Assessment of the Existing Noise Climate in the Vicinity of 53 Wakefield Road, Huddersfield.

Report Prepared for:

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1.0 Summary

Planning consent is being sought to permit the construction of a new extension to the rear of the existing building at 53 Wakefield Road in Mouldgreen, Huddersfield. The new extension would contain six self-contained bedrooms, arranged over three floors, the ground to the second floors.

In support of the application for planning permission, Druk Limited was commissioned to undertake an assessment of the existing noise climate in the vicinity of the proposed residential development at 53 Wakefield Road in Huddersfield. Using data from the existing noise climate assessment, calculations will be undertaken to assess the likely internal noise climate within the proposed residential accommodation resulting from external noise break-in.

The environment in the vicinity of the proposed dwelling was regarded as being essentially urban in character with the principal contributor to the noise climate being road traffic on Wakefield Road, although some occasional noise from the surrounding commercial premises was also audible. Overall the existing noise climate remained relatively steady until around 20:00 hours, after which time a generally reducing trend in the existing noise climate occurred.

Using the measured levels relating to the existing noise climate and applying the stated assumptions relating to the sound insulation of the proposed façade, it has been demonstrated that the internal noise levels within the proposed accommodation resulting from external noise break-in and under the windows closed but ventilation openings open scenario, would not exceed the design guidance contained within BS 8233:2014. Despite this it is recognised that opening the windows for ventilation purposes, purge ventilation purposes excepting, would result in the internal noise levels exceeding the design guide levels detailed in BS 8233:2014. As a result it is suggested that alternative means of ventilation, to permit the internal spaces to be ventilated without requiring the windows to be opened, should be considered. It should however be remembered that the alternative ventilation option would be applicable to the bedroom areas only.

As a consequence of the above, the existing noise climate should not be regarded as an impediment to the granting of planning permission providing the suggested sound insulation measures, or alternative no less effective measures, are applied to the proposed extension at 53 Wakefield Road. In addition, the foregoing has indicated that the proposed accommodation could be integrated into the existing environment without the potential for "*unreasonable restrictions*" to be placed upon already established businesses in the vicinity.

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2.0 Introduction

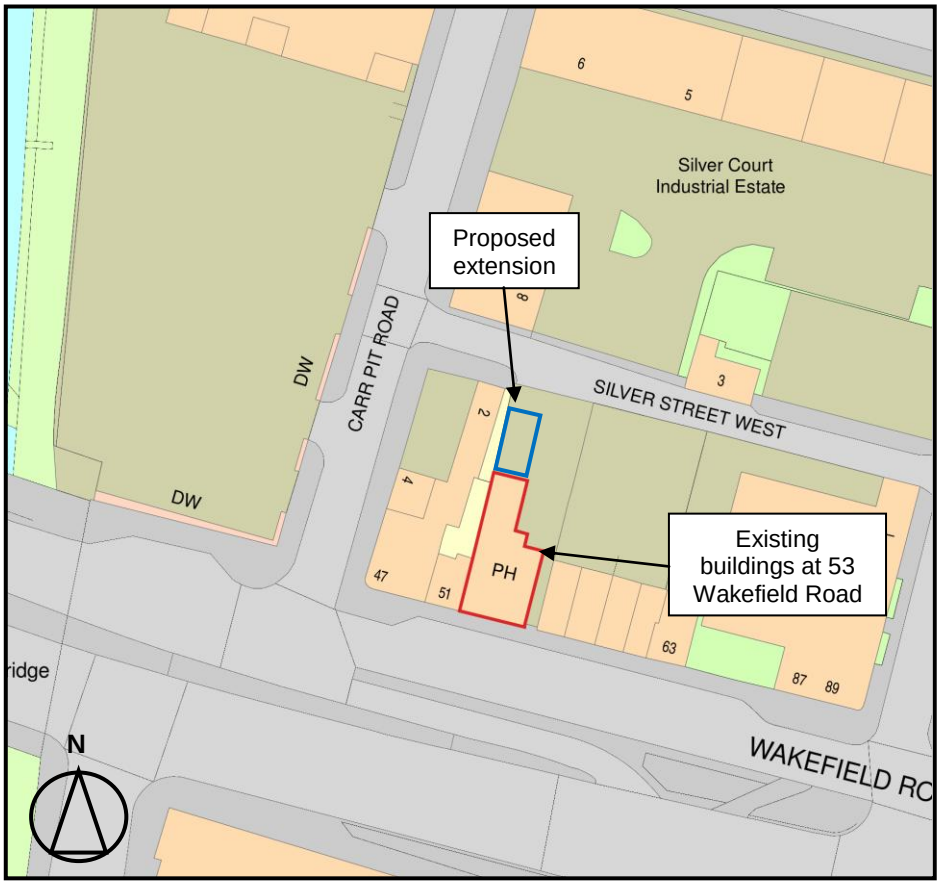
Planning consent is being sought to permit the construction of a new extension to the rear of the existing building at 53 Wakefield Road in Mouldgreen, Huddersfield. The new extension would contain six self-contained bedrooms, arranged over three floors, the ground to the second floors.

In support of the application for planning permission, Druk Limited was commissioned to undertake an assessment of the existing noise climate in the vicinity of the proposed residential development at 53 Wakefield Road in Huddersfield. Using data from the existing noise climate assessment, calculations will be undertaken to assess the likely internal noise climate within the proposed residential accommodation resulting from external noise break-in.

3.0 Site Description

The proposed residential accommodation will be formed within an extension to the rear of the existing buildings located at 53 Wakefield Road in Mouldgreen, Huddersfield (figure 1 overleaf). The existing building comprises two commercial uses, a barber shop and a fast food takeaway, on the Wakefield Road elevation of the building (photograph 1 overleaf), with residential accommodation over the existing commercial premises and contained within an existing rear addition to the building (photograph 2 overleaf). Immediately to the North of the proposed extension is Silver Street West with the Silver Court Industrial Estate beyond (photograph 3 overleaf). To the South of the proposed extension is Wakefield Road with the Capital Student accommodation block beyond (photograph 4 overleaf). To the East of the proposed extension are the numerous commercial properties on Wakefield Road (photograph 5 overleaf) and to the West of the proposed extension is a small retail park containing ASDA and Iceland supermarkets and a Greggs bakery (photograph 6 overleaf).

Figure 1. 53 Wakefield Road (edged in red) showing the approximate location of the proposed rear extension (edged in blue)



Photograph 1. 53 Wakefield Road showing the adjacent commercial premises

Photograph 2. Existing rear elevation of 53 Wakefield Road

Photograph 3. Silver Court Industrial Estate to the North of the proposed extension

Photograph 4. Wakefield Road and the Capitol student Accommodation to the South of 53 Wakefield Road

Photograph 5. Existing commercial premises to the East of 53 Wakefield Road

Photograph 6. Retail park to the West of 53 Wakefield Road

4.0 Assessment Criteria

As the planning application has not been determined, no planning conditions currently exist. Consequently, the aims of this assessment will be to evaluate the existing noise climate in the vicinity of the proposed accommodation at 53 Wakefield Road and to quantify what effect it may have on the proposed accommodation. With reference to these aims, the proposed development will be assessed with reference to the guidance contained within: the National Planning Policy Framework (NPPF), the Noise Policy Statement for England (NPSE) and the National Planning Practice Guidance (NPPG), British Standard (BS) 8233:2014 “Guidance on sound insulation and noise reduction for buildings” and the Planning and Noise: Professional Guidance on Planning and Noise (ProPG), May 2017, document, the guidance contained within the Acoustics, Ventilation and Overheating - Residential Design Guide.

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 main statement on noise contained within the revised NPPF, issued in December 2023, is to be found in paragraph 185:

185. 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 187 of the NPPF is also relevant and states:

187. 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 below.

Table 1. Noise exposure hierarchy table

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

The NPPG also highlights that the subjective nature of noise means that there is not a simple relationship between noise levels and the possible impact on those affected. It recognises that any effects will depend on how various factors combine in any particular situation, including absolute noise levels and how they may compare with the underlying

background noise, the impulsiveness or intermittence pattern of the noise, its spectral content, and the time of day. It discusses in very general terms the issues to consider when introducing noise sources to existing noise sensitive area, new residential development in areas affected by existing noise sources (most of which have their own specific guidance, such as BS 4142, BS 8233, etc.) and the potential impact on wildlife.

4.2 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 Standard states that the guidance it contains is applicable to the design of new buildings, or refurbished buildings undergoing a change of use and as such it is deemed applicable to this proposal.

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 dwelling houses flats and rooms in residential use, it is suggested that the guidance is applicable to 'anonymous' noise without a 'specific' character, and this is typically the situation where road traffic type noise is the dominant or principal contributor to the existing noise climate. This being the case BS 8233:2014 indicates that it would be desirable for the internal noise levels, resulting from the break-in of external noise, not to exceed the guide values detailed within table 4 of section 7.7.2. The main elements of the guidance contained within table 4 of section 7.7.2 of BS 8233:2014 are reproduced in table 2 below.

Table 2. 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 $L_{Aeq,\ 8\ hour}$

It should also be noted that BS8233:2014 applies the frequently quoted 'rule of thumb' that where a window is partially open for ventilation purposes etc., the sound levels just outside the window will be around 15dB higher than the levels just inside the window. Despite this, a number other documents indicate that the sound insulation provided by a partially open window would be in the region of 9 - 13dB.

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 5**. If relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation that does not compromise the façade insulation or the resulting sound level*.

***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.

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'.

4.3 Planning and Noise: Professional Guidance on Planning and Noise (ProPG)

This document was published in May 2017 and was produced jointly by representatives of the Chartered Institute of Environmental Health (CIEH), the Institute of Acoustics (IoA) and the Association of Noise Consultants (ANC). The ProPG document seeks to provide guidance on and complement the wider aims contained within the Noise Policy Statement for England (NPSE) and the additional guidance contained within the National Planning Policy Framework(NPPF). In addition the ProPG document acknowledges the contribution made by existing guidance contained within both the World Heath Organisations (WHO) "Guidelines for Community Noise" and (BS) 8233:2014 "Guidance on sound insulation and noise reduction for buildings".

The ProPG document guidance is restricted to the consideration of new residential developments and the potential implications for these developments arising from predominantly airborne noise that typical emanates from transportation noise sources. The document utilises a risk assessment based two stage approach to: Stage 1 - undertake an "initial noise risk assessment of the proposed development site" and Stage 2 - undertake a "systematic consideration of four key elements". It should however be remembered that these 'noise risk categories' are designed for the initial categorisation of the prevailing noise climate and the word 'risk' should be assessed with reference to this function only. With reference to the four key elements, these are defined as:

- Element 1 - demonstrating a "Good Acoustic Design Process".
- Element 2 - observing internal "Noise Level Guidelines".
- Element 3 - undertaking an "External Amenity Area Noise Assessment, and.
- Element 4 - consideration of "Other Relevant Issues".

With reference to Stage 1, the requirement to undertake a noise risk assessment of the proposed development site, the site 'risk' category boundaries are described with reference to the external free field noise levels that would affect a proposed

development and these are contained within figure 1 of Section 2 of the document. Whilst the ProPG document does not attribute specific noise levels to the 'risk' categories, an interpretation of the noise levels presented within figure 1 of the ProPG document is contained in table 3 below. Again, the guidance relates primarily to 'anonymous' type noise.

Table 3. Level 1 assessment 'risk' boundary noise levels (derived from figure 1 of the ProPG document)

Indicative noise levels		
Daytime (07:00 - 23:00) $L_{Aeq,\ 16\ hour}$	**Night time (23:00 - 07:00) $L_{Aeq,\ 8\ hour}$**	**Noise 'risk' assessment**
≤ 50dB	≤ 40dB	Negligible
> 50 and ≤ 63dB	> 40 and ≤ 53dB	Low
> 63 and ≤ 68dB	> 53 and ≤ 58dB	Medium
> 68dB	> 58dB	High

The guiding principle of the ProPG document with reference to the existing noise climate is that once the potential impact on a development has been quantified, good acoustic design should be implemented to mitigate the potential effects that the existing noise climate may have on the proposed resident of any new residential development. In this case the good design principle relates to both the internal acoustic environment within dwellings and any external amenity areas serving those dwellings. With reference to good acoustic design Pro PG does recognise that this does not mean "*overdesign or gold plating*", but it does mean delivering "*the optimum acoustic outcome for a particular site*".

With respect to the internal noise level guidelines, ProPG makes reference to the guidance contained within table 4 of section 7.7.2BS 8233:2014, reproduced in section 4.2 above. Whilst recognising that it is preferable to achieve the internal noise guidelines ProPG does, at paragraph 2.30, recognise that national planning and noise policy does not always require that these levels are achieved. This is particularly the case where to do so would "*disproportionately increase the cost of the development*".

Remaining with the issue of internal noise level guidance and the proposed levels for individual noise events, expressed as an L_{max}, the guidance contained within Appendix A of the ProPG is instructive. The Appendix 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*".

The potential impact of ventilation on the acoustic integrity of the façade of a dwelling is also addressed by the ProPG document. The document suggests that good acoustic design should be used to achieve the internal design targets in noise sensitive rooms with windows open. Here it is assumed that this relates to windows partially open for ventilation purposes. Despite this it also recognises the limitations of acoustic design

an highlights that internal noise levels may only be achievable with window closed in certain environments such as urban areas or sites adjacent to transportation noise sources. In these situations it is suggested that internal noise levels are assessed with windows closed but with any façade openings used for ventilation purposes in their open position. Finally and with reference to ventilation ProPG at paragraph 2.35 states that "*internal noise level guidance are generally not applicable under purge ventilation conditions*".

4.4 Acoustics, Ventilation and Overheating - Residential Design Guide

There is an increasing recognition that in addition to securing an acceptable internal noise climate, there needs to be a degree of integration between acoustic design and the requirement to address both the ventilation and thermal comfort of a dwelling. Typically, achieving a good internal acoustic environment has been achieved by requiring dwelling windows to remain closed, but most ventilation and overheating assessments look to the ability to open windows to permit both adequate ventilation and the management of the internal thermal environment. In many locations, particularly urban environments, it is recognised that opening windows will typically have negative impacts on the internal acoustic environment within a dwelling.

In an attempt to provide additional guidance on the interplay between suitable ventilation to address potential overheating within a noisy environment, The "Acoustics Ventilation and Overheating Residential Design Guidance", hereafter referred to as the AVO Guide, has been formulated by the Association of Noise Consultants (ANC). This comprehensive document seeks to strike a balance between the often competing requirements relating to both good acoustic conditions within a residential dwelling and the provision of ventilation to mitigate potential overheating.

In its simplest form the AVO Guide provides for a two stage assessment procedure. The first stage, level 1, may be considered as a 'site risk' assessment and is based on the external noise levels to which a residential dwelling may be exposed. Again, it should be borne in mind that the 'site risk' relates to the categorisation of the prevailing noise climate and the word 'risk' should be assessed with reference to this function only. A level 2 assessment seeks to assess the potential adverse effects that may result and would be based on a combination of the internal ambient noise levels the duration, times and the frequency when open windows would be required etc. It should however be remembered that this report will restrict itself to a level 1, 'site risk', assessment. A level 2 assessment is considered to be beyond the remit of this report and should be considered by other parties.

A level 1 assessment is predicated on the adoption of partially open windows as the primary method of internal temperature control. The various site 'risk' categories have been described according to the external free field noise levels that are likely to affect a proposed development and these are detailed in table 3.2 of the Guide. Although the AVO Guide does not attribute specific noise levels to the various 'risk' categories, an interpretation of the noise levels presented within table 3.2 of the AVO Guide and the likely 'risk' categories to which they correspond, is produced in table 4 overleaf. As with the guidance contained within BS 8233:2014 and the ProPG document, the guidance relates primarily to 'anonymous' type noise.

Table 4. Level 1 assessment 'risk' boundary noise levels (derived from table 3.2 of the AVO Guide)

External free - field noise level at façade		
Daytime (07:00 - 23:00) $L_{Aeq,\ 16\ hour}$	**Night time (23:00 - 07:00) $L_{Aeq,\ 8\ hour}$**	**Level 1 'risk' category**
≤ 52dB	≤ 47dB	Negligible
> 52 and ≤ 57dB	> 47 and ≤ 52dB	Low
> 57 and ≤ 62dB	> 52 and ≤ 55dB	Medium
> 62dB	> 55dB	High

Note 4. Where 78dB L_{AFmax} is normally exceed during the night time period a level 2 assessment is recommended.

The guidance also recognises that there may be instances where occupants may 'trade' the internal acoustic environment by accepting higher noise levels for a period of time in order to maintain control over the thermal environment.

The document relates primarily to residential developments that are subject to airborne noise from transportation noise sources. Despite its focus on new residential dwellings, predominantly flats and houses, the AVO Guide does suggest that it may also be applicable to other forms of residential dwellings such as care homes and residential institutions.

The potential implications of opening windows on the internal acoustic environment and the possible outcomes for the occupants of the ventilated spaces are summarised in table 5 below, which combines the guidance contained within table 3.3 and figures B-2 and B-3 from the AVO Guide.

Table 5. Guidelines for a level 2 assessment (derived from table 3.3 and figures B.2 and B.3 of the AVO Guide)

Internal ambient noise level (from road traffic noise)			
$L_{Aeq,T}$ during 07:00 - 23:00	**$L_{Aeq,T}$ during 23:00 - 07:00**	**Individual noise events, L_{AFmax}, during 23:00 - 07:00**	**Potential outcome**
≤ 35dB	≤ 30dB	45dB not normally exceeded more than 10 times a night	**LOAEL**: Noise can be heard but does not cause any change in behaviour
> 35 and ≤ 40dB	> 30 and ≤ 35dB	Increasing adverse effect ↓	Increasing adverse effect ↓
> 40 and ≤ 50dB	> 35 and ≤ 42dB		
> 50dB	> 42dB	Normally exceeds 65dB	**Exceeds SOAEL**: Noise causes a material change in behaviour, e.g. keeping windows closed

In essence, the higher the external noise level the more likely it is that the internal noise levels would exceed the guide values detailed within BS 8233:2014 and summarised in table 2 above, with windows partially open for ventilation purposes. As a consequence, as the external noise levels increase it is more than likely that additional or alternative

ventilation requirements will be required in order to ensure the internal areas can be effectively ventilated, in all but purge ventilation conditions, without prejudicing the façade sound insulation and so the internal noise climate. It must however be remembered that where alternative mechanical ventilation is specified, the emission of noise from such systems must not lead to an unnecessary increase in the internal noise climate.

4.5 Ventilation - Approved Document F (ADF)

With reference to the relevant guidance relating to the ventilation of dwellings, this is contained within Approved Document F (ADF) guidance to the Building Regulations 2010, currently in the 2021 edition as it relates to dwellings.

In summary the ventilation strategies outlined in ADF relies on a combination of approaches, including: Extract ventilation to remove water vapour or pollutants; whole dwelling ventilation to provide fresh air to the building and to dilute, disperse and remove water vapour and pollutants not removed by extract ventilation and purge ventilation to remove high concentrations of pollutants and water vapour. With reference to extract ventilation in individual rooms this is typically achieved via intermittent extraction fans, whole house ventilation is often achieved through a combination of background (trickle) ventilators and/or continuous extract and or supply fans. It is acknowledged that purge ventilation is typically achieved through the opening of windows. ADF also states that "*Other ventilation systems may be acceptable if they can be shown to meet an equal level of performance*".

Approved Document F details four main types of ventilation systems that can be used to provide ventilation to dwellings, typically described as systems 1 to 4. A summary of these systems is provided within table 6 below and this table also provides additional annotation that is expands upon the details provided within ADF.

Table 6. Summary of the ADF ventilation systems 1 - 4

Ventilation system	**Purge ventilation**
System 1: background ventilation (trickle ventilators) and intermittent extraction fans	Typically provided by opening windows
System 2: passive stack (natural)	Typically provided by opening windows
System 3: Continuous mechanical extraction (MEV) (Trickle ventilators provide inlet air)	Typically provided by opening windows
System 4: Continuous mechanical supply and extract with heat recovery (MVHR)	Typically provided by opening windows

Ventilation provisions conforming to the descriptions of systems 1, 3 and 4 are most commonly found within dwellings. With reference to purge ventilation, in addition to securing rapid exchange of air to remove pollutants, this can and is typically used to address the thermal comfort of occupants. It must however be remembered that the issue of thermal comfort is not covered by Approved Document F, guidance to the Building Regulations.

It should however be borne in mind that when specifying the ventilation provision for a dwelling, the interaction of the ventilation provision with the internal noise levels should be considered. This interaction is a result of the fact that the provision of suitable ventilation openings in a building façade can affect that the sound insulation of the façade elements, which in turn can affect the level of external noise break-in and so the internal noise levels that will prevail within a dwelling. Whilst this report will specify an appropriate type of ventilation provision in accordance with the general descriptions contained within table above, it is not intended to be a detailed ventilation design statement and a full evaluation of any ventilation provision is beyond the remit of this report.

The ventilation of the internal spaces of a dwelling can include the opening of windows to the provision of dedicated mechanical ventilation. With reference to the opening of windows, as suggested above this will not only permit the exchange of air but will also facilitate the ingress of external noise. In this respect the estimates of the sound insulation provided by a window partially open for ventilation purposes can and do vary. With respect to the level of sound insulation provided by an open window, BS 8233:2014 quotes the 15dB 'rule of thumb' which suggests that where a window is partially open for ventilation purposes etc., the sound levels just outside the window will be around 15dB higher than the levels just inside the window. The "Acoustics Ventilation and Overheating Residential Design Guidance", the AVO Guide, formulated by the Association of Noise Consultants (ANC) suggests that a partially open window can provide a sound insulation value of around 13dB. Finally, data presented by Søndergaard & Egedal (2016) suggested that for a top hung window with an opening equivalent to 0.35m^2, a sound insulation value of around 9dB R_w would be expected.

Consequently, it is suggested that in all but the quietest of areas that the opening of windows would result in the internal noise levels exceeding the adopted internal design guide levels. As such, in the majority of locations it will be necessary to provide alternative methods of ventilation to ensure that the internal spaces can be adequately ventilated without having to resort to opening windows and so detrimentally affecting the internal noise climate.

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 residential accommodation to the rear of 53 Wakefield Road were conducted between 22:00 - 02:00 on Tuesday 4th into Wednesday 5th June 2024 and between 15:30 - 22:00 hours on Wednesday 5th June 2024. These survey periods were selected as they encompassed the afternoon peak periods, with respect to the road traffic, extending into the night time period.

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 survey the weather conditions were as follows:

Tuesday 4th - Wednesday 5th June 2024

All surfaces were dry, cloud cover ranged between approximately 0 - 30%, the temperature was approximately 9°C, the wind speed was approximately 1.6m/s and the barometric pressure was approximately 1000mb.

Wednesday 5th June 2024

All surfaces were dry, cloud cover was approximately 70%, the temperature was approximately 15°C, the wind speed was approximately 3.6m/s (gusting to 4.7m/s) and the barometric pressure was approximately 1004mb.

5.3 Equipment

The noise surveys and associated measurements were conducted using the equipment detailed in the table 7 below. The sound level meters were field calibrated before, after and during the surveys as necessary, during which time no significant deviations in the calibrated levels were observed.

Table 7. Equipment used during the existing sound level measurements

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
Weather protection enclosure	NTI Audio	WP30	-

5.4 Measurement Procedure

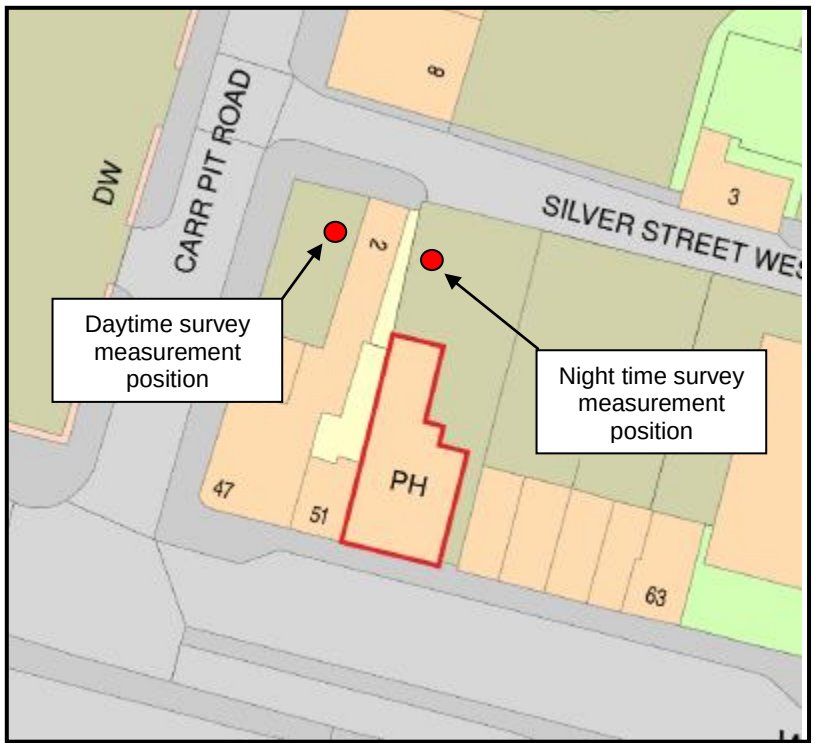
The location of the proposed residential development suggested that the principal contributor to the existing noise climate would be road traffic from vehicles on Wakefield Road. In addition it was considered that additional contributions from the commercial enterprises in the vicinity of 53 Wakefield Road may also be possible. With reference to the commercial enterprises in the vicinity of 53 Wakefield Road, these comprised the following premises:

- Kentucky Fried Chicken (49 Wakefield Road)
- The Gourmet Hub and Babylon Barbers (53 Wakefield Road)
- Huddersfield Taxis (55 Wakefield Road)
- Kebabish takeaway (57 Wakefield Road)
- Subway (61 Wakefield Road)

During the course of the noise survey site visits, it was observed that the latest opening of any of the above commercial retail enterprises was 00:00 hours. Despite this the Huddersfield Taxis' booking office was noted to operate 24 hours a day, however no noise from this source was audible during the noise surveys. In addition, it was noted that the nearest licensed premises, the Smile bar and venue, was approximately 250 metres to the West of 53 Wakefield Road. As such it was considered unlikely that any noise emission from these premises would have an effect on the proposed extension and residential accommodation.

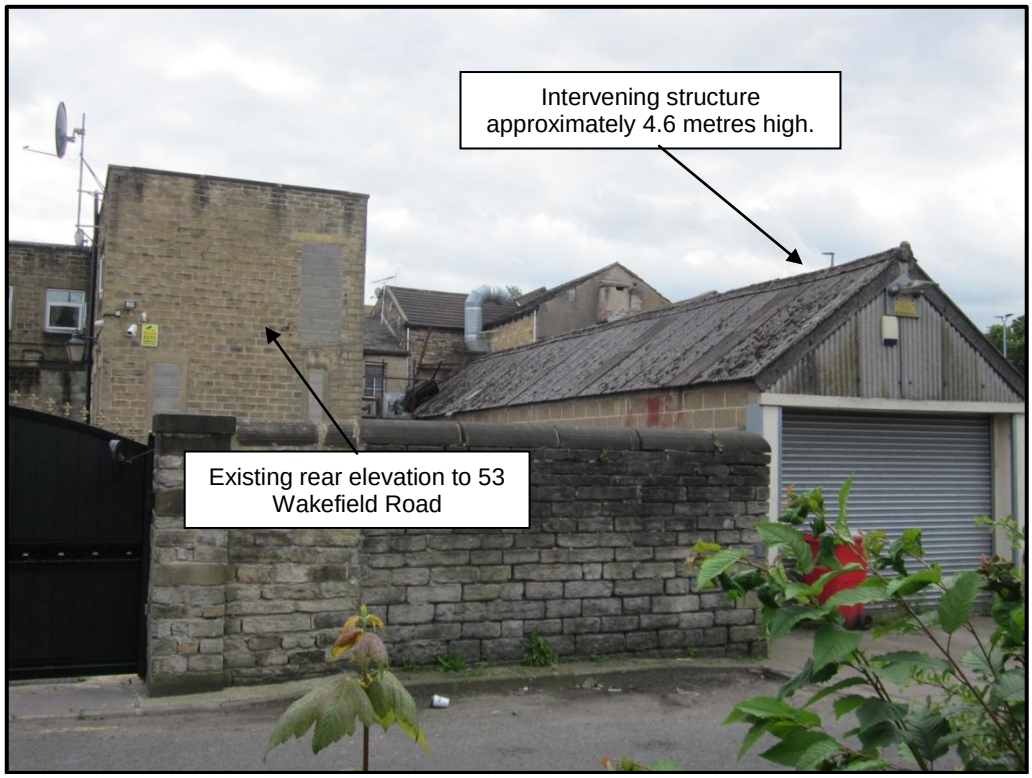
As a consequence, it was anticipated that measurements made in a single position that accorded with the rear elevation of the proposed extension would provide a representative assessment of the existing noise climate in the vicinity of the proposed extension. With reference to the late evening/night time survey conducted between 22:00 - 02:00 hours on Tuesday 4th to Wednesday 5th June, the measurements were obtained from the position indicated on figure 2 below.

Figure 2. Approximate location of the noise survey measurement positions



In the late evening/night time measurement position, it was possible that the existing intervening structure, detailed in photograph 7 overleaf, would shield the microphone so attenuating the measured levels. As this intervening structure was approximately 4.6 metres high, the sound level meter microphone was placed within the weather protection enclosure and mounted on a vertical boom such that the microphone was elevated to a height of approximately 5.6 metres. This elevation ensured the microphone was not shielded by this or any other structure from the primary noise source, road traffic on Wakefield Road.

Photograph 7. Location of the intervening structure relative to the position of the proposed extension



During the course of the daytime noise survey conducted on the 5th June, the gusty wind conditions suggested that adopting the same elevated microphone position would not be possible as the wind would induce too much movement in the microphone boom. As a consequence the daytime noise survey was conducted in the position detailed on figure 2 above. In this position the microphone, placed within the weather protection enclosure, was again mounted on a vertical boom but elevated to a height of only approximately 2.5 metres. At this elevation the influence of the wind on the microphone/boom assembly was much reduced.

In both positions the microphone was at least 3 metres from any large and reflecting surfaces, the measurement time interval was 5 minutes, all measurements were made with the 'fast' time weighting engaged and all measurements were attended for the duration of the surveys.

6.0 Noise Survey Results

The environment in the vicinity of the proposed dwelling was regarded as being essentially urban in character with the principal contributor to the noise climate being road traffic on Wakefield Road with some occasional noise from the surrounding commercial premises.

6.1 Qualitative Assessment

Without doubt the principal contributor to the existing noise climate was from road traffic noise from vehicles on the busy Wakefield Road. Throughout the survey the majority of the vehicles on Wakefield Road comprised private cars and taxis although a number of light and heavier goods vehicles and buses were also noted.

During the daytime period the volume of traffic on Wakefield Road remained relatively steady between the commencement of the survey and around 20:00 hours, after which a slight reduction in road traffic was noted. It was also noted that the numbers of light and heavier goods vehicles on Wakefield Road reduced considerably after this time. A further reduction in road traffic became apparent from around 22:00 hours, with the period after 22:00 hours being characterised by a generally reducing trend with periodic slight increases in traffic numbers.

Turning to the other noise sources audible during the noise survey, these included some noise from the flues serving the commercial premises surrounding 53 Wakefield Road and some noise from the nearby retail park car park. During the daytime period, up to approximately 19:30 hours, the majority of the other noises noted during the survey emanated from the car park serving the retail park to the West. Much of this noise comprised vehicle associated noise such as sounding horns and vehicles entering and leaving the car park, but also some noise from the shoppers and the occasional vehicle alarm.

From around 18:15 hours it was possible to hear a relatively low level contribution to the existing noise climate from the flues serving the various food establishments, with that serving the Kentucky Fried Chicken at 49 Wakefield Road being slightly more audible that the rest of the flues. Despite this, it must be stated that at no time was the emission of noise from the flues or the commercial premises regarded as intrusive or indeed particularly noticeable. As a result it is suggested that to require a separate assessment of any noise contribution from these would be regarded as disproportionate to the contribution to the existing noise climate made by the emission of noise from the flues.

6.2 Basic Results and Discussion

With reference to the measured noise levels from the daytime measurements position, as this was a little closer to Wakefield Road, the principal noise source, than was the night time measurement position, an appropriate distance correction has been applied to the measured levels. As significant amounts of measured noise data were collected during the surveys, table 8 and graph 1 overleaf contain summaries of the noise data from the noise surveys. Table 9 overleaf contains a brief summary of any noise events that were discernible above the general more 'anonymous' noise climate. The measured noise data are presented in Appendix 2.

Table 8. Measured noise level summary, proposed extension

	$L_{Aeq,T}$	$L_{Amax,T}$	$L_{A10,T}$	$L_{A90,T}$
Standard deviation, daytime period	2.02	4.40	1.78	2.36
Standard deviation, night time period	2.06	4.26	1.98	1.74
Mean (log), daytime period	58	73	59	52
Mean (log), night time period	51	66	53	44
Modal value, daytime period	58	70	60	52
Modal value, night time period	49	60	53	43
Maximum value daytime period	61	83	63	55
Minimum value daytime period	53	63	55	45
Maximum value night time period	55	77	57	47
Minimum value night time period	46	56	48	40

Graph 1. Measured noise levels, proposed extension, 53 Wakefield Road

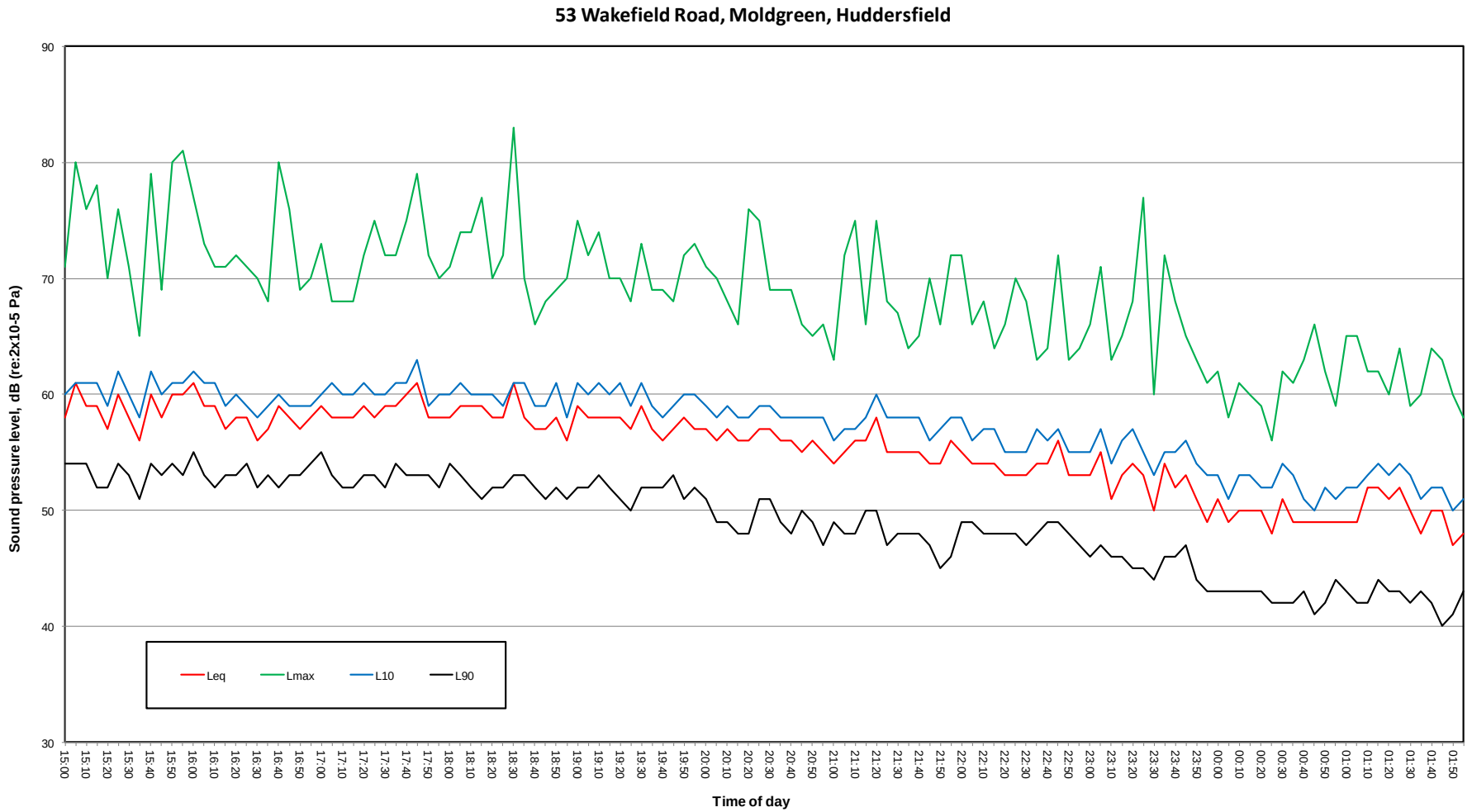


Table 9. Summary of discrete noise emission events, 53 Wakefield Road

Time period	Comment
23:03	Distant music (bass) just audible above traffic noise
23:39	Metallic 'clanging' noise coming from the direction of the ASDA car park
00:19	Distant alarm sounding
01:06	Distant alarm sounding
01:30	Emergency ambulance on Wakefield Road briefly sounds siren
16:05	Emergency ambulance on Wakefield Road, sirens sounding
16:42	Emergency ambulance on Wakefield Road, sirens sounding
18:15	Noise from extraction flues just audible during lulls in traffic noise
20:58	Rain shower

As can be seen from table 8 and graph 1, the noise climate remained relatively steady throughout the day until around 20:00 hours after which a steady reduction in the overall existing noise climate was measured.

During the daytime period the mean (log) and modal values for the L_{eq} parameter were 58dB for both parameters and turning the night time period the mean (log) and modal values for the L_{eq} parameter were 51 and 49dB respectively for both parameters. With reference to the ProPG initial site noise assessment procedure, assuming the obtained noise levels were representative of the mean 16 and 8 hour L_{eq} values, the mean (log) levels would fall within the 'low' noise risk category for the daytime and night time periods. Consequently and as suggested, it is likely that suitable measures would need to be employed to mitigate and minimise the potential ingress of external noise to the rooms within the proposed extension. With reference to these suitable measures, the guidance contained within the Pro PG document, at paragraph 2.34, suggests:

"*Where the LPA accepts that there is a justification that the internal target noise levels can only be practically achieved with windows closed, which may be the case in urban areas and at sites adjacent to transportation noise sources... In such circumstances, internal noise levels can be assessed with windows closed but with any façade openings used to provide "whole building ventilation" in accordance with Building Regulations Approved Document F (e.g. trickle ventilation) in the open position*".

With reference to the AVO Guide, again assuming the obtained levels would be representative of levels measured over a full 16 or 8 hour period, the mean (log) and modal values for the L_{eq} parameter into the 'medium' and 'low' risk categories during the day and night time periods respectively.

7.0 External Noise Break-in Calculations

Using the measured noise levels from the existing noise climate surveys, calculations have been performed to assess the likely internal noise levels within the proposed accommodation. As the existing noise climate comprised essentially 'anonymous' noise without 'specific' character the assessments will be conducted according to the guide values contained within table 2 of section 4.2 above.

The subsequent assessment of the potential internal noise levels within the proposed extension will be undertaken using the highest measured levels from the noise surveys and these are detailed in table 10 below. By applying the highest measured noise levels from the surveys, it is suggested that the following calculations may be regarded as worst case assessments using noise levels that are unlikely to persist for all but very short periods of time.

Table 10. Highest measured noise levels

OBCF, Hz*	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**Overall, dB(A)**
Daytime, L_{Aeq}, (15:00 - 15:05 hours)	67	59	56	54	57	55	47	43	**61**
Night time, $L_{Aeq.}$ (23:05 - 23:10 hours)	59	53	51	53	51	47	39	37	**55**
Night time, $L_{Amax,}$ (23:25 - 23:30 hours)	67	64	62	66	71	73	70	56	**77**

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 and ventilation provision that can be considered as the ‘weak’ links acoustically, therefore increasing the sound insulation of these elements will improve the overall sound insulation of the façade. The result of the calculation is a composite sound insulation value for the whole façade.

The following assessments of the likely internal noise levels within the proposed dwelling have been undertaken according to the room and façade dimensions detailed on the drawings issued by D B Architects of Meltham. 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.
- The calculations have been produced assuming the windows would be closed but the ventilation openings would be open.
- The measured sound levels would be equally incident upon all the elevations of the proposed extension

7.1 Construction Specification

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

External Walls

The external walls of the proposed accommodation would be of cavity masonry construction around 300 mm thick and the following general composition has been assumed: an external brick leaf, a 75 - 100mm cavity and a 100mm thick aggregate 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 52dB R_w, with the octave band sound insulation values being as detailed in table 11 below.

Table 11. Masonry Cavity Wall Construction**,** 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 suggested glazing for the proposed accommodation would be of the sealed unit type and would be of the following nominal specification: 4mm pane - 12 - 20mm cavity - 4mm pane. Laboratory test data obtained from Pilkington Glass indicate that this configuration should provide a sound insulation value of around 31dB R_w. The octave band sound insulation values are as detailed in table 12 below.

Alternative glazing configurations would be acceptable providing the sound insulation performances are at least equivalent to the specifications detailed in table 12 below.

Table 12. Glazing, octave band sound insulation values

OBCF, Hz*	**125**	**250**	**500**	**1k**	**2k**	**4k**	**Overall, R_w (C_{tr}) dB**
4mm, 12 - 20mm, 4mm	24	20	25	35	38	35	**31 (-6)**

* Octave Band Centre Frequency

Ventilation

The noise survey has indicated that the existing environment is urban in nature but was not regarded as being particularly noisy. As a result Initial calculations will be undertaken assuming the use of background ventilation which will be provided by window frame mounted background ventilators of the Greenwood 4000EAV and Titan V50/standrad canopy types. In the case of the Titan ventilator specification, this may be regarded as a higher performance acoustic type ventilator. Units offering equivalent sound insulation performance would be acceptable.

Laboratory test data indicates that the specified window frame mounted ventilators should provide a sound insulation values of 33 and 38dB $D_{n,e,w}$ respectively in their open positions. The octave band sound insulation values for the selected window frame mounted ventilators are detailed in table 13 overleaf. Alternative ventilator configurations would be acceptable providing the sound insulation performance is at least equivalent to the specification detailed in table 13 overleaf.

Table 13. Background ventilation**,** octave band sound insulation values

OBCF, Hz*	**125**	**250**	**500**	**1k**	**2k**	**4k**	**Overall, $D_{n,e,w}$ dB**
Greenwood 4000EAV	36	37	34	30	33	38**	**33**
Titan V50/standrard canopy	34	37	35	36	41	42	**38**

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

7.2 Calculation Results and Discussion

For the purposes of the internal noise climate assessments the highest noise levels from the survey, detailed in table 10 above, were used in the calculations. The results of the break-in noise calculations are presented, with reference to the design guidance contained within section 4.0 above, in table 14 below. With respect to the presentation of the results for the night time period, the night time L_{Aeq} and L_{Amax} results are presented in the same columns with the L_{Amax} results being contained within brackets. Full data are available in Appendix 3.

Table 14. Calculated internal noise levels, proposed extension

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 room/kitchen*	35	**33**	-	**-**
Bedroom 1**	35	**29**	30 (45)	**25 (42)**
Bedroom 2*	35	**32**	30 (45)	**23 (45)**
Bedroom 3**	35	**29**	30 (45)	**25 (42)**
Bedroom 4**	35	**31**	30 (45)	**26 (44)**
Bedroom 5**	35	**30**	30 (45)	**25 (43)**
Bedroom 6**	35	**30**	30 (45)	**26 (43)**

* Greenwood 4000EAV ventilator

** Titan V50/standard canopy ventilator

As can be seen from table 14 above, based on the stated assumptions relating to the sound insulation of the proposed façade elements and under the windows closed but ventilation openings open scenario, the calculated internal noise levels within the proposed accommodation, resulting from external noise break-in, would not exceed the design guidance contained within BS 8233:2014. It should however be remembered that the results presented in the table above must be considered as a worst case using the highest measured L_{Aeq} noise levels. With this in mind it is suggested that the internal levels within the proposed accommodation would, for the majority of the time, be below the levels presented within tables 14.

The results presented within table 14 highlight that the adopted guidance relating to the internal noise levels within the proposed flats can be achieved with closed windows and open background ventilation. It is however recognised that opening the windows for ventilation purposes, purge ventilation purposes excepting, would result in the internal noise levels exceeding the design guide levels detailed in BS 8233:2014. Assuming the level difference in outside to inside sound levels of 9 - 15dB, it can be seen from both the measured noise levels obtained during the existing noise climate survey and the results presented within table 14 above, that partially opening the windows for ventilation purposes would result in internal noise levels that exceeded the design guide levels. As a result it is suggested that alternative means of ventilation, to permit the internal spaces to be ventilated without requiring the windows to be opened, should be considered. It should however be remembered that the alternative ventilation option would be applicable to the bedroom areas only.

Two ventilation options that would be capable of meeting the above brief would fall under the description of what are termed systems 3 and 4 as defined within Approved Document F, guidance to the Building Regulations. System 3 relates to a continuous mechanical extraction (MEV) system which operates to remove air from the building with the 'make-up' air being drawn in via background ventilators. System 4 refers to a fully mechanical system incorporating heat recovery and is typically used in noisy environments etc. In both cases the requirement to ventilate to internal spaces would need to be carefully considered as the benefit to the occupants should be balanced with the possible disincentives to use, such as the perceived complexity of the installation and running costs.

In this case and with reference to the ventilation options presented within table 6 above, bearing in mind the existing noise climate was not regarded as being particularly noisy, the alternative ventilation strategy could take the form of a system 3 provision. As with any ventilation installation it is essential that the emission of sound from the ventilation system is adequately controlled to ensure that this element does not detrimentally affect the internal noise climate. In addition it is essential that the occupants must also be provided with the option to open windows as they choose.

As a consequence of the foregoing, it is suggested the sound insulation of the proposed façade elements and proposed alternative ventilation provision, would be sufficient to limit the ingress of external noise to the proposed accommodation in compliance with the adopted design guidance. As such, it is suggested that the proposed flats could be integrated into the existing environment without the potential for "*unreasonable restrictions*" to be placed upon already established businesses in the vicinity. The proposed mitigation measures would also comply with the requirement contained within the ProPG document which requires that the acoustic design statement "*confirms how the adverse impacts of noise will be mitigated and minimised, and which clearly demonstrate that a significant adverse noise impact will be avoided in the finished development*".

Consequently, the existing noise climate should not be regarded as an impediment to the granting of planning permission providing the suggested sound insulation measures, or alternative no less effective measures, are applied to the proposed extension at 53 Wakefield Road.

8.0 Conclusion

The noise survey identified that the environment in the vicinity of the proposed extension at 53 Wakefield Road was regarded as being essentially urban in character and was subject to noise contributions primarily from road traffic on Wakefield Road with occasional noise contributions from the surrounding commercial enterprises.

Using the measured noise level data from the existing noise climate surveys and applying the stated assumptions relating to the sound insulation of the proposed façade elements and under the windows closed but ventilation openings open scenario, the calculated internal noise levels within the proposed accommodation, resulting from external noise break-in, would not exceed the design guidance contained within BS 8233:2014. Despite this it is recognised that opening the windows for ventilation purposes, purge ventilation purposes excepted, would result in the internal noise levels exceeding the design guide levels detailed in BS 8233:2014. As a result it is suggested that alternative means of ventilation, to permit the internal spaces to be ventilated without requiring the windows to be opened, should be considered. It should however be remembered that the alternative ventilation option would be applicable to the bedroom areas only.

As a consequence of the above, the existing noise climate should not be regarded as an impediment to the granting of planning permission providing the suggested sound insulation measures, or alternative no less effective measures, are applied to the proposed extension at 53 Wakefield Road. In addition, the foregoing has indicated that the proposed accommodation could be integrated into the existing environment without the potential for "*unreasonable restrictions*" to be placed upon already established businesses in the vicinity.

Appendix 1: Existing Noise Climate Surveys, Measured Levels

53 Wakefield Road, Moldgreen, Huddersfield

Time	$L_{Aeq\ 5\ mins}$	$L_{Amax,\ 5\ mins}$	$L_{A10,\ 5\ mins}$	$L_{A90,\ 5\ mins}$
15:00	58	71	60	54
15:05	61	80	61	54
15:10	59	76	61	54
15:15	59	78	61	52
15:20	57	70	59	52
15:25	60	76	62	54
15:30	58	71	60	53
15:35	56	65	58	51
15:40	60	79	62	54
15:45	58	69	60	53
15:50	60	80	61	54
15:55	60	81	61	53
16:00	61	77	62	55
16:05	59	73	61	53
16:10	59	71	61	52
16:15	57	71	59	53
16:20	58	72	60	53
16:25	58	71	59	54
16:30	56	70	58	52
16:35	57	68	59	53
16:40	59	80	60	52
16:45	58	76	59	53
16:50	57	69	59	53
16:55	58	70	59	54

Time	$L_{Aeq\ 5\ mins}$	$L_{Amax,\ 5\ mins}$	$L_{A10,\ 5\ mins}$	$L_{A90,\ 5\ mins}$
17:00	59	73	60	55
17:05	58	68	61	53
17:10	58	68	60	52
17:15	58	68	60	52
17:20	59	72	61	53
17:25	58	75	60	53
17:30	59	72	60	52
17:35	59	72	61	54
17:40	60	75	61	53
17:45	61	79	63	53
17:50	58	72	59	53
17:55	58	70	60	52
18:00	58	71	60	54
18:05	59	74	61	53
18:10	59	74	60	52
18:15	59	77	60	51
18:20	58	70	60	52
18:25	58	72	59	52
18:30	61	83	61	53
18:35	58	70	61	53
18:40	57	66	59	52
18:45	57	68	59	51
18:50	58	69	61	52
18:55	56	70	58	51

Time	$L_{Aeq\ 5\ mins}$	$L_{Amax,\ 5\ mins}$	$L_{A10,\ 5\ mins}$	$L_{A90,\ 5\ mins}$
19:00	59	75	61	52
19:05	58	72	60	52
19:10	58	74	61	53
19:15	58	70	60	52
19:20	58	70	61	51
19:25	57	68	59	50
19:30	59	73	61	52
19:35	57	69	59	52
19:40	56	69	58	52
19:45	57	68	59	53
19:50	58	72	60	51
19:55	57	73	60	52
20:00	57	71	59	51
20:05	56	70	58	49
20:10	57	68	59	49
20:15	56	66	58	48
20:20	56	76	58	48
20:25	57	75	59	51
20:30	57	69	59	51
20:35	56	69	58	49
20:40	56	69	58	48
20:45	55	66	58	50
20:50	56	65	58	49
20:55	55	66	58	47

Time	$L_{Aeq\ 5\ mins}$	$L_{Amax,\ 5\ mins}$	$L_{A10,\ 5\ mins}$	$L_{A90,\ 5\ mins}$
21:00	54	63	56	49
21:05	55	72	57	48
21:10	56	75	57	48
21:15	56	66	58	50
21:20	58	75	60	50
21:25	55	68	58	47
21:30	55	67	58	48
21:35	55	64	58	48
21:40	55	65	58	48
21:45	54	70	56	47
21:50	54	66	57	45
21:55	56	72	58	46
22:00	55	72	58	49
22:05	54	66	56	49
22:10	54	68	57	48
22:15	54	64	57	48
22:20	53	66	55	48
22:25	53	70	55	48
22:30	53	68	55	47
22:35	54	63	57	48
22:40	54	64	56	49
22:45	56	72	57	49
22:50	53	63	55	48
22:55	53	64	55	47

Time	$L_{Aeq\ 5\ mins}$	$L_{Amax,\ 5\ mins}$	$L_{A10,\ 5\ mins}$	$L_{A90,\ 5\ mins}$
23:00	53	66	55	46
23:05	55	71	57	47
23:10	51	63	54	46
23:15	53	65	56	46
23:20	54	68	57	45
23:25	53	77	55	45
23:30	50	60	53	44
23:35	54	72	55	46
23:40	52	68	55	46
23:45	53	65	56	47
23:50	51	63	54	44
23:55	49	61	53	43
00:00	51	62	53	43
00:05	49	58	51	43
00:10	50	61	53	43
00:15	50	60	53	43
00:20	50	59	52	43
00:25	48	56	52	42
00:30	51	62	54	42
00:35	49	61	53	42
00:40	49	63	51	43
00:45	49	66	50	41
00:50	49	62	52	42
00:55	49	59	51	44

Time	$L_{Aeq\ 5\ mins}$	$L_{Amax,\ 5\ mins}$	$L_{A10,\ 5\ mins}$	$L_{A90,\ 5\ mins}$
01:00	49	65	52	43
01:05	49	65	52	42
01:10	52	62	53	42
01:15	52	62	54	44
01:20	51	60	53	43
01:25	52	64	54	43
01:30	50	59	53	42
01:35	48	60	51	43
01:40	50	64	52	42
01:45	50	63	52	40
01:50	47	60	50	41
01:55	48	58	51	43

Appendix 2: Break-in Noise Calculations (windows closed, ventilators open)

53 Wakefield Road, Huddersfield

Break-in Noise Calculations - Ground Floor

Ground floor

L_{Aeq} Assessment, daytime

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}		61	67	67	59	56	54	57	55	47	43	38
B	Exposed façade, m^2	6.3		8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
C	Volume of receiving room, m^3	21.1											
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)			-8.4	-8.4	-8.4	-8.4	-8.4	-8.4	-8.4	-8.4	-8.4	-8.4
F	Composite SRI			20.8	25.8	30.8	27.5	32.5	42.5	45.5	42.5	47.5	52.5
G	A + B + E - F		24	46.0	40.5	27.8	28.0	21.3	13.7	8.7	4.5	-4.5	-14.6
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		27	49.0	43.5	30.8	31.0	24.3	16.7	11.7	7.5	-1.5	-11.6
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				29	34	37	35	36	41	42	51	
M	$L_{Aeq} - D_{n,e} + 10*\log(10) - B$				39.8	27.1	20.9	21.2	22.6	15.6	7.5	-5.5	
N	Internal room noise level, vent open		29		45.1	32.4	31.4	26.0	23.6	17.0	10.5	0.0	

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

Ventilator type: *Titan V50/standard canopy*

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_{max}		61	67	67	59	56	54	57	55	47	43	38
B	Exposed façade, m^2	6.2		7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9
C	Volume of receiving room, m^3	27.1											
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)			-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	27.4	32.4	42.4	45.4	42.5	47.5	52.4
G	A + B + E - F		23	44.9	39.4	26.7	26.9	20.2	12.6	7.6	3.4	-5.6	-15.7
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	47.9	42.4	29.7	29.9	23.2	15.6	10.6	6.4	-2.6	-12.7
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				29	34	37	35	36	41	42	51	
M	$L_{Aeq} - D_{n,e} + 10*\log(10) - B$				39.8	27.1	20.9	21.2	22.6	15.6	7.5	-5.5	
N	Internal room noise level, vent open		29		44.3	31.6	30.4	25.3	23.4	16.8	10.0	-0.8	

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

Ventilator type: *Titan V50/standard canopy*

Bedroom 2 - gable

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		61	67	67	59	56	54	57	55	47	43	38
B	Exposed façade, m^2	10.5		10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
C	Volume of receiving room, m^3	27.1											
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)			-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		13	40.0	34.5	21.8	14.6	4.9	-0.7	-6.7	-13.8	-22.8	-28.0
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		16	43.0	37.5	24.8	17.6	7.9	2.3	-3.7	-10.8	-19.8	-25.0

Glazing: -

Ventilator type: -

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_{eq}		61	67	67	59	56	54	57	55	47	43	38
B	Exposed façade, m^2	6.2		7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9
C	Volume of receiving room, m^3	27.1											
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)			-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5
F	Composite SRI			22.8	27.8	32.8	29.9	35.0	44.9	48.0	45.1	50.1	54.9
G	A + B + E - F		20	42.9	37.4	24.7	24.4	17.6	10.1	5.0	0.8	-8.2	-18.2
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		23	45.9	40.4	27.7	27.4	20.6	13.1	8.0	3.8	-5.2	-15.2
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				29	34	37	35	36	41	42	51	
M	$L_{Aeq} - D_{n,e} + 10*\log(10) - B$				39.8	27.1	20.9	21.2	22.6	15.6	7.5	-5.5	
N	Internal room noise level, vent open		27		43.2	30.5	28.3	23.9	23.1	16.3	9.1	-2.3	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Titan V50/standard canopy*												
	Combined sound level, dB(A)		31										

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	65	59	53	51	53	51	47	39	37	21
B	Exposed façade, m^2	6.3		8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
C	Volume of receiving room, m^3	21.1											
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)			-8.4	-8.4	-8.4	-8.4	-8.4	-8.4	-8.4	-8.4	-8.4	-8.4
F	Composite SRI			20.8	25.8	30.8	27.5	32.5	42.5	45.5	42.5	47.5	52.5
G	A + B + E - F		20	43.7	32.3	21.7	23.4	19.8	8.4	0.6	-4.1	-11.1	-31.4
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		23	46.7	35.3	24.7	26.4	22.8	11.4	3.6	-1.1	-8.1	-28.4
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				29	34	37	35	36	41	42	51	
M	$L_{Aeq} - D_{n,e} + 10*\log(10) - B$				31.5	20.9	16.2	19.7	17.3	7.5	-1.2	-12.2	
N	Internal room noise level, vent open		25		36.8	26.2	26.8	24.5	18.3	9.0	1.9	-6.7	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Titan V50/standard canopy*												

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_{max}		55	65	59	53	51	53	51	47	39	37	21
B	Exposed façade, m^2	6.2		7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9
C	Volume of receiving room, m^3	27.1											
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)			-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	27.4	32.4	42.4	45.4	42.5	47.5	52.4
G	A + B + E - F		19	42.6	31.2	20.6	22.3	18.7	7.4	-0.5	-5.2	-12.2	-32.5
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		22	45.6	34.2	23.6	25.3	21.7	10.4	2.5	-2.2	-9.2	-29.5
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				29	34	37	35	36	41	42	51	
M	$L_{Aeq} - D_{n,e} + 10*\log(10) - B$				31.6	21.0	16.3	19.8	17.4	7.6	-1.1	-12.1	
N	Internal room noise level, vent open		24		36.1	25.5	25.8	23.9	18.2	8.8	1.4	-7.4	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Titan V50/standard canopy*												

Bedroom 2 - gable

	* Octave Band Centre Frequency, Hz		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		55	65	59	53	51	53	51	47	39	37	21
B	Exposed façade, m^2	10.5		10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
C	Volume of receiving room, m^3	27.1											
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)			-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		7	37.7	26.3	15.7	10.0	3.5	-5.9	-14.7	-22.4	-29.4	-44.8
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		10	40.7	29.3	18.7	13.0	6.5	-2.9	-11.7	-19.4	-26.4	-41.8
Glazing:	-												
Ventilator type:	-												

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_{eq}		55	65	59	53	51	53	51	47	39	37	21
B	Exposed façade, m^2	6.2		7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9
C	Volume of receiving room, m^3	27.1											
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)			-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5
F	Composite SRI			22.8	27.8	32.8	29.9	35.0	44.9	48.0	45.1	50.1	54.9
G	A + B + E - F		16	40.6	29.2	18.6	19.8	16.1	4.8	-3.0	-7.8	-14.8	-35.0
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		19	43.6	32.2	21.6	22.8	19.1	7.8	0.0	-4.8	-11.8	-32.0
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				29	34	37	35	36	41	42	51	
M	$L_{Aeq} - D_{n,e} + 10*\log(10) - B$				31.6	21.0	16.3	19.8	17.4	7.6	-1.1	-12.1	
N	Internal room noise level, vent open		23		34.9	24.3	23.6	22.5	17.8	8.3	0.4	-8.9	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Titan V50/standard canopy*												
	Combined sound 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}		77	79	67	64	62	66	71	73	70	56	30
B	Exposed façade, m^2	6.3		8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
C	Volume of receiving room, m^3	21.1											
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)			-8.4	-8.4	-8.4	-8.4	-8.4	-8.4	-8.4	-8.4	-8.4	-8.4
F	Composite SRI			20.8	25.8	30.8	27.5	32.5	42.5	45.5	42.5	47.5	52.5
G	A + B + E - F		35	57.6	40.3	33.0	34.3	32.8	27.8	27.0	27.1	7.8	-22.9
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	60.6	43.3	36.0	37.3	35.8	30.8	30.0	30.1	10.8	-19.9
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				29	34	37	35	36	41	42	51	
M	$L_{Aeq} - D_{n,e} + 10*\log(10) - B$				39.5	32.2	27.1	32.7	36.7	33.9	30.0	6.7	
N	Internal room noise level, vent open		42		44.8	37.5	37.7	37.5	37.7	35.4	33.1	12.2	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Titan V50/standard canopy*												

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_{max}		77	79	67	64	62	66	71	73	70	56	30
B	Exposed façade, m^2	6.2		7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9
C	Volume of receiving room, m^3	27.1											
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)			-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	27.4	32.4	42.4	45.4	42.5	47.5	52.4
G	A + B + E - F		34	56.5	39.2	31.9	33.2	31.7	26.8	25.9	26.0	6.7	-24.0
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		37	59.5	42.2	34.9	36.2	34.7	29.8	28.9	29.0	9.7	-21.0
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				29	34	37	35	36	41	42	51	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				39.6	32.3	27.2	32.8	36.8	34.0	30.1	6.8	
N	Internal room noise level, vent open		42		44.1	36.8	36.7	36.9	37.6	35.2	32.6	11.5	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Titan V50/standard canopy*												

Bedroom 2 - gable

	* Octave Band Centre Frequency, Hz		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{max}		77	79	67	64	62	66	71	73	70	56	30
B	Exposed façade, m^2	10.5		10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
C	Volume of receiving room, m^3	27.1											
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)			-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		21	51.6	34.3	27.0	20.9	16.5	13.5	11.7	8.8	-10.5	-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		24	54.6	37.3	30.0	23.9	19.5	16.5	14.7	11.8	-7.5	-33.3
Glazing:	-												
Ventilator type:	-												

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_{max}		77	79	67	64	62	66	71	73	70	56	30
B	Exposed façade, m^2	6.2		7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9
C	Volume of receiving room, m^3	27.1											
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)			-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5
F	Composite SRI			22.8	27.8	32.8	29.9	35.0	44.9	48.0	45.1	50.1	54.9
G	A + B + E - F		32	54.5	37.2	29.9	30.7	29.1	24.2	23.4	23.4	4.1	-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		35	57.5	40.2	32.9	33.7	32.1	27.2	26.4	26.4	7.1	-23.5
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				29	34	37	35	36	41	42	51	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				39.6	32.3	27.2	32.8	36.8	34.0	30.1	6.8	
N	Internal room noise level, vent open		41		42.9	35.6	34.5	35.5	37.2	34.7	31.6	10.0	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Titan V50/standard canopy*												
	Combined sound level, dB(A)		45										

First floor

L_{Aeq} Assessment, daytime

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_{eq}		61	67	67	59	56	54	57	55	47	43	38
B	Exposed façade, m^2	6.5		8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
C	Volume of receiving room, m^3	19.7											
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)			-8.1	-8.1	-8.1	-8.1	-8.1	-8.1	-8.1	-8.1	-8.1	-8.1
F	Composite SRI			20.9	25.9	30.9	27.6	32.6	42.6	45.6	42.7	47.7	52.6
G	A + B + E - F		24	46.4	40.9	28.2	28.3	21.6	14.0	9.0	4.8	-4.2	-14.3
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		27	49.4	43.9	31.2	31.3	24.6	17.0	12.0	7.8	-1.2	-11.3
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				29	34	37	35	36	41	42	51	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				39.6	26.9	20.7	21.0	22.4	15.4	7.3	-5.7	
N	Internal room noise level, vent open		29		45.3	32.6	31.7	26.1	23.5	17.0	10.6	0.1	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Titan V50/standard canopy*												

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_{max}		61	67	67	59	56	54	57	55	47	43	38
B	Exposed façade, m^2	7.5		8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8
C	Volume of receiving room, m^3	37.6											
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)			-10.9	-10.9	-10.9	-10.9	-10.9	-10.9	-10.9	-10.9	-10.9	-10.9
F	Composite SRI			21.4	26.4	31.4	28.2	33.3	43.2	46.2	43.3	48.3	53.2
G	A + B + E - F		21	43.7	38.2	25.5	25.5	18.8	11.2	6.2	2.0	-7.0	-17.1
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		24	46.7	41.2	28.5	28.5	21.8	14.2	9.2	5.0	-4.0	-14.1
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				37.0	24.3	20.1	21.4	27.8	22.8	10.7	1.7	
N	Internal room noise level, vent open		31		42.6	29.9	29.1	24.6	28.0	23.0	11.7	2.7	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Greenwood 4000EAV*												

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_{eq}		61	67	67	59	56	54	57	55	47	43	38
B	Exposed façade, m^2	10.5		10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
C	Volume of receiving room, m^3	37.6											
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)			-10.9	-10.9	-10.9	-10.9	-10.9	-10.9	-10.9	-10.9	-10.9	-10.9
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		11	38.6	33.1	20.4	13.2	3.5	-2.1	-8.1	-15.2	-24.2	-29.4
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		14	41.6	36.1	23.4	16.2	6.5	0.9	-5.1	-12.2	-21.2	-26.4
Glazing:	-												
Ventilator type:	-												

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_{eq}		61	67	67	59	56	54	57	55	47	43	38
B	Exposed façade, m^2	9.3		9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7
C	Volume of receiving room, m^3	37.6											
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)			-10.9	-10.9	-10.9	-10.9	-10.9	-10.9	-10.9	-10.9	-10.9	-10.9
F	Composite SRI			23.9	28.9	33.9	31.5	36.7	46.6	49.7	46.8	51.8	56.5
G	A + B + E - F		19	42.1	36.6	23.9	23.1	16.2	8.8	3.7	-0.5	-9.5	-19.5
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		22	45.1	39.6	26.9	26.1	19.2	11.8	6.7	2.5	-6.5	-16.5
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	23.4	19.2	20.5	26.9	21.9	9.8	0.8	
N	Internal room noise level, vent open		30		41.2	28.5	26.9	22.9	27.0	22.0	10.5	1.5	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Greenwood 4000EAV*												
	Combined sound level, dB(A)		33										

L_{Aeq} Assessment, night time

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_{eq}		55	65	59	53	51	53	51	47	39	37	21
B	Exposed façade, m^2	6.5		8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
C	Volume of receiving room, m^3	19.7											
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)			-8.1	-8.1	-8.1	-8.1	-8.1	-8.1	-8.1	-8.1	-8.1	-8.1
F	Composite SRI			20.9	25.9	30.9	27.6	32.6	42.6	45.6	42.7	47.7	52.6
G	A + B + E - F		20	44.0	32.6	22.0	23.7	20.1	8.7	0.9	-3.8	-10.8	-31.1
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	47.0	35.6	25.0	26.7	23.1	11.7	3.9	-0.8	-7.8	-28.1
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				29	34	37	35	36	41	42	51	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				31.4	20.8	16.1	19.6	17.2	7.4	-1.3	-12.3	
N	Internal room noise level, vent open		25		37.0	26.4	27.0	24.7	18.3	9.0	1.9	-6.5	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Titan V50/standard canopy*												

L_{Amax} Assessment, night time

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_{max}		77	79	67	64	62	66	71	73	70	56	30
B	Exposed façade, m^2	6.5		8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
C	Volume of receiving room, m^3	19.7											
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)			-8.1	-8.1	-8.1	-8.1	-8.1	-8.1	-8.1	-8.1	-8.1	-8.1
F	Composite SRI			20.9	25.9	30.9	27.6	32.6	42.6	45.6	42.7	47.7	52.6
G	A + B + E - F		36	57.9	40.6	33.3	34.6	33.1	28.1	27.3	27.4	8.1	-22.6
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		39	60.9	43.6	36.3	37.6	36.1	31.1	30.3	30.4	11.1	-19.6
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				29	34	37	35	36	41	42	51	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				39.4	32.1	27.0	32.6	36.6	33.8	29.9	6.6	
N	Internal room noise level, vent open		42		45.0	37.7	37.9	37.7	37.7	35.4	33.1	12.4	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Titan V50/standard canopy*												

Second floor

L_{Aeq} Assessment, daytime

Bedroom 4 - rear elevation

	Octave Band Centre Frequency, Hz		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		61	67	67	59	56	54	57	55	47	43	38
B	Exposed façade, m^2	3.5		5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
C	Volume of receiving room, m^3	17.7											
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)			-7.6	-7.6	-7.6	-7.6	-7.6	-7.6	-7.6	-7.6	-7.6	-7.6
F	Composite SRI			18.7	23.7	28.7	25.0	30.0	40.0	43.0	40.0	45.0	50.0
G	A + B + E - F		24	46.4	40.9	28.2	28.7	22.0	14.4	9.4	5.3	-3.7	-13.9
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		27	49.4	43.9	31.2	31.7	25.0	17.4	12.4	8.3	-0.7	-10.9
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				29	34	37	35	36	41	42	51	
M	$L_{Aeq} - D_{n,e} + 10*\log(10) - B$				42.3	29.6	23.4	23.7	25.1	18.1	10.0	-3.0	
N	Internal room noise level, vent open		31		46.2	33.5	32.3	27.4	25.8	19.1	12.2	1.3	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Titan V50/standard canopy*												

Bedroom 5 - rear elevation

	Octave Band Centre Frequency, Hz		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		61	67	67	59	56	54	57	55	47	43	38
B	Exposed façade, m^2	6.5		8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
C	Volume of receiving room, m^3	16.7											
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)			-7.4	-7.4	-7.4	-7.4	-7.4	-7.4	-7.4	-7.4	-7.4	-7.4
F	Composite SRI			20.9	25.9	30.9	27.6	32.6	42.6	45.6	42.7	47.7	52.6
G	A + B + E - F		25	47.1	41.6	28.9	29.0	22.3	14.7	9.7	5.5	-3.5	-13.6
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		28	50.1	44.6	31.9	32.0	25.3	17.7	12.7	8.5	-0.5	-10.6
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				29	34	37	35	36	41	42	51	
M	$L_{Aeq} - D_{n,e} + 10*\log(10) - B$				39.6	26.9	20.7	21.0	22.4	15.4	7.3	-5.7	
N	Internal room noise level, vent open		30		45.8	33.1	32.3	26.7	23.7	17.3	11.0	0.7	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Titan V50/standard canopy*												

Bedroom 6 - rear elevation

	Octave Band Centre Frequency, Hz		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		61	67	67	59	56	54	57	55	47	43	38
B	Exposed façade, m^2	6.5		8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
C	Volume of receiving room, m^3	16.7											
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)			-7.4	-7.4	-7.4	-7.4	-7.4	-7.4	-7.4	-7.4	-7.4	-7.4
F	Composite SRI			20.9	25.9	30.9	27.6	32.6	42.6	45.6	42.7	47.7	52.6
G	A + B + E - F		25	47.1	41.6	28.9	29.0	22.3	14.7	9.7	5.5	-3.5	-13.6
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		28	50.1	44.6	31.9	32.0	25.3	17.7	12.7	8.5	-0.5	-10.6
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				29	34	37	35	36	41	42	51	
M	$L_{Aeq} - D_{n,e} + 10*\log(10) - B$				39.6	26.9	20.7	21.0	22.4	15.4	7.3	-5.7	
N	Internal room noise level, vent open		30		45.8	33.1	32.3	26.7	23.7	17.3	11.0	0.7	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Titan V50/standard canopy*												

Bedroom 6 - gable

	* Octave Band Centre Frequency, Hz		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		61	67	67	59	56	54	57	55	47	43	38
B	Exposed façade, m^2	10.5		10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
C	Volume of receiving room, m^3	22.3											
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)			-8.6	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6
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	40.8	35.3	22.6	15.4	5.7	0.1	-5.9	-13.0	-22.0	-27.2
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	43.8	38.3	25.6	18.4	8.7	3.1	-2.9	-10.0	-19.0	-24.2
Glazing:	-												
Ventilator type:	-												

Bedroom 6 - front elevation

	* Octave Band Centre Frequency, Hz		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		61	67	67	59	56	54	57	55	47	43	38
B	Exposed façade, m^2	1.8		2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
C	Volume of receiving room, m^3	22.3											
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)			-8.6	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6
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	33.2	27.7	15.0	7.8	-1.9	-7.5	-13.5	-20.6	-29.6	-34.8
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		9	36.2	30.7	18.0	10.8	1.1	-4.5	-10.5	-17.6	-26.6	-31.8
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Titan V50/standard canopy*												
	Combined sound level, dB(A)		30										

L_{Aeq} Assessment, night time

Bedroom 4 - 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	65	59	53	51	53	51	47	39	37	21
B	Exposed façade, m^2	3.5		5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
C	Volume of receiving room, m^3	17.7											
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)			-7.6	-7.6	-7.6	-7.6	-7.6	-7.6	-7.6	-7.6	-7.6	-7.6
F	Composite SRI			18.7	23.7	28.7	25.0	30.0	40.0	43.0	40.0	45.0	50.0
G	A + B + E - F		20	44.1	32.7	22.1	24.1	20.5	9.1	1.3	-3.4	-10.4	-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	47.1	35.7	25.1	27.1	23.5	12.1	4.3	-0.4	-7.4	-27.7
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				29	34	37	35	36	41	42	51	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				34.1	23.5	18.8	22.3	19.9	10.1	1.4	-9.6	
N	Internal room noise level, vent open		26		37.9	27.3	27.7	26.0	20.5	11.1	3.6	-5.4	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Titan V50/standard canopy*												

Bedroom 5 - 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	65	59	53	51	53	51	47	39	37	21
B	Exposed façade, m^2	6.5		8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
C	Volume of receiving room, m^3	16.7											
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)			-7.4	-7.4	-7.4	-7.4	-7.4	-7.4	-7.4	-7.4	-7.4	-7.4
F	Composite SRI			20.9	25.9	30.9	27.6	32.6	42.6	45.6	42.7	47.7	52.6
G	A + B + E - F		21	44.7	33.3	22.7	24.4	20.8	9.5	1.6	-3.1	-10.1	-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		24	47.7	36.3	25.7	27.4	23.8	12.5	4.6	-0.1	-7.1	-27.4
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				29	34	37	35	36	41	42	51	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				31.4	20.8	16.1	19.6	17.2	7.4	-1.3	-12.3	
N	Internal room noise level, vent open		25		37.5	26.9	27.7	25.2	18.4	9.2	2.3	-6.0	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Titan V50/standard canopy*												

Bedroom 6 - 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	65	59	53	51	53	51	47	39	37	21
B	Exposed façade, m^2	6.5		8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
C	Volume of receiving room, m^3	16.7											
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)			-7.4	-7.4	-7.4	-7.4	-7.4	-7.4	-7.4	-7.4	-7.4	-7.4
F	Composite SRI			20.9	25.9	30.9	27.6	32.6	42.6	45.6	42.7	47.7	52.6
G	A + B + E - F		21	44.7	33.3	22.7	24.4	20.8	9.5	1.6	-3.1	-10.1	-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		24	47.7	36.3	25.7	27.4	23.8	12.5	4.6	-0.1	-7.1	-27.4
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				29	34	37	35	36	41	42	51	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				31.4	20.8	16.1	19.6	17.2	7.4	-1.3	-12.3	
N	Internal room noise level, vent open		25		37.5	26.9	27.7	25.2	18.4	9.2	2.3	-6.0	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Titan V50/standard canopy*												

Bedroom 6 - gable

	* Octave Band Centre Frequency, Hz		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		55	65	59	53	51	53	51	47	39	37	21
B	Exposed façade, m^2	10.5		10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
C	Volume of receiving room, m^3	22.3											
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)			-8.6	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6
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	38.5	27.1	16.5	10.8	4.3	-5.1	-13.9	-21.6	-28.6	-44.0
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		11	41.5	30.1	19.5	13.8	7.3	-2.1	-10.9	-18.6	-25.6	-41.0
Glazing:	-												
Ventilator type:	-												

Bedroom 6 - front elevation

	* Octave Band Centre Frequency, Hz		dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		55	65	59	53	51	53	51	47	39	37	21
B	Exposed façade, m^2	1.8		2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
C	Volume of receiving room, m^3	22.3											
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)			-8.6	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6
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		0	30.8	19.4	8.8	3.1	-3.4	-12.8	-21.6	-29.3	-36.3	-51.7
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		3	33.8	22.4	11.8	6.1	-0.4	-9.8	-18.6	-26.3	-33.3	-48.7
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Titan V50/standard canopy*												
	Combined sound level, dB(A)		26										

L_{Amax} Assessment, night time

Bedroom 4 - rear elevation

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{max}		77	79	67	64	62	66	71	73	70	56	30
B	Exposed façade, m^2	3.5		5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
C	Volume of receiving room, m^3	17.7											
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)			-7.6	-7.6	-7.6	-7.6	-7.6	-7.6	-7.6	-7.6	-7.6	-7.6
F	Composite SRI			18.7	23.7	28.7	25.0	30.0	40.0	43.0	40.0	45.0	50.0
G	A + B + E - F		36	58.0	40.7	33.4	35.0	33.5	28.5	27.7	27.8	8.5	-22.2
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		39	61.0	43.7	36.4	38.0	36.5	31.5	30.7	30.8	11.5	-19.2
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				29	34	37	35	36	41	42	51	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				42.1	34.8	29.7	35.3	39.3	36.5	32.6	9.3	
N	Internal room noise level, vent open		44		45.9	38.6	38.6	39.0	39.9	37.5	34.8	13.5	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Titan V50/standard canopy*												

Bedroom 5 - rear elevation

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		77	79	67	64	62	66	71	73	70	56	30
B	Exposed façade, m^2	6.5		8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
C	Volume of receiving room, m^3	16.7											
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)			-7.4	-7.4	-7.4	-7.4	-7.4	-7.4	-7.4	-7.4	-7.4	-7.4
F	Composite SRI			20.9	25.9	30.9	27.6	32.6	42.6	45.6	42.7	47.7	52.6
G	A + B + E - F		36	58.6	41.3	34.0	35.3	33.8	28.9	28.0	28.1	8.8	-21.9
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		39	61.6	44.3	37.0	38.3	36.8	31.9	31.0	31.1	11.8	-18.9
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				29	34	37	35	36	41	42	51	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				39.4	32.1	27.0	32.6	36.6	33.8	29.9	6.6	
N	Internal room noise level, vent open		43		45.5	38.2	38.6	38.2	37.8	35.6	33.5	12.9	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Titan V50/standard canopy*												

Bedroom 6 - rear elevation

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{max}		77	79	67	64	62	66	71	73	70	56	30
B	Exposed façade, m^2	6.5		8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
C	Volume of receiving room, m^3	16.7											
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)			-7.4	-7.4	-7.4	-7.4	-7.4	-7.4	-7.4	-7.4	-7.4	-7.4
F	Composite SRI			20.9	25.9	30.9	27.6	32.6	42.6	45.6	42.7	47.7	52.6
G	A + B + E - F		36	58.6	41.3	34.0	35.3	33.8	28.9	28.0	28.1	8.8	-21.9
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		39	61.6	44.3	37.0	38.3	36.8	31.9	31.0	31.1	11.8	-18.9
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				29	34	37	35	36	41	42	51	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				39.4	32.1	27.0	32.6	36.6	33.8	29.9	6.6	
N	Internal room noise level, vent open		43		45.5	38.2	38.6	38.2	37.8	35.6	33.5	12.9	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Titan V50/standard canopy*												

Bedroom 6 - gable

	* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{max}			77	79	67	64	62	66	71	73	70	56	30
B	Exposed façade, m^2	10.5			10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
C	Volume of receiving room, m^3	22.3												
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)				-8.6	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6
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			22	52.4	35.1	27.8	21.7	17.3	14.3	12.5	9.6	-9.7	-35.5
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			25	55.4	38.1	30.8	24.7	20.3	17.3	15.5	12.6	-6.7	-32.5
Glazing:	-													
Ventilator type:	-													

Bedroom 6 - front elevation

	* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{max}			77	79	67	64	62	66	71	73	70	56	30
B	Exposed façade, m^2	1.8			2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
C	Volume of receiving room, m^3	22.3												
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)				-8.6	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6
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	44.7	27.4	20.1	14.0	9.6	6.6	4.8	1.9	-17.4	-43.2
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	47.7	30.4	23.1	17.0	12.6	9.6	7.8	4.9	-14.4	-40.2
Glazing:	*4mm, 16/20mm, 4mm*													
Ventilator type:	*Titan V50/standard canopy*													
	Combined sound level, dB(A)			43										

Appendix 3. References

L.S. Søndergaard, R. Egeda. “Open windows with better sound insulation”, DELTA Acoustics, Denmark, 2016.