1	68.1	68.5	65.8	64.4	54.7
L_{10}	**62.8**	70.1	72.1	64.1	58.1	56.1	60.1	55.1	48.1	41.1	36.1
L_{90}	**51.4**	55.1	56.1	50.1	48.1	46.1	48.1	44.1	37.1	33.1	35.1
1700											
L_{Aeq}	**59.3**	64.9	66.9	57.9	55.0	52.9	56.6	51.8	43.3	37.7	36.9
L_{max}	**72.2**	88.7	84.0	77.8	72.7	66.5	66.9	61.7	61.3	61.7	57.9
L_{10}	**61.7**	67.1	70.1	61.1	57.1	55.1	59.1	54.1	46.1	38.1	36.1
L_{90}	**49.0**	52.1	54.1	47.1	45.1	43.1	46.1	41.1	35.1	33.1	35.1
1715											
L_{Aeq}	**58.9**	64.1	68.0	59.0	54.1	52.4	56.2	51.2	43.0	39.2	36.3
L_{max}	**74.2**	83.3	88.6	79.5	68.0	68.7	68.7	61.8	67.3	64.3	49.4
L_{10}	**61.7**	66.1	70.1	60.1	57.1	55.1	59.1	54.1	45.1	38.1	36.1
L_{90}	**46.5**	50.1	52.1	45.1	42.1	41.1	43.1	39.1	33.1	32.1	35.1
1730											
L_{Aeq}	**60.0**	63.8	67.5	61.6	55.8	53.9	57.3	52.4	43.2	37.2	36.3
L_{max}	**76.5**	85.1	84.7	85.8	77.1	74.5	69.6	64.5	59.5	55.7	50.7
L_{10}	**62.6**	66.1	70.1	61.1	58.1	56.1	60.1	55.1	45.1	38.1	36.1
L_{90}	**50.1**	51.1	54.1	48.1	45.1	44.1	47.1	43.1	34.1	33.1	35.1

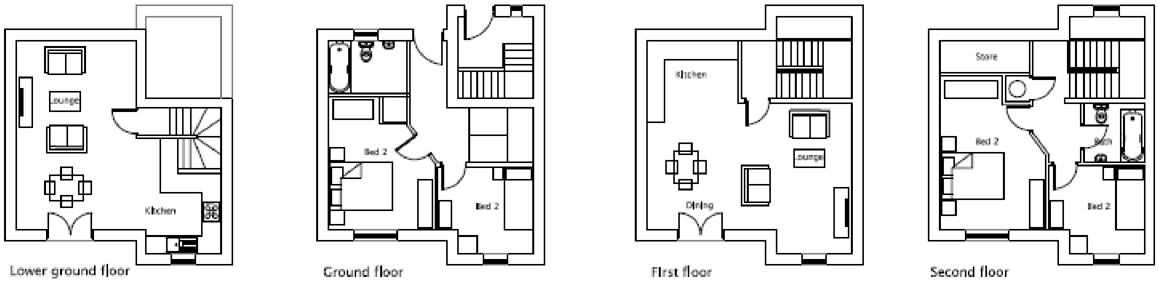
1745												
L_{Aeq}		**60.1**	63.7	67.6	60.4	55.7	53.5	57.2	52.7	44.3	42.1	37.3
L_{max}		**80.2**	83.2	87.3	79.3	74.2	70.4	72.0	77.2	64.6	66.2	61.0
L_{10}		**62.6**	65.1	70.1	61.1	57.1	56.1	60.1	55.1	46.1	39.1	36.1
L_{90}		**49.8**	51.1	54.1	47.1	45.1	44.1	47.1	42.1	34.1	33.1	35.1
1800												
L_{Aeq}		**60.0**	65.6	68.1	61.1	55.1	53.1	57.3	52.5	43.3	41.1	36.4
L_{max}		**74.1**	86.1	88.5	80.2	74.8	65.0	69.3	64.2	59.5	64.9	58.0
L_{10}		**62.6**	67.1	70.1	62.1	57.1	56.1	60.1	55.1	46.1	39.1	36.1
L_{90}		**48.0**	52.1	54.1	46.1	43.1	42.1	45.1	40.1	34.1	32.1	35.1
1815												
L_{Aeq}		**59.3**	62.9	65.5	57.7	54.1	52.4	56.8	51.9	42.2	36.6	36.7
L_{max}		**76.2**	88.7	87.0	77.8	76.0	70.6	69.4	71.3	58.6	54.2	62.1
L_{10}		**62.5**	64.1	67.1	59.1	57.1	56.1	60.1	55.1	45.1	37.1	36.1
L_{90}		**45.9**	47.1	50.1	43.1	41.1	39.1	43.1	38.1	32.1	32.1	35.1
1830												
L_{Aeq}		**58.9**	63.1	64.9	56.9	53.2	51.8	56.4	51.7	41.9	36.4	36.1
L_{max}		**71.3**	85.2	82.0	77.3	68.3	62.2	67.3	64.4	56.8	57.4	46.8
L_{10}		**62.5**	64.1	68.1	59.1	56.1	56.1	60.1	55.1	45.1	37.1	36.1
L_{90}		**44.5**	47.1	49.1	43.1	40.1	38.1	41.1	37.1	31.1	32.1	35.1
1845												
L_{Aeq}		**59.9**	60.4	67.5	64.1	57.4	53.0	56.9	51.9	43.4	40.7	36.8
L_{max}		**76.9**	78.0	87.7	87.3	79.1	69.8	68.7	65.2	64.5	65.6	58.5
L_{10}		**62.6**	63.1	68.1	60.1	58.1	56.1	60.1	55.1	45.1	38.1	36.1
L_{90}		**44.9**	48.1	49.1	43.1	41.1	39.1	42.1	36.1	30.1	32.1	35.1

Appendix 3. House types and layout of the proposed development

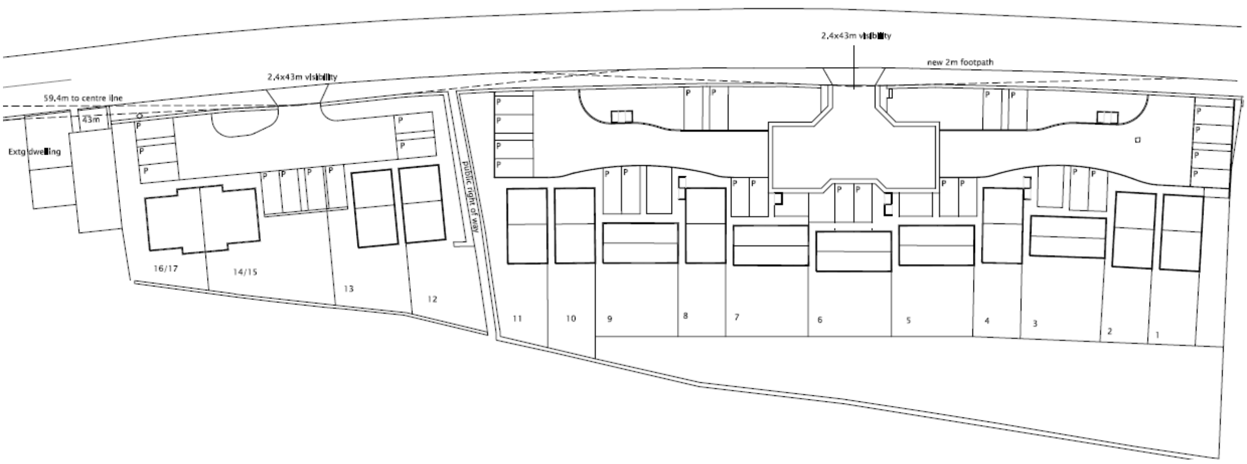
House type A, 4 bedroom house

House type C, 4 bedroom house

House type D, 2 bedroom apartments



Proposed development layout



Appendix 4: Ventilator specification

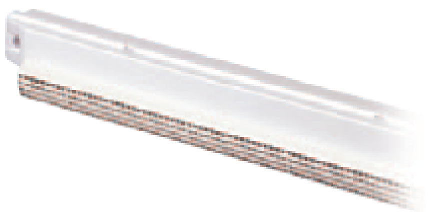
Greenwood EAR42W ventilator

EAR42W

Acoustic window ventilator

Physical specification

All measurements in millimetres



External

Acoustic spacer

Internal

Features and benefits

One of the best performing acoustic window ventilators available in the UK.

Provides an outstanding Dn,e,w; 42dB(A) for areas with high external noise transmission, those likely in PPG24 categories B, C and D.

Humidity control to regulate supply of fresh air effectively throughout the day in response to changing indoor humidity levels.

Manual override control option for occupants to ensure a comfortable environment at all times.

Upward air deflection to eliminate replacement air causing draughts.

Manufactured from ABS – available in white as standard.

May require add on section in some installations.

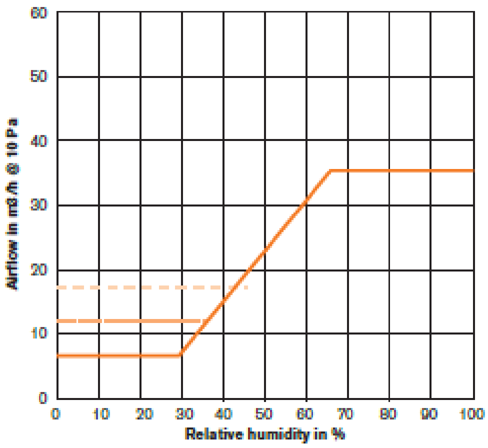
Models and control options

Product code	Equivalent area (mm²)	Slot height (mm)	Slot Size (mm) Length	Central gap	Length	Control	Colour
EAR42W	3912	12	172	10	172	Bottom	White

Scottish Building Regulations: Free Area Performance (see page 11 for full details). EAR42W – 3925mm².

Performance

Model	Acoustic performance Dn,e,w	Dn,e,w (C)	Dn,e,w (Ctr)	Equivalent area mm²
EAR42	42dB(A)	41dB	39dB	3912



Key

EAR² 5-35m ³/h

EAR² 17-35m ³/h

EAR² 11-35m ³/h

Acoustic performance

Dn,e,w = 42dB(A)
Dn,e,w (C) = 42dB
Dn,e,w (Ctr) = 42dB
Dn,e,w: Average weighted performance across frequency range
C: Pink noise
Ctr: Road noise

Closed Position:
Dn,e,w: 45dB (A)

Ordering information

To Order: EAR42W

Appendix 5. Break-in Noise Calculations

Residential development, Lower Gate, Huddersfield

Break-in Noise Calculations

L_{Aeq} Assessment, daytime

House type A

Kitchen/dining room - gable

** Octave Band Centre Frequency, Hz*			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		60	70	71	63	57	54	57	53	47	44	36
B	Exposed façade, m^2	20.6		13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1
C	Volume of receiving room, m^3	49.2											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-12.1	-12.1	-12.1	-12.1	-12.1	-12.1	-12.1	-12.1	-12.1	-12.1
F	Composite SRI			25.4	30.4	35.4	34.0	39.3	49.1	52.2	49.4	54.4	59.0
G	A + B + E - F		21	45.8	42.1	28.8	23.7	16.3	8.6	1.5	-1.7	-9.6	-21.4
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		24	48.8	45.1	31.8	26.7	19.3	11.6	4.5	1.3	-6.6	-18.4
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				28	33	39	39	43	50	53	56	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				40.2	26.9	14.4	12.3	10.4	-0.5	-9.5	-15.4	
N	Internal room noise level, vent open		25		46.3	33.0	26.9	20.1	14.0	5.7	1.7	-6.0	

Glazing: *4mm, 16/20mm, 4mm*
Ventilator type: *Greenwood EAR42W*

House type A

Kitchen/dining room - front elevation

** Octave Band Centre Frequency, Hz*			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		60	70	71	63	57	54	57	53	47	44	36
B	Exposed façade, m^2	5.5		7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4
C	Volume of receiving room, m^3	49.2											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-12.1	-12.1	-12.1	-12.1	-12.1	-12.1	-12.1	-12.1	-12.1	-12.1
F	Composite SRI			16.9	21.9	26.9	23.1	28.1	38.1	41.1	38.1	43.1	48.1
G	A + B + E - F		25	48.5	44.8	31.5	28.9	21.8	13.9	7.0	3.9	-4.0	-16.2
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		28	51.5	47.8	34.5	31.9	24.8	16.9	10.0	6.9	-1.0	-13.2
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				28	33	39	39	43	50	53	56	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				46.0	32.7	20.2	18.1	16.2	5.3	-3.7	-9.6	
N	Internal room noise level, vent open		29		50.0	36.7	32.2	25.6	19.5	11.2	7.3	-0.4	

Glazing: *4mm, 16/20mm, 4mm*
Ventilator type: *Greenwood EAR42W*

House type A

Kitchen/dining room - rear elevation

** Octave Band Centre Frequency, Hz*			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		55	65	66	58	51	49	51	47	41	38	31
B	Exposed façade, m^2	10		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
C	Volume of receiving room, m^3	49.2											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-12.1	-12.1	-12.1	-12.1	-12.1	-12.1	-12.1	-12.1	-12.1	-12.1
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		8	34.5	30.8	17.5	7.0	-3.1	-9.0	-16.9	-22.9	-30.8	-38.1
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		11	37.5	33.8	20.5	10.0	-0.1	-6.0	-13.9	-19.9	-27.8	-35.1

Glazing: -
Ventilator type: -

Combined noise level, dB(A)	31

House type A

Living room - rear elevation

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		50	60	61	53	47	44	47	43	37	34	26
B	Exposed façade, m^2	10		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
C	Volume of receiving room, m^3	42.2											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-11.4	-11.4	-11.4	-11.4	-11.4	-11.4	-11.4	-11.4	-11.4	-11.4
F	Composite SRI			17.3	22.3	27.3	23.4	28.5	38.4	41.4	38.5	43.5	48.4
G	A + B + E - F		18	41.4	37.7	24.4	21.8	14.6	6.8	-0.2	-3.2	-11.1	-23.3
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		21	44.4	40.7	27.4	24.8	17.6	9.8	2.8	-0.2	-8.1	-20.3
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				28	33	39	39	43	50	53	56	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				33.4	20.1	7.6	5.5	3.6	-7.3	-16.3	-22.2	
N	Internal room noise level, vent open		21		41.5	28.2	24.8	17.9	10.7	3.2	-0.1	-7.9	

Glazing: *4mm, 16/20mm, 4mm*

Ventilator type: *Greenwood EAR42W*

House type A

Living room - gable

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		60	70	71	63	57	54	57	53	47	44	36
B	Exposed façade, m^2	10		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
C	Volume of receiving room, m^3	42.2											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-11.4	-11.4	-11.4	-11.4	-11.4	-11.4	-11.4	-11.4	-11.4	-11.4
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		14	40.7	37.0	23.7	13.2	3.1	-2.8	-10.7	-16.7	-24.6	-31.9
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		17	43.7	40.0	26.7	16.2	6.1	0.2	-7.7	-13.7	-21.6	-28.9

Glazing: -

Ventilator type: -

House type A

Living room - gable

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		60	70	71	63	57	54	57	53	47	44	36
B	Exposed façade, m^2	10		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
C	Volume of receiving room, m^3	42.2											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-11.4	-11.4	-11.4	-11.4	-11.4	-11.4	-11.4	-11.4	-11.4	-11.4
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		14	40.7	37.0	23.7	13.2	3.1	-2.8	-10.7	-16.7	-24.6	-31.9
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		17	43.7	40.0	26.7	16.2	6.1	0.2	-7.7	-13.7	-21.6	-28.9

Glazing: -

Ventilator type: -

Combined noise level, dB(A): 24

House type A

Bedroom 1 - rear elevation

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		50	60	61	53	47	44	47	43	37	34	26
B	Exposed façade, m^2	10		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
C	Volume of receiving room, m^3	38.4											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0
F	Composite SRI			21.6	26.6	31.6	28.4	33.5	43.4	46.4	43.5	48.5	53.4
G	A + B + E - F		14	37.5	33.8	20.5	17.2	10.0	2.2	-4.7	-7.8	-15.7	-27.9
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		17	40.5	36.8	23.5	20.2	13.0	5.2	-1.7	-4.8	-12.7	-24.9
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				28	33	39	39	43	50	53	56	
M	$L_{Aeq} - D_{n,e}$ + 10*log(10) - B				33.4	20.1	7.6	5.5	3.6	-7.3	-16.3	-22.2	
N	Internal room noise level, vent open		18		38.4	25.1	20.5	13.7	7.5	-0.7	-4.5	-12.2	

Glazing: *4mm, 16/20mm, 4mm*

Ventilator type: *Greenwood EAR42W*

House type A

Bedroom 1 - gable

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		60	70	71	63	57	54	57	53	47	44	36
B	Exposed façade, m^2	8.6		9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3
C	Volume of receiving room, m^3	38.4											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		13	40.4	36.7	23.4	12.9	2.8	-3.1	-11.0	-17.0	-24.9	-32.2
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		16	43.4	39.7	26.4	15.9	5.8	-0.1	-8.0	-14.0	-21.9	-29.2

Glazing: -

Ventilator type: -

House type A

Bedroom 1 - gable

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		60	70	71	63	57	54	57	53	47	44	36
B	Exposed façade, m^2	8.6		9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3
C	Volume of receiving room, m^3	38.4											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		13	40.4	36.7	23.4	12.9	2.8	-3.1	-11.0	-17.0	-24.9	-32.2
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		16	43.4	39.7	26.4	15.9	5.8	-0.1	-8.0	-14.0	-21.9	-29.2

Glazing: -

Ventilator type: -

Combined noise level, dB(A)	22

House type A

Bedroom 2 - gable

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		60	70	71	63	57	54	57	53	47	44	36
B	Exposed façade, m^2	11		10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4
C	Volume of receiving room, m^3	27.6											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		16	42.9	39.2	25.9	15.4	5.3	-0.6	-8.5	-14.5	-22.4	-29.7
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		19	45.9	42.2	28.9	18.4	8.3	2.4	-5.5	-11.5	-19.4	-26.7

Glazing: -

Ventilator type: -

House type A

Bedroom 2 - front elevation

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		60	70	71	63	57	54	57	53	47	44	36
B	Exposed façade, m^2	10		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
C	Volume of receiving room, m^3	27.6											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5
F	Composite SRI			21.6	26.6	31.6	28.4	33.5	43.4	46.4	43.5	48.5	53.4
G	A + B + E - F		25	48.9	45.2	31.9	28.7	21.5	13.6	6.7	3.6	-4.3	-16.4
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		28	51.9	48.2	34.9	31.7	24.5	16.6	9.7	6.6	-1.3	-13.4
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				28	33	39	39	43	50	53	56	
M	$L_{Aeq} - D_{n,e}$ + 10*log(10) - B				43.4	30.1	17.6	15.5	13.6	2.7	-6.3	-12.2	
N	Internal room noise level, vent open		29		49.5	36.2	31.8	25.0	18.4	10.5	6.9	-0.9	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Greenwood EAR42W*												
	Combined noise level, dB(A)		29										

House type A

Bedroom 3 - gable

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		60	70	71	63	57	54	57	53	47	44	36
B	Exposed façade, m^2	10		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
C	Volume of receiving room, m^3	20.2											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		17	43.9	40.2	26.9	16.4	6.3	0.4	-7.5	-13.5	-21.4	-28.7
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		20	46.9	43.2	29.9	19.4	9.3	3.4	-4.5	-10.5	-18.4	-25.7
Glazing:	-												
Ventilator type:	-												

House type A

Bedroom 3 - front elevation

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		60	70	71	63	57	54	57	53	47	44	36
B	Exposed façade, m^2	4.8		6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
C	Volume of receiving room, m^3	20.2											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2
F	Composite SRI			21.5	26.5	31.5	28.2	33.3	43.2	46.3	43.3	48.3	53.2
G	A + B + E - F		23	47.3	43.6	30.3	27.0	19.8	12.0	5.0	2.0	-5.9	-18.1
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		26	50.3	46.6	33.3	30.0	22.8	15.0	8.0	5.0	-2.9	-15.1
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				28	33	39	39	43	50	53	56	
M	$L_{Aeq} - D_{n,e}$ + 10*log(10) - B				46.6	33.3	20.8	18.7	16.8	5.9	-3.1	-9.0	
N	Internal room noise level, vent open		28		49.6	36.3	30.5	24.2	19.0	10.1	5.6	-2.0	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Greenwood EAR42W*												
	Combined noise level, dB(A)		28										

House type A

Bedroom 4 - gable

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		60	70	71	63	57	54	57	53	47	44	36
B	Exposed façade, m^2	10		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
C	Volume of receiving room, m^3	20.1											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		17	43.9	40.2	26.9	16.4	6.3	0.4	-7.5	-13.5	-21.4	-28.7
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		20	46.9	43.2	29.9	19.4	9.3	3.4	-4.5	-10.5	-18.4	-25.7
Glazing:	-												
Ventilator type:	-												

House type A

Bedroom 4 - rear elvation

	** Octave Band Centre Frequency, Hz*		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured $L_{A\,eq}$		50	60	61	53	47	44	47	43	37	34	26
B	Exposed façade, m²	4.8		6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
C	Volume of receiving room, m³	20.1											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2
F	Composite SRI			21.5	26.5	31.5	28.2	33.3	43.2	46.3	43.3	48.3	53.2
G	A + B + E - F		14	37.3	33.6	20.3	17.0	9.8	2.0	-4.9	-8.0	-15.9	-28.1
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		17	40.3	36.6	23.3	20.0	12.8	5.0	-1.9	-5.0	-12.9	-25.1
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				28	33	39	39	43	50	53	56	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				36.6	23.3	10.8	8.7	6.8	-4.1	-13.1	-19.0	
N	Internal room noise level, vent open		18		39.6	26.3	20.5	14.2	9.0	0.1	-4.4	-11.9	

Glazing: *4mm, 16/20mm, 4mm*

Ventilator type: *Greenwood EAR42W*

Combined noise level, dB(A)	22

L_{Aeq} Assessment, night time

House type A

Bedroom 1 - rear elevation

	** Octave Band Centre Frequency, Hz*		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured $L_{A\,eq}$		49	51	55	49	46	44	46	41	35	29	29
B	Exposed façade, m²	10		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
C	Volume of receiving room, m³	38.4											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0
F	Composite SRI			21.6	26.6	31.6	28.4	33.5	43.4	46.4	43.5	48.5	53.4
G	A + B + E - F		12	28.0	27.3	16.2	16.2	9.2	2.1	-5.9	-9.4	-20.2	-25.6
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		15	31.0	30.3	19.2	19.2	12.2	5.1	-2.9	-6.4	-17.2	-22.6
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				28	33	39	39	43	50	53	56	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				26.9	15.8	6.6	4.7	3.5	-8.5	-17.9	-26.7	
N	Internal room noise level, vent open		15		31.9	20.8	19.5	12.9	7.4	-1.9	-6.1	-16.7	

Glazing: *4mm, 16/20mm, 4mm*

Ventilator type: *Greenwood EAR42W*

House type A

Bedroom 1 - gable

	** Octave Band Centre Frequency, Hz*		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured $L_{A\,eq}$		59	61	65	59	56	54	56	51	45	39	39
B	Exposed façade, m²	8.6		9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3
C	Volume of receiving room, m³	38.4											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		9	30.9	30.2	19.1	11.9	2.0	-3.2	-12.2	-18.6	-29.4	-29.9
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		12	33.9	33.2	22.1	14.9	5.0	-0.2	-9.2	-15.6	-26.4	-26.9

Glazing: -

Ventilator type: -

House type A

Bedroom 1 - gable

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured $L_{A\,eq}$		59	61	65	59	56	54	56	51	45	39	39
B	Exposed façade, m^2	8.6		9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3
C	Volume of receiving room, m^3	38.4											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		9	30.9	30.2	19.1	11.9	2.0	-3.2	-12.2	-18.6	-29.4	-29.9
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		12	33.9	33.2	22.1	14.9	5.0	-0.2	-9.2	-15.6	-26.4	-26.9

Glazing: -

Ventilator type: -

Combined noise level, dB(A): 18

House type A

Bedroom 2 - gable

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured $L_{A\,eq}$		59	61	65	59	56	54	56	51	45	39	39
B	Exposed façade, m^2	11		10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4
C	Volume of receiving room, m^3	27.6											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		12	33.4	32.7	21.6	14.4	4.5	-0.7	-9.7	-16.1	-26.9	-27.4
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		15	36.4	35.7	24.6	17.4	7.5	2.3	-6.7	-13.1	-23.9	-24.4

Glazing: -

Ventilator type: -

House type A

Bedroom 2 - front elevation

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured $L_{A\,eq}$		59	61	65	59	56	54	56	51	45	39	39
B	Exposed façade, m^2	10		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
C	Volume of receiving room, m^3	27.6											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5
F	Composite SRI			21.6	26.6	31.6	28.4	33.5	43.4	46.4	43.5	48.5	53.4
G	A + B + E - F		23	39.4	38.7	27.6	27.7	20.7	13.5	5.5	2.0	-8.8	-14.1
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		26	42.4	41.7	30.6	30.7	23.7	16.5	8.5	5.0	-5.8	-11.1
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				28	33	39	39	43	50	53	56	
M	$L_{Aeq} - D_{n,e} + 10^*\log(10) - B$				36.9	25.8	16.6	14.7	13.5	1.5	-7.9	-16.7	
N	Internal room noise level, vent open		27		43.0	31.9	30.8	24.2	18.3	9.3	5.3	-5.4	

Glazing: *4mm, 16/20mm, 4mm*

Ventilator type: *Greenwood EAR42W*

Combined noise level, dB(A): 27

House type A

Bedroom 3 - gable

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured $L_{A\,eq}$		59	61	65	59	56	54	56	51	45	39	39
B	Exposed façade, m^2	10		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
C	Volume of receiving room, m^3	20.2											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		13	34.4	33.7	22.6	15.4	5.5	0.3	-8.7	-15.1	-25.9	-26.4
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		16	37.4	36.7	25.6	18.4	8.5	3.3	-5.7	-12.1	-22.9	-23.4

Glazing: -

Ventilator type: -

House type A

Bedroom 3 - front elevation

Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		59	61	65	59	56	54	56	51	45	39	39
B	Exposed façade, m^2	4.8		6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
C	Volume of receiving room, m^3	20.2											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2
F	Composite SRI			21.5	26.5	31.5	28.2	33.3	43.2	46.3	43.3	48.3	53.2
G	A + B + E - F		21	37.8	37.1	26.0	26.0	19.0	11.9	3.8	0.4	-10.4	-15.8
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		24	40.8	40.1	29.0	29.0	22.0	14.9	6.8	3.4	-7.4	-12.8
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				28	33	39	39	43	50	53	56	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				40.1	29.0	19.8	17.9	16.7	4.7	-4.7	-13.5	
N	Internal room noise level, vent open		26		43.1	32.0	29.5	23.4	18.9	8.9	4.0	-6.5	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Greenwood EAR42W*												
	Combined noise level, dB(A)		26										

House type A

Bedroom 4 - gable

Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		59	61	65	59	56	54	56	51	45	39	39
B	Exposed façade, m^2	10		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
C	Volume of receiving room, m^3	20.1											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		13	34.4	33.7	22.6	15.4	5.5	0.3	-8.7	-15.1	-25.9	-26.4
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		16	37.4	36.7	25.6	18.4	8.5	3.3	-5.7	-12.1	-22.9	-23.4
Glazing:	-												
Ventilator type:	-												

House type A

Bedroom 4 - rear elvation

Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		49	51	55	49	46	44	46	41	35	29	29
B	Exposed façade, m^2	4.8		6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
C	Volume of receiving room, m^3	20.1											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2
F	Composite SRI			21.5	26.5	31.5	28.2	33.3	43.2	46.3	43.3	48.3	53.2
G	A + B + E - F		11	27.8	27.1	16.0	16.0	9.0	1.9	-6.1	-9.6	-20.4	-25.8
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		14	30.8	30.1	19.0	19.0	12.0	4.9	-3.1	-6.6	-17.4	-22.8
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				28	33	39	39	43	50	53	56	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				30.1	19.0	9.8	7.9	6.7	-5.3	-14.7	-23.5	
N	Internal room noise level, vent open		16		33.1	22.0	19.5	13.4	8.9	-1.1	-6.0	-16.4	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Greenwood EAR42W*												
	Combined noise level, dB(A)		19										

L_{Amax} Assessment, night time

House type A

Bedroom 1 - rear elevation

	** Octave Band Centre Frequency, Hz*		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Amax}		68	71	75	73	68	65	63	55	50	46	53
B	Exposed façade, m^2	10		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
C	Volume of receiving room, m^3	38.4											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0
F	Composite SRI			21.6	26.6	31.6	28.4	33.5	43.4	46.4	43.5	48.5	53.4
G	A + B + E - F		33	48.7	47.0	40.3	38.4	30.9	18.8	7.3	5.5	-3.8	-1.5
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		36	51.7	50.0	43.3	41.4	33.9	21.8	10.3	8.5	-0.8	1.5
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				28	33	39	39	43	50	53	56	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				46.6	39.9	28.8	26.4	20.2	4.7	-3.0	-10.3	
N	Internal room noise level, vent open		37		51.6	44.9	41.7	34.6	24.1	11.3	8.8	-0.3	

Glazing: *4mm, 16/20mm, 4mm*

Ventilator type: *Greenwood EAR42W*

House type A

Bedroom 1 - gable

	** Octave Band Centre Frequency, Hz*		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Amax}		78	81	85	83	78	75	73	65	60	56	63
B	Exposed façade, m^2	8.6		9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3
C	Volume of receiving room, m^3	38.4											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		31	51.6	49.9	43.2	34.1	23.7	13.5	1.0	-3.7	-13.0	-5.8
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		34	54.6	52.9	46.2	37.1	26.7	16.5	4.0	-0.7	-10.0	-2.8

Glazing: -

Ventilator type: -

House type A

Bedroom 1 - gable

	** Octave Band Centre Frequency, Hz*		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Amax}		78	81	85	83	78	75	73	65	60	56	63
B	Exposed façade, m^2	8.6		9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3
C	Volume of receiving room, m^3	38.4											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		31	51.6	49.9	43.2	34.1	23.7	13.5	1.0	-3.7	-13.0	-5.8
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		34	54.6	52.9	46.2	37.1	26.7	16.5	4.0	-0.7	-10.0	-2.8

Glazing: -

Ventilator type: -

Combined noise level, dB(A)	40

House type A

Bedroom 2 - gable

	** Octave Band Centre Frequency, Hz*		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Amax}		78	81	85	83	78	75	73	65	60	56	63
B	Exposed façade, m^2	11		10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4
C	Volume of receiving room, m^3	27.6											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		34	54.1	52.4	45.7	36.6	26.2	16.0	3.5	-1.2	-10.5	-3.3
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		37	57.1	55.4	48.7	39.6	29.2	19.0	6.5	1.8	-7.5	-0.3

Glazing: -

Ventilator type: -

House type A

Bedroom 2 - front elevation

** Octave Band Centre Frequency, Hz*			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Amax}		78	81	85	83	78	75	73	65	60	56	63
B	Exposed façade, m^2	10		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
C	Volume of receiving room, m^3	27.6											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5
F	Composite SRI			20.8	25.8	30.8	35.6	47.1	53.8	53.0	60.1	65.1	66.7
G	A + B + E - F		40	61.0	59.3	52.6	42.6	28.8	19.8	12.1	0.4	-8.9	-3.3
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		43	64.0	62.3	55.6	45.6	31.8	22.8	15.1	3.4	-5.9	-0.3
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				28	33	39	39	43	50	53	56	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				56.6	49.9	38.8	36.4	30.2	14.7	7.0	-0.3	
N	Internal room noise level, vent open		44		63.3	56.6	46.5	37.7	30.9	17.9	8.5	0.7	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Greenwood EAR42W*												
	Combined noise level, dB(A)		45										

House type A

Bedroom 3 - gable

** Octave Band Centre Frequency, Hz*			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Amax}		78	81	85	83	78	75	73	65	60	56	63
B	Exposed façade, m^2	10		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
C	Volume of receiving room, m^3	20.2											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		34	55.1	53.4	46.7	37.6	27.2	17.0	4.5	-0.2	-9.5	-2.3
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		37	58.1	56.4	49.7	40.6	30.2	20.0	7.5	2.8	-6.5	0.7
Glazing:	-												
Ventilator type:	-												

House type A

Bedroom 3 - front elevation

** Octave Band Centre Frequency, Hz*			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Amax}		78	81	85	83	78	75	73	65	60	56	63
B	Exposed façade, m^2	4.8		6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
C	Volume of receiving room, m^3	20.2											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2
F	Composite SRI			20.6	25.6	30.6	35.5	47.0	53.7	52.9	60.0	65.0	66.6
G	A + B + E - F		38	59.3	57.6	50.9	41.0	27.0	18.1	10.4	-1.4	-10.7	-5.1
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		41	62.3	60.6	53.9	44.0	30.0	21.1	13.4	1.6	-7.7	-2.1
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				28	33	39	39	43	50	53	56	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				59.8	53.1	42.0	39.6	33.4	17.9	10.2	2.9	
N	Internal room noise level, vent open		45		63.2	56.5	46.1	40.0	33.6	19.2	10.7	3.2	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Greenwood EAR42W*												
	Combined noise level, dB(A)		45										

House type A

Bedroom 4 - gable

** Octave Band Centre Frequency, Hz*			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Amax}		78	81	85	83	78	75	73	65	60	56	63
B	Exposed façade, m^2	10		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
C	Volume of receiving room, m^3	20.1											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		35	55.1	53.4	46.7	37.6	27.2	17.0	4.5	-0.2	-9.5	-2.3
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		38	58.1	56.4	49.7	40.6	30.2	20.0	7.5	2.8	-6.5	0.7
Glazing:	-												
Ventilator type:	-												

House type A

Bedroom 4 - rear elvation

	** Octave Band Centre Frequency, Hz*		**dB(A)**	**31.5***	**63***	**125***	**250***	**500***	**1k***	**2k***	**4k***	**8k***	**16k***
A	Measured L_{Amax}		**68**	71	75	73	68	65	63	55	50	46	53
B	Exposed façade, m^2	**4.8**		6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
C	Volume of receiving room, m^3	**20.1**											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2
F	Composite SRI			21.5	26.5	31.5	28.2	33.3	43.2	46.3	43.3	48.3	53.2
G	A + B + E - F		**33**	48.5	46.8	40.1	38.2	30.7	18.6	7.1	5.3	-4.0	-1.7
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		**36**	51.5	49.8	43.1	41.2	33.7	21.6	10.1	8.3	-1.0	1.3
K	Number of ventilators	**1**											
L	Ventilator $D_{n,e}$				28	33	39	39	43	50	53	56	
M	$L_{Aeq} - D_{n,e}$ + 10*log(10) - B				49.8	43.1	32.0	29.6	23.4	7.9	0.2	-7.1	
N	Internal room noise level, vent open		**37**		52.8	46.1	41.7	35.1	25.6	12.1	8.9	0.0	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Greenwood EAR42W*												
	Combined noise level, dB(A)		**40**										

Residential development, Lower Gate, Huddersfield

Break-in Noise Calculations

L_{Aeq} Assessment, daytime

House type C

Dining/kitchen - gable

	** Octave Band Centre Frequency, Hz*		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		60	70	71	63	57	54	57	53	47	44	36
B	Exposed façade, m²	10		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
C	Volume of receiving room, m³	53.5											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-12.4	-12.4	-12.4	-12.4	-12.4	-12.4	-12.4	-12.4	-12.4	-12.4
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		13	39.7	36.0	22.7	12.2	2.1	-3.8	-11.7	-17.7	-25.6	-32.9
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		16	42.7	39.0	25.7	15.2	5.1	-0.8	-8.7	-14.7	-22.6	-29.9

Glazing: -

Ventilator type: -

House type C

Dining/kitchen - rear elevation

	** Octave Band Centre Frequency, Hz*		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		50	60	61	53	47	44	47	43	37	34	26
B	Exposed façade, m²	12.7		11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0
C	Volume of receiving room, m³	53.5											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-12.4	-12.4	-12.4	-12.4	-12.4	-12.4	-12.4	-12.4	-12.4	-12.4
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		4	30.7	27.0	13.7	3.2	-6.9	-12.8	-20.7	-26.7	-34.6	-41.9
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		7	33.7	30.0	16.7	6.2	-3.9	-9.8	-17.7	-23.7	-31.6	-38.9

Glazing: -

Ventilator type: -

House type C

Dining/kitchen - rear elevation

	** Octave Band Centre Frequency, Hz*		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		50	60	61	53	47	44	47	43	37	34	26
B	Exposed façade, m²	12.7		11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0
C	Volume of receiving room, m³	53.5											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-12.4	-12.4	-12.4	-12.4	-12.4	-12.4	-12.4	-12.4	-12.4	-12.4
F	Composite SRI			18.2	23.2	28.2	24.5	29.5	39.5	42.5	39.5	44.5	49.5
G	A + B + E - F		17	40.5	36.8	23.5	20.7	13.6	5.7	-1.2	-4.2	-12.1	-24.4
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		20	43.5	39.8	26.5	23.7	16.6	8.7	1.8	-1.2	-9.1	-21.4
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				28	33	39	39	43	50	53	56	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				32.3	19.0	6.5	4.4	2.5	-8.4	-17.4	-23.3	
N	Internal room noise level, vent open		20		40.5	27.2	23.8	16.9	9.7	2.2	-1.1	-8.9	

Glazing: *4mm, 16/20mm, 4mm*

Ventilator type: *Greenwood EAR42W*

Combined noise level, dB(A): 22

House type C

Lounge - gable

	** Octave Band Centre Frequency, Hz*		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		60	70	71	63	57	54	57	53	47	44	36
B	Exposed façade, m²	10		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
C	Volume of receiving room, m³	42.2											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-11.4	-11.4	-11.4	-11.4	-11.4	-11.4	-11.4	-11.4	-11.4	-11.4
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		14	40.7	37.0	23.7	13.2	3.1	-2.8	-10.7	-16.7	-24.6	-31.9
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		17	43.7	40.0	26.7	16.2	6.1	0.2	-7.7	-13.7	-21.6	-28.9

Glazing: -

Ventilator type: -

House type C

Lounge - rear elevation

	** Octave Band Centre Frequency, Hz*		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		50	60	61	53	47	44	47	43	37	34	26
B	Exposed façade, m^2	8.6		9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3
C	Volume of receiving room, m^3	42.2											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-11.4	-11.4	-11.4	-11.4	-11.4	-11.4	-11.4	-11.4	-11.4	-11.4
F	Composite SRI			17.0	22.0	27.0	23.2	28.2	38.2	41.2	38.2	43.2	48.2
G	A + B + E - F		18	41.0	37.3	24.0	21.3	14.2	6.3	-0.6	-3.6	-11.5	-23.8
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		21	44.0	40.3	27.0	24.3	17.2	9.3	2.4	-0.6	-8.5	-20.8
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				28	33	39	39	43	50	53	56	
M	$L_{Aeq} - D_{n,e}$ + 10*log(10) - B				34.0	20.7	8.2	6.1	4.2	-6.7	-15.7	-21.6	
N	Internal room noise level, vent open		21		41.2	27.9	24.5	17.6	10.5	2.9	-0.4	-8.3	

Glazing: *4mm, 16/20mm, 4mm*

Ventilator type: *Greenwood EAR42W*

House type C

Lounge - front elevation

	** Octave Band Centre Frequency, Hz*		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		60	70	71	63	57	54	57	53	47	44	36
B	Exposed façade, m^2	8.6		9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3
C	Volume of receiving room, m^3	36.5											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-10.8	-10.8	-10.8	-10.8	-10.8	-10.8	-10.8	-10.8	-10.8	-10.8
F	Composite SRI			20.4	25.4	30.4	26.9	32.0	42.0	45.0	42.0	47.0	51.9
G	A + B + E - F		25	48.3	44.6	31.3	28.2	21.1	13.2	6.3	3.3	-4.6	-16.9
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		28	51.3	47.6	34.3	31.2	24.1	16.2	9.3	6.3	-1.6	-13.9
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				28	33	39	39	43	50	53	56	
M	$L_{Aeq} - D_{n,e}$ + 10*log(10) - B				44.0	30.7	18.2	16.1	14.2	3.3	-5.7	-11.6	
N	Internal room noise level, vent open		29		49.2	35.9	31.4	24.7	18.3	10.3	6.5	-1.2	

Glazing: *4mm, 16/20mm, 4mm*

Ventilator type: *Greenwood EAR42W*

Combined noise level, dB(A)	30

House type C

Bedroom 1 - front elevation

	** Octave Band Centre Frequency, Hz*		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		60	70	71	63	57	54	57	53	47	44	36
B	Exposed façade, m^2	9.6		9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
C	Volume of receiving room, m^3	34.3											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5
F	Composite SRI			21.7	29.5	30.9	32.3	42.0	50.0	51.3	58.5	61.5	64.6
G	A + B + E - F		21	47.7	41.2	31.5	23.6	11.8	5.9	0.7	-12.5	-18.4	-28.8
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		24	50.7	44.2	34.5	26.6	14.8	8.9	3.7	-9.5	-15.4	-25.8
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				28	33	39	39	43	50	53	56	
M	$L_{Aeq} - D_{n,e}$ + 10*log(10) - B				43.6	30.3	17.8	15.7	13.8	2.9	-6.1	-12.0	
N	Internal room noise level, vent open		25		46.9	35.9	27.2	18.2	15.0	6.3	-4.5	-10.4	

Glazing: *6mm, 16/20mm, 6.8mm*

Ventilator type: *Greenwood EAR42W*

House type C

Bedroom 1 - gable

	** Octave Band Centre Frequency, Hz*		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		60	70	71	63	57	54	57	53	47	44	36
B	Exposed façade, m^2	10		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
C	Volume of receiving room, m^3	34.3											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		15	41.6	37.9	24.6	14.1	4.0	-1.9	-9.8	-15.8	-23.7	-31.0
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		18	44.6	40.9	27.6	17.1	7.0	1.1	-6.8	-12.8	-20.7	-28.0

Glazing: -

Ventilator type: -

House type C

Bedroom 1 - rear elevation

	** Octave Band Centre Frequency, Hz*		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		50	60	61	53	47	44	47	43	37	34	26
B	Exposed façade, m^2	8.2		9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1
C	Volume of receiving room, m^3	34.3											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5
F	Composite SRI			20.2	25.2	30.2	26.7	31.8	41.8	44.8	41.8	46.8	51.7
G	A + B + E - F		15	38.5	34.8	21.5	18.5	11.3	3.5	-3.4	-6.5	-14.4	-26.6
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		18	41.5	37.8	24.5	21.5	14.3	6.5	-0.4	-3.5	-11.4	-23.6
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				28	33	39	39	43	50	53	56	
M	$L_{Aeq} - D_{n,e}$ + 10*log(10) - B				34.2	20.9	8.4	6.3	4.4	-6.5	-15.5	-21.4	
N	Internal room noise level, vent open		19		39.4	26.1	21.7	15.0	8.6	0.5	-3.2	-11.0	

Glazing: *4mm, 16/20mm, 4mm*

Ventilator type: *Greenwood EAR42W*

Combined noise level, dB(A)	27

House type C

Bedroom 2 - Gable

	** Octave Band Centre Frequency, Hz*		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		60	70	71	63	57	54	57	53	47	44	36
B	Exposed façade, m^2	6		7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8
C	Volume of receiving room, m^3	26.9											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-9.4	-9.4	-9.4	-9.4	-9.4	-9.4	-9.4	-9.4	-9.4	-9.4
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		13	40.4	36.7	23.4	12.9	2.8	-3.1	-11.0	-17.0	-24.9	-32.2
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		16	43.4	39.7	26.4	15.9	5.8	-0.1	-8.0	-14.0	-21.9	-29.2

Glazing: -

Ventilator type: -

House type C

Bedroom 2 - rear elevation

	** Octave Band Centre Frequency, Hz*		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		50	60	61	53	47	44	47	43	37	34	26
B	Exposed façade, m^2	7.9		9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
C	Volume of receiving room, m^3	26.9											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-9.4	-9.4	-9.4	-9.4	-9.4	-9.4	-9.4	-9.4	-9.4	-9.4
F	Composite SRI			20.1	25.1	30.1	26.6	31.6	41.6	44.6	41.6	46.6	51.6
G	A + B + E - F		16	39.5	35.8	22.5	19.6	12.4	4.5	-2.4	-5.4	-13.3	-25.5
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		19	42.5	38.8	25.5	22.6	15.4	7.5	0.6	-2.4	-10.3	-22.5
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				28	33	39	39	43	50	53	56	
M	$L_{Aeq} - D_{n,e}$ + 10*log(10) - B				34.4	21.1	8.6	6.5	4.6	-6.3	-15.3	-21.2	
N	Internal room noise level, vent open		20		40.2	26.9	22.7	15.9	9.3	1.4	-2.2	-10.0	

Glazing: *4mm, 16/20mm, 4mm*

Ventilator type: *Greenwood EAR42W*

Combined noise level, dB(A)	21

House type C

Bedroom 3 - rear elevation

	** Octave Band Centre Frequency, Hz*		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		50	60	61	53	47	44	47	43	37	34	26
B	Exposed façade, m^2	7.2		8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
C	Volume of receiving room, m^3	16.1											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-7.2	-7.2	-7.2	-7.2	-7.2	-7.2	-7.2	-7.2	-7.2	-7.2
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		6	33.4	29.7	16.4	5.9	-4.2	-10.1	-18.0	-24.0	-31.9	-39.2
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		9	36.4	32.7	19.4	8.9	-1.2	-7.1	-15.0	-21.0	-28.9	-36.2

Glazing: -

Ventilator type: -

House type B

Study - front elevation

	** Octave Band Centre Frequency, Hz*		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Amax}		60	70	71	63	57	54	57	53	47	44	36
B	Exposed façade, m^2	5.8		7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
C	Volume of receiving room, m^3	16.1											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-7.2	-7.2	-7.2	-7.2	-7.2	-7.2	-7.2	-7.2	-7.2	-7.2
F	Composite SRI			19.7	24.7	29.7	26.1	31.2	41.2	44.2	41.2	46.2	51.1
G	A + B + E - F		27	50.8	47.1	33.8	30.9	23.7	15.9	8.9	5.9	-2.0	-14.2
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		30	53.8	50.1	36.8	33.9	26.7	18.9	11.9	8.9	1.0	-11.2
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				28	33	39	39	43	50	53	56	
M	$L_{Aeq} - D_{n,e}$ + 10*log(10) - B				45.7	32.4	19.9	17.8	15.9	5.0	-4.0	-9.9	
N	Internal room noise level, vent open		31		51.5	38.2	34.0	27.3	20.7	12.8	9.1	1.4	

Glazing: *4mm, 16/20mm, 4mm*

Ventilator type:

Combined noise level, dB(A)	31

House type C

Bedroom 4/study - rear elevation

	** Octave Band Centre Frequency, Hz*		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		50	60	61	53	47	44	47	43	37	34	26
B	Exposed façade, m^2	7.2		8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
C	Volume of receiving room, m^3	18											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-7.7	-7.7	-7.7	-7.7	-7.7	-7.7	-7.7	-7.7	-7.7	-7.7
F	Composite SRI			22.8	27.8	32.8	29.9	35.0	44.9	48.0	45.0	50.0	54.9
G	A + B + E - F		14	38.2	34.5	21.2	17.6	10.4	2.5	-4.4	-7.5	-15.4	-27.5
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		17	41.2	37.5	24.2	20.6	13.4	5.5	-1.4	-4.5	-12.4	-24.5
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				28	33	39	39	43	50	53	56	
M	$L_{Aeq} - D_{n,e}$ + 10*log(10) - B				34.8	21.5	9.0	6.9	5.0	-5.9	-14.9	-20.8	
N	Internal room noise level, vent open		18		39.4	26.1	20.9	14.3	8.3	-0.1	-4.1	-11.8	

Glazing: *4mm, 16/20mm, 4mm*

Ventilator type: *Greenwood EAR42W*

House type B

Bedroom 4 - gable

	** Octave Band Centre Frequency, Hz*		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		60	70	71	63	57	54	57	53	47	44	36
B	Exposed façade, m^2	6		7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8
C	Volume of receiving room, m^3	18											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-7.7	-7.7	-7.7	-7.7	-7.7	-7.7	-7.7	-7.7	-7.7	-7.7
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		15	42.2	38.5	25.2	14.7	4.6	-1.3	-9.2	-15.2	-23.1	-30.4
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		18	45.2	41.5	28.2	17.7	7.6	1.7	-6.2	-12.2	-20.1	-27.4

Glazing: -

Ventilator type: -

Combined noise level, dB(A)	21

L_{Aeq} Assessment, night time

House type C

Bedroom 1 - front elevation

	* Octave Band Centre Frequency, Hz		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		59	61	65	59	56	54	56	51	45	39	39
B	Exposed façade, m^2	9.6		9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
C	Volume of receiving room, m^3	34.3											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5
F	Composite SRI			21.7	29.5	30.9	32.3	42.0	50.0	51.3	58.5	61.5	64.6
G	A + B + E - F		18	38.2	34.7	27.2	22.6	11.0	5.8	-0.5	-14.1	-22.9	-26.5
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		21	41.2	37.7	30.2	25.6	14.0	8.8	2.5	-11.1	-19.9	-23.5
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				28	33	39	39	43	50	53	56	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				37.1	26.0	16.8	14.9	13.7	1.7	-7.7	-16.5	
N	Internal room noise level, vent open		23		40.4	31.6	26.2	17.4	14.9	5.1	-6.1	-14.9	

Glazing: *6mm, 16/20mm, 6.8mm*

Ventilator type: *Greenwood EAR42W*

House type C

Bedroom 1 - gable

	* Octave Band Centre Frequency, Hz		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		59	61	65	59	56	54	56	51	45	39	39
B	Exposed façade, m^2	10		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
C	Volume of receiving room, m^3	34.3											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		10	32.1	31.4	20.3	13.1	3.2	-2.0	-11.0	-17.4	-28.2	-28.7
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		13	35.1	34.4	23.3	16.1	6.2	1.0	-8.0	-14.4	-25.2	-25.7

Glazing: -

Ventilator type: -

House type C

Bedroom 1 - rear elevation

	* Octave Band Centre Frequency, Hz		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		49	51	55	49	46	44	46	41	35	29	29
B	Exposed façade, m^2	8.2		9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1
C	Volume of receiving room, m^3	34.3											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5
F	Composite SRI			21.2	26.2	31.2	27.9	32.9	42.9	45.9	43.0	48.0	52.9
G	A + B + E - F		12	28.1	27.4	16.3	16.4	9.4	2.2	-5.8	-9.2	-20.0	-25.4
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		15	31.1	30.4	19.3	19.4	12.4	5.2	-2.8	-6.2	-17.0	-22.4
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				28	33	39	39	43	50	53	56	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				27.7	16.6	7.4	5.5	4.3	-7.7	-17.1	-25.9	
N	Internal room noise level, vent open		16		32.3	21.2	19.6	13.2	7.8	-1.6	-5.9	-16.5	

Glazing: *4mm, 16/20mm, 4mm*

Ventilator type: *Greenwood EAR42W*

Combined noise level, dB(A): 24

House type C

Bedroom 2 - Gable

	* Octave Band Centre Frequency, Hz		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		59	61	65	59	56	54	56	51	45	39	39
B	Exposed façade, m^2	6		7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8
C	Volume of receiving room, m^3	26.9											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-9.4	-9.4	-9.4	-9.4	-9.4	-9.4	-9.4	-9.4	-9.4	-9.4
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		9	30.9	30.2	19.1	11.9	2.0	-3.2	-12.2	-18.6	-29.4	-29.9
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		12	33.9	33.2	22.1	14.9	5.0	-0.2	-9.2	-15.6	-26.4	-26.9

Glazing: -

Ventilator type: -

House type C

Bedroom 2 - rear elevation

	* Octave Band Centre Frequency, Hz		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		49	51	55	49	46	44	46	41	35	29	29
B	Exposed façade, m^2	7.9		9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
C	Volume of receiving room, m^3	26.9											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-9.4	-9.4	-9.4	-9.4	-9.4	-9.4	-9.4	-9.4	-9.4	-9.4
F	Composite SRI			20.1	25.1	30.1	26.6	31.6	41.6	44.6	41.6	46.6	51.6
G	A + B + E - F		14	30.0	29.3	18.2	18.6	11.6	4.4	-3.6	-7.0	-17.8	-23.2
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		17	33.0	32.3	21.2	21.6	14.6	7.4	-0.6	-4.0	-14.8	-20.2
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				28	33	39	39	43	50	53	56	
M	$L_{Aeq} - D_{n,e}$ + 10*log(10) - B				27.9	16.8	7.6	5.7	4.5	-7.5	-16.9	-25.7	
N	Internal room noise level, vent open		18		33.7	22.6	21.7	15.1	9.2	0.2	-3.8	-14.5	

Glazing: *4mm, 16/20mm, 4mm*

Ventilator type: *Greenwood EAR42W*

Combined noise level, dB(A): 18

House type C

Bedroom 3 - rear elevation

	* Octave Band Centre Frequency, Hz		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		49	51	55	49	46	44	46	41	35	29	29
B	Exposed façade, m^2	7.2		8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
C	Volume of receiving room, m^3	16.1											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-7.2	-7.2	-7.2	-7.2	-7.2	-7.2	-7.2	-7.2	-7.2	-7.2
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		2	23.9	23.2	12.1	4.9	-5.0	-10.2	-19.2	-25.6	-36.4	-36.9
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		5	26.9	26.2	15.1	7.9	-2.0	-7.2	-16.2	-22.6	-33.4	-33.9

Glazing: -

Ventilator type: -

House type B

Bedroom 3 - gable

	* Octave Band Centre Frequency, Hz		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Amax}		59	61	65	59	56	54	56	51	45	39	39
B	Exposed façade, m^2	5.8		7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
C	Volume of receiving room, m^3	16.1											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-7.2	-7.2	-7.2	-7.2	-7.2	-7.2	-7.2	-7.2	-7.2	-7.2
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		11	33.0	32.3	21.2	14.0	4.1	-1.1	-10.1	-16.5	-27.3	-27.8
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		14	36.0	35.3	24.2	17.0	7.1	1.9	-7.1	-13.5	-24.3	-24.8

Glazing: -

Ventilator type: -

Combined noise level, dB(A): 15

House type C

Bedroom 4/study - rear elevation

	* Octave Band Centre Frequency, Hz		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Aeq}		49	51	55	49	46	44	46	41	35	29	29
B	Exposed façade, m^2	7.2		8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
C	Volume of receiving room, m^3	18											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-7.7	-7.7	-7.7	-7.7	-7.7	-7.7	-7.7	-7.7	-7.7	-7.7
F	Composite SRI			22.8	27.8	32.8	29.9	35.0	44.9	48.0	45.0	50.0	54.9
G	A + B + E - F		12	28.7	28.0	16.9	16.6	9.6	2.4	-5.6	-9.1	-19.9	-25.2
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		15	31.7	31.0	19.9	19.6	12.6	5.4	-2.6	-6.1	-16.9	-22.2
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				28	33	39	39	43	50	53	56	
M	$L_{Aeq} - D_{n,e}$ + 10*log(10) - B				28.3	17.2	8.0	6.1	4.9	-7.1	-16.5	-25.3	
N	Internal room noise level, vent open		16		32.9	21.8	19.9	13.5	8.2	-1.3	-5.7	-16.3	

Glazing: *4mm, 16/20mm, 4mm*

Ventilator type: *Greenwood EAR42W*

L_{Amax} Assessment, night time

House type C

Bedroom 1 - front elevation

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Amax}		78	81	85	83	78	75	73	65	60	56	63
B	Exposed façade, m^2	9.6		9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
C	Volume of receiving room, m^3	34.3											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5
F	Composite SRI			21.7	29.5	30.9	32.3	42.0	50.0	51.3	58.5	61.5	64.6
G	A + B + E - F		40	58.9	54.4	51.3	44.8	32.7	22.5	12.7	0.8	-6.5	-2.4
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		43	61.9	57.4	54.3	47.8	35.7	25.5	15.7	3.8	-3.5	0.6
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				28	33	39	39	43	50	53	56	
M	$L_{Aeq} - D_{n,e}$ + 10*log(10) - B				56.8	50.1	39.0	36.6	30.4	14.9	7.2	-0.1	
N	Internal room noise level, vent open		44		60.1	55.7	48.4	39.1	31.6	18.3	8.8	1.5	

Glazing: *6mm, 16/20mm, 6.8mm*

Ventilator type: *Greenwood EAR42W*

House type C

Bedroom 1 - gable

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Amax}		78	81	85	83	78	75	73	65	60	56	63
B	Exposed façade, m^2	10		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
C	Volume of receiving room, m^3	34.3											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		32	52.8	51.1	44.4	35.3	24.9	14.7	2.2	-2.5	-11.8	-4.6
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		35	55.8	54.1	47.4	38.3	27.9	17.7	5.2	0.5	-8.8	-1.6

Glazing: -

Ventilator type: -

House type C

Bedroom 1 - rear elevation

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Amax}		68	71	75	73	68	65	63	55	50	46	53
B	Exposed façade, m^2	8.2		9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1
C	Volume of receiving room, m^3	34.3											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5
F	Composite SRI			21.2	26.2	31.2	27.9	32.9	42.9	45.9	43.0	48.0	52.9
G	A + B + E - F		33	48.8	47.1	40.4	38.6	31.1	18.9	7.4	5.7	-3.6	-1.3
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		36	51.8	50.1	43.4	41.6	34.1	21.9	10.4	8.7	-0.6	1.7
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				28	33	39	39	43	50	53	56	
M	$L_{Aeq} - D_{n,e}$ + 10*log(10) - B				47.4	40.7	29.6	27.2	21.0	5.5	-2.2	-9.5	
N	Internal room noise level, vent open		37		52.0	45.3	41.8	34.9	24.5	11.6	9.0	-0.1	

Glazing: *4mm, 16/20mm, 4mm*

Ventilator type: *Greenwood EAR42W*

Combined noise level, dB(A)	45

House type C

Bedroom 2 - Gable

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Amax}		78	81	85	83	78	75	73	65	60	56	63
B	Exposed façade, m^2	6		7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8
C	Volume of receiving room, m^3	26.9											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-9.4	-9.4	-9.4	-9.4	-9.4	-9.4	-9.4	-9.4	-9.4	-9.4
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		31	51.6	49.9	43.2	34.1	23.7	13.5	1.0	-3.7	-13.0	-5.8
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		34	54.6	52.9	46.2	37.1	26.7	16.5	4.0	-0.7	-10.0	-2.8

Glazing: -

Ventilator type: -

House type C

Bedroom 2 - rear elevation

	** Octave Band Centre Frequency, Hz*		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Amax}		**68**	71	75	73	68	65	63	55	50	46	53
B	Exposed façade, m^2	**7.9**		9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
C	Volume of receiving room, m^3	**26.9**											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-9.4	-9.4	-9.4	-9.4	-9.4	-9.4	-9.4	-9.4	-9.4	-9.4
F	Composite SRI			20.1	25.1	30.1	26.6	31.6	41.6	44.6	41.6	46.6	51.6
G	A + B + E - F		**35**	50.7	49.0	42.3	40.8	33.3	21.1	9.6	7.9	-1.4	0.9
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		**38**	53.7	52.0	45.3	43.8	36.3	24.1	12.6	10.9	1.6	3.9
K	Number of ventilators	**1**											
L	Ventilator $D_{n,e}$				28	33	39	39	43	50	53	56	
M	$L_{Aeq} - D_{n,e}$ + 10*log(10) - B				47.6	40.9	29.8	27.4	21.2	5.7	-2.0	-9.3	
N	Internal room noise level, vent open		**39**		53.4	46.7	43.9	36.8	25.9	13.4	11.1	1.9	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Greenwood EAR42W*												
	Combined noise level, dB(A)		**40**										

House type C

Bedroom 3 - rear elevation

	** Octave Band Centre Frequency, Hz*		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Amax}		**68**	71	75	73	68	65	63	55	50	46	53
B	Exposed façade, m^2	**7.2**		8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
C	Volume of receiving room, m^3	**16.1**											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-7.2	-7.2	-7.2	-7.2	-7.2	-7.2	-7.2	-7.2	-7.2	-7.2
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		**24**	44.6	42.9	36.2	27.1	16.7	6.5	-6.0	-10.7	-20.0	-12.8
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		**27**	47.6	45.9	39.2	30.1	19.7	9.5	-3.0	-7.7	-17.0	-9.8
Glazing:	-												
Ventilator type:	-												

House type C

Bedroom 3 - gable

	** Octave Band Centre Frequency, Hz*		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Amax}		**78**	81	85	83	78	75	73	65	60	56	63
B	Exposed façade, m^2	**5.8**		7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
C	Volume of receiving room, m^3	**16.1**											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-7.2	-7.2	-7.2	-7.2	-7.2	-7.2	-7.2	-7.2	-7.2	-7.2
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		**33**	53.7	52.0	45.3	36.2	25.8	15.6	3.1	-1.6	-10.9	-3.7
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		**36**	56.7	55.0	48.3	39.2	28.8	18.6	6.1	1.4	-7.9	-0.7
Glazing:	-												
Ventilator type:	-												
	Combined noise level, dB(A)		**37**										

House type C

Bedroom 4/study - rear elevation

	** Octave Band Centre Frequency, Hz*		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{Amax}		**68**	71	75	73	68	65	63	55	50	46	53
B	Exposed façade, m^2	**7.2**		8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
C	Volume of receiving room, m^3	**18**											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-7.7	-7.7	-7.7	-7.7	-7.7	-7.7	-7.7	-7.7	-7.7	-7.7
F	Composite SRI			22.8	27.8	32.8	29.9	35.0	44.9	48.0	45.0	50.0	54.9
G	A + B + E - F		**34**	49.4	47.7	41.0	38.8	31.3	19.1	7.6	5.8	-3.5	-1.1
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		**37**	52.4	50.7	44.0	41.8	34.3	22.1	10.6	8.8	-0.5	1.9
K	Number of ventilators	**1**											
L	Ventilator $D_{n,e}$				28	33	39	39	43	50	53	56	
M	$L_{Aeq} - D_{n,e}$ + 10*log(10) - B				48.0	41.3	30.2	27.8	21.6	6.1	-1.6	-8.9	
N	Internal room noise level, vent open		**37**		52.6	45.9	42.1	35.2	24.9	11.9	9.2	0.1	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Greenwood EAR42W*												