Assessment of the Existing Noise Climate and Sound Insulation of the Proposed New Residential Dwellings at 1145 Manchester Road, Slaithwaite

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1.0 Summary

Planning permission has been granted permitting the redevelopment of the former Croft House Surgery to form four new residential flats within the existing building, combined with the demolition of the existing car port/office building to be replaced with two semi-detached houses. The planning permission was granted subject to the imposition of a number of conditions one of which, condition nine, required an assessment of the existing noise climate in the immediate vicinity of the permitted development to be made. In addition the condition required the specification of a scheme of suitable noise attenuation measures to limit the ingress of external noise to the permitted dwellings to be formulated.

In accordance with the planning condition, noise surveys have been conducted to characterise the existing noise climate in the immediate vicinity of the permitted 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 new residential accommodation, resulting from external noise break-in, together with an assessment of the likely noise levels within the garden areas serving the dwellings.

The noise climate in the vicinity of 1145 Manchester Road in Slaithwaite was regarded as being essentially sub-urban in character with road traffic on the busy A62 Manchester Road representing the principal noise source. During both the afternoon and night time periods the traffic comprised mainly private cars, although some HGVs and buses were also noted. Additional noise sources included the sound of running water in the adjacent Bradley Brook, some daytime noise from construction activity on a nearby house and distant train noise.

Combining the measured noise levels obtained from the surveys with the sound insulation provided by the proposed building envelopes, the calculations have highlighted that the internal noise levels within the permitted dwellings, resulting from external noise break-in, would comply with the adopted design guide values. In addition it is suggested that the shielding created by the houses themselves would see the noise climate in the back gardens serving the houses comply with the design guide value of 50dB L_{Aeq}. Consequently it is suggested that the sound insulation measures detailed in this report would be sufficient to ensure that the internal noise climate within the dwellings, resulting from external noise break-in, would comply with the requirements of planning condition nine.

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2.0 Introduction

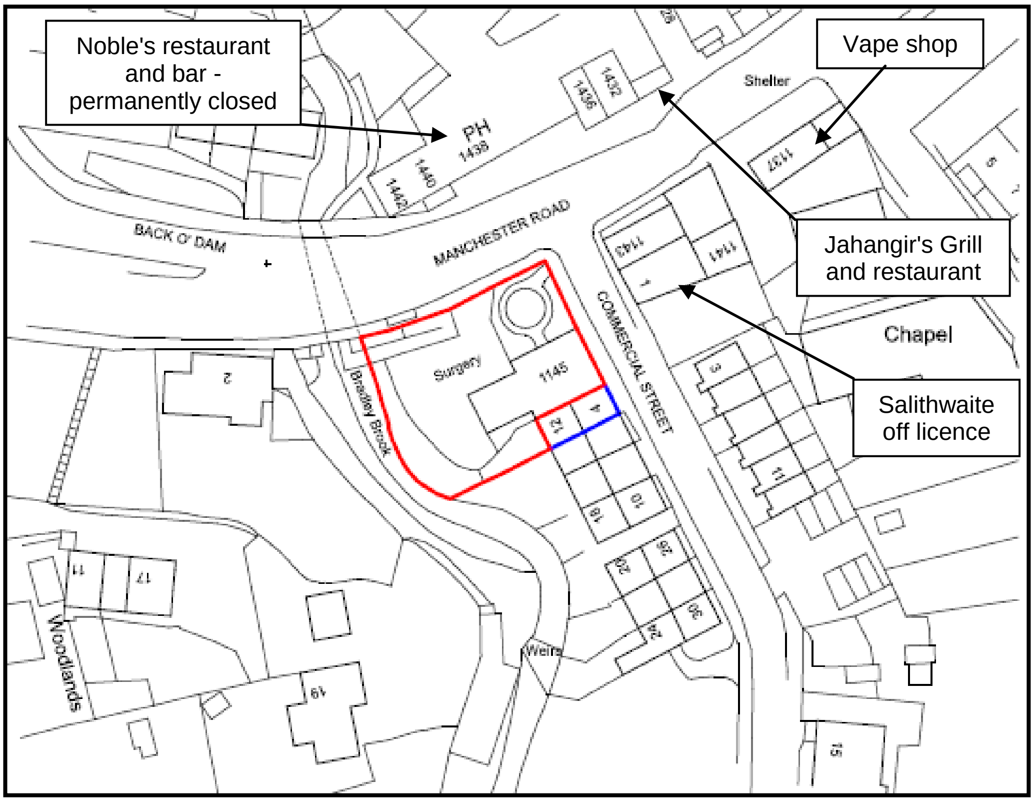
Planning permission has been granted permitting the redevelopment of the former Croft House Surgery to form four new residential flats within the existing building, combined with the demolition of the existing car port/office building to be replaced with two semi-detached houses. The planning permission was granted subject to the imposition of a number of conditions one of which, condition nine, required an assessment of the existing noise climate in the immediate vicinity of the permitted development to be made. In addition the condition required the specification of a scheme of suitable noise attenuation measures to limit the ingress of external noise to the permitted dwellings to be formulated.

In accordance with the planning condition, noise surveys have been conducted to characterise the existing noise climate in the immediate vicinity of the permitted 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 habitable rooms, resulting from external noise break-in, and the garden areas serving the dwellings.

3.0 Site Description

The permitted residential development is to be formed within the former Croft House Surgery at 1145 Manchester Road in Slaithwaite, with an additional two semi-detached houses being built of the site of the current car port/office building immediately adjacent to the existing Croft House Surgery (figure 1 and photograph 1 overleaf). Immediately to the North of the former Croft House Surgery is the A62 Manchester Road with existing residential dwellings, the site of the former Noble's Bar and Restaurant (now permanently closed) and Jahangir's Grill and Restaurant beyond (photograph 2 overleaf). Immediately to the South of the former Croft House Survey are the existing residential dwellings on Commercial Street. Directly to the East is Commercial Street with the Commercial Street Stores and Slaithwaite off-licence beyond (photograph 3 overleaf). Immediately to the West of the development site is the Bradley Brook (photograph 4 overleaf) with a number of existing residential properties beyond (photograph 5 overleaf).

Figure 1. Former Croft House Surgery development site (edged in red) at 1145 Manchester Road, Slaithwaite



Photograph 1. Former Croft House Surgery and adjacent car port/office building

Photograph 2. A62 Manchester Road, existing residential dwellings and commercial premises to the North of the development site

Photograph 3. Commercial Street Stores and Slaithwaite off-licence to the East

Photograph 4. Bradley Brook to the West of the development site

Photograph 5. Residential premises to the West of the development site beyond the Bradley Brook

4.0 Assessment Criteria

The planning permission for the development, granted in November 2021, contained a number of conditions, of which condition nine specifically related to the acoustic conditions to be achieved within the development. The full wording of planning condition nine is reproduced below.

> 9. Before development commences a report specifying the measures to be taken to protect the development from noise from all significant noise sources that are likely to affect the proposed development including road traffic shall be submitted to and approved in writing by the Local Planning Authority. The report shall:
>
> a) Determine the existing noise climate
> b) Predict the noise climate in gardens (daytime), bedrooms (night-time) and other habitable rooms of the development
> c) Detail the proposed attenuation/design necessary to protect the amenity of the occupants of the new residences (including ventilation if required),
>
> 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.
> **Reason**: To ensure that future occupants have adequate protection against noise disturbance and to accord with the aims of Policies LP24(b) and LP52 of the Kirklees Local Plan and Chapter 15 of the National Planning Policy Framework.

In addition to the requirements contained within planning condition nine, the existing noise climate and likely noise climate within the permitted dwellings will be evaluated with reference to the guidance contained within the following documents.

4.1 National Planning Policy Framework (NPPF), the Noise Policy Statement for England (NPSE) and the National Planning Practice Guidance (NPPG)

The National Planning Policy Framework (NPPF), the Noise Policy Statement for England (NPSE), originally released in 2010, and the National Planning Practice Guidance (NPPG) do not provide quantitative criteria for assessment purposes. Instead the documents detail general policy aims, statements as well as providing some guidance on how certain situations can be interpreted.

The NPPF's main statement on noise is to be found in paragraph 180:

180. Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

a. Mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life
b. Identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and

c. limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation.

In addition, paragraph 182 of the NPPF is also relevant and states:

182. Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed.

The NPPF also refers to the NPSE and as such details the following aims:

1. The avoidance of significant adverse impacts on health and quality of life;

2. Mitigate and minimise adverse impacts on health and quality of life; and

3. Where possible, contribute to the improvement of health and quality of life.

In order to reflect these objectives the NPSE referenced concepts utilised by the World Health Organisation, which in turn employed concepts from toxicology and applied them to noise impacts. These concepts are:

- NOEL – No Observed Effect Level. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.

- LOAEL – Lowest Observed Adverse Effect Level. This is the level above which adverse effects on health and quality of life can be detected.

- SOAEL – Significant Observed Adverse Effect Level. This is the level above which significant adverse effects on health and quality of life occur.

SOAEL is clearly something the policy seeks to avoid in aim 1. Aim 2 represents situations between SOAEL and LOAEL, and seeks to minimise and mitigate the possible effects.

The NPPG section on noise adds some further detail, much of it reproducing the NPPF and NPSE, but some useful qualitative guidance is provided in the noise exposure hierarchy table and this is reproduced in table 1 overleaf.

Table 1. Noise exposure hierarchy table

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

4.2 West Yorkshire, Planning Consultation Guidance - Noise and Vibration

This document was formulated and issued by the five West Yorkshire Local Authorities in order to provide additional guidance to Planners, Environmental Health Departments and applicants, on the aspects of noise and vibration issues pertinent to the determination of land use planning considerations. The intention of the document is to permit a determination of what effect, if any, the noise climate in the immediate vicinity of a proposed development may have on that development.

With regard to proposed new residential developments the guidance document attempts to expand on the guidance contained within the Noise Policy Statement for England (NPSE) document (originally released in 2010). The NPSE document provided guidance on 'acceptable' noise levels with particular reference to residential developments, and this was framed with reference to avoiding "significant adverse" impacts on health and quality of life and where necessary minimising such "adverse" impacts on health and quality of life.

In order to reflect these objectives the West Yorkshire guidance replicated the approach employed by the NPSE and extended the two concepts from toxicology and applied them to noise impacts. As in the case of the NPSE, these two concepts are:

- NOEL – No Observed Effect Level. This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.
- LOAEL – Lowest Observed Adverse Effect Level This is the level above which adverse effects on health and quality of life can be detected.

In addition the NPSE introduced the further concept of a Significant Observed Adverse Effect Level (SOAEL) and defined this as "the level above which significant adverse effects on health and quality of life occur".

The West Yorkshire, Planning Consultation Guidance - Noise and Vibration document provides additional guidance based on the potential source of the noise to which a development may be exposed. In this respect the document identifies the following main noise sources:

- Anonymous Noise Sources, such as Transportation Noise;
- Proposed Developments Containing Noise Generating Uses;
- Places of Worship;
- Entertainment Premises;
- Mixed Use Schemes;
- Wind Turbines;
- Multi-Use Games Areas;
- Nurseries;
- Schools;
- Taxi/Private Hire Premises;

With the above in mind the Planning Consultation Guidance document summarises the values for LOAEL for residential dwellings in noise environments that are primarily exposed to anonymous noise, in this case road traffic noise. This guidance is further condensed into a range of 'absolute' criteria for different internal and external areas and these 'absolute' criteria are summarised in table 2 overleaf.

Table 2. Recommended Maximum, LOAEL sound levels based upon an Absolute criterion. (Reproduced from table 1, section 4.1 of the Planning Consultation Guidance Document)

Location	Time Period	Ambient Level (dB $L_{Aeq,T}$)	Maximum noise level (dB L_{AFmax})
External amenity areas	0700 - 2300	55	-
External amenity areas	2300 - 0700	45	60
Habitable room	0700 - 2300	35	-
Bedroom	2300 - 0700	30	45
Dining room	0700 - 2300	40	-

4.3 BS 8233:2014 “Guidance on Sound Insulation and Noise Reduction for Buildings”

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 are reproduced in table 3 below.

Table 3. 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 $L_{Aeq, 16 hour}$	-
Dining	Dining room/area	40dB $L_{Aeq, 16 hour}$	-
Sleeping (daytime resting)	Bedroom	35dB $L_{Aeq, 16 hour}$	30dB $L_{Aeq, 8 hour}$

In addition to the internal noise design guidance detailed above, supplementary notes 4, 5 and 7 to table 4 of section 7.7.2 are deemed appropriate to this assessment and state the following:

***Note 4**. Regular individual noise events (for example scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or LAmax,F, depending on the character and number of events per night. Sporadic noise events could require separate values.*

***Note 7**. Where development is considered as necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5dB and reasonable internal conditions still achieved.*

With reference to note 4, the design guidance detailed within the previous 1999 version of BS 8233 relating to individual noise events, expressed as L_{Amax} levels, will be adopted for this assessment. This guidance stated: "*for a reasonable standard for bedrooms at night, individual noise events (measured with the fast time-weighting) should not normally exceed 45 dB L_{Amax}*", and this guidance complies with the provisions contained within the WHO document.

Additional guidance relating to individual noise events is contained within the Planning and Noise: Professional Guidance on Planning and Noise (ProPG) document issued in May 2017. The ProPG document was a collaboration between representatives of the Chartered Institute of Environmental Health (CIEH), the Institute of Acoustics (IoA) and the Association of Noise Consultants (ANC) and sought to provide additional guidance in addition to complementing the wider aims contained within documents such as: the Noise Policy Statement for England (NPSE), the National Planning Policy Framework (NPPF), the WHO "Guidelines for Community Noise" and (BS) 8233:2014 “Guidance on sound insulation and noise reduction for buildings”.

Of relevance to the issue of individual noise events is the guidance contained within Appendix A of the ProPG, which deals specifically with individual noise events and contains a short summary of research into the effects of individual noise events and the effect that these can have on sleep. In the light of this summary the document, at paragraph A.20, states the following, "...*therefore, it is considered that if, in bedrooms at night, the $L_{Amax,F}$ from individual noise events (from all sources) would not normally exceed 45dB more than 10 times a night, then this represents a reasonable threshold below which the events on sleep can be regarded as negligible*".

It must however be stated that many regard the 45dB L_{Amax} criterion as stringent. Additionally, it must be remembered that all of the above criteria are design guidance, they do not represent a set of rigid criteria, below which a development ‘passes’ and above which a development ‘fails’.

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 detailed above. Despite this and with reference to both the versions of the guidance contained within BS 8233, it must be remembered that the advice 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 permitted development were undertaken between 16:00 - 19:30 hours on the 26th November 2021 and between 23:00 - 01:00 hours on the 1st - 2nd December 2021.

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 existing noise climate surveys the weather conditions were as follows:

Afternoon, 26th November 2021

All surfaces were dry, cloud cover was 100%, the temperature was 4^{o}C, the wind speed was approximately 1.1m/s and the barometric pressure was 997mb.

Night time, 1st – 2nd December 2021

All surfaces were dry, the sky was clear, the temperature was 0^{o}C, the wind speed was less than 0.3m/s and the barometric pressure was 991mb.

5.3 Equipment

All the noise surveys and measurements were conducted using the equipment detailed in the table 4 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 4. 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

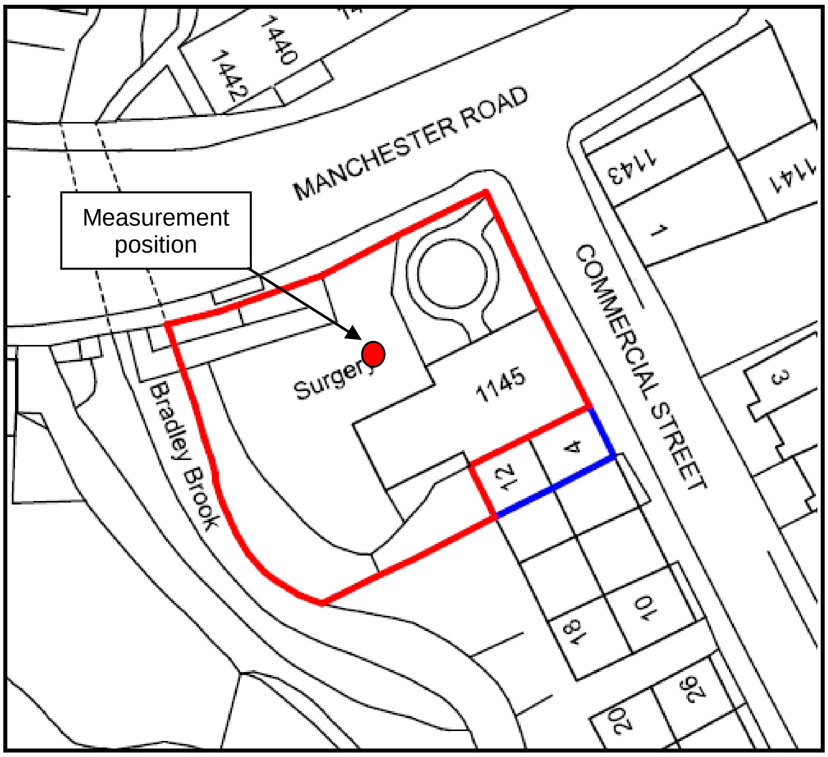
5.4 Measurement Procedure

An initial walk-over survey of the development site suggested that the principal contributor to the existing noise climate was road traffic on the A62 Manchester Road. Consequently a single measurement position was adopted and this is detailed on figure

2 below. In this position the measurement location was approximately in line with what would be the front elevations of the permitted dwellings.

The sound level meter was tripod mounted such that the microphone was approximately 1.3 metres above ground level and at least 3 metres from any potentially reflecting surfaces. 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.

Figure 2. Approximate location of the measurement position



6.0 Noise Survey Results

The existing noise climate in the vicinity of 1145 Manchester Road in Slaithwaite was regarded as being essentially sub-urban in character with road traffic on the busy A62 Manchester Road representing the main noise source. The following paragraphs contain brief subjective descriptions of the noise sources noted during the survey periods.

6.1 Qualitative Assessment: Afternoon Period

During the afternoon period the principal contributor to the ambient noise climate was road traffic noise on Manchester Road itself. Throughout the survey period the volume of traffic on Manchester Road remained relatively steady, although a very slight increase in the traffic was noted between 17:00 - 17:15 hours. In general the traffic comprised mainly private cars and taxis, although buses, HGVs, a few motorcycles were also noted. With reference to individual noisy events, this was largely limited to the passage of an emergency ambulance at 17:52 hours. With reference to the passage of buses along Manchester Road, during the course of the survey a few of these pulled in to the bus stop that is located approximately 16 metres to the North West of the measurement position. In general, relatively few passengers were waiting at the bus stop and those that did were waited quietly.

Additional noise sources noted during the survey included the constant sound of running water in the Bradley Brook, the relatively frequent sound of grinding from one of the houses to the West of the measurement position, the sound of a church clock striking the quarter hour and, between 16:30 - 16:45 hours, a little noise from a group of youths that had congregated on the corner of Manchester Road and Commercial Street.

6.2 Qualitative Assessment: Night time Period

During this period the principal contributors to the existing noise climate were road traffic on Manchester Road and the sound of the running water in the Bradley Brook. Again the road traffic comprised mainly private cars, a few HGVs and one bus that stopped at the bus stop.

Additional noise sources noted during this period included what sounded like distant train noise and during the quieter periods in the absence of road traffic, it was just possible to hear some noise from the existing houses on Commercial Street. At no time during the survey was any noise of a commercial nature audible in the measurement position.

6.3 Basic Results

The measured noise levels from the measurement position are presented in tables 5 and 6 below and overleaf. All data have been rounded to the nearest whole decibel and full data are presented in tabular form in Appendix 2.

Table 5. Existing ambient noise levels, afternoon/evening, 1145 Manchester Road

Start time	dB L_{Aeq}, (15 minutes)	dB L_{Amax}, (15 minutes)	dB L_{A10} (15minutes)	dB L_{A90}, (15 minutes)
16:00	62	75	65	55
16:15	62	76	65	56
16:30	62	81	64	55
16:45	61	74	63	55
17:00	63	78	64	56
17:15	61	75	63	55
17:30*	63	76	65	56
17:45**	62	86	63	55
18:00	60	71	63	55

***** Measurement period reduced to 5 minutes as a result of a brief rain shower
** Emergency ambulance on the A62

Table 5, continued. Existing ambient noise levels, afternoon/evening, 1145 Manchester Road

Start time	dB L_{Aeq}, (15 minutes)	dB L_{Amax}, (15 minutes)	dB L_{A10} (15minutes)	dB L_{A90}, (15 minutes)
18:15	60	75	63	54
18:30	60	75	63	54
18:45	61	78	63	55
19:00	60	76	62	53
19:15	60	78	63	54
Standard deviation	0.97	3.56	0.90	0.96
Mean (log) level	61	78	63	55

Table 6. Existing ambient noise levels, night time, Manchester Road

Start time	dB L_{Aeq}, (15 minutes)	dB L_{Amax}, (15 minutes)	dB L_{A10} (15minutes)	dB L_{A90}, (15 minutes)
2300	55	71	55	51
2315	55	71	57	51
2330	54	69	57	51
2345	53	68	54	50
0000	53	70	53	50
0015	51	60	51	50
0030	52	76	52	50
0045	51	61	51	50
Standard deviation	1.42	5.05	2.44	0.24
Mean (log) level	53	71	54	50

As can be seen from the tables 5 and 6 the daytime noise climate was steadier, in terms of the L_{Aeq}, L_{A10}, and L_{A90} parameters, than the night time noise climate, supporting the qualitative view that the existing 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 Manchester Road. With reference to the night time L_{Amax} levels, the highest measured level occurred between 00:30 - 00:45 hours and was a result of a car accelerating quickly in a Westerly direction along Manchester Road.

7.0 Noise Transmission Calculations

Using the measured sound levels from the afternoon and night-time measurement periods, calculations have been performed to assess the likely internal noise levels within the proposed new residential accommodation. 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 houses and apartments have been undertaken using the highest measured levels from the noise surveys and these levels are detailed in table 7 below. Consequently the following assessments may be regarded as worst case situations which are unlikely to persist for all but short periods of time.

With reference to the proposed rooms on the rear elevations of the permitted dwellings, as these elevations will be effectively shielded from the principal noise source by the buildings 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.

Table 7. Highest measured noise levels, Manchester Road

OBCF, Hz*	63	125	250	500	1k	2k	4k	8k	Overall, dB(A)
Daytime, L_{Aeq}, (17:00 - 17:15 hours)	68	63	61	58	59	55	50	44	**63**
Night time, $L_{Aeq,}$ (23:00 - 23:15 hours)	57	54	53	51	50	47	43	35	**55**
Night time, $L_{Amax.}$ (00:30 - 00:45 hours)	72	66	63	65	69	73	66	50	**76**

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 drawings issued by One 17 Architects of the Dyehouse, Armitage Bridge in Huddersfield. 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.

As the measured noise levels were regarded as being relatively typical of an essentially sub-urban environment, a ventilation strategy adopting a 'passive' type system incorporating background ventilators with local mechanical extract ventilation (MEV) in areas of potentially high humidity. This approach would be similar to a system 1 ventilation strategy and will be assumed for the purposes of the calculations.

In each case the calculations have been produced assuming the windows are closed but with the specified ventilation is in its open position. Although this is the case it should however be remembered that in this, as in the majority of other locations, the implicit assumption is that ventilating the internal spaces by opening windows will inevitably permit the ingress of external noise which would affect the internal noise climate.

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 development will contain four apartments formed within the existing building and two new build semi-detached houses. Consequently two external wall constructions, solid masonry for the existing building and cavity masonry for the new semi-detached houses, have been assumed.

Solid masonry wall

The external walls of the existing building will be in the region of 325 - 375mm thick and are believed to comprise a stone facing with a nominal rubble filled cavity and a solid masonry (nominally 225mm thick) internal leaf. Test results for a similar construction suggest that external walls of this type should provide an overall sound insulation of at least 54dB R_w, with the octave band sound insulation values being as detailed in table 8 below.

Table 8. External wall**,** octave band sound insulation values

OBCF, Hz*	**125**	**250**	**500**	**1k**	**2k**	**4k**	**Overall, R_w dB(A)**
Sound Insulation, dB	43	45	52	58	65	65	54

* Octave Band Centre Frequency

Cavity wall construction

The external walls 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 9 below.

Table 9. 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 glazing will be of the sealed unit type and will be of 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 values of 31dB R_w in the closed position. The octave band sound insulation values are as detailed in table 10 below.

Alternative glazing configurations would be acceptable providing the sound insulation performances are at least equivalent to the specifications detailed in table 10 below.

Table 10. Glazing, octave band sound insulation values

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

* Octave Band Centre Frequency

Ventilation

As previously stated a passive ventilation strategy has been adopted for the proposed flats. In this respect background ventilation provision in compliance with the requirements of Approved Document F, will be provided by window frame mounted ventilators of the Greenwood 4000S type. However, units offering equivalent sound insulation performance would be acceptable. It is also anticipated that local mechanical extract ventilation (MEV) being provided in areas of high humidity.

Laboratory test data indicates that the specified Greenwood window frame mounted ventilator should provide a sound insulation value of 33dB $D_{n,e,w}$ in its open position. The octave band sound insulation values for the selected window frame mounted ventilators are detailed in table 11 below. Alternative ventilator configurations would be acceptable providing the sound insulation performance is at least equivalent to the specification detailed in table 11 below.

Table 11. Background ventilation**,** octave band sound insulation values

OBCF, Hz*	125	250	500	1k	2k	4k	Overall, $D_{n,e,w}$ dB
Greenwood 40000S	36	37	34	30	33	38**	**33**

* Octave Band Centre Frequency
****** Extrapolated value

Remaining with the issue of ventilation, the advice given in note 5 to paragraph 7.7.2 of BS8233:2014 should be borne in mind. This advice states the following: "*If relying on closed windows to meet the guide values, there needs to be appropriate alternative ventilation that does not compromise the facade insulation or the resulting noise level*". In this case, it is suggested that the passive type ventilation strategy with local mechanical extract ventilation (MEV), outlined above would comply with the advice given in note 5 to paragraph 7.7.2 of BS 8233:2014.

7.2 Calculation Results

For the purposes of the calculations the highest measured noise levels detailed in table 7 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 12 - 15 below and 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 2.

Table 12. Calculated internal noise levels, semi-detached houses

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})
Living/dining/kitchen	35	**33**	30 (45)	-
Front bedroom	35	**34**	30 (45)	**26 (45)**
Rear bedroom	35	**25**	30 (45)	**17 (36)**

Table 13. Calculated internal noise levels, first floor apartments

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})
Living/dining/kitchen	35	**33**	30 (45)	-
Bedroom 1	35	**25**	30 (45)	**16 (35)**

Table 14. Calculated internal noise levels, second floor right hand apartment

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})
Living/dining/kitchen	35	**35**	30 (45)	-
Bedroom 1	35	**34**	30 (45)	**32 (45)**

Table 15. Calculated internal noise levels, second floor left hand apartment

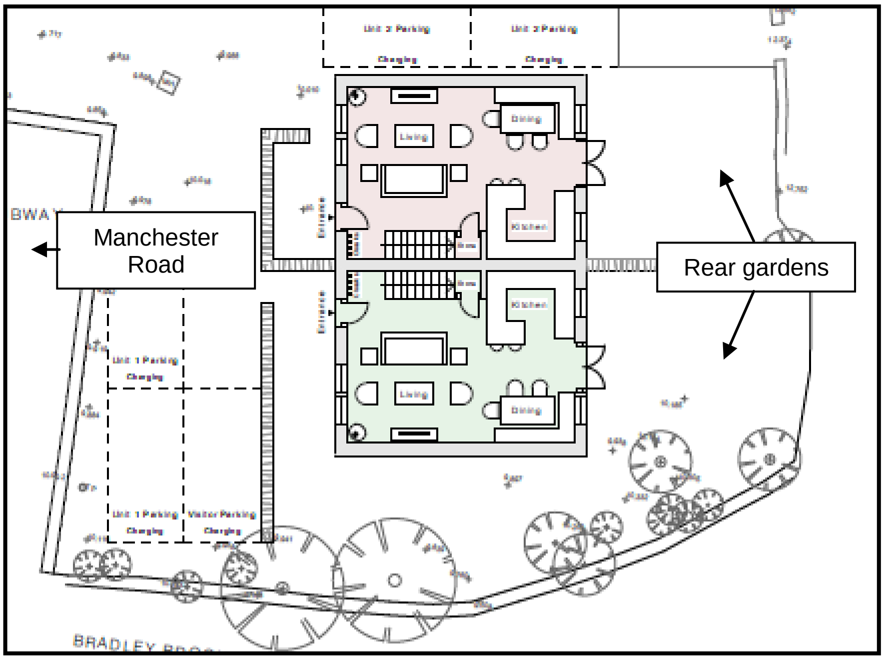
Location	Design target, daytime, dB L_{Aeq}	Calculated level, daytime, dB L_{Aeq}	Design target, night time, dB L_{Aeq}	Calculated levels, night time, dB L_{Aeq} and (L_{Amax})
Living/dining/kitchen	35	**35**	30 (45)	-
Bedroom 1	35	**35**	30 (45)	**27 (45)**

As can be seen from tables 12 - 15 the calculated internal noise levels resulting from external noise break-in would not exceed the design guidance contained within section 4 above. As such it is suggested that the sound insulation of the building envelope components detailed above, would be sufficient to limit the ingress of external noise to the interior of the permitted dwellings in accordance with the adopted design guidance detailed in section 4 above.

7.3 External Amenity Areas

With reference to the external amenity areas appurtenant to the permitted dwellings, only the two semi-detached houses have external amenity areas and these are to the rear of the dwellings, as detailed in figure 3 below. With reference to the likely effect that the existing noise climate may have on these external amenity areas, it has been assumed that the measured noise levels obtained from the afternoon period will be the most appropriate with reference to this evaluation.

Figure 3. Ground floor layout showing the external amenity space to the rear of the two semi-detached dwellings



The obtained noise levels from the afternoon survey indicate that the highest measured level was 63dB $L_{Aeq\ (15\ mins)}$ with a mean (log) value over the measurement period of 61dB $L_{Aeq,T.}$ As the principal contributor to the existing noise climate is noise from vehicles on the Manchester Road, the erection of the permitted dwellings would be expected to provide a considerable degree of acoustic shielding to the garden area directly behind the houses.

The assessment of the likely acoustic shielding that would be provided by the houses themselves will be assessed by establishing the path difference that would result from the interposition of the houses. In this assessment the following assumptions have been made:

- The permitted houses may be regarded as a rigid barrier approximately 7.8 metres high.
- The notional source height will be 0.5 metres.
- The effective centre point of the barrier (the houses) will be approximately 18.0 metres from the nearside carriageway of the A62 and approximately 8.5 metres from the centre point of the rear garden areas.
- The receiver, a seated person in the centre of the rear garden centre of a ground floor window, would be approximately 1.0 metre above ground level.

Applying the principles contained within the Calculation of Road Traffic (CRTN) document relating to the shielding provided by a barrier, the houses themselves, and assuming a receiver height of 1.2 metres, roughly equivalent to a seated person, the calculated path difference (δ) would be around 3.6 metres. Applying the potential barrier corrections contained within Chart 9b of CRTN would suggest an attenuation of at least 18dB would result. Applying this proposed reduction in level to both the highest and average levels from the afternoon period would see the resulting level in the back gardens reduce to around 45 or 43$L_{Aeq,T.}$ Both levels would comply with the *50dB* $L_{Aeq,T}$ guide value detailed in detailed in 7.7.3.2 of BS 8233:2014.

8.0 Conclusion

The noise climate in the vicinity of 1145 Manchester Road in Slaithwaite was regarded as being essentially sub-urban in character with road traffic on the busy A62 Manchester Road representing the principal noise source. During both the afternoon and night time periods the traffic comprised mainly private cars, although some HGVs and buses were also noted. Additional noise sources included the sound of running water in the adjacent Bradley Brook, some daytime noise from construction activity on a nearby house and distant train noise.

Combining the measured noise levels obtained from the surveys with the sound insulation provided by the proposed building envelopes, it can be seen that the calculated internal noise levels within the permitted dwellings, resulting from external noise break-in, would comply with the adopted design guide values. In addition it is suggested that the shielding created by the houses themselves would see the noise climate in the back gardens serving the houses comply with the design guide value of 50dB L_{Aeq}.

As a result it is suggested that the sound insulation measures detailed in this report would be sufficient to ensure that the internal noise climate within the dwellings, resulting from external noise break-in, would comply with the requirements of planning condition nine.

Appendix 1: Existing noise climate survey, measured levels

1145 Manchester Road, Slaithwaite										
Existing noise climate survey.										
26th November 2021										
Octave Band Centre Frequency, Hz.	**dB(A)**	**31.5**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**16k**
16:00											
L_{eq}	**62**	71	68	61	57	56	59	55	51	47	34
L_{max}	**75**	94	89	84	69	67	67	67	66	64	52
L_{10}	**65**	71	69	63	59	58	61	57	51	44	31
L_{90}	**55**	56	56	52	50	49	51	48	45	40	26
16:15											
L_{eq}	**62**	69	68	62	59	57	59	55	51	47	34
L_{max}	**76**	90	86	78	75	69	68	70	69	62	50
L_{10}	**65**	70	69	64	60	59	61	57	52	46	32
L_{90}	**56**	57	57	52	50	49	52	49	46	40	26
16:30											
L_{eq}	**62**	67	67	62	59	56	59	54	49	45	33
L_{max}	**81**	89	91	82	83	73	75	74	72	63	53
L_{10}	**64**	69	68	62	58	57	61	56	48	41	28
L_{90}	**55**	56	55	51	49	48	50	48	45	39	26
16:45											
L_{eq}	**61**	68	67	59	55	54	58	53	48	41	28
L_{max}	**74**	92	93	84	74	67	68	60	59	55	46
L_{10}	**63**	67	68	59	57	56	60	55	47	41	27
L_{90}	**55**	56	55	51	49	48	50	48	45	39	26
17:00											
L_{eq}	**63**	70	68	63	61	58	59	55	50	44	29
L_{max}	**78**	87	88	82	79	72	73	65	64	72	47
L_{10}	**64**	73	70	64	61	59	61	56	50	43	29
L_{90}	**56**	58	58	53	51	50	52	49	46	39	26
17:15											
L_{eq}	**61**	67	65	58	56	55	58	53	48	41	29
L_{max}	**75**	84	80	73	74	72	69	66	62	55	55
L_{10}	**63**	69	68	60	58	56	60	55	48	41	28
L_{90}	**55**	59	57	52	50	49	50	48	45	39	26
17:30 (measurement reduced to 5 mins because of rain shower)											
L_{eq}	**63**	68	67	63	60	57	60	55	49	42	29
L_{max}	**76**	89	89	83	76	72	71	65	63	56	47
L_{10}	**65**	69	69	64	61	59	62	57	49	43	29
L_{90}	**56**	58	57	53	51	50	52	49	46	40	26
17:45											
L_{eq}	**62**	69	67	68	60	56	58	53	48	41	28
L_{max}	**86**	90	86	98	88	82	79	72	63	50	44
L_{10}	**63**	70	69	63	57	56	60	55	48	41	28
L_{90}	**55**	56	55	52	49	48	50	48	45	39	25
18:00											
L_{eq}	**60**	70	66	59	57	55	57	53	48	42	28
L_{max}	**71**	88	83	70	73	68	66	62	57	60	44
L_{10}	**63**	71	68	61	58	56	60	54	48	41	28
L_{90}	**55**	57	57	52	50	49	50	48	46	39	26

18:15												
L_{eq}		**60**	66	66	59	56	54	58	53	48	41	28
L_{max}		**75**	87	89	83	70	67	71	66	63	56	46
L_{10}		**63**	68	67	60	58	57	60	55	48	41	27
L_{90}		**54**	55	54	50	49	48	49	47	45	39	25
18:30												
L_{eq}		**60**	68	64	58	55	54	57	52	48	42	28
L_{max}		**75**	92	82	74	74	68	69	69	68	60	48
L_{10}		**63**	68	67	61	57	57	60	54	48	41	27
L_{90}		**54**	55	53	50	48	47	48	47	45	39	25
18:45												
L_{eq}		**61**	69	68	63	59	56	58	53	48	42	28
L_{max}		**78**	90	87	86	82	75	70	65	61	55	42
L_{10}		**63**	70	69	63	59	57	60	55	48	42	28
L_{90}		**55**	56	55	51	50	49	50	48	45	39	25
19:00												
L_{eq}		**60**	67	64	59	58	55	57	52	48	41	28
L_{max}		**76**	85	79	80	78	73	70	65	62	54	44
L_{10}		**62**	69	67	60	57	56	59	54	48	41	27
L_{90}		**53**	55	53	50	48	47	48	46	45	39	25
19:15												
L_{eq}		**60**	67	64	58	57	55	57	53	49	42	29
L_{max}		**78**	84	80	75	75	69	71	71	72	66	54
L_{10}		**63**	69	66	61	58	57	60	54	48	41	27
L_{90}		**54**	53	53	50	48	48	48	47	45	39	25

1st - 2nd December 2021

Octave Band Centre Frequency, Hz.	dB(A)	31.5	63	125	250	500	1k	2k	4k	8k	16k
23:00											
L_{eq}	**55**	58	57	54	53	51	50	47	43	35	22
L_{max}	**71**	75	75	71	73	68	67	60	55	48	34
L_{10}	**55**	60	58	56	54	51	51	47	42	34	21
L_{90}	**51**	46	46	47	45	45	45	44	41	34	20
23:15											
L_{eq}	**55**	60	59	53	52	50	52	48	43	35	22
L_{max}	**71**	82	83	71	72	64	68	61	53	44	35
L_{10}	**57**	60	58	53	53	51	54	50	43	35	21
L_{90}	**51**	45	45	47	45	45	45	44	41	34	20
23:30											
L_{eq}	**54**	53	59	53	50	49	51	47	43	35	21
L_{max}	**69**	68	82	72	68	62	66	58	49	40	33
L_{10}	**57**	56	60	54	52	51	53	49	42	35	21
L_{90}	**51**	44	45	47	45	45	45	44	41	34	20
23:45											
L_{eq}	**53**	53	54	51	49	48	49	47	42	35	21
L_{max}	**68**	67	72	65	67	63	66	59	49	42	26
L_{10}	**54**	56	56	52	49	48	50	47	42	34	21
L_{90}	**50**	43	44	46	45	44	44	44	41	34	20
00:00											
L_{eq}	**53**	50	55	51	48	48	50	47	43	35	21
L_{max}	**70**	68	75	68	65	63	68	62	53	44	29
L_{10}	**53**	52	53	51	48	47	49	46	42	34	21
L_{90}	**50**	42	43	46	44	44	44	44	41	34	20
00:15											
L_{eq}	**51**	48	48	49	46	46	46	45	42	35	21
L_{max}	**60**	69	67	57	56	55	58	51	44	37	27
L_{10}	**51**	49	47	50	46	46	45	44	41	34	21
L_{90}	**50**	42	43	46	44	44	44	44	41	34	20
00:30											
L_{eq}	**52**	50	49	50	47	46	48	46	43	35	21
L_{max}	**76**	70	72	66	63	65	69	73	66	50	31
L_{10}	**52**	51	52	51	48	48	46	45	42	34	21
L_{90}	**50**	43	43	46	44	44	44	44	41	34	20
00:45											
L_{eq}	**51**	49	47	49	47	46	47	45	42	35	21
L_{max}	**61**	65	59	57	57	55	59	53	44	36	22
L_{10}	**51**	50	49	50	47	46	46	44	41	34	20
L_{90}	**50**	42	43	46	44	44	44	44	41	34	20

Appendix 2. Calculations

Houses

1145 Manchester Road, Slaithwaite
Break-in Noise Calculations

Ground floor - new houses

Units 1 and 2
L_{Aeq} Assessment, daytime

Ground floor
Living/dining/kitchen, Manchester Road elevation

	** Octave Band Centre Frequency, Hz*		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		63	70	68	63	61	58	59	55	50	44	29
B	Exposed façade, m^2	13		11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
C	Volume of receiving room, m^3	93.3											
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)			-14.8	-14.8	-14.8	-14.8	-14.8	-14.8	-14.8	-14.8	-14.8	-14.8
F	Composite SRI			19.3	24.3	29.3	25.6	30.7	40.6	43.7	40.7	45.7	50.6
G	A + B + E - F		26	47.4	40.3	30.0	31.2	23.1	14.9	7.5	5.3	-5.3	-25.0
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		29	50.4	43.3	33.0	34.2	26.1	17.9	10.5	8.3	-2.3	-22.0
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				31	36	37	34	30	33	38	43	
M	$L_{Aeq} - D_{n,e}$ + 10*log(10) - B				36.1	25.8	22.4	22.4	28.1	20.7	10.6	0.0	
N	Internal room noise level, vent open		32		44.0	33.7	34.5	27.7	28.5	21.1	12.6	2.0	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Greenwood 4000S*												

Ground floor
Living/dining/kitchen, gable

	** Octave Band Centre Frequency, Hz*		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		63	70	68	63	61	58	59	55	50	44	29
B	Exposed façade, m^2	17.3		12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4
C	Volume of receiving room, m^3	93.3											
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)			-14.8	-14.8	-14.8	-14.8	-14.8	-14.8	-14.8	-14.8	-14.8	-14.8
F	I bed existing			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	39.8	32.7	22.4	16.0	5.0	-1.3	-9.7	-14.8	-25.4	-40.2
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	42.8	35.7	25.4	19.0	8.0	1.7	-6.7	-11.8	-22.4	-37.2
Glazing:	-												
Ventilator type:	-												

Ground floor
Living/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_{eq}		53	60	58	53	51	48	49	45	40	34	19
B	Exposed façade, m^2	13		11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
C	Volume of receiving room, m^3	93.3											
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)			-14.8	-14.8	-14.8	-14.8	-14.8	-14.8	-14.8	-14.8	-14.8	-14.8
F	I bed existing			15.6	20.6	25.6	21.6	26.6	36.6	39.6	36.6	41.6	46.6
G	A + B + E - F		20	40.7	33.7	23.7	25.7	17.7	8.7	1.7	-0.3	-11.3	-31.3
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		23	43.7	36.7	26.7	28.7	20.7	11.7	4.7	2.7	-8.3	-28.3
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				31	36	37	34	30	33	38	43	
M	$L_{Aeq} - D_{n,e}$ + 10*log(10) - B				25.9	15.9	12.9	12.9	17.9	10.9	0.9	-10.1	
N	Internal room noise level, vent open		25		37.1	27.1	28.8	21.3	18.8	11.8	4.9	-6.1	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Greenwood 4000S*												
	Combined noise level, dB(A)		33										

First floor

Front bedroom, Manchester Road elevation

	Octave Band Centre Frequency, Hz		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		63	70	68	63	61	58	59	55	50	44	29
B	Exposed façade, m²	7.7		8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9
C	Volume of receiving room, m³	26											
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)			-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3
F	Composite SRI			20.7	25.7	30.7	27.3	32.3	42.3	45.3	42.4	47.4	52.3
G	A + B + E - F		27	49.2	42.1	31.8	32.8	24.7	16.5	9.1	6.9	-3.7	-23.4
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		30	52.2	45.1	34.8	35.8	27.7	19.5	12.1	9.9	-0.7	-20.4
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				31	36	37	34	30	33	38	43	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				38.3	28.0	24.6	24.6	30.3	22.9	12.8	2.2	
N	Internal room noise level, vent open		34		45.9	35.6	36.1	29.5	30.7	23.3	14.6	4.0	

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

Ventilator type: *Greenwood 4000S*

First floor

Front bedroom, gable

	Octave Band Centre Frequency, Hz		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		63	70	68	63	61	58	59	55	50	44	29
B	Exposed façade, m²	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, m³	26											
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)			-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3
F	I bed existing			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	35.1	24.8	18.4	7.4	1.1	-7.3	-12.4	-23.0	-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		18	45.2	38.1	27.8	21.4	10.4	4.1	-4.3	-9.4	-20.0	-35.1

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

Ventilator type: *Greenwood 4000S*

Combined noise level, dB(A): 34

First floor

Rear bedroom, rear elevation

	Octave Band Centre Frequency, Hz		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		53	60	58	53	51	48	49	45	40	34	19
B	Exposed façade, m²	7.7		8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9
C	Volume of receiving room, m³	26											
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)			-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3
F	Composite SRI			20.7	25.7	30.7	27.3	32.3	42.3	45.3	42.4	47.4	52.3
G	A + B + E - F		18	38.9	31.9	21.9	23.3	15.2	6.3	-0.7	-2.8	-13.8	-33.7
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		21	41.9	34.9	24.9	26.3	18.2	9.3	2.3	0.2	-10.8	-30.7
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				31	36	37	34	30	33	38	43	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				28.1	18.1	15.1	15.1	20.1	13.1	3.1	-7.9	
N	Internal room noise level, vent open		24		35.7	25.7	26.6	20.0	20.5	13.5	4.9	-6.1	

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

Ventilator type: *Greenwood 4000S*

First floor

Rear bedroom, gable

	Octave Band Centre Frequency, Hz		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		63	70	68	63	61	58	59	55	50	44	29
B	Exposed façade, m²	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, m³	26											
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)			-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3
F	I bed existing			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	35.1	24.8	18.4	7.4	1.1	-7.3	-12.4	-23.0	-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		18	45.2	38.1	27.8	21.4	10.4	4.1	-4.3	-9.4	-20.0	-35.1

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

Ventilator type: *Greenwood 4000S*

Combined noise level, dB(A): 25

L_{Aeq} Assessment, night time

First floor

Front bedroom, Manchester Road elevation

	* Octave Band Centre Frequency, Hz		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		55	58	57	54	53	51	50	47	43	35	22
B	Exposed façade, m^2	7.7		8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9
C	Volume of receiving room, m^3	26											
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)			-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3
F	Composite SRI			20.7	25.7	30.7	27.3	32.3	42.3	45.3	42.4	47.4	52.3
G	A + B + E - F		20	37.0	30.6	23.1	25.4	17.8	7.5	1.3	0.1	-12.5	-30.7
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		23	40.0	33.6	26.1	28.4	20.8	10.5	4.3	3.1	-9.5	-27.7
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				31	36	37	34	30	33	38	43	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				26.8	19.3	17.2	17.7	21.3	15.1	6.0	-6.6	
N	Internal room noise level, vent open		26		34.4	26.9	28.7	22.6	21.7	15.5	7.8	-4.8	

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

Ventilator type: *Greenwood 4000S*

First floor

Front bedroom, gable

	* Octave Band Centre Frequency, Hz		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		55	58	57	54	53	51	50	47	43	35	22
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	26											
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)			-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3
F	I bed existing			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	30.0	23.6	16.1	11.0	0.5	-7.9	-15.1	-19.2	-31.8	-45.1
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		9	33.0	26.6	19.1	14.0	3.5	-4.9	-12.1	-16.2	-28.8	-42.1

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

Ventilator type: *Greenwood 4000S*

Combined noise level, dB(A): 26

First floor

Rear bedroom, rear elevation

	* Octave Band Centre Frequency, Hz		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		45	48	47	44	43	41	40	37	33	25	12
B	Exposed façade, m^2	7.7		8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9
C	Volume of receiving room, m^3	26											
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)			-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3
F	Composite SRI			20.7	25.7	30.7	27.3	32.3	42.3	45.3	42.4	47.4	52.3
G	A + B + E - F		10	26.9	20.9	12.9	15.3	8.2	-2.7	-8.7	-9.8	-22.8	-40.7
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	29.9	23.9	15.9	18.3	11.2	0.3	-5.7	-6.8	-19.8	-37.7
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				31	36	37	34	30	33	38	43	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				17.1	9.1	7.1	8.1	11.1	5.1	-3.9	-16.9	
N	Internal room noise level, vent open		16		24.7	16.7	18.6	13.0	11.5	5.5	-2.1	-15.1	

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

Ventilator type: *Greenwood 4000S*

First floor

Rear bedroom, gable

	* Octave Band Centre Frequency, Hz		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		55	58	57	54	53	51	50	47	43	35	22
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	26											
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)			-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3
F	I bed existing			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	30.0	23.6	16.1	11.0	0.5	-7.9	-15.1	-19.2	-31.8	-45.6
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		9	33.0	26.6	19.1	14.0	3.5	-4.9	-12.1	-16.2	-28.8	-42.6

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

Ventilator type: *Greenwood 4000S*

Combined noise level, dB(A): 17

L_{Amax} Assessment, night time

First floor

Front bedroom, Manchester Road elevation

	** Octave Band Centre Frequency, Hz*		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{max}		76	70	72	66	63	65	69	73	66	50	31
B	Exposed façade, m^2	7.7		8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9
C	Volume of receiving room, m^3	26											
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)			-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3
F	Composite SRI			20.9	25.9	30.9	27.6	32.7	42.6	45.6	42.7	47.7	52.6
G	A + B + E - F		34	48.4	45.7	34.4	35.1	32.0	26.2	26.8	23.3	1.7	-22.4
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		37	51.4	48.7	37.4	38.1	35.0	29.2	29.8	26.3	4.7	-19.4
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				31	36	37	34	30	33	38	43	
M	$L_{Aeq} - D_{n,e}$ + 10*log(10) - B				42.2	30.9	27.2	32.2	40.3	41.0	29.5	7.9	
N	Internal room noise level, vent open		45		49.6	38.3	38.4	36.9	40.7	41.4	31.2	9.6	

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

Ventilator type: *Greenwood 4000S*

First floor

Front bedroom, gable

	** Octave Band Centre Frequency, Hz*		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{max}		76	70	72	66	63	65	69	73	66	50	31
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	26											
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)			-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3
F	I bed existing			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		20	41.7	39.0	27.7	21.0	15.0	11.1	10.8	4.3	-17.3	-36.1
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		23	44.7	42.0	30.7	24.0	18.0	14.1	13.8	7.3	-14.3	-33.1

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

Ventilator type: *Greenwood 4000S*

Combined noise level, dB(A)	45

First floor

Rear bedroom, rear elevation

	** Octave Band Centre Frequency, Hz*		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{max}		66	60	62	56	53	55	59	63	56	40	21
B	Exposed façade, m^2	7.7		8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9
C	Volume of receiving room, m^3	26											
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)			-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3
F	Composite SRI			20.7	25.7	30.7	27.3	32.3	42.3	45.3	42.4	47.4	52.3
G	A + B + E - F		25	38.9	35.9	24.9	25.3	22.2	16.3	17.3	13.2	-7.8	-31.7
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		28	41.9	38.9	27.9	28.3	25.2	19.3	20.3	16.2	-4.8	-28.7
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				31	36	37	34	30	33	38	43	
M	$L_{Aeq} - D_{n,e}$ + 10*log(10) - B				32.1	21.1	17.1	22.1	30.1	31.1	19.1	-1.9	
N	Internal room noise level, vent open		35		39.7	28.7	28.6	27.0	30.5	31.5	20.9	-0.1	

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

Ventilator type: *Greenwood 4000S*

First floor

Rear bedroom, gable

	** Octave Band Centre Frequency, Hz*		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{max}		76	70	72	66	63	65	69	73	66	50	31
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	26											
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)			-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3
F	I bed existing			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		20	41.7	39.0	27.7	21.0	15.0	11.1	10.8	4.3	-17.3	-36.1
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		23	44.7	42.0	30.7	24.0	18.0	14.1	13.8	7.3	-14.3	-33.1

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

Ventilator type: *Greenwood 4000S*

Combined noise level, dB(A)	36

Apartments

1145 Manchester Road, Slaithwaite
Break-in Noise Calculations

First floor - apartments

RH and LH apartments
L_{Aeq} Assessment, daytime

Living/dining/kitchen, Manchester Road elevation

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		63	70	68	63	61	58	59	55	50	44	29
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	53.8											
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			20.2	25.2	30.2	26.7	31.8	41.7	44.7	41.8	46.8	51.7
G	A + B + E - F		26	47.5	40.4	30.1	31.2	23.1	14.9	7.4	5.3	-5.3	-25.0
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		29	50.5	43.4	33.1	34.2	26.1	17.9	10.4	8.3	-2.3	-22.0
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				31	36	37	34	30	33	38	43	
M	$L_{Aeq} - D_{n,e}$ + 10*log(10) - B				37.4	27.1	23.7	23.7	29.4	22.0	11.9	1.3	
N	Internal room noise level, vent open		33		44.4	34.1	34.5	28.1	29.7	22.3	13.5	2.9	

Glazing: *4mm, 16/20mm, 4mm*
Ventilator type: *Greenwood 4000S*

Living/dining/kitchen, gable

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		63	70	68	63	61	58	59	55	50	44	29
B	Exposed façade, m^2	13.4		11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3
C	Volume of receiving room, m^3	53.8											
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	I bed existing			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	41.1	34.0	23.7	17.3	6.3	0.0	-8.4	-13.5	-24.1	-38.9
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	44.1	37.0	26.7	20.3	9.3	3.0	-5.4	-10.5	-21.1	-35.9

Glazing: -
Ventilator type: -

Combined noise level, dB(A)		33

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_{eq}		53	60	58	53	51	48	49	45	40	34	19
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	23.8											
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)			-8.9	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9
F	I bed existing			21.9	26.9	31.9	28.8	33.9	43.8	46.9	43.9	48.9	53.8
G	A + B + E - F		17	38.2	31.2	21.2	22.3	14.2	5.2	-1.8	-3.8	-14.8	-34.7
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	41.2	34.2	24.2	25.3	17.2	8.2	1.2	-0.8	-11.8	-31.7
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				31	36	37	34	30	33	38	43	
M	$L_{Aeq} - D_{n,e}$ + 10*log(10) - B				28.0	18.0	15.0	15.0	20.0	13.0	3.0	-8.0	
N	Internal room noise level, vent open		24		35.1	25.1	25.7	19.3	20.3	13.3	4.5	-6.5	

Glazing: *4mm, 16/20mm, 4mm*
Ventilator type: *Greenwood 4000S*

Bedroom 1, gable

	Octave Band Centre Frequency, Hz		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		63	70	68	63	61	58	59	55	50	44	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	23.8											
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)			-8.9	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9
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	42.0	34.9	24.6	18.2	7.2	0.9	-7.5	-12.6	-23.2	-38.0
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	45.0	37.9	27.6	21.2	10.2	3.9	-4.5	-9.6	-20.2	-35.0
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Greenwood 4000S*												
	Combined noise level, dB(A)		25										

L_{Aeq} Assessment, night time

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_{eq}		45	48	47	44	43	41	40	37	33	25	12
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	23.8											
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)			-8.9	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9
F	I bed existing			21.9	26.9	31.9	28.8	33.9	43.8	46.9	43.9	48.9	53.8
G	A + B + E - F		9	26.2	20.2	12.2	14.3	7.2	-3.8	-9.8	-10.8	-23.8	-41.7
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		12	29.2	23.2	15.2	17.3	10.2	-0.8	-6.8	-7.8	-20.8	-38.7
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				31	36	37	34	30	33	38	43	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				17.0	9.0	7.0	8.0	11.0	5.0	-4.0	-17.0	
N	Internal room noise level, vent open		16		24.1	16.1	17.7	12.3	11.3	5.3	-2.5	-15.5	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Greenwood 4000S*												

Bedroom 1, gable

	Octave Band Centre Frequency, Hz		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		55	58	57	54	53	51	50	47	43	35	22
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	23.8											
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)			-8.9	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9
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	29.8	23.4	15.9	10.8	0.3	-8.1	-15.3	-19.4	-32.0	-45.3
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		9	32.8	26.4	18.9	13.8	3.3	-5.1	-12.3	-16.4	-29.0	-42.3
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Greenwood 4000S*												
	Combined noise level, dB(A)		16										

L_{Amax} Assessment, night time

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_{max}		66	60	62	56	53	55	59	63	56	40	21
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	23.8											
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)			-8.9	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9
F	I bed existing			21.9	26.9	31.9	28.8	33.9	43.8	46.9	43.9	48.9	53.8
G	A + B + E - F		24	38.2	35.2	24.2	24.3	21.2	15.2	16.2	12.2	-8.8	-32.7
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		27	41.2	38.2	27.2	27.3	24.2	18.2	19.2	15.2	-5.8	-29.7
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				31	36	37	34	30	33	38	43	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				32.0	21.0	17.0	22.0	30.0	31.0	19.0	-2.0	
N	Internal room noise level, vent open		35		39.1	28.1	27.7	26.3	30.3	31.3	20.5	-0.5	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Greenwood 4000S*												

Bedroom 1, gable

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{max}		76	70	72	66	63	65	69	73	66	50	31
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	23.8											
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)			-8.9	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9
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		20	41.5	38.8	27.5	20.8	14.8	10.9	10.6	4.1	-17.5	-36.3
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		23	44.5	41.8	30.5	23.8	17.8	13.9	13.6	7.1	-14.5	-33.3
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Greenwood 4000S*												
	Combined noise level, dB(A)		35										

Second Floor apartments

RH apartment

L_{Aeq} Assessment, daytime

Living/dining/kitchen, Manchester Road elevation

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		63	70	68	63	61	58	59	55	50	44	29
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	40.3											
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)			-11.2	-11.2	-11.2	-11.2	-11.2	-11.2	-11.2	-11.2	-11.2	-11.2
F	Composite SRI			20.2	25.2	30.2	26.7	31.8	41.7	44.7	41.8	46.8	51.7
G	A + B + E - F		27	48.7	41.6	31.3	32.4	24.4	16.1	8.7	6.6	-4.0	-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		30	51.7	44.6	34.3	35.4	27.4	19.1	11.7	9.6	-1.0	-20.8
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				31	36	37	34	30	33	38	43	
M	$L_{Aeq} - D_{n,e}$ + 10*log(10) - B				37.4	27.1	23.7	23.7	29.4	22.0	11.9	1.3	
N	Internal room noise level, vent open		34		45.4	35.1	35.7	28.9	29.8	22.4	13.9	3.3	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Greenwood 4000S*												

Living/dining/kitchen, gable

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		58	65	63	58	56	53	54	50	45	39	24
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	40.3											
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)			-11.2	-11.2	-11.2	-11.2	-11.2	-11.2	-11.2	-11.2	-11.2	-11.2
F	Composite SRI			19.4	24.4	29.4	25.8	30.8	40.8	43.8	40.8	45.8	50.8
G	A + B + E - F		23	44.7	37.6	27.3	28.5	20.5	12.2	4.8	2.7	-7.9	-27.7
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		26	47.7	40.6	30.3	31.5	23.5	15.2	7.8	5.7	-4.9	-24.7
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				31	36	37	34	30	33	38	43	
M	$L_{Aeq} - D_{n,e}$ + 10*log(10) - B				32.2	21.9	18.5	18.5	24.2	16.8	6.7	-3.9	
N	Internal room noise level, vent open		29		41.2	30.9	31.8	24.7	24.7	17.3	9.2	-1.4	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Greenwood 4000S*												
	Combined noise level, dB(A)		35										

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_{eq}		53	60	58	53	51	48	49	45	40	34	19
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	26.4											
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)			-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3
F	I bed existing			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		5	31.6	24.6	14.6	8.6	-2.4	-9.4	-17.4	-22.4	-33.4	-48.4
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		8	34.6	27.6	17.6	11.6	0.6	-6.4	-14.4	-19.4	-30.4	-45.4
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				31	36	37	34	30	33	38	43	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				28.0	18.0	15.0	15.0	20.0	13.0	3.0	-8.0	
N	Internal room noise level, vent open		22		30.8	20.8	16.7	15.2	20.0	13.0	3.0	-8.0	

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

Ventilator type: *Greenwood 4000S*

Bedroom 1, gable

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		63	70	68	63	61	58	59	55	50	44	29
B	Exposed façade, m^2	8.4		9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2
C	Volume of receiving room, m^3	26.4											
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)			-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3
F	I bed existing			21.2	26.2	31.2	28.0	33.0	43.0	46.0	43.1	48.1	53.0
G	A + B + E - F		27	48.9	41.8	31.5	32.4	24.4	16.1	8.7	6.5	-4.1	-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		30	51.9	44.8	34.5	35.4	27.4	19.1	11.7	9.5	-1.1	-20.8
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				31	36	37	34	30	33	38	43	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				38.0	27.7	24.3	24.3	30.0	22.6	12.5	1.9	
N	Internal room noise level, vent open		34		45.7	35.4	35.8	29.1	30.3	22.9	14.2	3.6	

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

Ventilator type: *Greenwood 4000S*

Combined noise level, dB(A)	34

L_{Aeq} Assessment, night time

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_{eq}		55	58	57	54	53	51	50	47	43	35	22
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	26.4											
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)			-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3
F	I bed existing			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	29.7	23.3	15.8	10.7	0.2	-8.2	-15.4	-19.5	-32.1	-45.4
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		9	32.7	26.3	18.8	13.7	3.2	-5.2	-12.4	-16.5	-29.1	-42.4
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				31	36	37	34	30	33	38	43	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				26.7	19.2	17.1	17.6	21.2	15.0	5.9	-6.7	
N	Internal room noise level, vent open		24		29.5	22.0	18.8	17.8	21.2	15.0	5.9	-6.7	

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

Ventilator type: *Greenwood 4000S*

Bedroom 1, gable

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		59	62	65	65	60	57	55	45	37	29	20
B	Exposed façade, m^2	8.4		9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2
C	Volume of receiving room, m^3	26.4											
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)			-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3
F	I bed existing			21.2	26.2	31.2	28.0	33.0	43.0	46.0	43.1	48.1	53.0
G	A + B + E - F		26	40.2	38.1	33.9	31.4	23.5	11.5	-0.8	-6.1	-19.7	-33.6
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		29	43.2	41.1	36.9	34.4	26.5	14.5	2.2	-3.1	-16.7	-30.6
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				31	36	37	34	30	33	38	43	
M	$L_{Aeq} - D_{n,e} + 10*\log(10) - B$				34.3	30.1	23.3	23.4	25.4	13.1	-0.1	-13.7	
N	Internal room noise level, vent open		31		42.0	37.8	34.8	28.2	25.7	13.4	1.6	-12.0	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Greenwood 4000S*												
	Combined noise level, dB(A)		32										

L_{Amax} Assessment, night time

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_{max}		66	60	62	56	53	55	59	63	56	40	21
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	26.4											
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)			-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3
F	I bed existing			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	31.6	28.6	17.6	10.6	4.6	0.6	0.6	-6.4	-27.4	-46.4
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		13	34.6	31.6	20.6	13.6	7.6	3.6	3.6	-3.4	-24.4	-43.4
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				31	36	37	34	30	33	38	43	
M	$L_{Aeq} - D_{n,e} + 10*\log(10) - B$				32.0	21.0	17.0	22.0	30.0	31.0	19.0	-2.0	
N	Internal room noise level, vent open		35		34.8	23.8	18.7	22.2	30.0	31.0	19.0	-2.0	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Greenwood 4000S*												

Bedroom 1, gable

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{max}		76	70	72	66	63	65	69	73	66	50	31
B	Exposed façade, m^2	8.4		9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2
C	Volume of receiving room, m^3	26.4											
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)			-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3
F	I bed existing			21.2	26.2	31.2	28.0	33.0	43.0	46.0	43.1	48.1	53.0
G	A + B + E - F		34	48.4	45.7	34.4	35.0	32.0	26.1	26.8	23.2	1.6	-22.1
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	51.4	48.7	37.4	38.0	35.0	29.1	29.8	26.2	4.6	-19.1
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				31	36	37	34	30	33	38	43	
M	$L_{Aeq} - D_{n,e} + 10*\log(10) - B$				41.9	30.6	26.9	31.9	40.0	40.7	29.2	7.6	
N	Internal room noise level, vent open		45		49.6	38.3	38.4	36.7	40.3	41.0	30.9	9.3	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Greenwood 4000S*												
	Combined noise level, dB(A)		45										

Second Floor

LH apartment

L_{Aeq} Assessment, daytime

Living/dining/kitchen, Manchester Road elevation

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		63	70	68	63	61	58	59	55	50	44	29
B	Exposed façade, m^2	15.4		11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9
C	Volume of receiving room, m^3	60.5											
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)			-12.9	-12.9	-12.9	-12.9	-12.9	-12.9	-12.9	-12.9	-12.9	-12.9
F	Composite SRI			20.1	25.1	30.1	26.6	31.6	41.6	44.6	41.7	46.7	51.6
G	A + B + E - F		27	49.1	42.0	31.7	32.8	24.8	16.5	9.1	7.0	-3.6	-23.4
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		30	52.1	45.0	34.7	35.8	27.8	19.5	12.1	10.0	-0.6	-20.4
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				31	36	37	34	30	33	38	43	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				35.3	25.0	21.6	21.6	27.3	19.9	9.8	-0.8	
N	Internal room noise level, vent open		33		45.5	35.2	36.0	28.7	28.0	20.6	12.9	2.3	

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

Ventilator type: *Greenwood 4000S*

Living/dining/kitchen, gable

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		63	70	68	63	61	58	59	55	50	44	29
B	Exposed façade, m^2	10.3		10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1
C	Volume of receiving room, m^3	60.5											
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)			-12.9	-12.9	-12.9	-12.9	-12.9	-12.9	-12.9	-12.9	-12.9	-12.9
F	Composite SRI			21.7	26.7	31.7	28.5	33.6	43.5	46.6	43.6	48.6	53.5
G	A + B + E - F		24	45.8	38.7	28.4	29.2	21.1	12.8	5.4	3.3	-7.3	-27.0
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		27	48.8	41.7	31.4	32.2	24.1	15.8	8.4	6.3	-4.3	-24.0
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				31	36	37	34	30	33	38	43	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				37.1	26.8	23.4	23.4	29.1	21.7	11.6	1.0	
N	Internal room noise level, vent open		32		43.0	32.7	32.7	26.8	29.3	21.9	12.7	2.1	

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

Ventilator type: *Greenwood 4000S*

Combined noise level, dB(A)	35

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_{eq}		53	60	58	53	51	48	49	45	40	34	19
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	34.2											
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)			-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5
F	I bed existing			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	30.5	23.5	13.5	7.5	-3.5	-10.5	-18.5	-23.5	-34.5	-49.5
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		7	33.5	26.5	16.5	10.5	-0.5	-7.5	-15.5	-20.5	-31.5	-46.5

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

Ventilator type: *Greenwood 4000S*

Bedroom 1, gable

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		63	70	68	63	61	58	59	55	50	44	29
B	Exposed façade, m^2	10.1		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	34.2											
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)			-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5
F	I bed existing			18.1	23.1	28.1	24.3	29.3	39.3	42.3	39.3	44.3	49.3
G	A + B + E - F		30	51.8	44.7	34.4	35.8	27.7	19.4	12.0	9.9	-0.7	-20.4
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		33	54.8	47.7	37.4	38.8	30.7	22.4	15.0	12.9	2.3	-17.4
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				31	36	37	34	30	33	38	43	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				37.2	26.9	23.5	23.5	29.2	21.8	11.7	1.1	
N	Internal room noise level, vent open		35		48.1	37.8	38.9	31.5	30.0	22.6	15.3	4.7	

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

Ventilator type: *Greenwood 4000S*

Combined noise level, dB(A)	35

L_{Aeq} Assessment, night time

First floor

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_{eq}		45	48	47	44	43	41	40	37	33	25	12
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	34.2											
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)			-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5
F	I bed existing			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		-5	18.5	12.5	4.5	-0.5	-10.5	-19.5	-26.5	-30.5	-43.5	-56.5
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		-2	21.5	15.5	7.5	2.5	-7.5	-16.5	-23.5	-27.5	-40.5	-53.5

Glazing: *4mm, 16/20mm, 4mm*
Ventilator type: *Greenwood 4000S*

Bedroom 1, gable

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		55	58	57	54	53	51	50	47	43	35	22
B	Exposed façade, m^2	10.1		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	34.2											
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)			-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5
F	I bed existing			18.1	23.1	28.1	24.3	29.3	39.3	42.3	39.3	44.3	49.3
G	A + B + E - F		23	39.6	33.2	25.7	28.4	20.8	10.4	4.2	3.1	-9.5	-27.7
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		26	42.6	36.2	28.7	31.4	23.8	13.4	7.2	6.1	-6.5	-24.7
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				31	36	37	34	30	33	38	43	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				25.7	18.2	16.1	16.6	20.2	14.0	4.9	-7.7	
N	Internal room noise level, vent open		27		36.6	29.1	31.5	24.6	21.0	14.8	8.5	-4.1	

Glazing: *4mm, 16/20mm, 4mm*
Ventilator type: *Greenwood 4000S*

Combined noise level, dB(A)	27

L_{Amax} Assessment, night time

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_{max}		66	60	62	56	53	55	59	63	56	40	21
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	34.2											
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)			-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5
F	I bed existing			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	30.5	27.5	16.5	9.5	3.5	-0.5	-0.5	-7.5	-28.5	-47.5
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		12	33.5	30.5	19.5	12.5	6.5	2.5	2.5	-4.5	-25.5	-44.5

Glazing: *4mm, 16/20mm, 4mm*
Ventilator type: *Greenwood 4000S*

Bedroom 1, gable

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{max}		76	70	72	66	63	65	69	73	66	50	31
B	Exposed façade, m^2	10.1		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	34.2											
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)			-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5
F	I bed existing			18.1	23.1	28.1	24.3	29.3	39.3	42.3	39.3	44.3	49.3
G	A + B + E - F		38	51.3	48.6	37.3	38.4	35.3	29.4	30.1	26.6	5.0	-18.7
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		41	54.3	51.6	40.3	41.4	38.3	32.4	33.1	29.6	8.0	-15.7
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				31	36	37	34	30	33	38	43	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				41.1	29.8	26.1	31.1	39.2	39.9	28.4	6.8	
N	Internal room noise level, vent open		45		52.0	40.7	41.5	39.1	40.0	40.7	32.0	10.4	

Glazing: *4mm, 16/20mm, 4mm*
Ventilator type: *Greenwood 4000S*

Combined noise level, dB(A)	45