



Azymuth Acoustics UK

Professional Acoustic Services

Noise and Vibration Impact Assessment

Ref: Z49618revA

Proposed 50 New Build Apartments

at

Chorlton Baths, Manchester

for

Mosscares St Vincent's Housing



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1.0 Introduction

Azymuth Acoustics UK (henceforth Azymuth) has been contracted by Mosscafe St Vincent's Housing to perform a noise and vibration impact assessment for a residential development at the former Chorlton Baths site in Chorlton, Manchester.

A vibration assessment is required due to the proximity of the site to the Metrolink line between Manchester Airport and Manchester City Centre.



Figure 1 – Site location plan

This noise and vibration impact assessment is intended to provide information relating to potential noise and vibration levels affecting the site in order to support the detailed planning application for the residential development. In particular, the report sets out the following details:

- The results of a baseline noise and vibration survey undertaken in the vicinity of the Chorlton Baths Site.
- The appropriate assessment criteria and guidance relating to noise and vibration in the environment as associated with this kind of development.
- Recommendations to meet the targets as set out by the assessment criteria.

2.0 Baseline Noise and Vibration Surveys

2.1 Measurement Procedures

Noise and vibration measurements were recorded at 5No. locations around the site.

- Position A: Located at the front of site closest to Unicorn Grocery (at 6m from the edge of the road)
- Position B: Located at the furthest corner of the existing building away from Unicorn Grocery (at 6m from the edge of the road)
- Position C: Opposite The Font inbetween pos A and pos B (at 6m from the edge of the road)
- Position V1/D: On the car park of the BT premises closest to Trams (at an estimated 12m from the tram line)
- Position E: on Manchester Road the Far boundary of the proposed site closest to bridge (at 5m from the edge of the road)



Figure 2 - Satellite image showing the measurement locations used for the surveys

The procedures employed for the noise and vibration survey are described below.

2.1.2 Noise Survey

The instrumentation used for the noise and vibration survey consisted of a SvanTek 977 type 1 precision sound level meter and a SvanTekc 971 type 1 sound level meter. The equipment was calibrated before and after measurements. The sound level meter(s) measured A-weighted (fast response) noise levels as well as octave bands noise levels for all noise measurements.



Daytime noise level measurements were undertaken between 14:09hrs and 15:36hrs on Friday 17th February as well as between 14:30hrs and 16:41hrs on Wednesday 1st March 2023. The night-time measurements were undertaken between 23:48hrs and 00:23hrs on Wednesday 8th March 2023.

2.1.3 Vibration Survey

The vibration measurements were undertaken at position V1 (on the adjacent BT car park site). Vibration measurements were undertaken between 12:00hrs and 13:00hrs on 23/02/2023 using the Svantek 977 sound level meter and a Dytran model 3055R2 accelerometer.

2.2 Summary of Noise and Vibration Measurements

2.2.1 Results of Noise Measurements

The following table summarises the results of the noise measurements undertaken at the proposed site in terms of the average daytime and night-time noise levels.

Location	Period	L _{AFmax}	L _{Aeq}	L _{A10}	L _{A50}	L _{A90}
Pos A - Closest to Unicorn Grocery	Day	81.6	67.9	71.1	65.6	71.1
Pos B – Edge of existing building	Day	79.8	69.1	72.6	67.3	58.2
Pos C – Opposite the font in middle of Pos A,B	Day	69.4	72.6	66.5	58.3	69.4
Pos D – On BT carpark closest to Metrolink line	Day	82.3	68.9	71.2	62.2	51.2
Pos E - Closest to bridge over Metrolink line	Night	80.8	65.1	67.6	49.9	38.8

Table 1 – Summary of free field noise measurements

2.2.2 Review of Maximum Noise Levels

Azymuth Acoustics has carried out an assessment of the available night-time L_{Amax} noise level data for the Chorlton Baths Site (referenced to ~6m from the roadside). The highest measured L_{Amax} value was 82.3dB and the duration of the night-time survey was exactly 1hr, hence it is estimated that the 10th highest L_{Amax} over the entire 8hr night-time period is likely to be around this 80.8dB value or slightly below.

2.2.3 Results of Vibration Measurements

The estimated vibration dose values in the table below are taken from an estimation of trams every 6 minutes (as a worst case).

Measurement Period	Type of Averaging	Peak Vibration Acceleration (m/s ²)	Maximum Transient Vibration Value (m/s ²)	Average RMS Vibration over 5min (m/s ²)	eVDV _{b, event} (m/s ^{1.75})
Daytime (12:20-13:10)	Overall Average	0.40	0.04	0.01	0.01
	Highest 5%ile of vibration levels	0.76	0.052	0.007	N/A

Table 2 – Results of vibration survey, showing the average and (highest) worst case values

The figure below details the vibration acceleration that has been measured across 1/3 octave bands at Position V1/D.

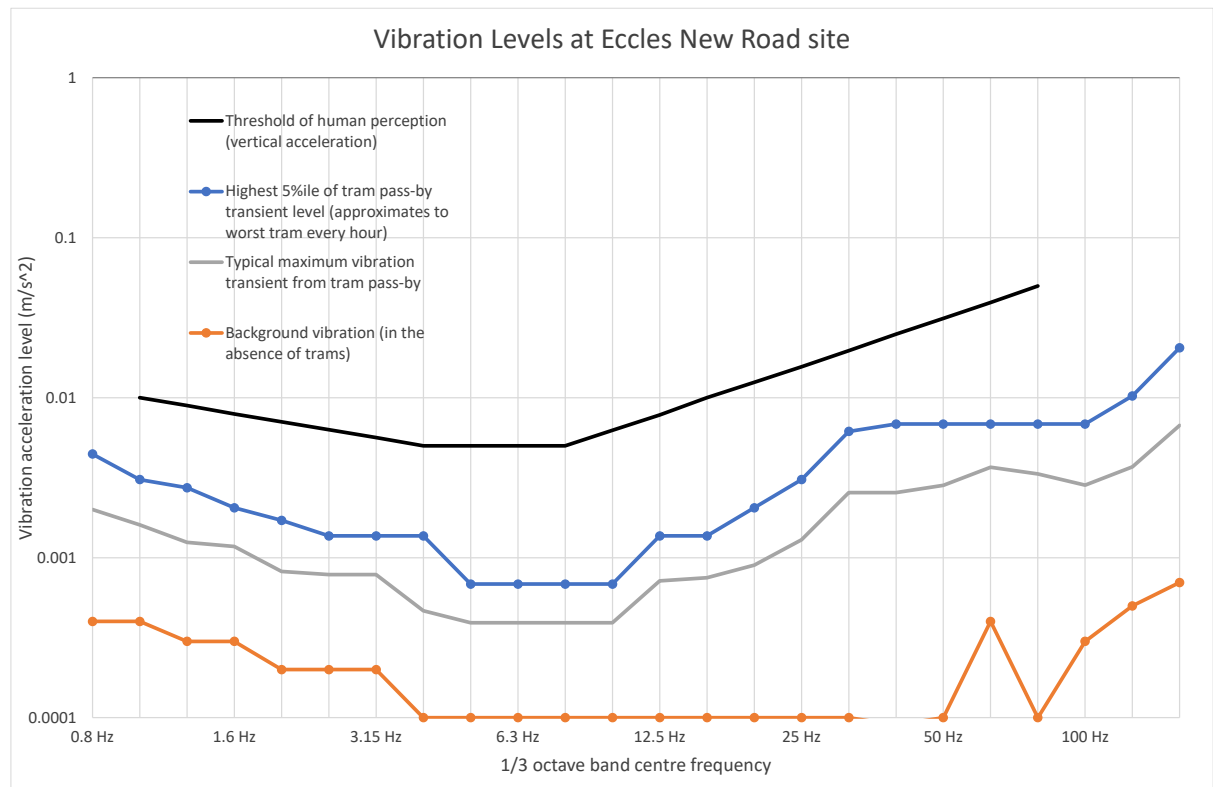


Figure 3 – The vibration acceleration level during the measurement period, displayed over 1/3 octave bands. Values without (between) trams, typical tram pass-by and the worst-case tram are included.

2.3 Noise and Vibration Climate

The noise climate at the proposed site is dominated by road traffic on Manchester Road where the measurement positions A, B, C, E are located. The regular road traffic includes cars, busses and occasional HGVs. The bus services serving Manchester Road includes the relatively frequent No.86 bus route.

The noise climate on Metrolink elevation where position D is located is controlled by tram movements as well the more general road traffic background noise. The Manchester Metrolink line serves routes from Manchester Airport and East Didsbury to Manchester City Centre in both directions on a regular basis. At night, there are few trams and buses passing with the tram timetable indicating that the first morning tram runs at 05:04h (southbound) and the last tram at night at 00:52h (northbound).

At this site, the potential vibration climate is likely to be dominated by the Metrolink Tram line near Chorlton Baths Site. However, the results of the vibration measurements and both a subjective assessment during the survey confirm the vibration levels are imperceptible at this location.

3.0 Assessment Criteria

In order to assess the extent of any measures required in order to comply with suitable conditions relating to potential noise sources, Azymuth Acoustics UK has reviewed various guidance documents and standards, these include:

- ProPG: Professional Practice Guidance on Planning and Noise (New residential development)
- National Planning Policy Framework (NPPF 2021)
- British Standard 8233:2014
- World Health Organisation Guidelines on Community Noise
- British Standard 4142:2014
- BS6472 Evaluation of Human Response to Vibration
- Manchester City Council Planning and Noise Technical Guidance Oct 2022
- IOA Guide to Demonstrating Compliance with the Noise Requirements of Approved Document O', July 2022.
- Acoustics Ventilation and Overheating Residential Design Guide 2020

3.1 ProPG: Planning and Noise - May 2017

This Professional Practice Guidance on Planning and Noise (ProPG) has been produced to provide practitioners with guidance on a recommended approach to the management of noise within the planning system in England. The National Planning Policy Framework (NPPF) encourages improved standards of design. The CIEH, IOA and the ANC have worked together to produce this guidance which encourages better acoustic design for new residential development and aims to protect people from the harmful effects of noise.

The Professional Practice Guidance on Planning and Noise States 'The recommended approach is intended to give the developer, noise practitioner, and decision maker an early indication of the likely initial suitability of the site for new residential development from a noise perspective and the extent of acoustic issues that would be faced'. It is important that acoustic design is reviewed at an early stage of the development process.

3.2 National Planning Policy Framework (NPPF) 2021

The NPPF provides guidance to local authorities taking into account noise in making planning decisions. Paragraph 185 of the National Planning Policy Framework (NPPF) states that planning policies and decisions should aim to:

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

The NPPF states that the planning system should distinguish between the hierarchy of international, national and locally designated sites; allocate land with the least environmental or amenity value, where consistent with other policies in this Framework. In addition NPPF states that the planning system should 'prevent 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'.

3.3 British Standard 8233: 2014

BS 8233 provides a code of practice for the sound insulation of a variety of building types affected by general environmental noise. It provides recommendations for control of noise in and around buildings and suggests appropriate internal ambient noise level criteria / limits for a variety of different situations including residential properties.

The following table summarises the noise limits suggested by BS 8233 applying to residential properties:

Activity	Room	Good Design Range $L_{Aeq, T}$ dB	
		07:00-23:00hrs	23:00-07:00
Resting	Living Room	35	-
Dining	Dining Room / Area	40	-
Sleeping (daytime resting)	Bedroom (at night)	35	30

Table 3 – Noise Limits for Residential Properties Suggested in BS 8233

3.4 World Health Organisation Environmental Noise Guidelines (ENG) 2018

The main purpose of the 2018 WHO guidelines is to provide recommendations for protecting human health from exposure to environmental noise originating from the following sources: transportation (road traffic, railway and aircraft), wind turbines and leisure activities.

The guidelines set out to define recommended exposure levels for environmental noise in order to protect population health. Exposure limits are average levels defined over a period of one year, measured outdoors in free field at the most exposed façade. It should be noted that the document does not provide guideline limit values for multiple noise sources in combination.

The 2018 guidelines supersede the Community Noise Guidelines from 1999. Nevertheless, the document recommends that all CNG indoor guideline values and any values not covered by the current guidelines should remain valid. As such, the following guidance would remain appropriate:

For protection against sleep disturbance inside dwellings, night time noise levels should not exceed 30dB L_{Aeq} for continuous noise and 45dB L_{Amax} for typical single sound events (which are exceeded 15times or more per night – see ProPG Appendix A.12 for more details).

To protect the majority of people from being seriously annoyed during the daytime, the outdoor sound level from steady, continuous noise (interpreted as noise from all sources combined) should not exceed 55dB L_{Aeq} on balconies, terraces and in outdoor living areas.

It should be noted that exposure levels defined in ENG and CNG are for guidance purposes as relates potential adverse health impacts and should not be interpreted as absolute limits or regulations.

3.5 British Standard 4142:2014

British Standard 4142: 2014 “Methods for assessing and rating industrial sound” describes methods for rating and assessing sound of an industrial and/or commercial nature. The methods described in this British Standard use outdoor sound levels to assess the likely

effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident.

- Typically, the greater the difference between background sound and industrial/commercial noise, the greater the magnitude of the impact.
- The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.
- A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context.
- A difference of around + 10dB or more is likely to be an indication of an adverse impact, depending on the context.

BS 4142 notes that: *“Adverse impacts include, but are not limited to, annoyance and sleep disturbance. Not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact.”*

3.6 Acoustics Ventilation and Overheating Residential Design Guide 2020

The Acoustics, Ventilation and Overheating Guide (AVO) is intended to be used by acoustics practitioners as well as all those involved in the planning, development, design and commissioning of new dwellings.

It recommends an approach to acoustics assessments for new residential development that take due regard of the interdependence of provisions for acoustics, ventilation and overheating. Application of the AVO Guide is intended to demonstrate good acoustic design as described in the ProPG, when considering internal noise level guidelines.

3.7 BS 6472 Evaluation of Human Response to Vibration

This British Standard provides guidance on the levels of vibration likely to produce varying degrees of adverse comment from people in residential buildings.

BS 6472 recommends the use of Vibration Dose Values (VDV) for the assessment of human response to vibration. The VDV can be derived from measured (or estimated) vibration acceleration values. Separate criteria are provided for daytime (16hr period e.g. 07:00-23:00 hours) and night-time (8hr period e.g. 23:00-07:00 hours). The criteria values set out in BS 6472 relating VDV to adverse comment are reproduced in Table 4 below:

Place and Time	Low probability of adverse comment ($\text{m/s}^{1.75}$)	Adverse comment possible ($\text{m/s}^{1.75}$)	Adverse comment probable ($\text{m/s}^{1.75}$)
Residential buildings 16hr day	0.2 - 0.4	0.4 – 0.8	0.8 – 1.6
Residential buildings 8hr night	0.1 – 0.2	0.2 – 0.4	0.4 – 0.8



Table 4 - Vibration dose value ranges which may result in various probabilities of adverse comment within residential buildings, taken from BS 6472-1:2008

From these guidelines, Azymuth recommends the following criteria:

- During the day, Vibration Dose Value should not exceed $0.4\text{m/s}^{1.75}$
- At night, Vibration Dose Value should not exceed $0.2\text{m/s}^{1.75}$

3.8 Recommended Noise and Vibration Assessment Criteria

Based on the guidance above it is recommended that the following criteria would be reasonable with the aim of minimising the impact of the environmental noise on the proposed new residential accommodation:

- Daytime noise levels not to exceed $35\text{dB } L_{Aeq, 16\text{hr}}$ in living rooms / bedrooms
- Daytime noise levels not to exceed $40\text{dB } L_{Aeq, 16\text{hr}}$ in dining room / kitchen
- Night-time noise levels in bedrooms not to exceed $30\text{dB } L_{Aeq, 8\text{hr}}$
- Night-time single sound events in bedrooms not to exceed $45\text{dB } L_{Amax}$ more than 15 times a night
- A broad target of as close to 55dBA for garden areas where this is possible within the constraints of the site.

Table 4, Note 5 of BS 8233:2014 states: '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 noise level. If applicable, any room should have adequate ventilation (e.g. trickle ventilators should be open) during assessment.'

Vibration levels should be at or below levels resulting in a low probability of adverse comment (as per BS 6472).



4.0 Assessment of Results

4.1 Noise Risk Assessment

The following noise risk assessment highlights the level of risk of an adverse noise effect based on the guidance from the ProPG and AVO documents as well as consideration of Part O of the Building Regulations.

Calculated values have been derived from the SounPLAN noise model.

Location	Time of Day	Noise Levels (dBA) (Measured/ Calculated)	ProPG Risk of Adverse Effect	AVO Guide Risk (Overheating) Category
Manchester Road (Posn A, B, C & E)	Daytime $L_{Aeq, 16hr}$	69 Measured	Medium – High	High
	Night-time $L_{Aeq, 8hr}$	65 Measured	High	High
Metrolink Elevation (Posn D)	Daytime $L_{Aeq, 16hr}$	69 Measured	Medium – High	High
	Night-time $L_{Aeq, 8hr}$	59 Calculated	Medium – High	High
Internal Facing Elevations	Daytime $L_{Aeq, 16hr}$	59 Calculated	Low – Medium	Medium
	Night-time $L_{Aeq, 8hr}$	54 Calculated	Medium	Medium- High

Table 5 – Noise risk assessment for Chorlton Baths

As shown above, the façades facing directly onto Manchester Road and the Metrolink elevation would represent the most significant risk in terms of potential adverse impact. These are east and west elevations and as such would indicate that there is an elevated risk of overheating requiring enhanced ventilation that would normally be offered by opening windows, however, the noise risk assessment indicates that relying on opening windows would result in significant noise intrusion, thus disrupting normal sleep. The AVO guide specifically states that:

“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.”

Hence specific mitigation measures have been included below in order to allow for enhanced levels of ventilation without the need to open windows to achieve comfortable internal conditions for the majority of the time, even during summer months.

It should be noted that ProPG does not account for daytime L_{Amax} instances. These instances may cause annoyance during the day to the potential residents. As such, extra mitigation has been recommended in order to minimise noise complaints to the premises.

4.2 SoundPLAN Model

In addition to the analysis above, Azymuth has used the data collected during the daytime and night-time surveys to produce a noise model of the site and surrounding area, outlining the contribution of various noise sources to the overall climate.

4.2.1 Grid Noise Map (GNM)

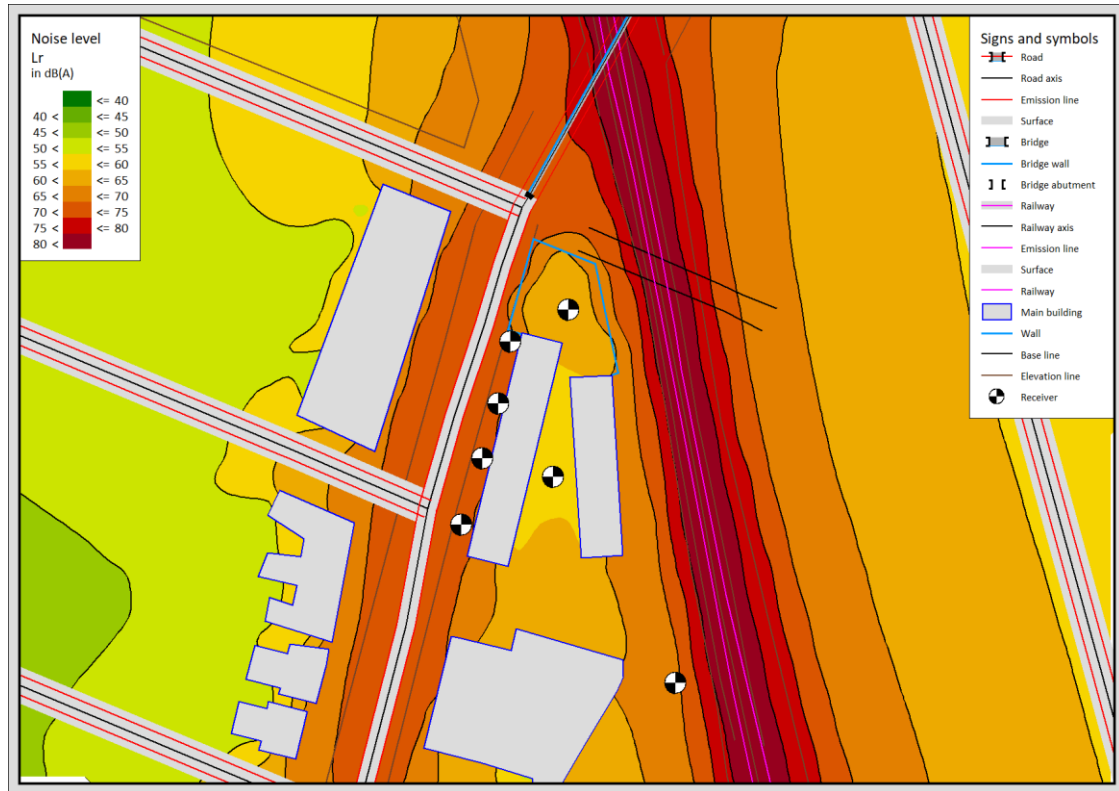


Figure 4 – GNM of the proposed site at Chorlton Baths

4.2.2 Façade Noise Map (FNM)

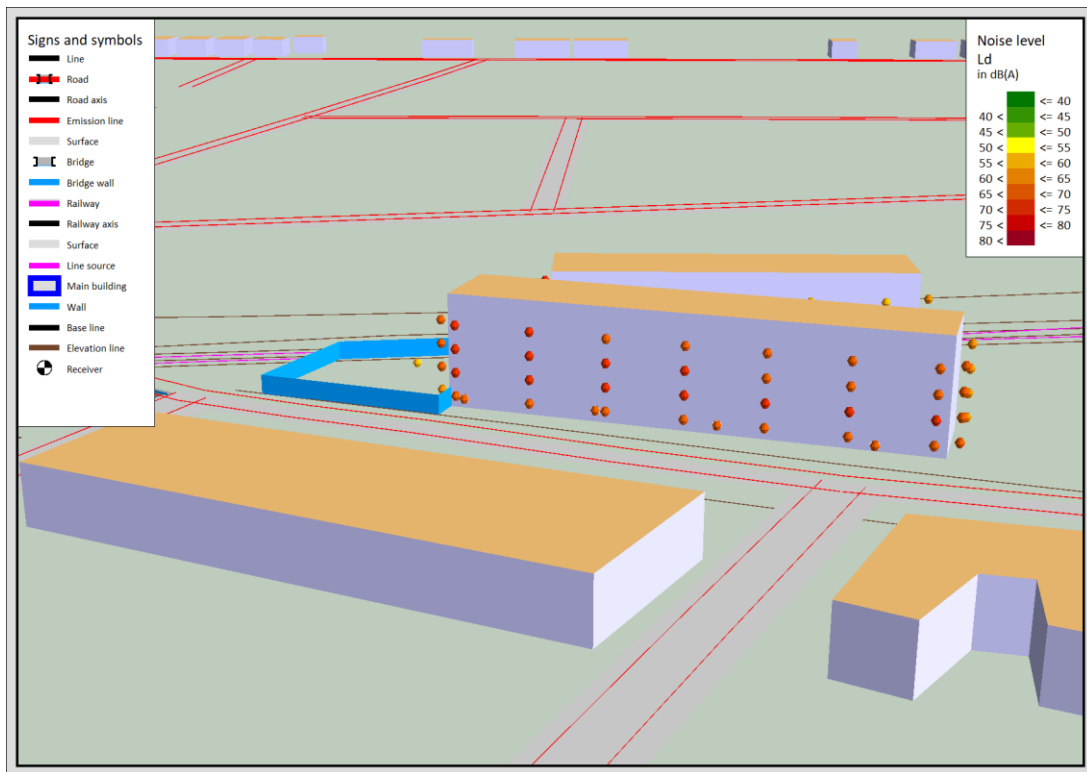


Figure 5 - FNM showing noise levels at different points on the elevation(s) facing onto Manchester Rd

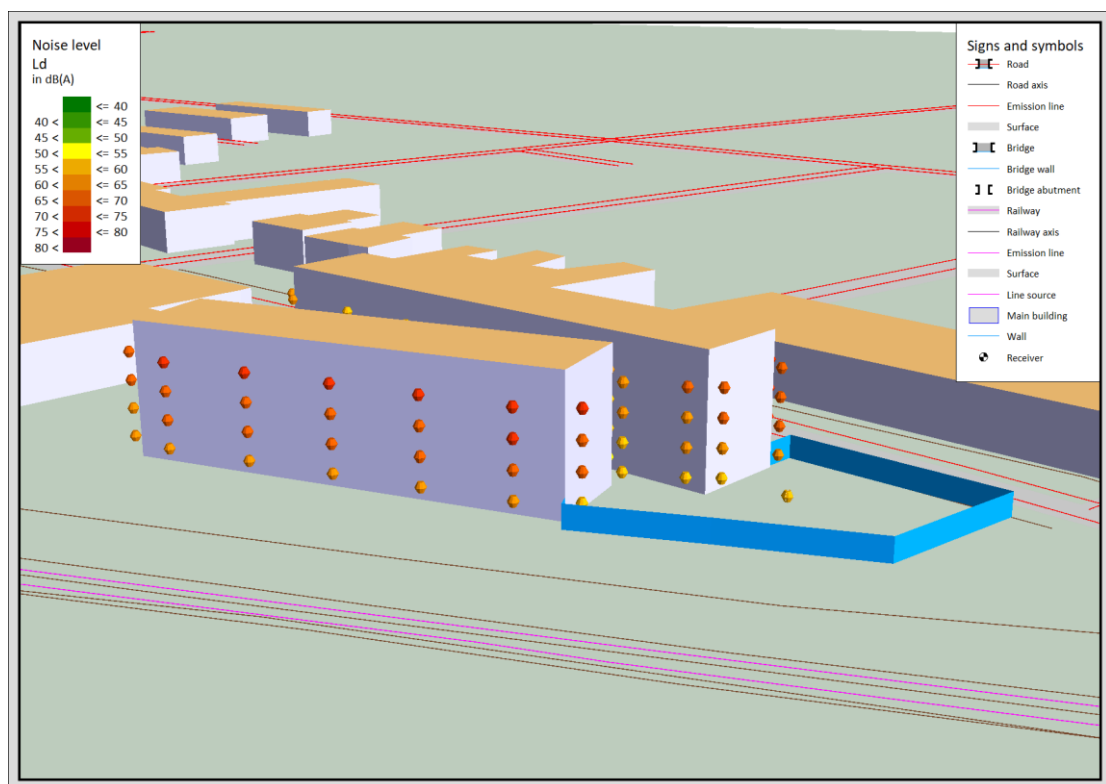


Figure 6 - FNM showing noise levels at different points on the elevation(s) facing onto Metrolink line

The model above shows the noise levels on the Chorlton Baths Site façade, with receivers placed at potential window locations, this information was used to inform the mitigation recommendations.

4.3 Vibration Assessment

The following table includes the estimated Vibration Dose Value at the measurement position at day and night, with trams passing every 6 minutes during the day, and trams operating for only a few hours at night.

Period	Estimated Vibration Dose Value ($\text{m/s}^{1.75}$ – period) at approx. 3m from edge of Chorlton Baths Site	Probability of Adverse Comment
Daytime (07:00-23:00)	0.05	Below the Low possibility of adverse comment threshold
Night-time (23:00-07:00)	0.03	Below the Low possibility of adverse comment threshold

Table 6 - Estimated Vibration Dose values for day and night, and their likelihood of adverse comment (Chorlton Baths boundary position)

5.0 Recommendations for Noise and Vibration Mitigation

5.1 Noise Mitigation

Based on survey data and the predicted noise levels derived from SoundPLAN, Azymuth has produced the following recommendations in order to mitigate the effects of noise within the proposed development. If these recommendations are followed, noise levels within the development will satisfy the criteria as set out in Section 3.8.

5.1.1 Glazing Specification

The table below outlines the glazing specification Azymuth would recommend in order to achieve the internal ambient noise level targets as set out in Section 3.8 of the report. See figure 7 for locations where these glazing specification are applicable.

Location (Habitable Spaces)	Glazing Specifications	Appropriate Glazing Types*
Manchester Road and Metrolink Elevations	Any building regulations approved min. 42dB R_W and 36dB R_W+C_{tr}	8mm/ 16mm argon/8.8mm Optiphon™
Internal Facing Elevations	Any building regulations approved min. 35dB R_W and 29dB R_W+C_{tr}	8mm/ 12mm/ 6mm thermal double glazing

Table 7 – Azymuth recommend glazing specification for the Chorlton Baths site

*Optiphon™ is a registered trademark of Pilkington glass.

NB where patio doors / large areas of glazing are proposed then additional care will be required in specifying door / window frames and opening elements with high quality acoustic seals (including threshold seals) in order to maintain the overall performance of the acoustic glazing.

5.1.2 Ventilation Strategy

Table 8 outlines the recommended ventilation that should be paired with the glazing specifications to ensure the appropriate sound insulation targets are met. With reference to the AVO and ProPG guidance, Azymuth recommends the following ventilation specification to ensure sufficient air flow to dwellings whilst also achieving internal noise level targets.

Location (Habitable Spaces)	Ventilation Specification	Appropriate Ventilation Types
All dwellings	System 4 - MVHR	No trickle vents. Any air inlets/outlets for MVHR should be appropriately attenuated

Table 8 - Azymuth recommend ventilation specification for the Chorlton Baths site

Below is a marked drawing of the proposed dwellings to indicate which glazing and ventilation specifications the façades require.

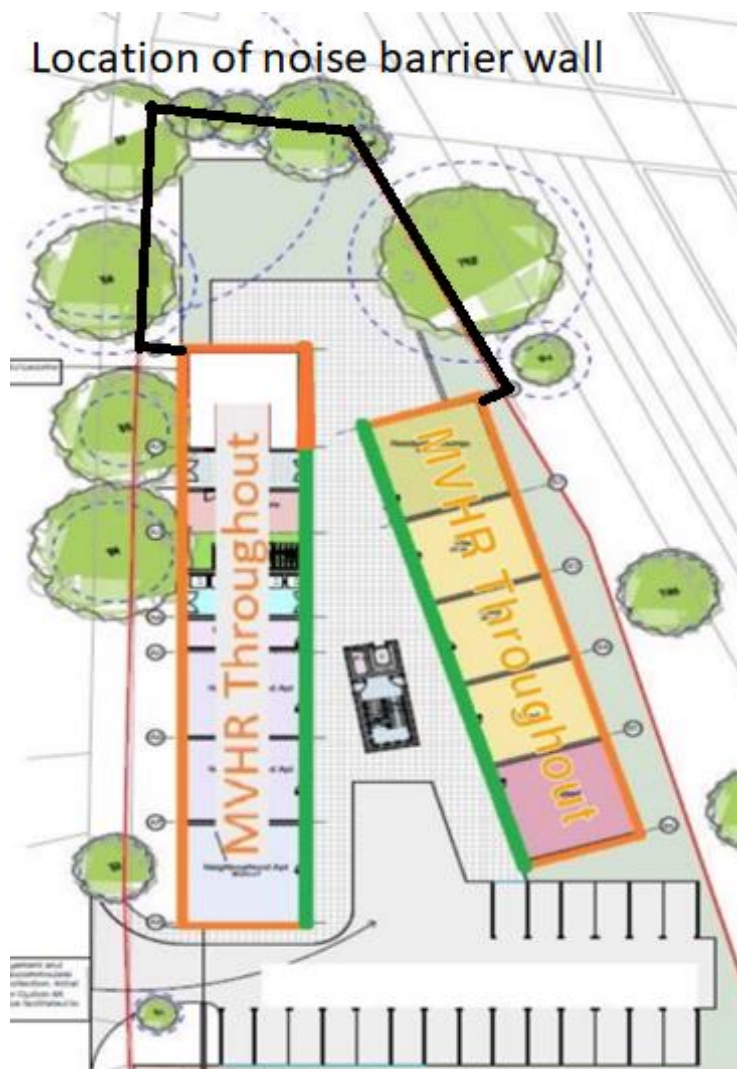


Figure 7 – Drawing of the proposed buildings, showing the two different specifications of glazing together with recommended ventilation and location of possible noise barrier wall.

5.1.3 Other Elements of Building Envelope

Other elements of the building envelope should have the following minimum sound insulation performance:

- External Walls: minimum sound insulation R_w 50dB. This minimum is likely to be significantly exceeded by a normal brickwork façade. Where alternative external wall types are proposed on habitable areas it will be appropriate to check that they comply with the R_w 40dB target.
- Roof: minimum sound insulation R_w 40dB. This minimum would likely be exceeded with a traditional slate tile roof with mineral wool loft insulation above plasterboard ceilings or by a suitably insulated concrete roof or composite flat roof. (NB for composite flat roof build-ups a minimum 200mm roof void and 100mm mineral wool insulation would be recommended over and above the rigid insulation required to provide the required levels of thermal insulation).

5.2 Boundary Treatment / Protection of Communal Gardens

The noise levels across the open site (no boundary treatment) would be in the range 63 to 67dBA depending on the distance from the Manchester Road and Metrolink site boundaries.

Azymuth Acoustics have reviewed various options for boundary treatment. In order to get close to a 55dBA noise level in the communal garden would require a noise barrier wall of greater than 4.5m height on 3 sides of the garden. Clearly this height of noise barrier is impractical and would be unlikely to be acceptable for a variety of reasons (i.e. resulting in an overbearing visual impact on residents using the communal garden and being visually unattractive within the street scene).

However, a noise barrier wall of 2.1 to 2.5m height would result in a noise level of 57-60dBA as calculated by the SoundPlan model. This is likely to be a reasonable compromise between aesthetic acceptability and noise attenuation. See Figure 7 for location of proposed noise barrier.

5.3 Vibration Mitigation

The vibration levels require little to no mitigation. As per the drawings received, the proposed apartment building will be set back from the site boundary, reducing the vibration dose value and bringing the dwellings themselves into the low probability zone. Despite this, Azymuth recommends both the proposed ground and first floors are constructed on concrete slabs (eg. in-situ concrete or beam and block construction) to reduce vibration.

6.0 Summary

- Noise & Vibration Guidance recommends the following criteria:
 - Daytime noise levels not to exceed 35dB $L_{Aeq, 16hr}$ in living rooms / bedrooms
 - Daytime noise levels not to exceed 40dB $L_{Aeq, 16hr}$ in dining room / kitchen
 - Night-time noise levels in bedrooms not to exceed 30dB $L_{Aeq, 8hr}$
 - Night-time single sound events in bedrooms not to exceed 45dB L_{Amax} more than 15 times a night
 - During the day, Vibration Dose Value should not exceed $0.4m/s^{1.75}$
 - During the night, Vibration Dose Value should not exceed $0.2m/s^{1.75}$
- As noise mitigation, Azymuth Acoustics UK recommends:
 - Glazing on the Manchester Road and Metrolink elevations to have airborne sound insulation min. R_w 44dB / R_w+Ctr 38dB on all non inward facing facades. (As Figure 7 **orange** facades).
 - In addition, glazing on the Metrolink elevation inward facing from Grid lines f2 to fB (see Buttress drawing CHOBABUT-ZZ-00-DR-A-04002-P03) to have airborne sound insulation min. R_w 42dB / R_w+Ctr 36dB. (this section of façade is not screened from the adjacent block) (As Figure 7 **orange** facades).
 - Glazing for the inner facades to have min. R_w 35dB / R_w+Ctr 29dB. (As Figure 7 **green** facades).
 - Use of System 4 MVHR ventilation in all apartments with windows on all façades. As all the dwellings have a front elevation this implies that MVHR is recommended throughout the scheme.
 - Whilst it will not be practical to achieve noise levels below 55dBA across the communal gardens, nevertheless a 2.1 to 2.5m high noise barrier wall has been proposed which would likely result in levels of less than 60dBA in the communal garden.
- For vibration mitigation, Azymuth Acoustics UK recommends the first and ground floor be constructed on a concrete slab (eg. in-situ concrete or beam and block construction)
- The guidance in Part O Overheating input is consistent with the AVO guide – ie System 4 MVHR ventilation is recommended. The AVO Guide suggests a high risk of overheating and as such we recommend that a complex CIBSE TM59 dynamic thermal model will be required to assess the Part O requirements.



Appendix A – Glossary of Acoustic Terms

Decibel (dB)

this is the unit used to measure sound. The human ear has an approximately logarithmic response to acoustic pressure over a very large dynamic range (typically 20 micro Pascal to 100 Pascal).

dB (A)

This is a measure of the overall noise level of sound across the audible spectrum with a frequency weighting (i.e. A-weighting) to compensate for the sensitivity of the human ear to sound of different frequencies. The A-weighting curve is implemented in sound level meters using an electronic filter that approximately corresponds to the frequency response of the ear.

Octave Band Noise Level

The human ear is sensitive to sound over a range of frequencies between approximately 20 Hz to 20 kHz. The ear is also generally more sensitive to medium and high frequencies than to low frequencies. In order to define the frequency content of a noise, the spectrum can be divided into frequency bands. The most commonly used frequency bands are octave bands, in which the mid-frequency of each band is twice that of the band below it.

L_{Aeq}

this is the equivalent steady sound level in dB (A) containing the same acoustic energy as the actual fluctuating sound level over a given time period.

Reverberation Time (RT or sometimes T₃₀ or T₆₀)

This is the time taken for the reverberant sound energy in an enclosure to decay one millionth of its equilibrium value, i.e. by 60 dB, after the source has been switched off, is known as the reverberation time. The reverberation time is frequency dependent and it is customary to measure its value in octave or one-third octave bands. Reverberation occurs when sound waves are repeatedly reflected from each surface of the room.

Sound Reduction Index (SRI)

Difference measured between the amount of energy flowing towards the wall in the source room and the total amount of energy flowing towards the wall in the source room and the total amount of energy entering the receiving room (usual range 100 - 3150 Hz for one third octave band values). The SRI varies with frequency and is measured in a laboratory in either octave or one-third octave bands.

$$SRI = L1 - L2 + 10 \log (S/A)$$

Where: L1 = Noise level in the source room

L2 = Noise levels in the receiving room

S = Surface area of test specimen

A = Equivalent acoustic absorption area in the receiving room

Weighted Sound Reduction Index (R_w)

this is a weighted single figure descriptor of the sound insulation performance of a partition measured under laboratory conditions. The procedure used to quantify the R_w is to compare the sound reduction index (SRI) in each of the one-third octave bands from 100Hz to 3150Hz against a set of standard reference curves.



Appendix B1 – Noise Measurement Data

Position	Date / Time	L _{AFMax}	L _{Aeq}	L _{A10}	L _{A50}	L _{A90}
	17/02/23					
A	14:09	81.5	66.7	73.7	70.3	64.2
A	14:14	80.6	67.9	75.2	71.1	65.5
A	14:19	88.1	69.4	75.8	72.6	67.2
A	14:24	81.4	68.1	75	71.2	66.6
A	14:29	80.7	68	75.5	71.5	65.2
A	14:34	82.7	66.9	73.7	70.4	64.5
A	14:39	80.8	67.8	77	70.4	66.3
A	14:44	74.9	66.8	73.4	70.6	64.3
A	14:49	83.5	68.7	76.9	71.6	66.7
B	14:56	81	67.8	74.6	71.4	65.7
B	15:01	80.1	69	76.2	72.3	67.6
B	15:06	82	70.5	77.8	73.5	69.2
B	15:11	78.3	69	75.8	72.4	67.5
B	15:16	78.6	68.9	76.2	72.8	67.2
B	15:21	78	68.3	76.2	71.8	66.6
B	15:26	77.3	69.5	76.3	73.2	67.8
B	15:31	76.5	68.5	75.5	72.4	66.6
B	15:36	86.5	70	76.8	73.8	67.7
	01/03/23					
C	15:56	79	67.2	73.8	66.6	60.6
C	16:01	82.3	69.5	71.8	67.2	57.7
C	16:06	81.1	71.7	72.4	67.7	57.8
C	16:11	79.3	69.3	72.8	66.2	60.4
C	16:21	78.6	68.5	71.4	67.5	56.7
C	16:26	82	68.3	70.9	67.9	57.3
C	16:31	77.7	68.5	74.5	62.4	60.2
C	16:36	78.5	70.5	73.2	65.4	58.8
C	16:41	82.5	69.2	73	67.9	55.1
D	14:30	79.5	67.3	71	61.1	51.7
D	14:35	81.3	67.5	71.4	63.1	51.4
D	14:40	78	67.5	71.1	62.3	51.4
D	14:45	78.7	65.6	71.1	62.3	51.4
D	14:50	89.9	71.3	71.9	61.7	48.6
D	14:55	78.2	65.6	71.9	61.7	48.6
D	15:00	76.9	65.9	70.2	62.6	52
D	15:05	85.9	65.6	70.2	62.6	52
D	15:10	94.4	74.2	70.9	60.7	50.2
D	15:15	79.4	66.1	70.9	60.7	50.2
D	15:20	81.4	67.2	71.9	63.7	53.2
D	15:25	92.9	73.8	71.9	63.7	53.2
D	15:30	77.5	65.4	71.1	62.2	50.7
D	15:35	80.1	66.8	71.1	62.2	50.7

Position	Date / Time	L _{AFMax}	L _{Aeq}	L _{A10}	L _{A50}	L _{A90}
D	15:40	79.8	66.3	71.6	62.9	52.3
	07/03/23					
E	23:48	79.2	64.7	68.8	50.7	36.2
E	23:53	81.3	64.9	69	50.6	39.1
E	23:58	79.8	62.9	61.7	42.9	35.5
	08/03/23					
E	00:03	80.5	65.4	68.5	52.1	39.9
E	00:08	85.9	68.1	71.4	55	45.2
E	00:13	78	63.1	66.9	47.6	35.5
E	00:18	80.5	63.7	66	47	36
E	00:23	81	65.5	68.7	52.9	43.2

Appendix B2 – Vibration Measurement Data

Position	Date / Time	Peak [m/s ²]	Max [m/s ²]	RMS [m/s ²]
	23/02/23			
V1	12:19	0.191	0.014	0.004
V1	12:24	0.407	0.051	0.005
V1	12:29	0.089	0.014	0.004
V1	12:34	0.28	0.026	0.005
V1	12:39	0.214	0.018	0.003
V1	12:44	0.759	0.052	0.006
V1	12:49	0.759	0.052	0.007
V1	12:54	0.528	0.05	0.007
V1	12:59	0.331	0.033	0.004
V1	13:04	0.407	0.043	0.007
V1	13:09	0.388	0.037	0.005