

Manchester Airport B401

BREEAM Acoustic Assessment Report

McLaren Construction Ltd

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1. Introduction

This report presents the results of acoustic testing and assessment undertaken at the recently constructed B401 at Manchester Airport.

AECOM has been appointed to undertake acoustic testing and assessment of the building. The assessment is to determine compliance with the acoustic requirements for the award of one of the three credits available under the Hea 05 section for control of internal ambient noise levels and the single credit available from the Pol 05 section of the BREEAM assessment for control of external noise emission from the development.

A glossary of acoustic terminology used within this report is included in Appendix A.

2. Hea 05 Credit – Internal Ambient Noise Levels

2.1 Requirements

One credit is awarded under the Hea 05 for achieving internal ambient noise levels in line with the guidance in BS 8233:2014 – *Guidance on sound insulation and noise reduction for buildings*. The criteria from this which apply to the B401 development were previously confirmed in the AECOM report *Building 401 BREEAM Acoustic Report* dated April 2022. These criteria are provided below in Table 1 for reference.

Table 1. BS 8233:2014 Internal Ambient Noise Level Requirements

Space	Design Range, $L_{Aeq,T}$ (dB)
Open Plan Office	45-50

2.2 Test Details

The measurements of the internal ambient noise levels within Building 401 have been undertaken by:

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100 Embankment
Cathedral Approach
Manchester M3 7FB
United Kingdom

Testing was undertaken on the evening of 11th September 2023. At the time of the testing, the rooms tested were generally complete with only minor internal decoration works outstanding. All windows and doors were complete and ceiling finishes had been installed. No work was taking place inside the building at the time of the measurements. During the measurements, windows to the rooms were open and the mechanical ventilation and cooling systems serving the spaces were confirmed to be operating.

Details of the test equipment used for the acoustic testing on each visit is provided in Table 2 below.

Table 2. Equipment Used for Acoustic Testing

Description	Manufacturer	Model	Serial No.	Date of Calibration	Calibration Certificate
Sound Level Meter	Rion	NL-52	00710387	11/10/2021	CONF102105
Microphone	Rion	UC-59	19663	11/10/2021	CONF102105
Pre-amp	Rion	NH-25	10930	11/10/2021	CONF102105
Calibrator	B&K	4231	3005464	09/12/2022	UCRT22/2452

Measurements were undertaken in general accordance with the guidance in the Association of Noise Consultants (ANC) document *Measurement of Sound Levels in Buildings – ANC Guidelines* dated June 2020.

2.3 Results

The results of these measurements of internal ambient noise levels are reported below in Table 3.

Table 3. Measured Internal Ambient Noise Levels

Unit	Room	BREEAM Hea 05 Internal Ambient Noise Level Requirement, L_{Aeq} (dB)	Measured Internal Ambient Noise Level, L_{Aeq} (dB)	Pass / Fail
Unit 1A	Open Plan Office	45 – 50	46	Pass
Unit 1B	Open Plan Office	45 - 50	46	Pass

It can be seen from the table above that the rooms where measurements were undertaken achieve the requirements for the BREEAM Hea 05 internal ambient noise level credit and it is considered that the credit should be awardable.

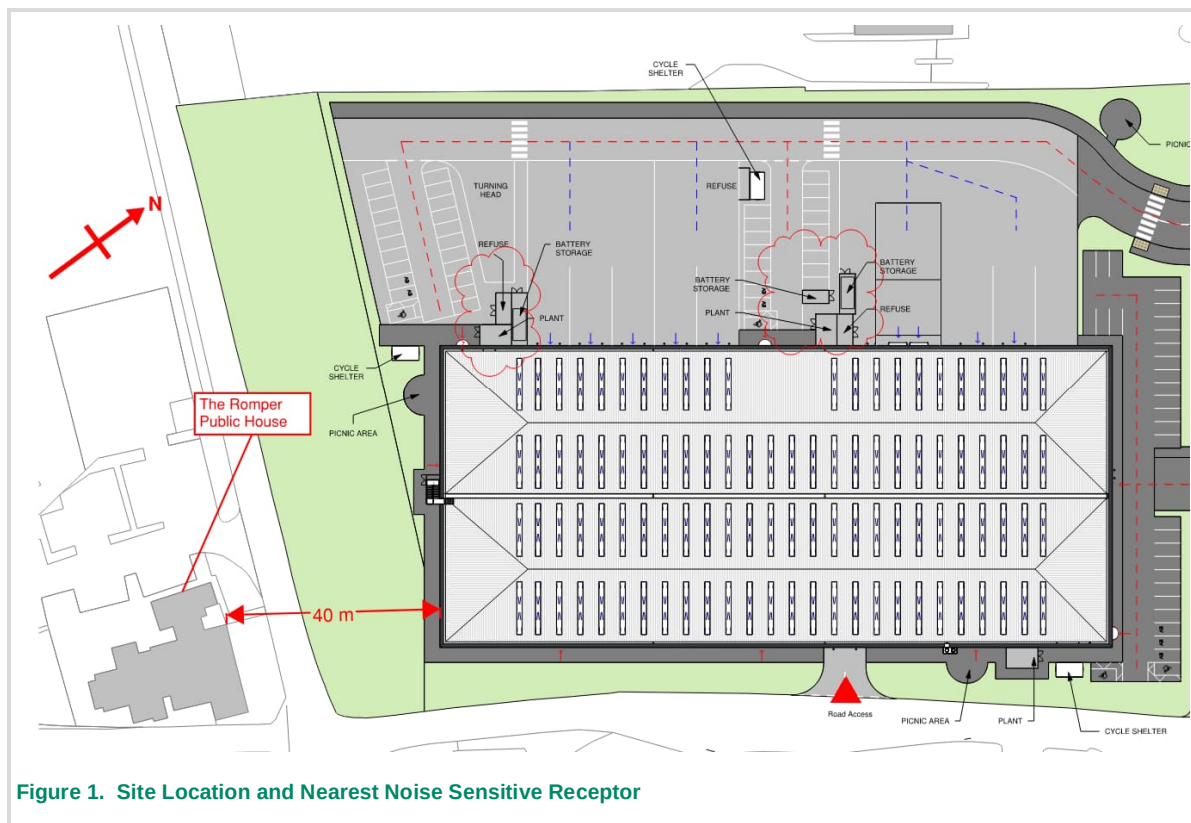
3. Plant Noise Emission – Pol 05 Credit

3.1 Requirement

This credit is awarded where the rating level of noise from the new development (typically new items of building services plant) is at least 5 dB below the pre-existing background noise level during the daytime (07:00 - 23:00) and during the night-time (23:00-07:00) when assessed in accordance with BS 4142:2014 at the nearest noise sensitive receivers.

3.2 Nearest Noise Sensitive Receivers

The existing Nearest Noise Sensitive Receiver to the proposed building is considered to be the Romper Public House, approximately 40 m to the south-west of the development site. This is shown in Figure 1 below.



3.3 Background Sound Levels

An external noise survey was undertaken in the vicinity of the site between 11th – 15th March 2022 to determine the prevailing background noise levels in the area. An unattended noise logger was left in-situ over several days to record the background noise levels at the site boundary in the south-west corner of the site, as shown in Figure 2 below.



Figure 2. Location of Noise Logger

The representative background sound levels established from these measurements are shown in Table 4 below and Appendix B. The representative background sound levels have been taken to be the value of the 10th percentile of all of the $L_{AF90,15 \text{ min}}$ values recorded during the respective daytime and night-time periods.

Table 4. $L_{AF90,15 \text{ min}}$ Background Sound Levels (dB)

Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)
49	42

To achieve the requirements of the BREEAM credit, the rating level of the noise from items of external plant should not exceed $L_{Ar} = 44$ dB during the daytime and $L_{Ar} = 37$ dB during the night-time.

3.4 External Building Services Plant

The items of external building services plant installed at the building consist of the following:

Table 5. External Items of Building Services Plant

Item	Model	Sound Power Level, L_w (dB)
Unit 1A Outdoor Condensing Unit	Mitsubishi PURY-EM250YNW	80
Unit 1B Outdoor Condensing Unit	Mitsubishi PURY-EM200YNW	78
Unit 1C Outdoor Condensing Unit	Mitsubishi PURY-EM200YNW	78

In addition to the externally located outdoor condensing units, there are heat recovery ventilation units located within the building which have their supply and exhaust ducts connected to atmosphere via a grille in the external wall. These units are identified below:

Table 6. Heat Recovery Ventilation Units

Unit	Heat Recovery Unit	Model
Unit 1A	HRU1	Mitsubishi LGH-25RVX-E
	HRU2	Mitsubishi LGH-80RVX-E
	HRU3	Mitsubishi LGH-80RVX-E
Unit 1B	HRU1	Mitsubishi LGH-25RVX-E
	HRU2	Mitsubishi LGH-80RVX-E
Unit 1A	HRU1	Mitsubishi LGH-25RVX-E
	HRU2	Mitsubishi LGH-80RVX-E
	HRU3	Mitsubishi LGH-80RVX-E

Mitsubishi do not provide in-duct sound power levels for the connections to these units and only provide a sound pressure level measured at 1.5 m beneath the unit when operating in an anechoic room. Based on this data, the sound power level of the units has been calculated assuming hemi-spherical radiation from the unit. In order to provide a robust assessment, it has been assumed that the entirety of the sound power generated by the unit is present in the intake and exhaust ducts. This is considered to be a worst case as in practice some of this sound power will be radiated by the case of the units and the supply and extract ducts within the building itself. Based on this assumption, the sound power levels assumed to be present in the intake and exhaust ducts connected to atmosphere have been assumed to be:

Table 7. Estimated In Duct Sound Power Levels (L_w) in dB for Intake and Exhaust Connections of Mitsubishi HRUs Operating at Highest Speed

HRU	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1000	2000	4000	8000
Mitsubishi LGH-25RVX-E	55	53	45	39	35	30	27	25
Mitsubishi LGH-80RVX-E	66	59	52	49	44	39	32	25

The intake and exhaust connections on these units are ducted to atmosphere with the ductwork incorporating acoustic attenuators, as below:

Table 8. Insertion Losses in dB of Attenuators to Heat Recovery Unit Intake and Exhaust Ducts

HRU	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1000	2000	4000	8000
Mitsubishi LGH-25RVX-E Units	1	2	6	16	23	19	17	12
Mitsubishi LGH-80RVX-E Units	1	2	6	15	20	15	14	10

Based on the acoustic data for the heat recovery units, internal ductwork layouts and the installed attenuators, the following sound power levels have been determined at heat intake and exhaust grilles (note that where there are 3 HRUs proposed in a unit, HRU2 and HRU3 share the same intake and exhaust connections).

Table 9. Sound Power Levels of External Intake and Exhaust Grilles

Unit	Heat Recovery Unit	Intake / Exhaust	Sound Power Level, L_{WA} (dB)
Unit 1A	HRU1	Intake	36
		Exhaust	36
	HRU2 & HRU3	Intake	43
		Exhaust	43
Unit 1B	HRU1	Intake	36
		Exhaust	42
	HRU2	Intake	36
		Exhaust	42
Unit 1C	HRU1	Intake	36
		Exhaust	43
	HRU2 & HRU3	Intake	36
		Exhaust	43

Figure 3 shows the location of the installed external noise sources at the building relative to the nearest noise sensitive receptor.

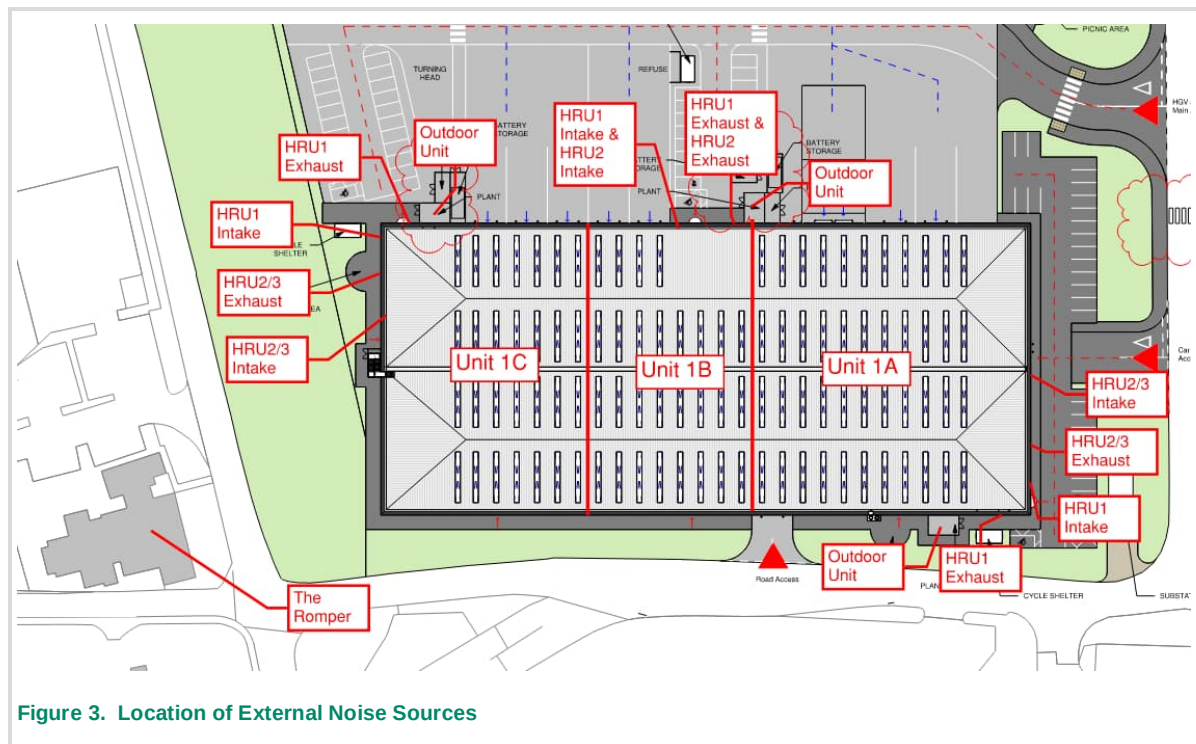


Table 10 shows the determination of the specific sound level of the noise from the sources of external noise at the building, including distance attenuation, directivity corrections allowing for reflections from the ground and building itself and screening corrections. Where there is no direct line of sight from the receptor to the noise source, a -10 dB screening correction has been applied.

The table also illustrates the determination of the Rating Level from the Specific Sound Level. The specific sound level is predicted to be significantly below the background sound level at the receptor location to such an extent which implies that even if the source of noise were tonal or impulsive, this would be unlikely to be perceived at the receptor location. Subjective observations made on site during the measurements reported in section 2 indicated no observable tonal or impulsive content to the noise and so no corrections for this have been applied in the determination of the Rating Level.

Table 10. Determination of Rating Level at Nearest Noise Sensitive Receptor

Unit	Noise Source	Sound Power Level, L_{WA} (dB)	Distance to receptor (m)	Distance Attenuation (dB)	Spherical radiation	Directivity Correction (dB)	Screening Correction (dB)	Sound Pressure Level at Receptor, L_{pA} (dB)
1A	Outdoor Unit	80	149	-43	-11	+6	0	32
	HRU1 Intake	39	165	-44	-11	+6	0	0
	HRU1 Exhaust	36	156	-44	-11	+6	-10	0
	HRU2/3 Intake	43	170	-45	-11	+6	-10	0
	HRU2/3 Exhaust	43	166	-44	-11	+6	-10	0
1B	Outdoor Unit	78	130	-42	-11	+6	-10	21
	HRU1 Intake	36	113	-41	-11	+6	-10	0
	HRU1 Exhaust	36	122	-42	-11	+6	-10	0
	HRU2 Intake	42	113	-41	-11	+6	-10	0
	HRU2 Exhaust	42	122	-42	-11	+6	-10	0
1C	Outdoor Unit	78	79	-38	-11	+6	-10	25
	HRU1 Intake	36	70	-37	-11	+6	0	0
	HRU1 Exhaust	36	74	-37	-11	+6	-10	0
	HRU2/3 Intake	43	58	-35	-11	+6	0	3
	HRU2/3 Exhaust	43	64	-36	-11	+6	0	2
Specific Sound Level at Receptor, L_{AS} (dB)								33 dB
Tonality Correction								0 dB
Intermittency / Impulsivity Correction								0 dB
Rating Level at Receptor, $L_{Ar,Tr}$ (dB)								33 dB

The Rating Level of the building services plant at the building has been determined to be $L_{Ar} = 33$ dB which is 16 dB below the daytime background sound level at the nearest receptor and 9 dB below the night-time background sound level. This achieves the requirement of the BREEAM Pol 05 credit for the noise to be controlled to be at least 5 dB below the background sound level at the nearest noise sensitive receptor therefore we anticipate this credit can be awarded.

It is also understood that the development is also subject to a planning condition which states:

Any externally mounted ancillary plant, equipment and servicing shall be selected and/or acoustically treated in accordance with a scheme designed so as to achieve a rating level of 5 dB (L_{Aeq}) below the typical background (L_{A90}) level at the nearest noise sensitive location. Prior to occupation of the development hereby approved the scheme shall be submitted to and approved in writing by the City Council as local planning authority and thereafter implemented in full.

The requirements of this planning condition are for the rating level of noise from the development to be controlled so it is at least 5 dB below the background sound level. This is the same as the requirement for the award of the BREEAM Pol 05 credit and so it is considered that the requirements of this planning condition have also been achieved.

4. BREEAM Summary

Based on the results of the acoustic testing undertaken in the building, the table below presents a summary of whether the requirements for the award of the relevant BREEAM Hea 05 credits have been achieved.

Table 11. Summary of BREEAM Hea 05 Requirements

Credit	Achieved Requirements	Reason	Credit Awardable?
Hea 05 Credit – Internal ambient noise levels	Yes	All measurements of internal ambient noise levels undertaken achieved the design criteria	Yes
Pol 05 Credit	Yes	An assessment of external noise emissions has demonstrated that the rating level of noise from external plant is at least 5 dB below both the daytime and night-time background sound levels.	Yes

As can be seen from the table above, on the basis of the acoustic testing reported here, the targeted Hea 05 and Pol 05 credits would be awardable.

5. Suitably Qualified Acoustician

For the award of the acoustic credits, the BREEAM assessment requires that the work be undertaken by a suitably qualified acoustician, who it defines as an individual achieving the following requirements:

- Has a minimum of three years relevant experience (within the last five years).
- Holds a recognised acoustic qualification and membership of an appropriate professional body.

The author of this report has been awarded a BSc (Hons) in Acoustics awarded by the University of Salford with 18 years continuous post-graduate experience working as an acoustic engineer and is a corporate member of the Institute of Acoustics.

Appendix A Glossary of Acoustic Terminology

L_p	The instantaneous sound pressure level (L_p)
L_{pA} (or L_A)	The A-weighted instantaneous sound pressure level (L_{pAp} or L_A) This is the root mean square size of the pressure fluctuations in the air. This level can fluctuate wildly even for seemingly steady sounds. To make sound level meters easier to read the values on the display are smoothed or damped out. This is effectively done by taking a rolling average of the previous 0.125 s (FAST time constant) or the previous 1 s (SLOW time constant).
L_{AF}, L_{AS}	The letters F or S are added to the subscripts in the notation to indicate when the FAST or SLOW time constant has been used. These are often omitted but it is good practice to include them.
L_{max}	The maximum instantaneous sound pressure level (L_{max}),
L_{Amax}	The A-weighted maximum instantaneous sound pressure level (L_{Amax})
L_{AFmax}	The A-weighted maximum instantaneous sound pressure level with a FAST time constant (L_{AFmax}). This is the highest instantaneous sound pressure level reached during a measurement period. The opposite of the L_{max} is the minimum instantaneous sound pressure level or L_{min} etc.
L_{min}, L_{Fmin}	It is good practice to include the letter which identifies the time constant used as this can make a significant difference to the value.
$L_{N,T}$	The percentage exceedence sound pressure level ($L_{N,T}$),
$L_{AN,T}, L_{AFN,T}$	The A-weighted percentage exceedence sound pressure level ($L_{AN,T}$), the A-weighted percentage exceedence sound pressure level with a FAST time constant ($L_{AFN,T}$).
$N = \text{percentage value, 0-100}$	This is the sound pressure level exceeded for $N\%$ of time period T . E.g. If an A-weighted level of x dB is exceeded for a total of 6 minutes within one hour, the level will have been above x dB for 10% of the measurement period. This is written as $L_{A10,1hr} = x$ dB.
$T = \text{measurement time}$	L_{A0} (the level exceeded for 0 % of the time) is equivalent to the L_{Amax} and L_{A100} (the level exceeded for 100 % of the time) is equivalent to the L_{Amin} .
e.g. $L_{A90}, L_{A10}, L_{AF90}, 5 \text{ min}$	It is good practice to include the letter which identifies the time constant used as this can make a significant difference to the value.
$L_{eq,T}$	The equivalent continuous sound pressure level over period T ($L_{eq,T}$),
$L_{Aeq,T}$	The A-weighted equivalent continuous sound pressure level over period T ($L_{Aeq,T}$).
$T = \text{measurement time}$	This is effectively the average sound pressure level over a given period. As the decibel is a logarithmic quantity the L_{eq} is not a simple arithmetic mean value.
e.g. $L_{Aeq,5min}$	The L_{eq} is calculated from the raw sound pressure data. It is not appropriate to include a reference to the FAST and SLOW time constants in the notation.

Appendix B Measured Sound Pressure Levels

