MZA ACOUSTICS

PLYMOUTH GROVE, MANCHESTER

Planning Condition 20 (a): External Building Fabric

Document History

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1. INTRODUCTION

MZA Acoustics has been appointed to provide an acoustic report to discharge the Planning Condition 20(a) relating to façade sound insulation and internal noise levels at the proposed student residential development on Plymouth Grove, Manchester (planning application ref. *138294/FO/2023*).

To discharge the above condition, this report presents an assessment of noise break-in through the building envelope.

An environmental noise survey has been undertaken at the site, with the results summarised in this report.

Calculations of noise break-in to the proposed rooms have been undertaken, considering the proposed façade, window, and ventilation elements.

This report occasionally employs technical language. To assist the reader, a glossary of acoustic terminology is presented in Appendix A.

2. SITE DESCRIPTION

2.1 The Site

The site is located at the north-east end of Plymouth Grove, at its junction with Dryden Street, in an area that is a mixture of residential (to the north of the site) and commercial (to the south of the site). Manchester City Centre is located around 1.5 km to the northwest.

Manchester Central Ambulance Station is located around 150 m to the southeast of the site, accessed via Plymouth Grove.

The site location is illustrated in the location plan in **Figure 1**.



Figure 1 – Site location (red)

2.2 Proposed Development

The site is to be developed to provide a single block of student accommodation over 7 storeys (Levels 1 to 7), with student amenity at ground floor level.

A typical internal floor layout is included in **Figure 2**.



Figure 2 – Typical floor plan

3. CRITERIA AND ASSESSMENT GUIDANCE

3.1 Local Planning Authority Guidance

While this report relates solely to the discharge of Condition 20(a).

3.1.1 Planning Condition 20 (a)

Condition 20 of the planning approval (*138294/FO/2023*) is repeated below:

> *20) (a) Prior to any above ground works, a scheme for acoustically insulating the proposed student accommodation against noise shall be submitted for approval in writing by the City Council as Local Planning Authority.*
>
> *There may be other actual or potential sources of noise which require consideration on or near the site, including any local commercial/industrial premises.*
>
> *The potential for overheating shall also be assessed and the noise insulation scheme shall take this into account.*
>
> *Noise survey data shall include measurements taken during a rush-hour period and night time to determine the appropriate sound insulation measures necessary. The following noise criteria shall be required to be achieved when providing adequate ventilation as defined by Approved Document F of the Building Regulations (whole dwelling ventilation):*
>
> > *Bedrooms (night time - 23.00 - 07.00) 30 dB L_{Aeq} (individual noise events shall not exceed 45 dB $L_{Amax,F}$ by more than 15 times)*
> >
> > *Living Rooms (daytime - 07.00 - 23.00) 35 dB L_{Aeq}*
> >
> > *Gardens and terraces (daytime) 55 dB L_{Aeq}*
>
> *Higher internal noise levels than those specified above may be allowed when higher rates of ventilation are required in relation to the overheating condition*
>
> *Additionally, where entertainment noise is a factor in the noise climate the sound insulation scheme shall be designed to achieve internal noise levels in the 63Hz and 125Hz octave centre frequency bands so as not to exceed (in habitable rooms) 47dB and 41dB ($L_{eq,5min}$), respectively*
>
> *The approved noise insulation and ventilation scheme shall be completed before the first occupation of the student accommodation plot C of the development.*
>
> *(b) Prior to the first occupation of the student accommodation, a verification report will be required to validate that the work undertaken conforms to the recommendations and requirements approved as part of part (a) of this planning condition. The verification report shall include post completion testing to confirm the noise criteria has been met with windows and purge vent doors closed. In instances of non-conformity, these shall be detailed along with mitigation measures required to ensure compliance with the noise criteria. A verification report and measures shall be agreed until such a time as the development complies with part (a) of this planning condition.*

3.2 Overheating Conditions

Condition 20 acknowledges that noise levels during overheating conditions should be considered, stating that:

> "*Higher internal noise levels than those specified above may be allowed when higher rates of ventilation are required in relation to the overheating condition".*

While Approved Document O does not provide any statutory criterion for internal noise levels during the daytime and, indeed, we recommend that the use of open windows during the daytime should be considered where appropriate to preclude the need for alternate means of cooling, the same relaxation has been taken for the daytime as the night-time.

On this basis, **a relaxation of 10 dB has been allowed for in the assessment of internal levels during overheating conditions**, as discussed in Section 7 of this report.

3.3 Entertainment Noise

There are no significant sources of entertainment noise affecting the site and, therefore, no assessment of such noise is undertaken.

4. BASELINE NOISE LEVELS

4.1 Environmental Noise Survey

A survey of existing external noise levels at the site was undertaken by MZA Acoustics between Monday 7th and Wednesday 9th July 2025, at two locations:

- MP1: Long-term noise monitor located at the southwest of the site, approximately 2.5 m high (above existing hoarding), on the site boundary overlooking Plymouth Grove
- MP2: Long-term noise monitor located on the north boundary of the Site, approximately 2.5 m high (above existing hoarding), on the site boundary overlooking Dryden Street.

The measurement locations are indicated in plan in **Figure 3.**



Figure 3 – MZA measurement location (July 2025)

Table 1 presents a summary of the results of the unattended measurements.

Average noise levels are the average of the equivalent continuous sound levels across the period ($L_{Aeq,T}$) measured on all dates.

Maximum noise levels were very variable throughout the survey, however there were consistent emergency sirens affecting the site which have been considered in the noise break-in assessment.

The background noise levels presented are the lowest modal value during the assessment period.

Table 1 –Unattended noise measurement summary

Measurement Position	Period	Average Noise Level (dB $L_{Aeq,T}$)	Maximum Noise Level (dB L_{AFmax})	Background Noise Level (dB $L_{AF90,5m}$)
MP1 Plymouth Grove	Daytime (07:00 – 23:00)	67	N/A	55
	Night-time (23:00 – 07:00)	61	79	42
MP2 Dryden Street	Daytime (07:00 – 23:00)	58	N/A	52
	Night-time (23:00 – 07:00)	51	71	41

Spectral noise levels, which have been used in the calculations of noise break-in, are detailed in Section 7 of this report.

4.2 Emergency Sirens Affecting the Proposed Development

A number of sirens were measured during the night-time period, which affected both measurement locations (although MP1 to a much greater extent) – particularly the maximum noise levels.

Often, such events would be considered atypical. However, given the Site's proximity to Manchester Central Ambulance Station, and the magnitude above the "typical" maximum noise levels that have been measured (average of around 88 dB(A)), these events have been considered in the design – and dictate the acoustic performance requirements for the building envelope.

It should be considered that, once the development is completed, the maximum noise level experienced at MP2 (and the façade that overlooks Dryden Street) will be significantly different to that measured during the survey due to the screening introducted by the development itself.

On this basis, a 3D noise model has been developed to calculate the propagation of noise around the development – discussed below.

5. DIGITAL 3D NOISE MODELLING

A 3D noise model of the site has been built and calibrated to the results of the environmental noise survey to accurately predict the propagation of noise across the building façades, particularly from sirens, which drive the sound insulation performance requirements on elevations which are affected by them.

An image of the 3D noise model is presented below.

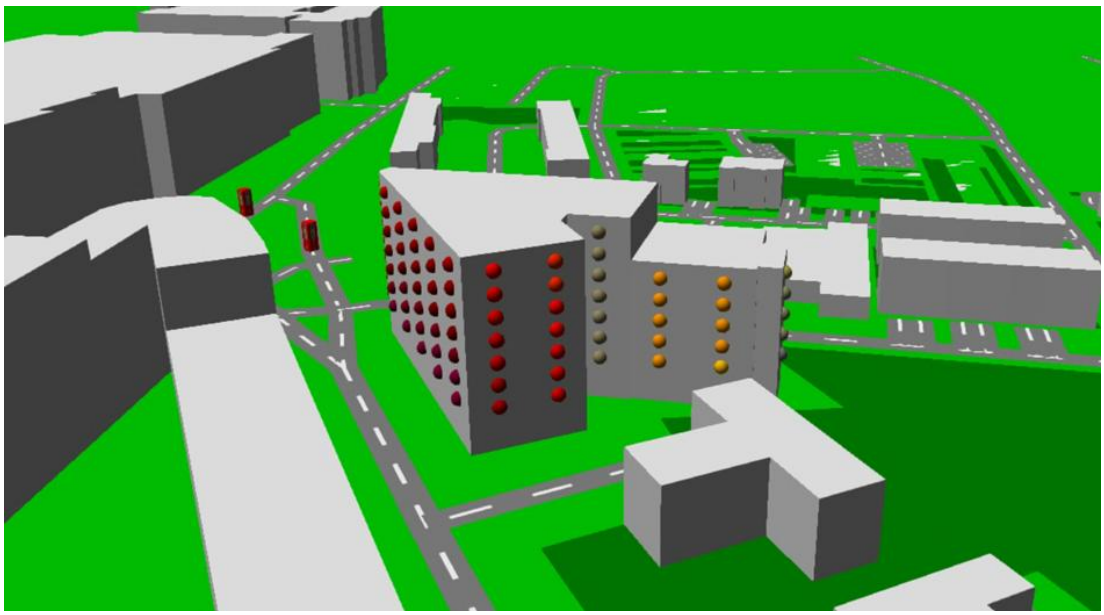


Figure 4 – Digital 3D noise model (CadnaA 2025)

5.1 Objects and Topography

Information on the surrounding roads, buildings and their heights have been established using Open Street Map and Google Earth data.

The topography of the site and surrounding area have been imported from the Government Environmental Agency's National LIDAR Programme.

5.2 Source Noise Levels

The main noise sources affecting the site are road traffic on Plymouth Grove and Dryden Street – with other sources to the rear of the site being comparatively insignificant.

Roads have been modelled as line sources and calibrated to the measurement results of the MZA survey, with spectral noise levels included in the model. This method is applied to both continuous (L_{Aeq}) and maximum (L_{AFmax}) noise levels.

5.3 Building Calculation Points

The proposed building was then introduced and receiver points spaced across the façades at each floor level.

6. FAÇADE AND VENTILATION DETAILS

6.1 Introduction

The noise break-in calculations, discussed in the following section, are undertaken in accordance with BS 12354, and depend on a number of factors relating to the building design, including the façade and ventilation strategies. These are discussed below.

6.2 Façade Construction

6.2.1 Non-Glazed Façade

The primary external wall build-up to the residential elements consists of a brick exterior with internal sheathing board and linings, as illustrated in **Figure 5**.

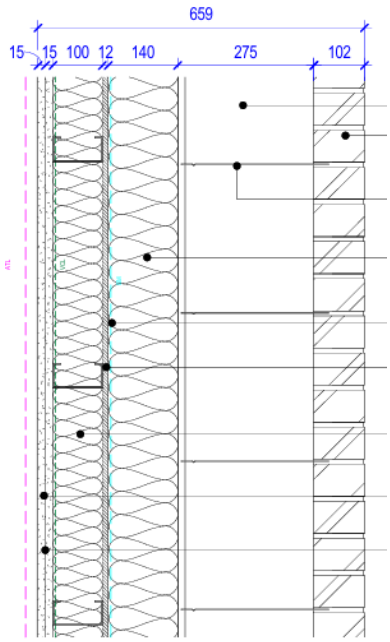


Figure 5 – Primary external brick-faced build-up (Wall type E-WT-01A)

There are feature areas (adjacent to windows) where the cavity is reduced, however it is determined that the overall composite acoustic performance of the façade is not significantly affected.

Calculations of the noise break-in assume a performance of 53 dB $R_w + C_{tr}$ for the brick elements of the façade – although, in practice, it is considered likely that this would be higher.

6.2.2 Windows

Given there are a relatively large range of noise levels experienced across the development, and that there are a number of different room types, six window specifications have been provided – four of which apply to the residential elements of the development.

Window Type 6, with the highest performance, is proposed to rooms to the north of the development which include large glazed areas using curved windows.

Acoustic performance data has been provided as a mixture of test data for various glass types in the proposed frame, prediction data for glass only, and prediction data for the glass and frame.

The performance requirements are generally driven noise from sirens across the elevations which have line of sight to Plymouth Grove – with specific requirements in the 1 kHz and 2 kHz octave bands.

At more distant locations (further down Dryden Street and the rear elevations of the proposed development) noise levels are typically low enough that standard thermal double glazing, with no specific requirements at the mid-frequencies, is appropriate.

The acoustic performance of the proposed windows is presented in **Table 2**, which have been determined through extrapolation between the laboratory and prediction data provided.

Table 2 –Window performance data

Window Type	Sound Reduction Index (dB)			Notes
	R_w (C_{tr})	R @ 1 kHz	R @ 2 kHz	
1	N/A			Non-residential use only
2	N/A			Non-residential use only
3	40 (-6)	43	46	Performance taken from glass & frame prediction
4	41 (-7)	44	46	Performance taken from glass & frame prediction
5	44 (-4)	43	46	Performance taken from glass & frame prediction
6[1]	45 (-5)	44	47	Performance data extrapolated from laboratory test data

[1] Curved windows have used data provided for flat glass units, see Section 6.2.2.1.

A mark-up illustrating the proposed window type layout on the Plymouth Grove elevation is included in **Figure 6**. The majority of windows on the rest of the scheme are provided with Window Type 3 as they do not have significantly onerous requirements.

Windows which are provided with Type 5 (orange) are to accessible and dual aspect studios, which include two windows to the room and, therefore, require a higher performance for each window.

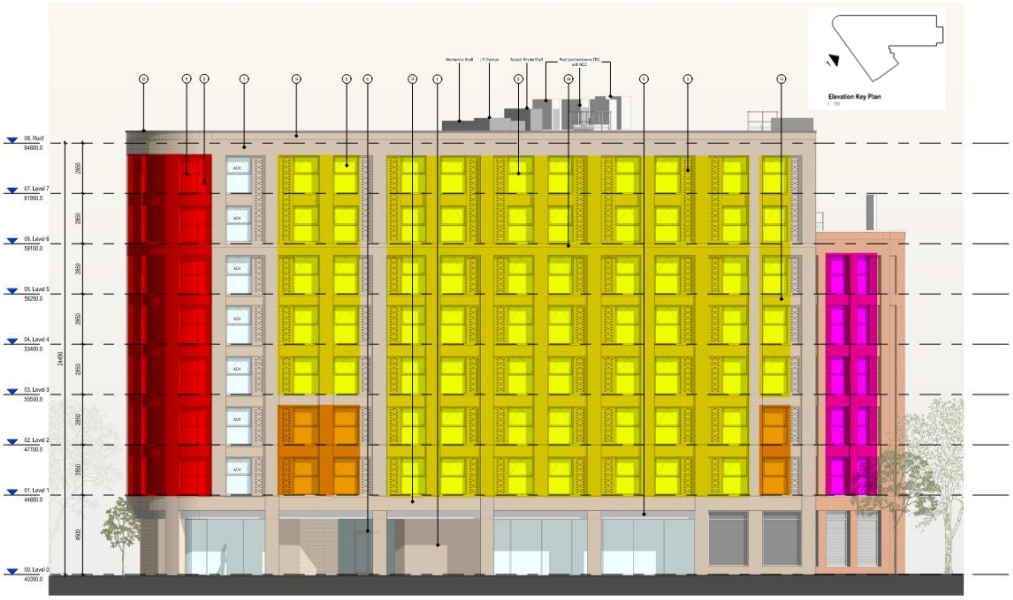


Figure 6 – Plymouth Grove elevation windows layout

6.2.2.1 Curved Windows

The difference in performance for curved windows compared to flat systems of the same build-up is not known, and no test data has been able to be provided.

Based on MZA's predictions, the effects of stiffening of the glass that may occur due to the curvature is not likely to significantly influence the acoustic performance.

However, where MZA consider there to be a risk is to the effect on the compression of seals and gaskets in the frame, the magnitude of which cannot be easily quantified and is highly dependent on the manufacturing quality of the units and the workmanship during installation.

Potential remediation for this, should it be required, is discussed in Section 7.

6.2.3 Ventilation

All rooms on the project are to be mechanically ventilated.

To control noise break-in, attenuators are required between the external termination and the internal supply/extract grilles.

A minimum of one attenuator is to be installed between the MVHR unit and the room on both supply and extract branches to control noise from the MVHR unit.

A typical, indicative, studio ventilation layout is presented in **Figure 7**.

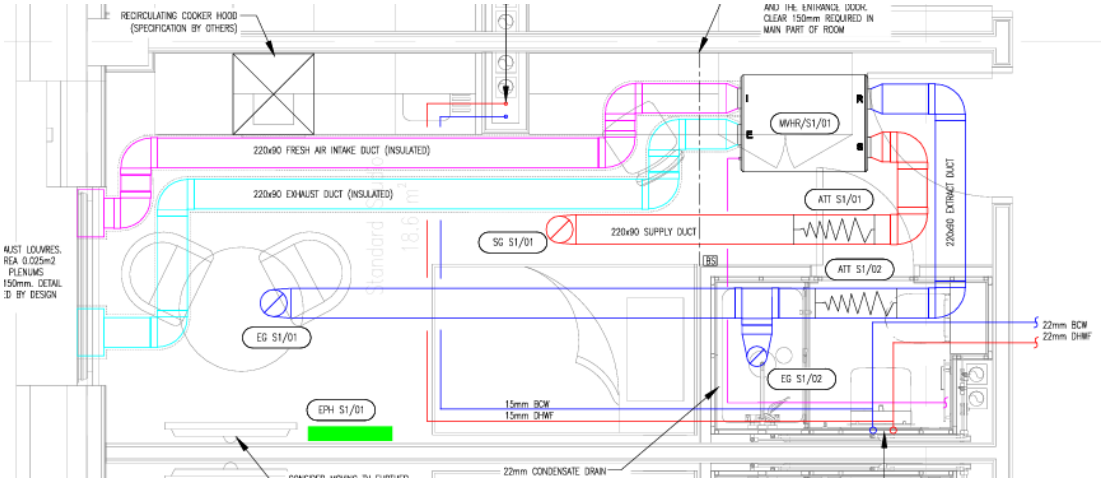


Figure 7 – Typical studio ventilation layout (indicative)

In rooms where higher levels of noise are experienced, an additional attenuator is required between the unit and the connection at the façade. These locations are illustrated on the elevations in **Appendix B**.

The attenuator performance is specified in **Table 3**:

Table 3 – Proposed attenuator insertion loss

Indicative Unit	**Insertion loss (dB) at Octave Band Centre Frequency**							
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**
Domus Microban 500 mm silencer	-	0.2	4.2	7.4	19	19.3	24.6	22.2

7. ASSESSMENT

7.1 Introduction

The assessment of noise to rooms has been undertaken in accordance with BS 12354 and based on the design information discussed above.

7.2 Noise Break-in Calculations

A sample calculation for the worst-case room (corner room on the Plymouth Grove elevation) is presented in **Table 4**, with results for all calculated rooms presented in **Appendix C**.

It should be noted that calculations are not presented for *all* rooms in the development, but for the rooms with the highest noise level of each window/MVHR combination (i.e. calculations are not presented for the rear of the development, where noise levels are lower than those on elevations which overlook Dryden Street but have the same glazing and attenuation proposed).

Table 4 – Sample noise break-in calculation (Level 1 corner room overlooking Plymouth Grove)

Calculation Step	63	125	250	500	1000	2000	4000	8000	dB(A)
General									
Room volume	52 m^3								-
Reverberation time (s)	1.0	0.8	0.7	0.5	0.5	0.5	0.5	0.5	-
Absorption Area, A (m^2)	8.3	11.1	12.8	16.6	16.6	16.6	16.6	16.6	-
External Noise Levels									
Daytime Average $L_{Aeq,16h}$	65	61	61	59	64	61	52	42	67
Night-time Average $L_{Aeq,8h}$	59	55	55	54	59	54	47	38	62
Typical Maximum L_{Fmax}	69	68	69	72	85	83	78	66	88
Façade Transmission									
Façade SRI	39	45	50	50	56	63	65	65	
Façade area	23 m^2								
Window Transmission									
SRI (Type 6)	28	28	40	45	45	49	51	51	
Window area	15 m^2								

MVHR Transmission									
Duct connection area	0.22 x 0.09 m^2 (-17 dB)								
Duct losses (incl. 2 NO attenuators and room effects)	25	23	16	33	36	44	41	42	
Total (Internal Levels)									
Daytime Average $L_{Aeq,16h}$	43	38	30	18	21	14	4	-6	**27**
Night-time Average $L_{Aeq,8h}$	37	31	24	13	17	8	-1	-10	**22**
Typical Maximum L_{AFmax}	47	44	37	31	43	37	30	18	**45**

[1] Internal level = external level - SRI + 10log(S/A) +3)

[2] Includes correction for end reflection into room. Does not include losses through the MVHR unit itself.

The above calculations predict **compliance with the criteria of Condition 20,** with the daytime and night-time L_{Aeq} values significantly below the criteria.

Given the large difference between the maximum noise level and the average noise levels measured during the survey, this is to be expected – and it is the maximum noise level which drives the mitigation requirements across the majority of the development.

It should be acknowledged that the design goes beyond the strict requirements of Condition 20, by using higher than "typical" maximum noise levels from emergency sirens, which occur less frequently than other sources (though are significantly louder).

Furthermore, no losses have been assumed for the transmission of sound through the MVHR unit itself – which are likely to occur due to the internal components within the unit.

7.3 Overheating Strategy

The overheating strategy for the project has been developed to meet the requirements of Approved Document E, and with the provisions of the Association of Noise Consultants Acoustics (ANC), *Acoustics, Ventilation and Overheating: Residential Design Guide* (the AVO Guide) in mind.

Using the calculation method provided by the ANC in its *Approved Document O Noise Guide (Nov 2024)* the proposed windows would provide an outside to inside level difference of approximately 15 dB when opened to the full extent of the restrictor.

Guidance previously provided by the Association of Noise Consultants for compliance with Approved Document O stated that the internal noise level should not average the internal noise levels under both the open and closed window conditions (i.e. it should not be relied upon that the window would only be opened for a portion of the time in order to meet internal noise level targets).

On the above basis, **Table 5** sets out the external noise thresholds at which open windows should not be relied upon for relief of overheating.

Table 5 –External noise limits for use of open windows to mitigate overheating

Period	Normal Internal Criteria	Relaxation for Overheating Condition	Outside to Inside Level Difference from Open Window	External Noise Level Limit
Daytime Equivalent Continuous	35 dB $L_{Aeq,16h}$	+10 dB	15 dB	60 dB $L_{Aeq,16h}$
Daytime Equivalent Continuous	30 dB $L_{Aeq,8h}$	+10 dB	15 dB	55 dB $L_{Aeq,8h}$
Night-time Maximum	45 dB L_{Afmax}	+10 dB	15 dB	70 dB L_{Afmax}

On the above basis, and with reference to the external noise levels measured, as summarised in **Table 1**, the following strategy has been adopted:

- Elevations overlooking Plymouth Grove: **Open windows are not to be relied upon during either daytime or night-time for relief of overheating**
- Other facades: **Windows may be used during the daytime for relief of overheating, but not to be relied upon during the night-time.**

On the above basis, and where necessary as determined through an overheating assessment, provision of alternative means of cooling are made for rooms which cannot rely upon open windows for mitigation of overheating.

It should be noted that windows remain openable in all apartments except the corner apartments with curved windows for purge ventilation, and at occupant discretion.

7.4 Part (b) of Condition 20

As demonstrated above, the selected glazing (window type 6) is predicted to meet the internal criteria in the worst-case "corner" room – and this glass is proposed in all "corner rooms", with the largest glazed areas and curved glass.

It is acknowledged that there remains an element of uncertainty over the performance of the curved glazing, particularly with respect to the sealing into the frames etc.

Part (b) of condition 20 requires that testing be undertaken to the completed rooms to demonstrate compliance with the requirements of part (a) of the condition, and states:

> *"In instances of non-conformity, these shall be detailed along with mitigation measures required to ensure compliance with the noise criteria."*

As such, it should be noted that there is currently provision for secondary glazing to rooms, should it be required, which can be actioned if necessary following the post-completion testing undertaken to discharge part (b) of Condition 20.

8. CONCLUSION

MZA Acoustics has been appointed to provide an acoustic report to discharge the planning condition relating to façade sound insulation and internal noise levels at the Plymouth Grove student residential development in Manchester.

This report relates to the discharge of Condition 20 of the approved planning application (Ref: *138294/FO/2023*).

Based on the results of noise surveys undertaken at the site, and the proposed external building fabric and mechanical designs, calculations of the internal noise levels have been made.

Most of the development, especially those façades which do not directly overlook Plymouth Grove, experiences environmental noise levels which are relatively low, such that fairly standard thermal double glazing is appropriate for the control of noise ingress.

The average noise levels (daytime and night-time L_{Aeq}) comfortably meet the criteria of BCC in the worst-case room, a “corner room” with large areas of glazing and overlooking Plymouth Grove, while the maximum noise level (which is driven by irregular sirens) just meets the criterion.

Consideration has been made to the noise levels during overheating conditions, with a strategy developed to preclude the use of open windows in locations where this would lead to significant exceedances (>10 dB) of normal internal noise criteria.

As such, it is considered that the assessments within this report are appropriate to discharge part (a) of Condition 20 of the approved planning application (Ref: *138294/FO/2023*).

Acknowledging the uncertainty in both the test procedures of the proposed building elements, and the calculation, provision is made for incorporation of secondary glazing to these rooms, should it be required, after the post-completion testing is undertaken to demonstrate compliance with part (b) of Condition 20.

Appendices

Appendix A - Glossary of Acoustic Terminology

Acoustics and Noise

Acoustics is the branch of physics concerned with the properties of sound, including ultrasound, infrasound and vibration. A scientist or engineer who works in the field of acoustics is an acoustician or acoustic engineer.

Sound can be measured by a sound level meter or other measuring system. Noise is related to a human response, and is routinely described as unwanted sound, or sound that is considered undesirable or disruptive.[1] Care has been taken in this document to use the most relevant of these terms (whereby 'sound' is used predominantly); however, in most reference documents, and, indeed, generally, 'sound' and 'noise' are used interchangeably. Consequently, just because the term 'noise' is used doesn't necessarily mean a negative effect exits or will occur, and the context of the accompanying text should be considered.

Human hearing can respond to sound in the frequency range 20 Hz (deep bass) to 20,000 Hz (high treble), and over the audible range of 0 dB (the threshold of perception) to 140 dB (the threshold of pain).

The ear does not respond equally to different frequencies of the same magnitude but is more responsive to mid-frequencies than to lower or higher frequencies. To quantify sound in a manner that approximates the response of the human ear, a weighting mechanism is used, which reduces the importance of lower and higher frequencies in a similar manner to human hearing.

The weighting mechanism that best corresponds to the response of the human ear (though not necessarily perfectly) is the 'A'-weighting scale. This is widely used for environmental sound measurement, and the levels are denoted as dBA, dB(A) or L_{Aeq}, L_{A90} etc. according to the metric being measured or determined (see the Definitions over leaf).

The decibel scale is logarithmic rather than linear, and hence a 3 dB increase in sound level represents a doubling of the sound energy present. Judgement of sound is subjective, but as a general guide a 10 dB increase can be taken to represent a doubling of loudness, whilst an increase in the order of 3 dB is generally regarded as the minimum difference needed to perceive a change under normal listening conditions. Where other changes occur (associated with the change in sound level), such as additional vehicle movements on a road, which can be seen, then these may result in changes in sound level being more noticeable than they might otherwise be.

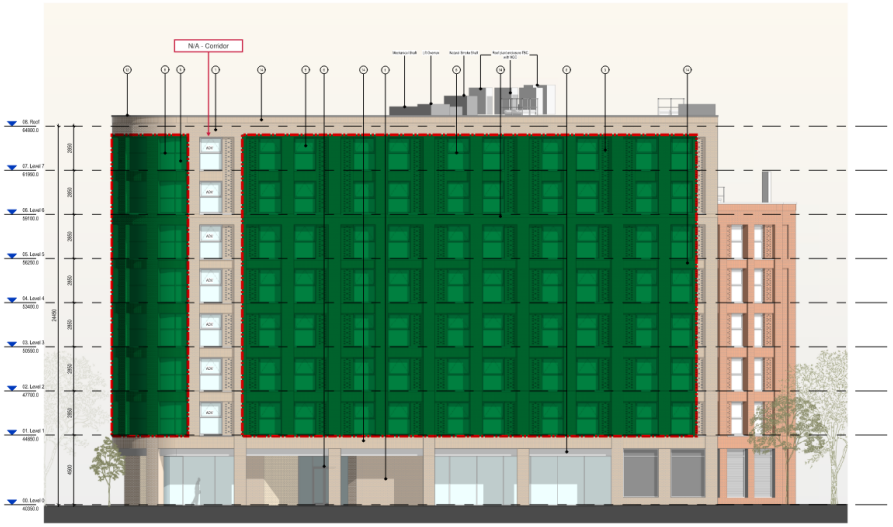
Further to such visual clues, and any other non-acoustical factors that affect people's response (such personal characteristics, and social, residential or environmental factors), the subjective response to a sound is dependent not only upon the sound pressure level and component frequencies, but also its intermittency. Consequently, various metrics have been developed to try and correlate people's attitudes to different sounds with the sound level and its fluctuations. The metrics used in this document, as per the relevant guidance, are defined overleaf.

[1] Taken from the Foreword to BS 4142:2014 *Methods for rating and assessing industrial and commercial sound*.

Airborne Sound	Sound that reaches the point of interest by propagation through air.
Ambient Sound:	Sound from all sources at any given time, form both near and far. Usually measured in terms of L_{Aeq}.
A-Weighting	The unit of sound level, weighted according to the A-scale, which takes into account the increased sensitivity of the human ear at some frequencies.
Background Sound Level	The A-weighted sound pressure level that can be considered the baseline in the absence of any noise from a specific source of sound under assessment. Measured in terms of $L_{A90,\,T}$.
Calibration	The measurement system/ chain should be periodically calibrated, within a laboratory, against traceable calibration instrumentation, to either National Standards or as UKAS-Accredited, as required. The calibration of the system should also be checked in the field using a portable calibrator before and after each short term measurements, and periodically for longer term monitoring.
Class 1	The Class of a sound level meter describes its accuracy as defined by the relevant international standards – Class 1 is more accurate than Class 2. The older standard IEC 60651 referred to the grade as "Type", whereas the new standard IEC 61672 refers to it as the "Class". The most accurate meters used in the field (as opposed to a laboratory) are Class 1. Class 2 meters can be used in some instances; however MZA use Class 1 (or Type 1) meters by default, as required by BS 4142:2014, for example.
Decibel	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds (s1 and s2) is given by 20 log10 (s1/s2). The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20 Pa.
Fast time Weighting (F)	Averaging time used in sound level meters. Defined in BS EN 61672-2:2013 Electroacoustics. Sound level meters. Pattern evaluation tests.
Free-field / Façade	Far from the presence of sound reflecting objects (except the ground), usually taken to mean at least 3.5 m away.
IoA	The Institute of Acoustics is the UK's professional body for those working in acoustics, noise and vibration. It was formed in 1974 from the amalgamation of the Acoustics Group of the Institute of Physics and the British Acoustical Society (a daughter society of the Institution of Mechanical Engineers). It is a nominated body of the Engineering Council, offering registration at Chartered and Incorporated Engineer levels. All our consultants/ engineers are individual Members of the Institute.
$L_{AF90,\,T}$	The A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T, measured using time fast time-weighting (F). Generally used to describe the 'background' sound conditions.
L_{AFmax}	The maximum A-weighted sound pressure level during a given time period. L_{max} is sometimes used for the assessment of occasional loud sounds, which may have little effect on the overall L_{eq} noise level, but could still affect the sound environment. Unless described otherwise, it is measured using the fast time-weighting (F).

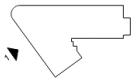
$L_{eq,\,T}$	A sound level index called the equivalent continuous sound level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded. Where the value is A-weighted, is will be presented '$L_{Aeq,T}$' or 'dBA $L_{eq,T}$', otherwise is should be an un-weighted (or linear) value.
L_p	See Sound Pressure Level.
Noise	Related to human response to sound. Unwanted sound, or sound that is considered undesirable or disruptive.
Octave Band	Frequency ranges in which the upper limit of each band is twice the lower limit. Octave bands are identified by their geometric mean frequency, or centre frequency.
Line Source	An idealised way of modelling a sound source, consisting of a uniform, flat plane.
Point Source	An idealised way of modelling a sound source, consisting of an infinitesimally small point, radiating sound equally in all dimensions
Sound Level Metrics	Sound levels usually fluctuate over time, so it is often necessary to consider an average or statistical sound level. This can be done in several ways, so a number of different metrics have been defined, according to how the averaging or statistics are carried out.
Sound Power	In a specified frequency band, the rate at which acoustic energy is radiated from a source. In general, the rate of flow of sound energy, whether from a source, through an area, or into an absorber.
Sound Power Level	Of airborne sound, ten times the common logarithm of the ratio of the sound power under consideration of the standard reference power of 1 pW. Expressed in decibels.
Sound Pressure	Sound, or sound pressure, is a fluctuation in air pressure over the static ambient pressure.
Sound Pressure Level	The sound level is the sound pressure relative to a standard reference pressure of 20 Pa (20×10^{-6} Pascals) on a decibel scale.
Specific Sound	The sound source being assessed in a BS 4142:2014 assessment.
UKAS	United Kingdom Accreditation Service, recognised by government to assess organisations that provide certification, testing, inspection and calibration services against internationally agreed standards.

Appendix B – Additional Attenuator Locations



GA Elevation 01

1 : 100



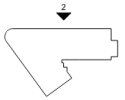
Elevation Key Plan

1 : 750



GA Elevation 02

1 : 100



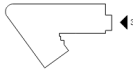
Elevation Key Plan

1 : 750



GA Elevation 03

1 : 100



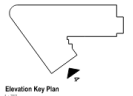
Elevation Key Plan

1 : 750



GA Elevation 04

1 : 100



Elevation Key Plan

1 : 750

Appendix C – Noise Break-in Calculation Results

As the mitigation requirements across most of the development (particularly those elevations with line of sight to Plymouth Grove) are driven by the maximum noise events from sirens, the internal average (L_{Aeq}) noise levels are presented to demonstrate compliance for rooms at first floor only to for brevity.

Calculations are not presented for *all* rooms in the development, but for the rooms with the highest noise level of each window/MVHR combination (i.e. calculations are not presented for the rear of the development, where noise levels are lower than those on elevations which overlook Dryden Street but have the same glazing and attenuation proposed).

Location / Glass Type / Attenuator Strategy	**Sound Pressure Level (dB) at Octave Band Centre Frequency (Hz)**								**dB(A)**
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	
Dryden Street 1st Floor Standard Studio / Type 3 / 1 attenuator									
Typical Max L_{AFmax}	40	38	36	30	42	35	32	20	**43**
Plymouth Grove "Corner" Room – 1st Floor / Type 6 / 2 attenuators *(same strategy to corner rooms on all levels)*									
Daytime $L_{Aeq,16h}$	43	38	30	18	21	14	4	-6	**27**
Night-time $L_{Aeq,8h}$	37	31	24	13	17	8	-1	-10	**22**
Typical Max L_{AFmax}	47	44	37	31	43	37	30	18	**45**
Plymouth Grove "Accessible" Room – 1st Floor / Type 5 / 2 attenuators									
Daytime $L_{Aeq,16h}$	38	33	31	17	20	14	3	-7	**26**
Night-time $L_{Aeq,8h}$	30	25	23	11	14	6	-4	-13	**19**
Typical Max L_{AFmax}	41	39	38	30	41	36	28	17	**43**
Plymouth Grove "Accessible" Room – 3rd Floor / Type 5 / 2 attenuators *(same strategy to rooms on levels above)*									
Typical Max L_{AFmax}	44	42	39	28	38	33	25	13	**40**

Location / Glass Type / Attenuator Strategy	Sound Pressure Level (dB) at Octave Band Centre Frequency (Hz)								dB(A)
	63	125	250	500	1000	2000	4000	8000	
Plymouth Grove Standard Room – 1st Floor / Type 4 / 2 attenuators *(same strategy to rooms on levels above)*									
Daytime $L_{Aeq,16h}$	41	37	33	17	18	12	1	-10	**27**
Night-time $L_{Aeq,8h}$	33	29	26	10	12	4	-6	-16	**20**
Typical Max L_{AFmax}	44	43	41	29	39	34	26	14	**42**
Plymouth Grove Dual Aspect Standard Room – 1st Floor / Type 5 / 2 attenuators *(same strategy to rooms on L1 and L2)*									
Daytime $L_{Aeq,16h}$	38	33	31	18	21	15	4	-7	**26**
Night-time $L_{Aeq,8h}$	30	25	24	11	15	7	-3	-13	**19**
Typical Max L_{AFmax}	41	40	39	31	42	37	29	17	**44**
Plymouth Grove Dual Aspect Standard Room – 3rd Floor / Type 5 / 2 attenuators *(same strategy to rooms on levels above)*									
Typical Max L_{AFmax}	44	43	40	28	38	34	25	13	**41**

For reference, key calculations of the "typical" internal maximum noise levels excluding sirens are included below.

Location / Glass Type / Attenuator Strategy	Sound Pressure Level (dB) at Octave Band Centre Frequency (Hz)								dB(A)
	63	125	250	500	1000	2000	4000	8000	
Dryden Street 1st Floor Standard Studio / Type 3 / 1 attenuator									
Typical Max L_{AFmax}	46	39	38	28	31	21	16	6	**34**
Plymouth Grove "Corner" Room – 1st Floor / Type 6 / 2 attenuators									
Typical Max L_{AFmax}	49	46	41	32	35	24	14	3	**38**
Plymouth Grove Standard Room – 1st Floor / Type 4 / 2 attenuators									
Typical Max L_{AFmax}	47	45	44	30	31	22	10	-2	**38**

Full calculations are available on request.

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