



Azymuth Acoustics UK

Professional Acoustic Services

Acoustic Review of Proposed External Plant Ref: AA0449RevA

AO Arena Mezzanine Extension Manchester

On behalf of

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1.0 Introduction

Azymuth Acoustics UK (henceforth Azymuth) has been appointed by Galliford Try Plc. to provide acoustic design advice for the proposed mezzanine extension at Manchester's AO Arena. The extension shall consist of:

1. A new VIP bar and restaurant located on a new mezzanine floor within the building.
2. A viewing platform extending from the VIP area through the existing terracing.
3. Extensive MEP alterations and diversions.
4. High end finishes.
5. Demolition
6. New toilets and ancillary areas.

This report considers the proposed external plant noise and impact on surrounding noise receptors. Further reports will be provided at a later date to consider other aspects of the acoustic performance for this extension.

The location of the proposed external roof plant can be seen in the figure below.



Figure 1 – Location of proposed external roof plant

2.0 Guidance and 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:

- National Planning Policy Framework (NPPF 2021)
- World Health Organisation Guidelines on Community Noise
- British Standard 4142:2014

2.1 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:

- Avoid noise 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

The National Planning Policy Framework 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’.

2.2 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 15 times 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.

2.3 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 a significant 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.”

3.0 Assessment of External Plant

3.1 Noise Survey

Ambient noise measurements were undertaken on the roof where the external plant is proposed as well as on the upper roof where the existing external plant resides. The existing external plant typically consists of condensing units serving air handling units and air conditioning systems within the arena.

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

The noise measurements were undertaken using the sound level meter at the position(s) shown in figure 2 below:

- Position 1: Proposed plant roof (circa 4-5m lower than positions 2/3 and circa 5m above ground level)
- Position 2: Existing plant roof (highest roof level)
- Position 3: External roof plant measurement (highest roof level)
- Position 4: Car park plant measurement 1 (circa 3m lower than positions 2/3)
- Position 5: Car park plant measurement 2 (circa 3m lower than positions 2/3)

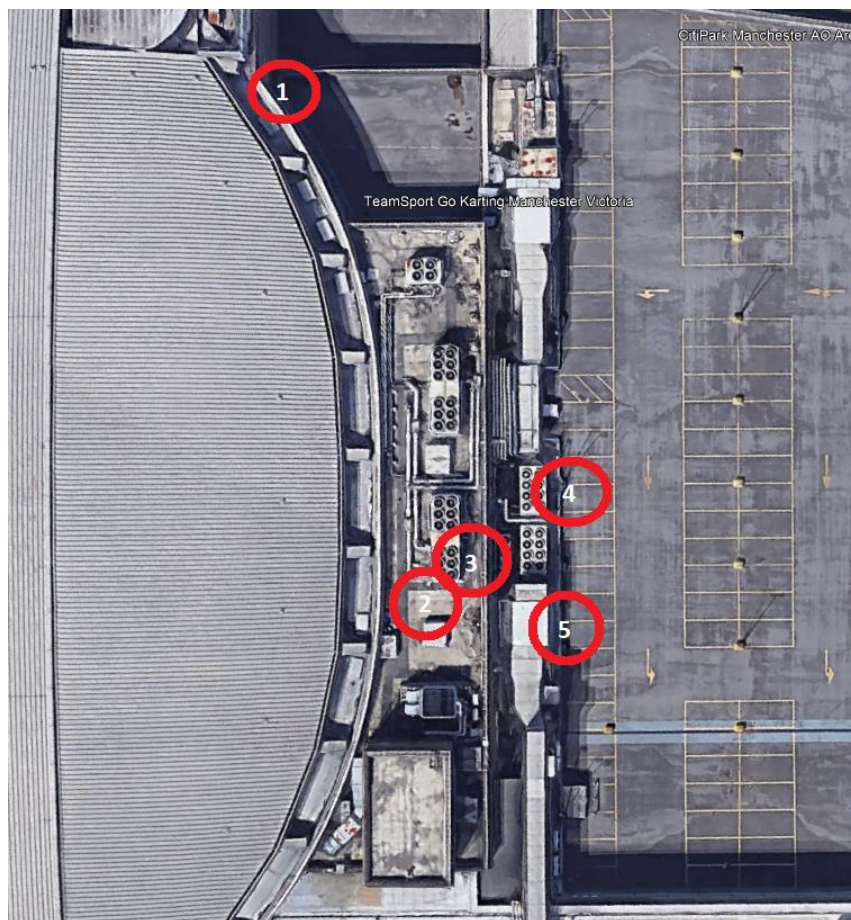


Figure 2 – Noise measurement positions

Location	Time	L _{AFmax}	L _{Aeq}	L _{A10}	L _{A50}	L _{A90}
1) Proposed plant roof	00:15:00	66.2	62.8	63.8	62.7	61.8
2) Existing plant roof	00:10:00	60.5	55.8	56.7	55.5	54.3
3) External roof plant measurement	00:01:30	65.5	64.6	65.3	64.5	64.0
4) Car park plant measurement 1	00:01:30	84.4	72.3	62.0	61.3	60.4
5) Car park plant measurement 2	00:01:30	69.0	67.6	68.4	67.5	67.0

Table 1 – Noise measurement data

3.2 Proposed Extension External Plant Layout

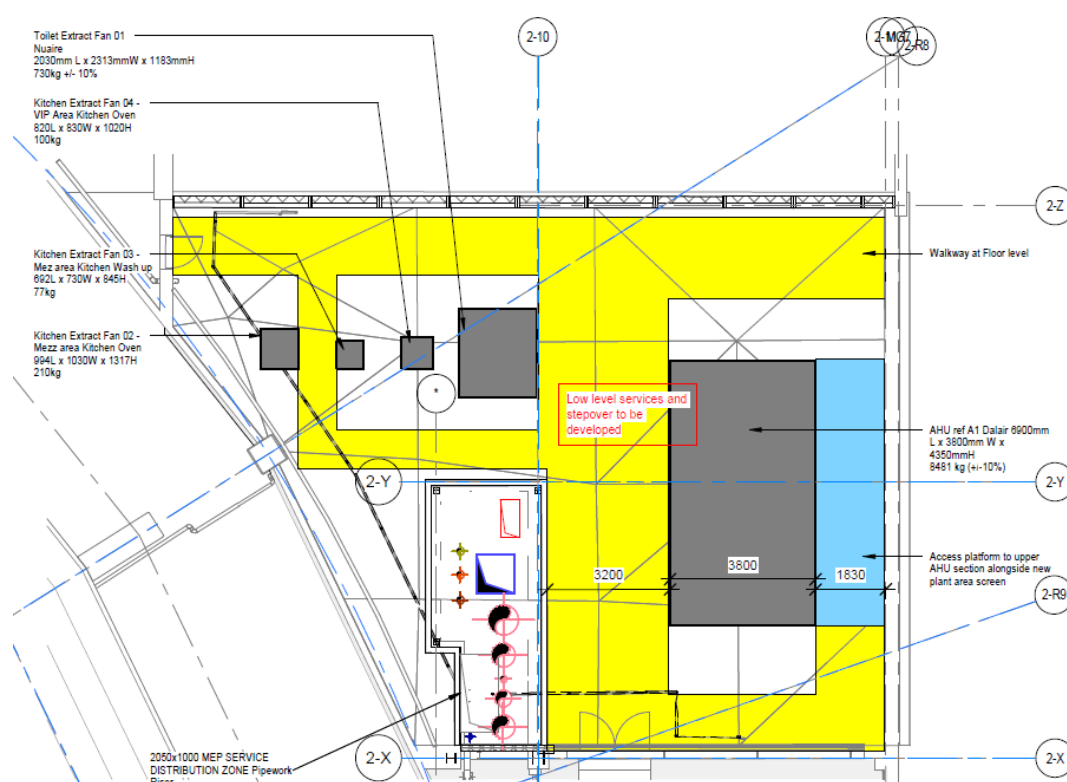


Figure 3 – Proposed lower roof plant locations

The proposed external plant area is noise screened along the East, West and South facing orientations by the existing building which are at least 3-4m higher than where the external plant is located. Along grid line 2-Z facing North towards the noise sensitive receptors there is a proposed external louvre, Azymuth have provided an acoustic rating for this louvre within the report section 3.4.



Figure 4 – Proposed upper roof plant locations

The noise levels for each individual item of plant have been provided in the relevant data sheets with the worst-case possible noise level (100% fan speed) used for assessment purposes. The Airtech Air Handling Unit (AHU) has 6 sections all of which have their own separate noise data. The total noise level for the Airtech Air Handling Unit (AHU) has been calculated by summing the total noise levels from each section of the unit.

The octave band data used for the noise model is as follows:

Plant	Octave Band Centre Frequency (Hz)								~LwA (dB)
	63	125	250	500	1000	2000	4000	8000	
AHU Airtech Ciat 600	82	83	96	92	91	88	75	72	96
Kitchen Extract Fan 02	86	94	84	82	76	74	71	59	84
Kitchen Extract Fan 03	78	86	74	69	65	67	60	45	75
Kitchen Extract Fan 04	79	84	81	78	68	69	65	47	79
Kitchen Cooling Units	76	84	72	67	63	65	58	43	73
Toilett Extract Fan 01	94	81	90	84	80	74	65	59	86
DX Cooling Unit HT-CU 1	72	80	68	63	59	61	54	39	69
DX Cooling Unit HT-CU 2	74	82	70	65	61	63	56	41	71

Table 2 – Octave band data for each item of plant

3.3 SoundPLAN Noise Modelling

Azymuth has undertaken noise modelling in SoundPLAN 8.2 to predict and visualise the effect of plant noise on the surrounding environment. The nearest noise sensitive receptor is

the 4-storey new build Manchester College located on 60 Great Ducie Street which opened in Sept 2022.

3.3.1 Grid Noise Map (GNM)

The below figure shows the effect of the proposed Arena roof plant on the local environment at ground floor level (1.5m height).



Figure 5 – GNM of noise propagation at ground floor level (1.5m)

Figure 6 shows the noise propagation from the roof plant at a height of ~15m.



Figure 6 – GNM of noise propagation at height of 15m

3.3.2 Façade Noise Maps (FNM)

The façade noise maps below show the effect of noise on the facades of the nearest receptor (Manchester College) and other surrounding buildings which are further away. The external plant has been modelled as a point noise source and is indicated as an Asterix (magenta colour) on each FNM below.

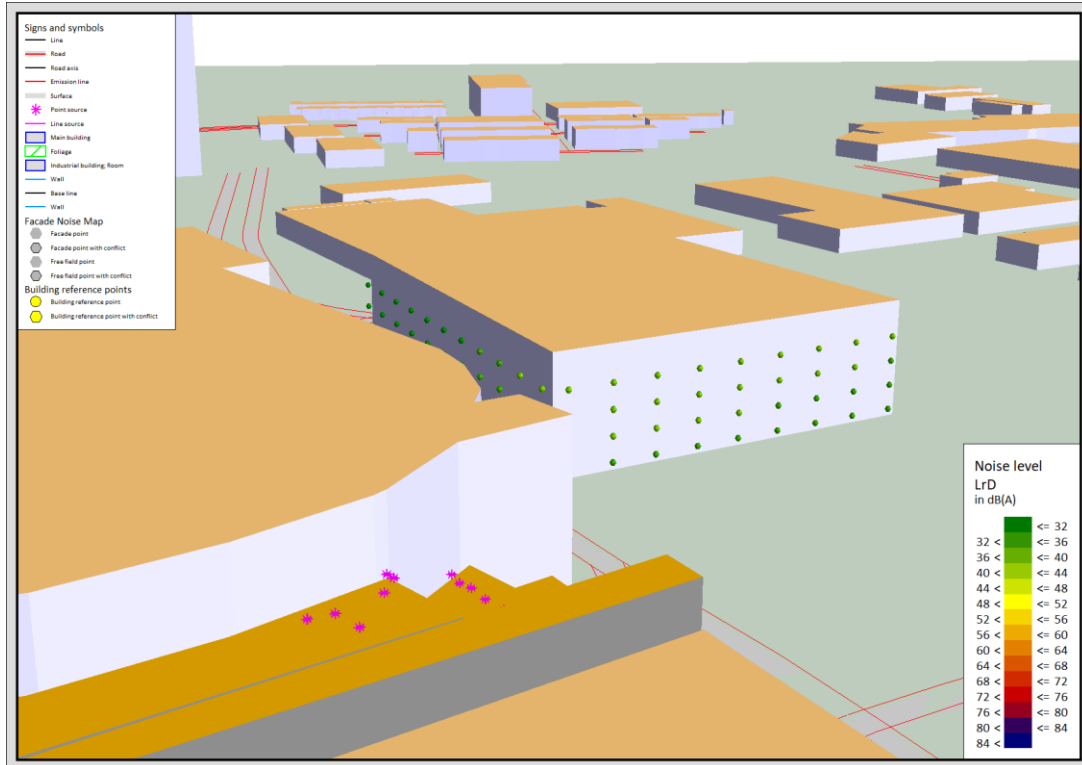


Figure 7 – FNM of the effect of noise on Manchester College

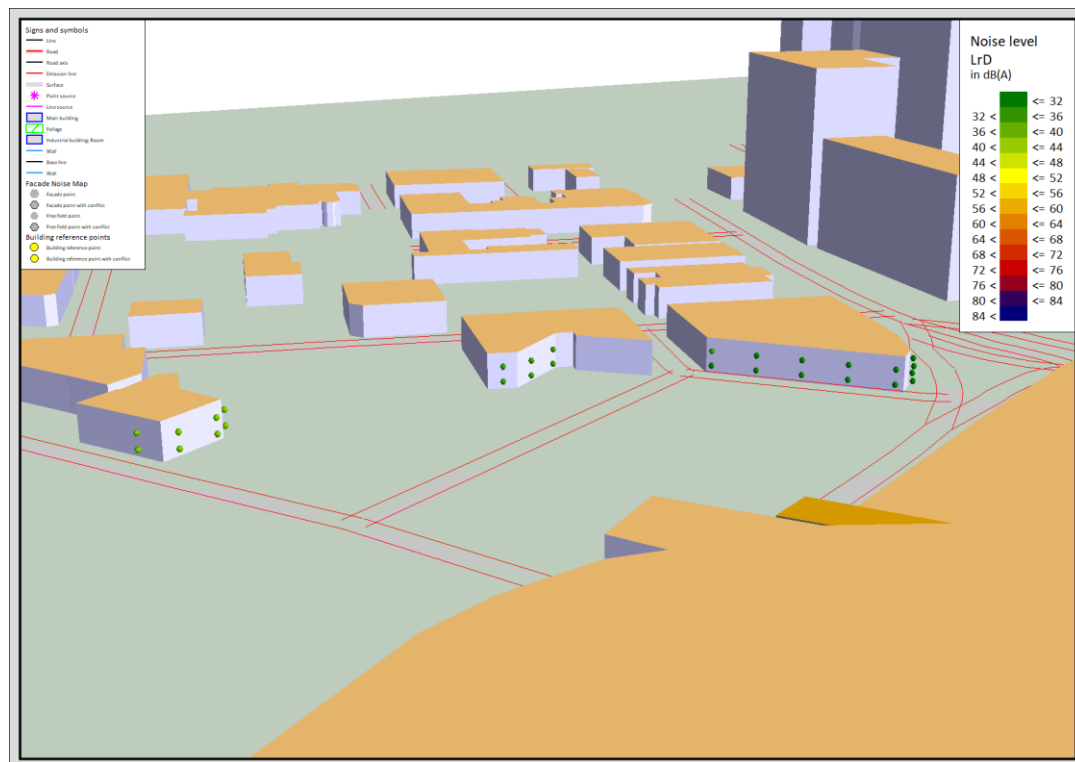


Figure 8 – FNM of the effect of noise on Adjacent buildings

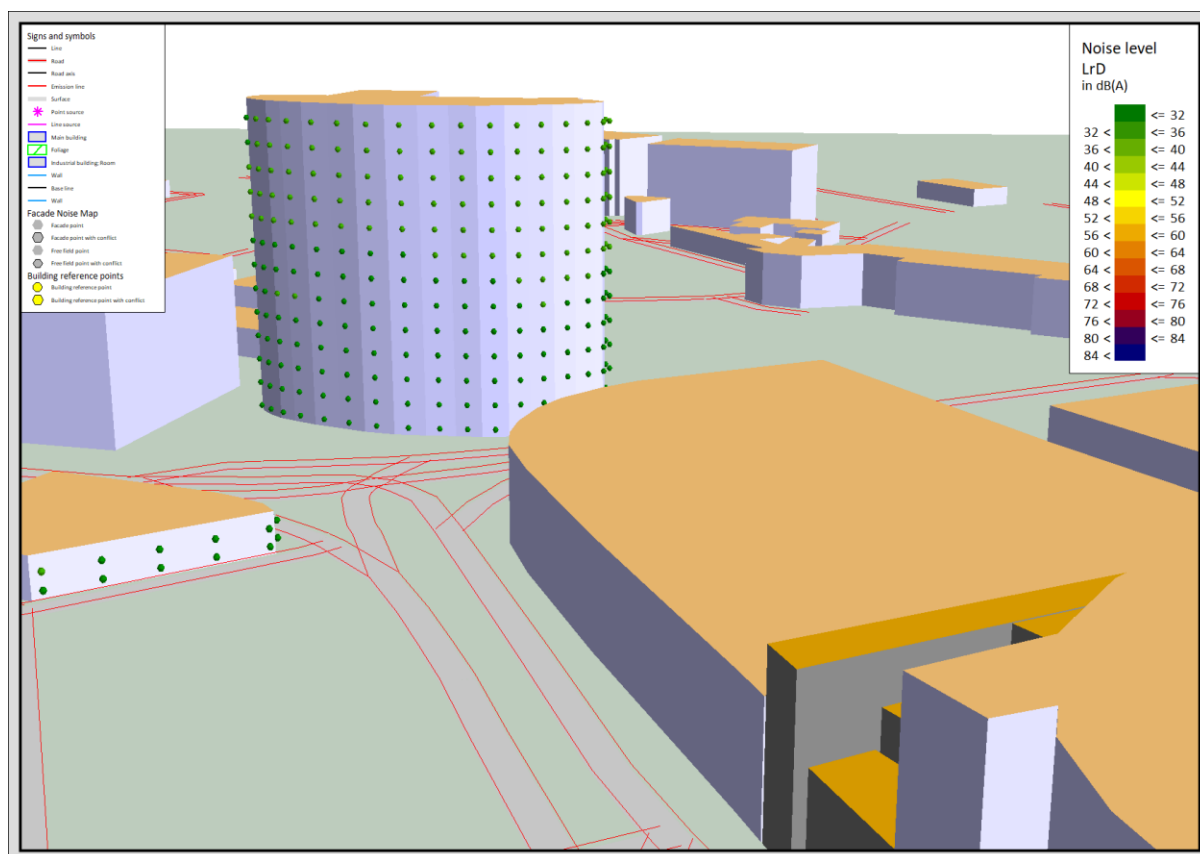


Figure 9 – FNM of the effect of noise on Peninsula office block

3.3.3 Noise Predictions

The below table provides the predicted noise levels at the worst effected façade of each of the nearby receptors.

Receptor Location	Distance from source to receiver (approx. m)	Predicted Noise Level (dBA)
8-10 Dutton Street	110	39.3
Manchester College Building (60 Great Ducie Street)	72	39.5
Peninsula Office (Victoria Place)	150	34.6

Table 3 – Noise levels at nearby receptors

3.4 Noise Mitigation: Louvre Rating

Rooftop louvres are proposed to the new plant roof. To mitigate the effect of plant noise on the surrounding environment, Azymuth would advise that any non-acoustically rated louvre would be sufficient in reducing the impact of noise for this scheme.

4.0 Summary

Azymuth has undertaken an acoustic design review in relation to predicted noise break out from the proposed external plant serving the new extension to the AO Arena. The extension involves the installation of a new Mezzanine Bar and VIP Lounge.

Azymuth has undertaken a baseline noise survey on the roof where the new external plant associated with the bar/lounge shall be located.

A noise model has been created in SoundPLAN 8.2 to predict the impact of noise associated with the proposed plant on the surrounding environment.

The noise levels predicted at the nearest noise sensitive receptors, as set out in section 3.3.3, are no more than ~39dBA which is lower than the existing background noise levels. Therefore, we do not predict any noise impact on the surrounding environment.

To reduce the impact of plant noise on the surrounding environment Azymuth have recommended that any non-acoustically rated louvre may be used on the plant roof. We would still anticipate that this louvre would provide a slight reduction in plant noise on the nearest receptors by a few decibels.



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 20Hz to 20kHz. 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 T_{30} or T_{60})

This is the time taken for the reverberant sound energy in an enclosure to decay one millionth of its equilibrium value, i.e. by 60dB, 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 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.

$SRI = L_1 - L_2 + 10 \log (S/A)$, where:

L_1 = Noise level in the source room

L_2 = 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 B – Noise Measurement Data

Start	Position	Time	L _{Amax}	L _{Aeq}	L _{A10}	L _{A50}	L _{A90}
Thursday 9 th December 2022							
09:55:00	1	00:05:00	67.4	62.7	63.7	62.6	61.7
10:00:00	1	00:05:00	65.7	62.9	63.8	62.7	62
10:05:00	1	00:05:00	65.5	62.9	63.8	62.7	61.8
11:04:00	3	00:00:30	65.7	64.8	65.6	64.7	64.1
11:04:30	3	00:00:30	65.4	64.5	64.9	64.4	64
11:05:00	3	00:00:30	65.5	64.6	65.4	64.5	64
11:07:00	2	00:01:00	63.1	55	56.2	54.6	53.6
11:08:00	2	00:01:00	68.5	56.3	57	56.1	54.2
11:09:00	2	00:01:00	59.5	55.6	56.7	55.3	54.2
11:10:00	2	00:01:00	60.1	57.3	58.7	57.2	55
11:11:00	2	00:01:00	58.4	55.9	56.9	55.8	55
11:12:00	2	00:01:00	57.9	55.4	56.4	55.3	54.2
11:13:00	2	00:01:00	57.5	55.7	56.7	55.6	54.6
11:14:00	2	00:01:00	62.9	55.2	55.9	55	53.9
11:15:00	2	00:01:00	59.7	54.9	55.8	54.7	54
11:16:00	2	00:01:00	57.4	55.7	56.6	55.6	54.7
11:31:32	4	00:00:30	90.5	67.9	61.9	61.2	60.2
11:32:02	4	00:00:30	99.7	76.4	61.9	61.3	60.3
11:32:32	4	00:00:30	62.9	61.5	62.1	61.4	60.7
11:33:40	5	00:00:30	68.5	67.6	68.4	67.5	67
11:34:10	5	00:00:30	68.8	67.6	68.4	67.5	67
11:34:40	5	00:00:30	69.8	67.6	68.5	67.5	66.9

Table B1 – AO Arena plant noise measurement data