Acoustic assessment of a proposed residential development at Lower Gower Road, Royston

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0. SUMMARY

- ACA Acoustics Limited has been commissioned to assess external noise intrusion along with ground-borne vibration to a proposed new residential development at Lower Gower Road, Royston. The assessment is required by the Local Planning Authority, North Hertfordshire District Council, to assist their consideration of a planning application for the development.

- A sound level survey was carried out at the development site over nominally a 24-hour period between 30th and 31st October 2017. Whilst on site, the author considered the sound climate during the daytime to be generally low, punctuated by trains passing on the adjacent line. The author understands that existing commercial units on the site are to be demolished as part of the development and as such assessment of noise from these sources in accordance with BS 4142:2014 is not necessary.

- Measured sound levels at the rear of the site, closest to the railway lines, are $LAeq_{16\ hour}$ 59dB during the daytime and $LAeq_{8\ hour}$ 53dB overnight. Short-term individual noise events overnight do not regularly exceed a level of LAfmax 78dB. Short-term measurements around the centre of the site, further removed and partially screened from the railway lines indicate that levels at this position are typically at least 4dBA lower than those immediately adjoining the railway.

- An outline scheme for sound insulation of the building envelope has been developed such that internal sound levels during the daytime do not exceed LAeq 35dB within living rooms. Sound levels at night shall not exceed LAeq 30dB and LAfmax 45dB to bedrooms. These levels correspond with recommended limits set out in BS 8233:2014 and World Health Organisation guidelines. Details of the outline sound insulation scheme are provided within this report.

- Sound levels to the rear of the site, closest to the railway lines, currently exceed recommended criteria to external amenity areas. However, a 2m high close-boarded timber fence along the boundary of the private gardens should provide in the region 6dBA reduction to the currently achieved levels. Sound levels within gardens closest to the railway lines will therefore be around LAeq 53dB and levels in gardens further removed from the railway will be significantly lower, achieving a reasonable standard of amenity for future residential occupants.

- Vibration measurements have been carried out at the proposed development site over a representative period during daytime hours. Results of the survey have been used to assess vibration levels at the site in terms of Vibration Dose Values (VDV) in accordance with procedures in BS 6472-1:2008. Vibration levels at the site are below the range of values where it is considered there is a low probability of adverse comment, as defined in BS 6472-1:2008, and no additional measures to reduce ground-borne vibration will be required.

- It is the author's opinion that, allowing for the recommended acoustic specification for façade envelope elements set out in this report, internal sound and vibration levels within the new

residential units should not be detrimental to the amenity of future occupants and the site is suitable for residential development.

1. INTRODUCTION

ACA Acoustics Limited has been commissioned to carry out a survey and assessment of external sound levels along with ground-borne vibration to a proposed residential development at Lower Gower Road, Royston and, where necessary, to make recommendations for a suitable sound and vibration mitigation scheme.

The objective of the assessment is to determine the impact that existing noise and vibration sources would have on the proposed residential units in accordance with national planning policies and other relevant British Standards and guidance documents.

This report presents results of the sound and vibration level survey and assessment along with a scheme for sound insulation such that suitable internal sound and vibration levels are achieved.

2. ACOUSTIC CRITERIA

The proposed sound and vibration level measurement and assessment methodology is based on ACA Acoustics Limited's experience of undertaking assessments for similar developments. A review of the relevant parts of each of the routinely used planning guidance documents and British Standards is provided below.

2.1 North Hertfordshire District Council's Planning Requirements

Based on similar developments, ACA Acoustics anticipate that North Hertfordshire District Council would impose the following noise-related condition on any planning approval:

Prior to the commencement of the development the developer shall carry out a noise assessment in accordance with relevant guidance and standards and a scheme for sound insulation and noise control measures shall be submitted for the Council's written approval. The approved scheme shall be implemented in accordance with the approved details in order to achieve the following internal noise targets:
Bedrooms (23:00 – 07:00 hrs) 30dB LAeq (8 hour) and 45dB LAmax(f)
Living rooms (07:00 – 23:00 hrs) 35dB LAeq (16 hour)
Dining room / area (07:00 – 23:00 hrs) 40dB LAeq (16 hours)
Once implemented, the scheme of measures shall be maintained in accordance with the approved details.

North Hertfordshire District Council also typically require the sound level in outdoor amenity areas (gardens, balconies) should be less than LAeq 55dB.

The recommended criteria correspond with guidelines set out in British Standard 8233:2014 and World Health Organisation document.

2.2 National Planning Policy Framework (NPPF) and Noise Policy Statement for England (NPSE)

The National Planning Policy Framework (referred to as NPPF) sets out the Governments' planning policies for England and provides guidance on how these are expected to be applied, providing a framework within which Local Authorities can produce their own distinctive local and neighbourhood plans, which reflect the needs and priorities of their communities.

Paragraph 109 of the NPPF states that:

"*The planning system should contribute to and enhance the natural and local environment by: preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability*".

It also talks specifically about noise and states that:

"*Planning policies and decisions should aim to:*

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

In March 2010 the Department for Environment, Food and Rural Affairs (Defra) issued Noise Policy Statement for England (referred to as NPSE). This sets out the Government's long-term policy aims that are intended to be considered by Local Planning Authorities when development their own Local Policies relating to noise. Stated aims of NPSE are:

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

- *Avoid significant adverse impacts on health and quality of life;*
- *Mitigate and minimise adverse impacts on health and quality of life; and*
- *Where possible, contribute to the improvement of health and quality of life.*"

Paragraphs 2.19 to 2.24 clarify the above aims, referring to established concepts from toxicology; NOEL (No Observed Effect Level) and LOAEL (Lowest Observed Adverse Effect Level). It also introduces a new concept relating to *"significant adverse*" of SOAEL (Significant Observed Adverse Effect Level), however stating that "*it is not possible to have a single objective noise-based measure that describes SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times*".

The second aim of the NPSE refers to the situation where the impact lies somewhere between LOAEL and SOAEL. It requires that all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also considering the guiding principles of sustainable development, as set out in the NPPF.

Paragraph 2.7 advises that "… *the application of the NPSE should enable noise to be considered alongside other relevant issues and not to be considered in isolation. In the past, the wider benefits of a particular policy, development or other activity may not have been given adequate weight*

when assessing the noise implications". This provides clear guidance that noise must not be considered in isolation but as part of the overall scheme taking into account the overall sustainability and associated impacts of the proposed development; there is no benefit in reducing noise to an excessively low level if this creates or increases some other adverse impact. Similarly, it may be appropriate in some cases for noise to have an adverse impact if this is outweighed by the reduction or removal of some other adverse impact that is of greater significance to the development.

2.3 Planning Practice Guidance – Noise (PPG-N)

Related to the NPSE and the NPPF, The Department for Communities and Local Government has published additional guidance and clarifications within the Planning Practice Guidance – Noise (PPG-N), available at https://www.gov.uk/guidance/noise--2.

Paragraph 003 of the PPG advises that

"Local planning authorities' plan-making and decision taking should take account of the acoustic environment and in doing so consider:

- *Whether or not a significant adverse effect is occurring or likely to occur;*
- *Whether or not an adverse effect is occurring or likely to occur; and*
- *Whether or not a good standard of amenity can be achieved.*

In line with the Explanatory Note of the Noise Policy Statement for England, this would include identifying whether the overall effect of the noise exposure … is, or would be, above or below the significant observed adverse effect level and the lowest observed adverse effect level for the given situation."

This guidance is very like that set out in the NPPF and NPSE, however, Paragraph 005 of the PPG provides outline guidance on the definition of '*significant adverse effect*' and '*adverse effect*'. Copy of the table provided within Paragraph 005 is repeated on the following page.

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 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

Table 1: Likely average response to noise exposure

Although this provides description of definitions for the LOAEL and SOAEL, as with the NPPF and NPSE there are no numerical values provided and consideration of guideline values provided in

other British Standards, including BS 8233:2014, may be considered appropriate. Discussion of BS 8233:2014 is provided below.
Paragraph 009 of the PPG-N also provides an evaluation of the use of local amenity areas to offset the noise impacts of high sound level sources, noting:

"Noise impact may be partially off-set if the residents of those dwellings have access to:

- *A relatively quiet facade (containing windows to habitable rooms) as part of their dwelling, and/or;*
- *A relatively quiet external amenity space for their sole use, (e.g. a garden or balcony). Although the existence of a garden or balcony is generally desirable, the intended benefits will be reduced with increasing noise exposure and could be such that significant adverse effects occur, and/or;*
- *A relatively quiet, protected, nearby external amenity space for sole use by a limited group of residents as part of the amenity of their dwellings, and/or;*
- *A relatively quiet, protected, external publicly accessible amenity space (e.g. a public park or a local green space designated because of its tranquillity) that is nearby (e.g. within a 5 minutes walking distance).*"

2.4 British Standard 8233:2014

The introduction to BS 8233:2014 *Guidance on sound insulation and noise reduction for buildings* advises that "*this guide suggests criteria, such as suitable sleeping/resting conditions, and proposes noise levels that normally satisfy these criteria*". As such it is considered that guideline noise limits set out in BS 8233:2014 are suitable to protect future occupants of the dwelling from noise disturbance and compliance with these values would ensure sound levels within the new developments are below the Lowest Observed Adverse Effect Level and comply with the principles of the NPPF, NPSE and PPG-N, along with corresponding to the recommended criteria provided by the Local Authority.

Guidance limits for internal sound levels within living rooms and bedrooms, taken from Table 4 of BS 8233:2014, are shown in Table 2 below:

Activity	Location	07:00 – 23:00	23:00 – 07:00
Resting	Living Room	35dB LAeq, 16hr	-
Dining	Dining Room/Area	40dB LAeq, 16hr	-
Sleeping (daytime resting)	Bedroom	35dB LAeq, 16hr	30dB LAeq, 8hr *

Table 2: BS 8233:2014 indoor ambient sound levels for dwellings

***:** Note 4 of Table 4 confirms that "*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 LAFmax, depending on the character and number of events per night*"; no specific criteria is set within the 2014 revision of the standard. The previous edition of the standard advises that individual noise events should not regularly exceed LAFmax ≤45dB overnight. The author considers that this standard is suitable to protect future residents from regular individual noise events.

Paragraph 7.7.3.2 of the Standard provides design criteria for external noise and advises that:

> *"It is desirable that the external noise level does not exceed 50dB LAeq, T, with an upper guideline value of 55dB LAeq, T, which would be acceptable in noisier environments. However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable … In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited".*

2.5 World Health Organisation (WHO)

The World Health Organisation's guidance "*Community Noise 1999*" recommends a limit of Leq 30dBA for bedrooms at night as preventing sleep disturbance to vulnerable people. The WHO guidance also states that "*for a good sleep, it is believed that indoor sound pressure levels should not exceed 45dB LAFmax more than 10-15 times per night*".

The levels advised in The World Health Organisation's guidance correlate very well with those in BS 8233 described above.

2.6 British Standard 6472-1:2008

British Standard 6472-1:2008 *Guide to evaluation of human exposure to vibration in buildings – Part 1: Vibration sources other than blasting* is commonly used to assess the suitability of a site for residential development where there is potential for raised levels of ground-borne vibration, particularly where a proposed residential development site is close to railway lines.

BS 6472-1:2008 provides detailed guidance on the measurement and assessment of vibration levels and offers guideline criteria for levels of vibration which may cause adverse comment. For intermittent vibration, as in the case of trains, the standard recommends vibration is assessed in terms of Vibration Dose Values (VDV). This takes account of the severity of the vibration for each event (trains passing), the frequency, and the duration of vibration events to give separate day and night time VDV levels for comparison with guideline limits.

The significance for human response to vibration within residential dwellings, taken from Table 1 of BS 6472-1:2008. Is shown in Table 3 on the following page.

Reference Time	Low Probability of Adverse Comment $m/s^{-1.75}$	Adverse Comment Possible $m/s^{-1.75}$	Adverse Comment Probable $m/s^{-1.75}$
Daytime (07:00 – 23:00)	0.2 – 0.4	0.4 – 0.8	0.8 – 1.6
Night time (23:00 – 07:00)	0.1 – 0.2	0.2 – 0.4	0.4 – 0.8

Table 3: BS 6472-1:2008 assessment results criteria

Typically, ACA Acoustics recommends designing daytime and night time VDV to not exceed the range of values defined in BS 6472-1:2008 as achieving a 'low probability of adverse comment'. It is considered this will provide a good standard of amenity for future residential occupants.

3. REVIEW OF SITE LOCATION & DEVELOPMENT PROPOSALS

The development site is at Lower Gower Road, Royston, Hertfordshire. The site is currently of various small industrial and commercial units. The north of the site faces rear gardens of residential properties along Stuart Drive. Railway lines border the site to the east. Residential properties on Titchmarsh Close are to the south, with the railway lines running beyond and Lower Gower Road is to the west. With the exception of the buildings on the development site itself, the surrounding area is almost exclusively of residential dwellings.



Figure 1: Site layout plan

Drawing showing layout of the proposed development, provided by the client, is shown in Figure 1 below.

The development comprises sixteen dwelling-houses, along with associated private and communal amenity space and parking.

Sound levels to the site during the daytime are relatively low, punctuated by short-term peaks as trains pass the site. The author understands that existing industrial units on the site are to be demolished as part of the development and as such assessment of noise from these uses is not required.

4. SOUND LEVEL SURVEY

To assess the impact of existing sound sources, a sound level survey was conducted at the development site to determine levels incident on the proposed residential units.

The site was considered secure and therefore an unattended survey was carried out over nominally a 24-hour period between 30th and 31st October 2017. Sound level measurements were recorded in consecutive 15-minute samples of overall Lmax, LAeq and L90 values along with other statistical indices and octave band spectra.

A single measurement position was used for the survey at eastern boundary of the site, at a position equivalent to the rear façade of Plot 15, facing towards the railway lines. In addition to the unattended measurements, during the visit to site on 30th October sound levels were also recorded at a position towards the front of the site, equivalent to the proposed dwellings further removed from the railway.

The following equipment was used during the survey; the sound level meters were calibrated before the survey and checked after with no deviation noted.

Equipment	Serial Number	Calibration Certificate
NTi Audio sound level meter type XL2 Class 1, complete with weatherproof and lockable outdoor environmental kit	A2A-06294-E0	160915
NTi Audio sound level meter type XL2-TA Class 1 complete with weatherproof and lockable outdoor environmental kit	A2A-12174-E0	42691
Castle calibrator type 4226. Compliant to IEC 60942-1:2003 (Calibrated to a reference traceable to NIST)	1551589	044039/68679

Table 4: Equipment used

The following weather conditions were recorded at the start and end of the survey. No precipitation was recorded throughout the survey. These conditions are considered reasonable and will not have had an adverse impact on measured sound levels.

Time	Temperature	Wind Speed m/s	Wind Direction	Precipitation mm
11:00 30th October	7 °C	4	East	0
15:30 31st October	12 °C	6	East	0

Table 5: Recorded meteorological conditions

Results of the survey are shown in Figure 2. Summary of the daytime and night time sound level survey results are shown in tabular form in Table 6 below.

Date	Daytime (07:00 – 23:00) LAeq	Night Time (23:00 – 07:00) LAeq	Night Time (23:00 – 07:00) Typical LAfmax
30th – 31st October 2017	59dB	53dB	78dB

Table 6: Summary sound level survey results

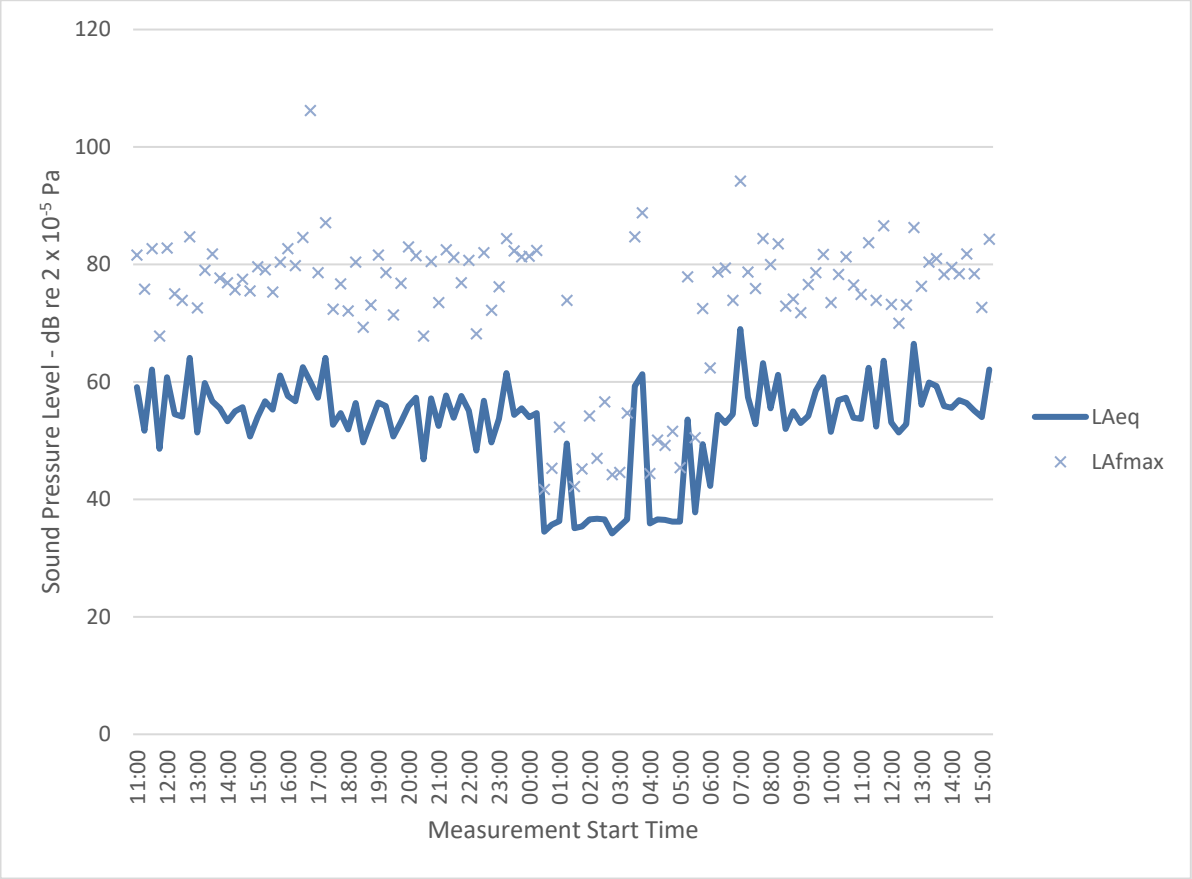


Figure 2: Sound level survey results

The author remained on site for the first hour of measurements, from around 11:00 to 12:00 hours on 30th October 2017. During this time dominant sound sources were observed to be occasional passing trains on the adjacent railway. Between train passes sound levels were subjectively low and primarily due to pedestrians passing on the public footpath, distant traffic on surrounding roads and occasional low-level activity from some of the industrial units on the site.

Sound levels measured at the middle of the site, at a position equivalent to around Plot 8, were measured at LAeq 54dB between 11:00 and 12:00. This is 4dBA lower than levels measured simultaneously in the logging survey.

5. FAÇADE ACOUSTIC ASSESSMENT

A scheme for sound insulation is necessary to ensure sound levels inside rooms of the new residential apartments are reasonable and comply with the requirements of BS 8233:2014 and World Health Organisation guidelines.

A computer model has been set up using the measured sound levels incident on the façade of the flats along with anticipated façade elements. The computer model is based on the calculation procedures outlined in BS EN ISO 12354-3:2000 and BS 8233:2014.

Confirmation of the acoustic performance of the building envelope elements used in the calculation model is provided below. *Note that consideration of non-acoustic aspects including, but not limited to, Building Regulations Approved Documents and structural calculations are outside the scope of ACA Acoustics Limited and should be considered by others accordingly*.

Performance specification for windows/doors and the roof has been provided in 'Zones'. Location of the zones are shown in Figure 3 on the following page; Zone 1 is shown in green and Zone 2 coloured in purple. For the roof/ceiling, where rooms have an elevation in Zone 1 then the associated ceiling construction should be used.

Description	Rw (dB)	Rw + C'tr (dB)	Typical Construction
Façade Walls	60	53	100mm facing brickwork, minimum 50mm cavity and 100mm medium density blockwork with plasterboard or wet plaster to the inner face
Windows to Living Rooms – Zone 1	32	27	Thermal double-glazing, such as 4-16-4 configuration or similar
Windows to Bedrooms – Zone 1	38	32	Acoustic double-glazing with laminated or toughened panes, such as 8.8-22-4 or similar
Windows to Living Rooms – Zone 2	32	27	Thermal double-glazing, such as 4-16-4 configuration or similar
Windows to Bedrooms – Zone 2	35	30	Double-glazing with asymmetrical panes such as 4-14-6 or similar
Roof/Ceiling – Zone 1	56	49	Pitched tile/slate roof with minimum 100mm mineral wool insulation in the loft cavity and two layers 12.5mm plasterboard on joists independent to the rafters.
Roof/Ceiling – Zone 2	52	44	Pitched tile/slate roof with minimum 100mm mineral wool insulation in the loft cavity and one layer 12.5mm plasterboard on joists independent to the rafters.

Table 7: Acoustic performance specification for facade elements

Note that the constructions provided are typical and slight variations on the specification would be acceptable, so long as the installed construction achieved the specified sound insulation performance. The specification provided for glazed elements is for the window/door as a complete unit, including frames and seals, and it is recommended the successful glazing supplier confirm their unit supplied will comply with the specified performance.

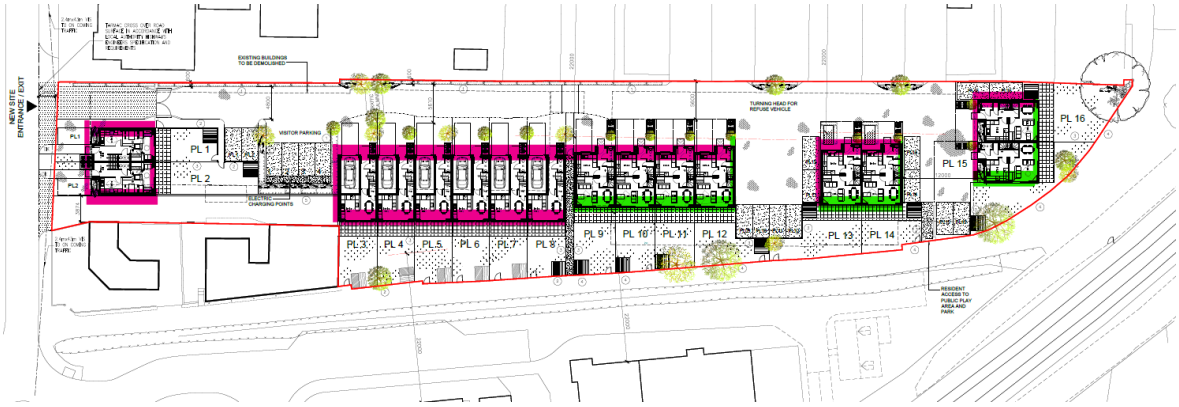


Figure 3: Acoustic specification construction zones

It is usual to satisfy internal sound level criteria whilst achieving the background ventilation rate defined by Approved Document F of the Building Regulations, rather than for the purge ventilation rate. It is therefore anticipated that it will be necessary to incorporate an acoustic ventilation scheme into the design such that residents can achieve background ventilation without necessarily needing to open windows.

Values in Table 8 below show a specification schedule of ventilator sound insulation performance for the development, used in the computer model. Note that there are many different passive ventilators including through-wall type and those built into the window frame. If the Dn,e,w performance is not lower than that shown in Table 8 then any alternative ventilator may be used.

Description	Dn,e,w (dB)	Typical Construction
Living rooms to Zone 1 and Zone 2	35	Traditional hit-and-miss trickle ventilators
Bedrooms to Zone 1 and Zone 2	40	Acoustic ventilators such as Velfac's Window Frame Air Vent or similar

Table 8: Specification for ventilator Element Normalized Level Difference - Dn,e,w (dB)

Should the client prefer, ventilation may be provided by mechanical systems, such as MVHR or MEV. Suppliers including Titan or Vent Axia would be able to offer suitable ventilation systems for residential purposes. It is important that any self-noise (i.e. noise from the fans) and external noise intrusion through the ducted system must not cause internal sound levels to exceed the design requirements. To achieve these limits, it is recommended that the overall noise from any

mechanical ventilation system will need to be no higher than LAeq 25dB to allow for accumulation of noise sources. Suitable MVHR systems must also incorporate summer bypass mode to minimise the potential for overheating during summer months.

Copy of acoustic calculations for daytime and night time noise intrusion into sample rooms is provided in Appendix A. Summary results are confirmed in Table 9 below and demonstrate that intrusive sound levels within rooms of the proposed residential units will comply with guidance limits in British Standard BS 8233:2014.

Plot / Room	Calculated Internal Sound Level		BS 8233:2014 Criteria
	LAeq	LAfmax	
Plot 8, Living Room	27dB	-	LAeq ≤ 35dBA
Plot 8, Bedroom	17dB	42dB	LAeq ≤ 30dBA LAfmax ≤ 45dBA
Plot 15, Living Room	29dB	-	LAeq ≤ 35dBA
Plot 15, Bedroom	24dB	45dB	LAeq ≤ 30dBA LAfmax ≤ 45dBA

Table 9: Summary internal sound levels within sample habitable rooms

6. EXTERNAL AMENITY AREAS

External amenity areas to the plots from around the middle of the site forwards, will be further removed and screened from passing trains on the nearby railway. Based on short-term measurements, this is anticipated to provide in the region ≥4dBA reduction from sound levels measured at the location of Plot 15 adjacent to the railway line, equating to daytime sound levels within these amenity spaces of $LAeq_{16\ hour}$ ≤55dB. This is below the upper guideline limit and will ensure a reasonable standard of amenity for future residents.

Sound levels to external amenity areas at the rear of the site, closest to the railway, have been measured at LAeq 59dB. This exceeds the recommended guideline value of LAeq 55dB by 4dBA. Based on topography of the site provided by the client, and estimated height of the railway tracks by the author on site, it is calculated that a 2m high close-boarded timber boundary fence around the rear gardens will reduce sound levels from passing trains by at least 6dBA to a position in the centre of the garden, thus achieving a sound level of $LAeq_{16\ hour}$ ≤53dB and ensuring a reasonable standard of amenity.

It is also of benefit to consider that BS 8233:2014 discusses the scenario where ambient sound levels exceed the recommended limits and advises that "*it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable … In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited*". The PPG-N also discusses situations where external sound levels slightly exceed ideal values and notes that the noise impact may be offset through the availably of "*a relatively quiet, protected, external publicly accessible amenity space (e.g. a public park or a local green space designated because of its tranquillity) that is nearby*"; additional public amenity space further removed from the railway is available at a large children's play park and open field beyond, accessed from Serby Avenue, around 250m from the site, complying with the PPG-N. This should ensure a reasonable standard of amenity for future residents.

7. VIBRATION SURVEY AND ASSESSMENT

To assess vibration from trains passing the site, vibration was measured in terms of rms acceleration, Vibration Dose Values (VDV) and peak particle velocity. This was carried out using an accelerometer fixed to a mounting block located at ground floor level at the nominal location of Plot 15, closest to the adjacent railway lines.

Due to the type of meter, it was not considered secure enough to leave the vibration monitoring equipment unattended and therefore a manned vibration survey was carried out during a representative daytime hour period.

In accordance with Section 3.5 of BS6472-1 "*where the vibration conditions are constant or repeated regularly, only one representative sample, of duration τ seconds, needs to be measured. If the vibration dose value determined is VDVb/d,τ then the total vibration dose value for the day, VDVb/d,day will be given by…*

$VDV_{b/d,day} = (t_{day}/t_{\tau})^{0.25} \times VDV_{b/d,\tau}$"

Vibration levels have been taken to be at this maximum daytime level over a full 24-hours, to account for potential train movements overnight. It is anticipated that vibration levels during late evening and night time periods will likely be lower when train numbers will reduce and therefore the assessment can be considered to be robust and levels of vibration incident on the new dwellings will consequently be lower than those predicted.

Vibration levels were measured as 30 second samples in the vertical (Z-Axis) and horizontal direction (X- and Y-Axis). The following equipment was used during the survey.

Equipment	Serial Number
Rion vibration meter type VM-54	00360146
Rion vibration pick-up type PV-83CW (accelerometer)	0063644
Extension cable and mounting block arrangement	-

Table 10: Equipment used for vibration survey

The measured vibration levels in terms of VDV values are shown in graphical form in Figure 4 below. Vibration levels in the vertical direction (Z-axis) are higher than those in the horizontal direction; this is normal for ground-borne vibration due to trains affecting adjacent residential sites. The measured individual peaks correlate with train passes, including a freight train at 11:42 hours.

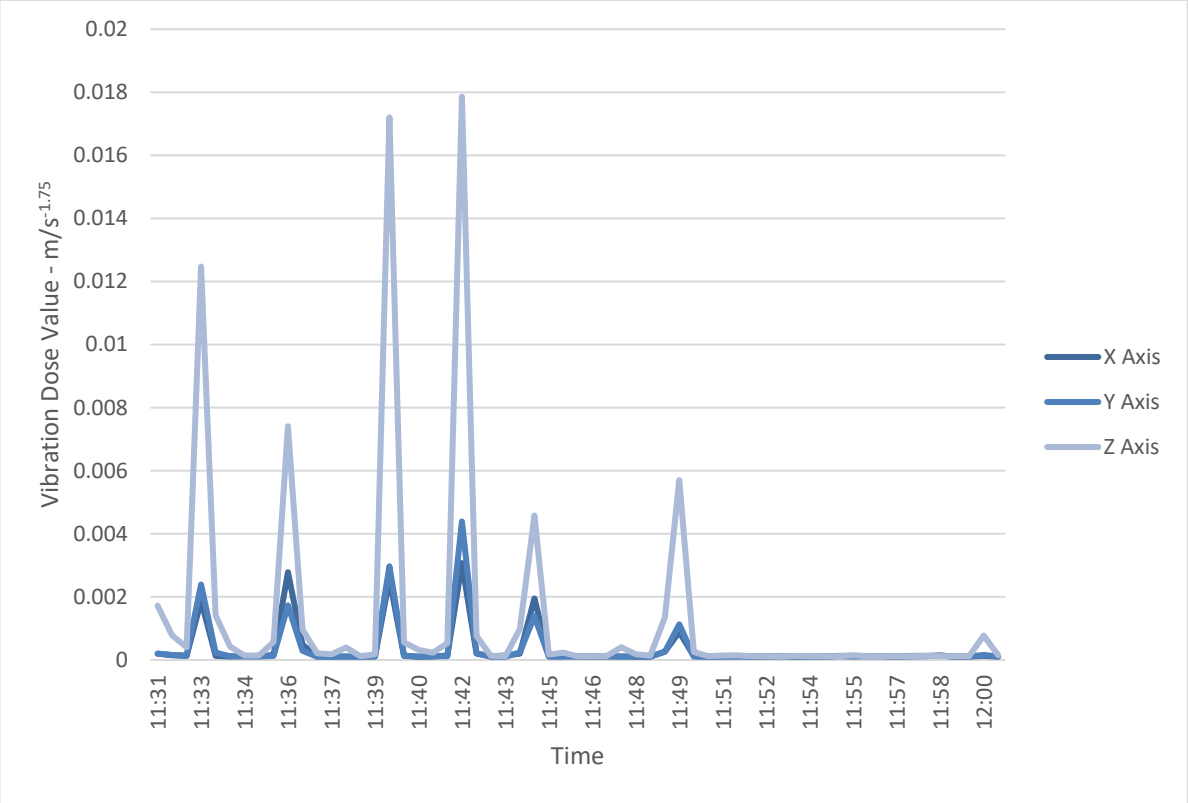


Figure 4: Vibration survey results

The individual Vibration Dose Values shown in Figure 4 are used to assess the likelihood of adverse comments due to vibration within the proposed residential buildings.

Daytime and night time VDVs have been calculated for the site in accordance with procedures outlined in Section 3.5 and Annex B of BS 6472-1. The calculated day and night time VDV for the site are shown in Table 7 below; note that as discussed in Section 6, vibration measurements were carried out over a busy daytime period and have been taken to be equivalent to those measured throughout the period of train passes. Vibration levels will likely be lower during evening periods when number of train passes will be lower and therefore the assessment can be considered to be robust and levels of vibration incident on the new dwellings will consequently be lower than those predicted:

Period	X-Axis VDV $m/s^{-1.75}$	Y-Axis VDV $m/s^{-1.75}$	Z-Axis VDV $m/s^{-1.75}$	Comments
Daytime	0.009	0.011	0.052	Vibration is below the level of a low probability of adverse comment
Night time	0.008	0.010	0.044	Vibration is below the level of a low probability of adverse comment

Table 11: Summary vibration survey VDV results for daytime and night time periods

Measured vibration levels at the proposed development site are below the range of values where there is a low probability of adverse comment, when assessed to BS 6472-1 and no specialist vibration mitigation measures would be required.

8. CONCLUSION

A planning application is to be submitted to North Hertfordshire District Council for the construction of new residential dwellings on land at Lower Gower Road, Royston.

ACA Acoustics have undertaken sound level surveys in the vicinity and calculated sound intrusion through the façade to the new dwellings. Calculated internal sound levels comply with recommended criteria set out in BS 8233:2014 and World Health Organisation guidance.

In addition to the sound intrusion assessment, ACA Acoustics have undertaken a survey of ground-borne vibration from passing trains and calculated the daytime and night time Vibration Dose Values (VDV). Calculated VDVs to the new dwellings are below the range of values where there is a low probability of adverse comment, as set out in BS 6472-1:2008.

It is the author's opinion that, allowing for the recommended acoustic specification for façade envelope elements set out in this report, internal sound and vibration levels within the new residential dwellings should not be detrimental to the amenity of future occupants and the site is suitable for residential development.

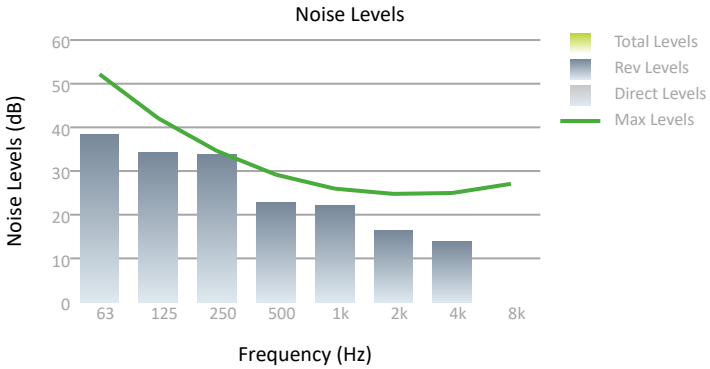
APPENDIX A

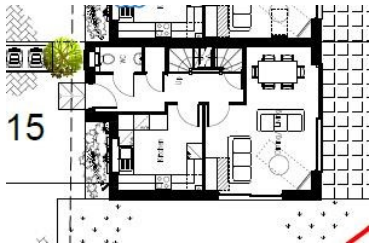
Acoustic Calculations

ACA acoustics

Lower Gower Road, Royston

Reference	Plot 15, Living
Description	Living Room
Target Sound Level	35dB(A)
Max Sound Level	35dB(A)
Calculated Sound Level	29dB(A)
Calculated Tmf T60 (s)	0.48
Volume (m^3)	64.5





Calculated Internal Sound Levels

Reference	Quantity	Noise Levels (dB)							
		63	125	250	500	1k	2k	4k	8k
Leq,ff	1	38	34	34	23	22	16	14	-

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Calculation Sheet

Plot 15, Living

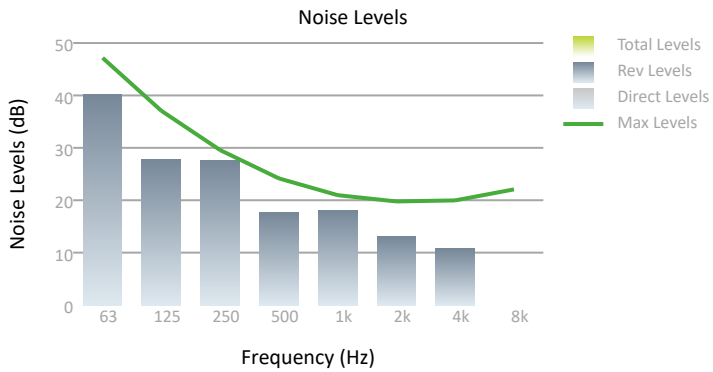
		Octave Band Centre Frequency (Hz)								
		63	125	250	500	1k	2k	4k	8k	
Sound Level at Facade										
Source dBA	**59.0**									
Octave Band Frequencies										
Leq,ff		**61.0**	**56.0**	**54.0**	**53.0**	**56.0**	**50.0**	**47.0**	**47.0**	**Row A**
Facade Wall Element										
		-39.4	*-42.4*	*-46.4*	*-46.4*	*-55.4*	*-59.4*	*-61.4*	*-66.4*	
Facade Glazed Element										
		-27.1	*-25.6*	*-24.5*	*-34.1*	*-43.1*	*-44.3*	*-40.5*	-	
Ventilators										
		-35.8	*-36.8*	*-29.8*	*-39.8*	*-37.8*	*-36.8*	*-37.8*	*-38.8*	
Cumulative Lp										
Result		**34.6**	**30.8**	**30.6**	**20.2**	**19.4**	**14.2**	**11.7**	**-**	
ISO 12354-3 Lfs Correction										
		0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	-	
Room Corrections										
		3.8	*3.5*	*3.1*	*2.7*	*2.7*	*2.2*	*2.2*	-	
Internal Receiver Noise										
Internal Receiver Noise - Plot 15, Living										
Reverberant Field, LPrev:		**38.4**	**34.2**	**33.7**	**22.8**	**22.1**	**16.4**	**13.9**	**-**	

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Lower Gower Road, Royston

Reference	Plot 15, Bedroom
Description	Typical Bedroom
Target Sound Level	30dB(A)
Max Sound Level	30dB(A)
Calculated Sound Level	24dB(A)
Calculated Tmf T60 (s)	0.45
Volume (m^3)	34.3





Calculated Internal Sound Levels

Reference	Quantity	Noise Levels (dB)							
		63	125	250	500	1k	2k	4k	8k
Leq,ff	1	40	28	28	18	18	13	11	-

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Calculation Sheet

Plot 15, Bedroom

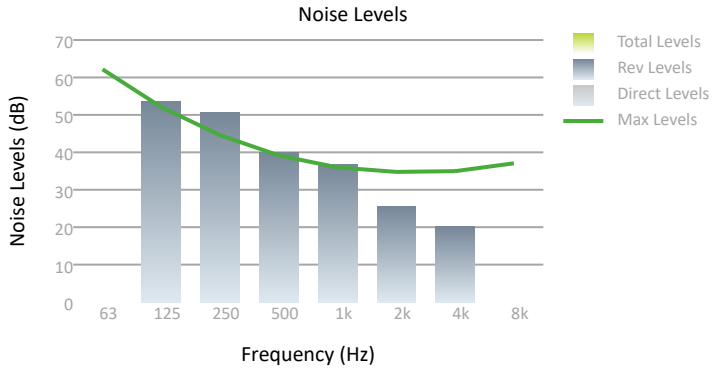
		Octave Band Centre Frequency (Hz)								
		63	125	250	500	1k	2k	4k	8k	
Sound Level at Facade										
Source dBA	**53.0**									
Octave Band Frequencies										
Leq,ff		**55.0**	**50.0**	**48.0**	**47.0**	**50.0**	**44.0**	**41.0**	**41.0**	**Row A**
Facade Wall Element										
		-40.8	*-43.8*	*-47.8*	*-47.8*	*-56.8*	*-60.8*	*-62.8*	*-67.8*	
Facade Glazed Element										
		-33.1	*-31.6*	*-30.5*	*-40.1*	*-49.1*	*-50.3*	*-46.5*	*-*	
Facade Roof Element										
		-23.9	*-40.9*	*-50.9*	*-56.9*	*-61.9*	*-62.9*	*-63.9*	*-*	
Ventilators										
		-38.1	*-39.1*	*-32.1*	*-42.1*	*-40.1*	*-39.1*	*-40.1*	*-41.1*	
Cumulative Lp										
Result		**31.8**	**19.8**	**19.9**	**10.0**	**10.9**	**6.4**	**4.0**	**-**	
ISO 12354-3 Lfs Correction										
		0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*-*	
Room Corrections										
		8.4	*8.1*	*7.7*	*7.7*	*7.2*	*6.7*	*6.7*	*-*	
Internal Receiver Noise										
Internal Receiver Noise - Plot 15, Bedroom **Reverberant Field, LPrev:**		**40.2**	**27.9**	**27.6**	**17.6**	**18.1**	**13.1**	**10.7**	**-**	

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Lower Gower Road, Royston

Reference	Plot 18, Bedroom - Lmax
Description	Typical Bedroom
Target Sound Level	-
Max Sound Level	45dB(A)
Calculated Sound Level	45dB(A)
Calculated Tmf T60 (s)	0.45
Volume (m^3)	34.3





Calculated Internal Sound Levels

Reference	Quantity	Noise Levels (dB)							
		63	125	250	500	1k	2k	4k	8k
Lmax,ff	1	-	54	51	40	37	26	20	-

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Calculation Sheet

Plot 15, Bedroom - Lmax

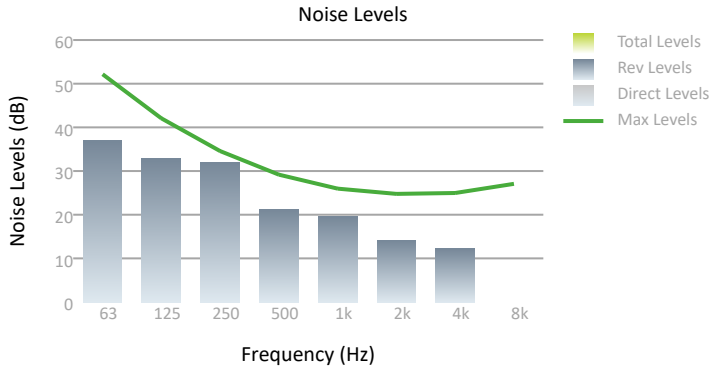
		Octave Band Centre Frequency (Hz)								
		63	125	250	500	1k	2k	4k	8k	
Sound Level at Facade										
Source dBA	**78.0**									
Octave Band Frequencies										
Lmax,ff		**78.0**	**78.0**	**80.0**	**72.0**	**71.0**	**70.0**	**70.0**	**65.0**	**Row A**
Facade Wall Element										
		-40.7	*-43.7*	*-47.7*	*-47.7*	*-56.7*	*-60.7*	*-62.7*	*-67.7*	
Facade Glazed Element										
		-36.2	*-33.8*	*-38.0*	*-49.2*	*-51.4*	*-55.0*	*-60.3*	-	
Facade Roof Element										
		-23.9	*-40.9*	*-50.9*	*-56.9*	*-61.9*	*-62.9*	*-63.9*	-	
Ventilators										
		-	*-48.1*	*-50.1*	*-41.1*	*-42.1*	*-55.1*	*-66.1*	-	
Cumulative Lp										
Result		**-**	**45.5**	**42.9**	**32.4**	**29.6**	**18.9**	**13.5**	**-**	
ISO 12354-3 Lfs Correction										
		-	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	-	
Room Corrections										
		-	*8.1*	*7.7*	*7.7*	*7.2*	*6.7*	*6.7*	-	
Internal Receiver Noise										
Internal Receiver Noise - Plot 18, Bedroom - Lmax **Reverberant Field, LPrev:**		**-**	**53.5**	**50.5**	**40.0**	**36.8**	**25.6**	**20.2**	**-**	

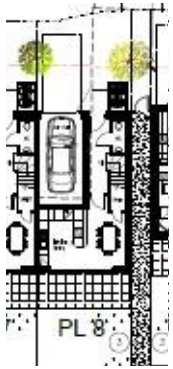
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Lower Gower Road, Royston

Reference	Plot 8, Living
Description	Living Room
Target Sound Level	35dB(A)
Max Sound Level	35dB(A)
Calculated Sound Level	27dB(A)
Calculated Tmf T60 (s)	0.48
Volume (m^3)	52.7





Calculated Internal Sound Levels

Reference	Quantity	Noise Levels (dB)							
		63	125	250	500	1k	2k	4k	8k
Leq,ff	1	37	33	32	21	20	14	12	-

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Calculation Sheet

Plot 8, Living

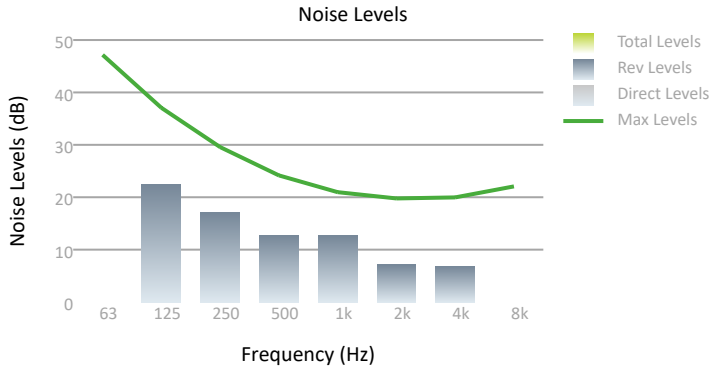
		Octave Band Centre Frequency (Hz)								
		63	125	250	500	1k	2k	4k	8k	
Sound Level at Facade										
Source dBA	**55.0**									
Octave Band Frequencies										
Leq,ff		**57.0**	**52.0**	**50.0**	**49.0**	**52.0**	**46.0**	**43.0**	**43.0**	**Row A**
Facade Wall Element										
		-40.0	*-43.0*	*-47.0*	*-47.0*	*-56.0*	*-60.0*	*-62.0*	*-67.0*	
Facade Glazed Element										
		-25.8	*-24.3*	*-23.2*	*-32.8*	*-41.8*	*-43.0*	*-39.2*	-	
Ventilators										
		-36.3	*-37.3*	*-30.3*	*-40.3*	*-38.3*	*-37.3*	*-38.3*	*-39.3*	
Cumulative Lp										
Result		**31.7**	**28.0**	**27.6**	**17.2**	**15.6**	**10.6**	**8.7**	**-**	
ISO 12354-3 Lfs Correction										
		0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	-	
Room Corrections										
		5.2	*4.8*	*4.5*	*4.0*	*4.0*	*3.6*	*3.6*	-	
Internal Receiver Noise										
Internal Receiver Noise - Plot 8, Living										
Reverberant Field, LPrev:		**36.9**	**32.8**	**32.0**	**21.2**	**19.6**	**14.1**	**12.2**	**-**	

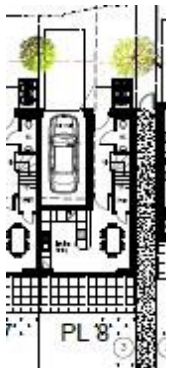
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Lower Gower Road, Royston

Reference	Plot 8, Bedroom
Description	Typical Bedroom
Target Sound Level	30dB(A)
Max Sound Level	30dB(A)
Calculated Sound Level	17dB(A)
Calculated Tmf T60 (s)	0.45
Volume (m^3)	40.6





Calculated Internal Sound Levels

Reference	Quantity	Noise Levels (dB)							
		63	125	250	500	1k	2k	4k	8k
Leq,ff	1	-	22	17	13	13	7	7	-

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Calculation Sheet

Plot 8, Bedroom

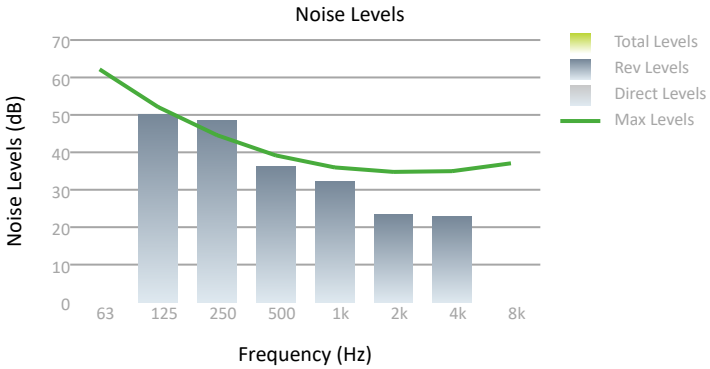
		Octave Band Centre Frequency (Hz)								
		63	125	250	500	1k	2k	4k	8k	
Sound Level at Facade										
Source dBA	**49.0**									
Octave Band Frequencies										
Leq,ff		**51.0**	**46.0**	**44.0**	**43.0**	**46.0**	**40.0**	**37.0**	**37.0**	**Row A**
Facade Wall Element										
		-40.8	*-43.8*	*-47.8*	*-47.8*	*-56.8*	*-60.8*	*-62.8*	*-67.8*	
Facade Glazed Element										
		-36.8	*-35.7*	*-35.7*	*-45.5*	*-51.2*	*-51.2*	*-50.6*	-	
Facade Roof Element										
		-17.7	*-34.7*	*-46.7*	*-54.7*	*-59.7*	*-60.7*	*-61.7*	-	
Ventilators										
		-	*-48.7*	*-50.7*	*-41.7*	*-42.7*	*-55.7*	*-66.7*	-	
Cumulative Lp										
Result		**-**	**14.4**	**9.5**	**5.2**	**5.5**	**0.5**	**0.2**	**-**	
ISO 12354-3 Lfs Correction										
		-	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	-	
Room Corrections										
		-	*8.0*	*7.6*	*7.6*	*7.1*	*6.6*	*6.6*	-	
Internal Receiver Noise										
Internal Receiver Noise - Plot 8, Bedroom **Reverberant Field, LPrev:**		**-**	**22.4**	**17.1**	**12.8**	**12.6**	**7.1**	**6.8**	**-**	

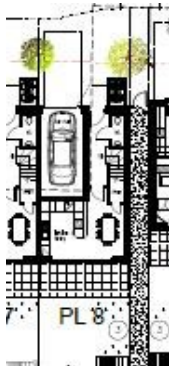
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Lower Gower Road, Royston

Reference	Plot 8, Bedroom - Lmax
Description	Typical Bedroom
Target Sound Level	-
Max Sound Level	45dB(A)
Calculated Sound Level	42dB(A)
Calculated Tmf T60 (s)	0.45
Volume (m^3)	40.6





Calculated Internal Sound Levels

Reference	Quantity	Noise Levels (dB)							
		63	125	250	500	1k	2k	4k	8k
Leq,ff	1	-	50	49	36	32	23	23	-

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Calculation Sheet

Plot 8, Bedroom - Lmax

		Octave Band Centre Frequency (Hz)								
		63	125	250	500	1k	2k	4k	8k	
Sound Level at Facade										
Source dBA	**74.0**									
Octave Band Frequencies										
Lmax,ff		**74.0**	**74.0**	**76.0**	**68.0**	**67.0**	**66.0**	**66.0**	**61.0**	**Row A**
Facade Wall Element										
		-40.8	*-43.8*	*-47.8*	*-47.8*	*-56.8*	*-60.8*	*-62.8*	*-67.8*	
Facade Glazed Element										
		-36.8	*-35.7*	*-35.7*	*-45.5*	*-51.2*	*-51.2*	*-50.6*	-	
Facade Roof Element										
		-17.7	*-34.7*	*-46.7*	*-54.7*	*-59.7*	*-60.7*	*-61.7*	-	
Ventilators										
		-	*-48.7*	*-50.7*	*-41.7*	*-42.7*	*-55.7*	*-66.7*	-	
Cumulative Lp										
Result		**-**	**42.2**	**41.0**	**28.6**	**25.1**	**16.8**	**16.1**	**-**	
ISO 12354-3 Lfs Correction										
		-	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	-	
Room Corrections										
		-	*8.0*	*7.6*	*7.6*	*7.1*	*6.6*	*6.6*	-	
Internal Receiver Noise										
Internal Receiver Noise - Plot 8, Bedroom - Lmax **Reverberant Field, LPrev:**		**-**	**50.2**	**48.5**	**36.2**	**32.2**	**23.4**	**22.7**	**-**	

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