

Building Services Plant Noise Impact Assessment

Orchard House SEND School

Varley Street, Manchester

M40 8EF

Stroma Built Environment Ltd.

SBE Ref: OPP-092896 – AC - 1v2

I. Revision History

Revision	Date	Description	
1v1	01/08/2025	First Issue	
		Compiled By	Authorised By
		David Fryer AMIOA Acoustic Consultant	Ben Reed MIOA Senior Acoustic Consultant
1v2	05/08/2025	Second Issue – Updated background sound level assessment	
		David Fryer AMIOA Acoustic Consultant	Ben Reed MIOA Senior Acoustic Consultant

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1. Introduction

- 1.1 Stroma Built Environment (SBE) has been appointed by Winvic Construction (Client) to provide acoustic consultancy services for the Orchard House SEND School in Manchester, M40 8EF with regard to satisfying Planning Condition 21 set by the Local Planning Authority (LPA).
- 1.2 The purpose of this report is to consider the acoustic impact of all new fixed building services plant associated with the new development on the existing noise climate at the nearest noise sensitive receptors (NSR).
- 1.3 The assessment is based on manufacturer supplied plant equipment data including type, locations, operating hours and noise emissions, as provided to SBE.
- 1.4 This document has been prepared for the sole use, benefit and information of the Client for the purposes set out in the document or instructions commissioning the works. The liability of SBE in respect of the information contained herein will not extend to any third party.
- 1.5 This report is limited to addressing the specific acoustic issues contained herein and is based on information and drawings provided by the client.
- 1.6 Whilst every effort has been made to ensure that this report is easy to understand, it is technical in nature. A glossary of terminology is included in Appendix III.

2. Standards and BREEAM Requirements

Planning Condition Requirements

2.1 It is understood that the LPA has set a planning condition relating to noise-emitting building services plant associated with the new development.

2.2 Planning Condition 21 States:

“a) 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 commencement of the use hereby approved the scheme shall be submitted to and approved in writing by the City Council as local planning authority in order to secure a reduction in the level of noise emanating from the site.”

“b) Prior to occupation of the development a verification report shall be submitted to and approved in writing by the City Council as local planning authority to validate that the work undertaken throughout the development conforms to the recommendations and requirements in the approved acoustic report. The report shall also undertake post completion testing to confirm that the noise criteria have been met. Any instances of nonconformity with the recommendations in the report shall be detailed along with any measures required to ensure compliance with the agreed noise criteria.”

BS 4142:2014+A1: 2019 ‘Methods for rating and assessing industrial and commercial sound’

2.3 BS 4142 describes a method for assessing the adverse impact from noise sources that are of an industrial nature (e.g. fans, pumps, chillers, air handling units etc.). The assessment methodology is based upon determining a ‘*rating level*’ for the equipment being assessed, which is the level of noise from the item or items of plant being assessed (measured as an L_{Aeq}).

2.4 The rating level is then compared with the underlying background noise level (measured as a L_{A90}) in the absence of noise from the item or items of plant being assessed. 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.

2.5 BS 4142 states that a penalty should be added for any plant which gives rise to noise features that may increase disturbance such as tonal, impulsive or intermittent characteristics. Generally, a rating penalty for a sound should be based on a subjective assessment of its characteristics.

3. Site Description and Noise Survey

- 3.1 The development site is located at vacant land in between Sawley Road and James Street. Development proposals are for the construction of a new Special Educational Needs (SEN) school building with an external play area and car park with associated admin and ancillary spaces.
- 3.2 The closest noise sensitive receptor (NSR) to the site has been identified as residential properties along Sawley Road, northwest of the site. This has been labelled as NSR A in Figure 1 below.
- 3.3 The location of the short-term (ST1) and long-term (LT1 & LT2) measurement positions are displayed in Figure 1 below.

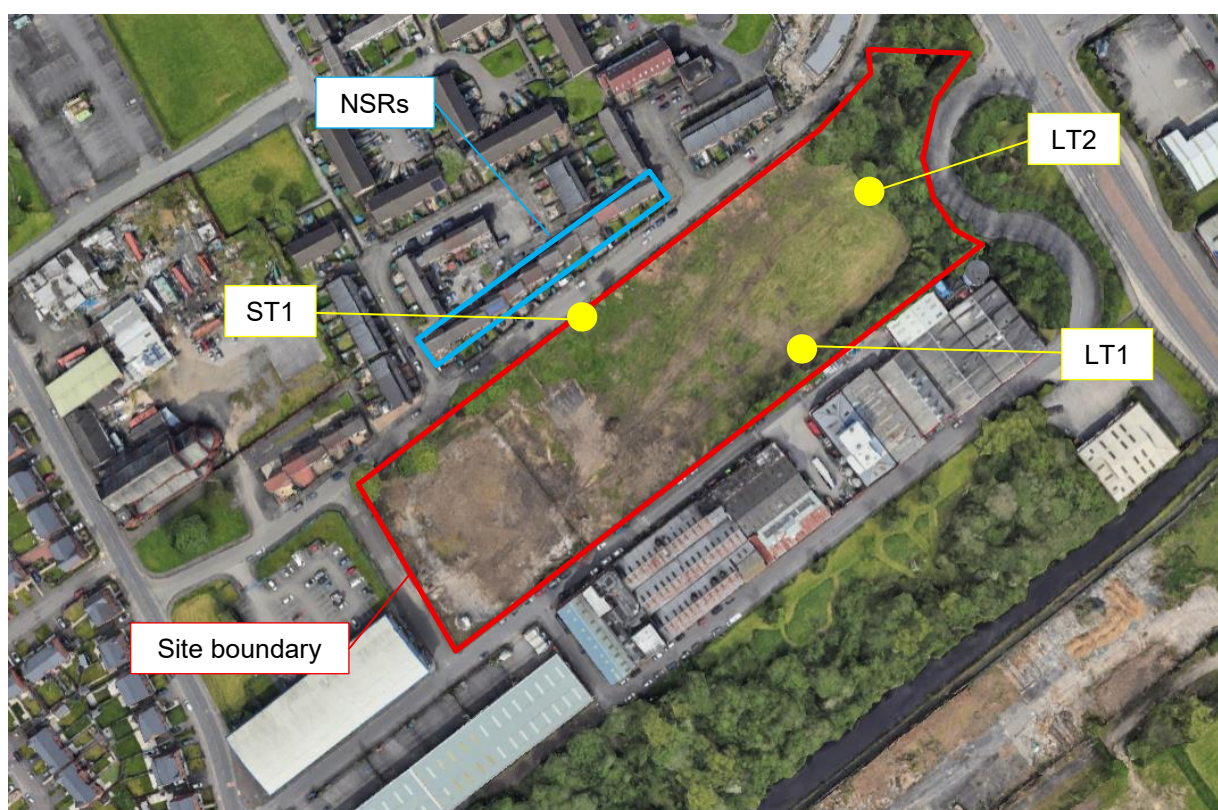


Figure 1: Site plan with approximate noise measurement locations

Noise Survey

- 3.4 A noise survey was undertaken at the site on the 21st of March 2023 to the 22nd of March 2023. A site plan with approximate noise measurement locations is shown in **Error! Reference source not found.** above.
- 3.5 The survey consisted of two long term measurement positions (LT1 and LT2) with one short term measurement position (ST1) to assess noise levels across the site.

- 3.6 The noise environment at the time of the noise survey was primarily controlled by traffic noise travelling along the A6010 with additional passing traffic along James Street with works being heard in the industrial premises such as forklift movement.
- 3.7 Measured noise levels are summarised in Table 1 below.

Table 1: Summary of noise survey

Measurement Location	Start Time	$L_{Aeq,T}$ (dB) ^[1]	$L_{A90,T}$ (dB) ^[2]
LT1	13:12 – 23:00 (daytime)	59	57
	23:00 – 07:00 (night-time)	58	57
	07:00 – 13:52 (daytime)	59	56
LT2	13:21 – 23:00 (daytime)	60	57
	23:00 – 07:00 (night-time)	59	56
	07:00 – 13:47 (daytime)	60	58
ST1	13:42 – 14:13 (daytime)	52	50
Notes to Table 1 [1] logarithmic average of the measurement period [2] Arithmetic average of the measurement period			

4. Noise Impact Assessment

Plant Noise Limits

- 4.1 The representative background noise level had been previously established in the SBE Planning Stage Noise Impact Assessment report (reference: OPP-092858 AC 1v1) dated 28/03/2023. This background noise level is shown below in Table 2 along with the requirements of Planning Condition 21 which states that building services must be 5 dB below this level.
- 4.2 Identified noise sources are road traffic from the A6010 and industrial / plant noise from the south east. No measurement was undertaken during the night time at the identified NSR, however monitoring at positions LT1 and LT2 indicate that background sound levels generated by traffic and industrial noise are consistent during day and night time periods. The identified Noise Sensitive Receptor (NSR) is exposed to the same noise sources, therefore it is considered that night time background levels at the NSR during the night will be similar to the daytime.
- 4.3 Generally building services plant will operate during daytime hours when the building is occupied, however allowance is made for potential limited night time operation for frost protection and summertime purge ventilation. Any night time operation is expected to be at significantly reduced duty, and hence lower noise levels, however full operation has been considered as a worst case assessment.

Table 2: Established background noise level and plant noise level limit

Period	Representative background noise level, L_{A90} (dB)	BS4142 Rating Level, $L_{Ar,Tr}$ (dB)
Daytime (07:00-23:00)	50	≤ 45
Night-time (23:00-07:00)	50	≤ 45

Assessed Building Services Plant

- 4.4 Sources of externally located, or externally terminating, noise generating mechanical building services plant associated with the development that have been considered in this assessment are set out in

4.5 Table 3.

Table 3: Plant noise sources considered in the assessment

Plant	Make	Model	Quantity	Location
HVUs	Monodraught	HVU Zero X+ Ducted	38	Terminations ducted to facade
MVHRs	Komfovent	DOMEKT-CF-500-F-R1-F7/M5-C6M-X	11	Terminations ducted to facade
	Komfovent	DOMEKT-CF-700-F-R1-F7/M5-C6M-X	3	Terminations ducted to facade
	Verso	DOMEKT-CF-1300-F-R1-F7/M5-C6M-X	2	Terminations ducted to facade
	Verso	DOMEKT-CF-1500-F-R1-F7/M5-C6M-X	1	Terminations ducted to facade
Heat Pump	Mitsubishi	PUZ-ZM60-VHA2	2	Roof plant area
ASHP 001	Mitsubishi	CAHV-R450YA-HPB	1	Roof plant area
ASHP 101 & 102	Daikin	EQYT175B-SRA1+OP204	2	Roof plant area
KEF	BIFLOW SB	Bifurcated Axial Flow Fan SB400-CON2-3	1	Roof plant area
AHU	Verso	Verso-S-20-X-H-PM/IE5/1.4/X-F7-HW/4R/2.6-X-R1-C5-O/OUT	1	Roof plant area
TEF	Jetflow	SJMF125	1	Termination ducted to facade

Noise Impact Assessment

4.6 To assess noise emission from the fixed mechanical plant, a noise model of the site and its surroundings has been developed using Datakustik CadnaA noise modelling software. The noise model is based on the following assumptions and limitations:

- Noise propagation is calculated according to ISO 9613:2024 methodology;
- Sound reflections up to the 1st order have been considered;
- Ground absorption of 0.5 has been used to reflect the environment;
- Building absorption has been set to 0.2;
- On-site geometry and site levels are based on drawings provided by the Client;
- Receptor height has been set to 1.5 m to reflect ground floor level and 4 m to reflect first floor level of the identified NSRs;
- Receptors are set to 1 m from facades of all NSRs;

- Sound power levels and (sound pressure levels where sound power levels are unavailable) for each plant item have been taken from plant technical submission and manufacturer data documents supplied by the Client;
- Attenuator data for the extract and supply fans have been provided by the client and applied;
- Assessment has been undertaken on the basis that all plant may operate concurrently at any point during the daytime or night-time at design duty; while this is unlikely to be the case in reality, this assumption presents a worst-case assessment;
- BS 4142 acoustic feature corrections have not been included in the calculations as based on the type of plant equipment and manufacturer noise data provided, SBE does not expect impulsive or tonal characteristics, or distinctive intermittency to the noise emitted.

4.7 Appendix II presents the noise data used.

4.8 Table 4 presents the predicted cumulative plant noise levels at the identified NSR along with a comparison against the planning condition noise level limit.

Table 4: Calculated plant noise levels at NSRs

Period	Representative background noise level, L_{A90} (dB)	Planning condition noise level limit (dB $L_{Ar,Tr}$)	Calculated rating level at NSR (dB $L_{Ar,Tr}$)	Compliance
Daytime (07:00-23:00)	50	≤ 45	38	YES
Night-time (23:00-07:00)	50	≤ 45	38	YES

4.9 The rating levels predicted at the NSRs are below the planning condition noise level limits and therefore complies with the requirements of Planning Condition 21.

4.10 It is noted that the planning condition states that post-completion testing shall be completed to confirm the noise criteria is met, this will be completed prior to the building handover completion date as per the requirements of Condition 21.

4.11 *The report shall also undertake post completion testing to confirm that the noise criteria have been met.*

Calculation Uncertainty Estimation

4.12 Given the nature of the assessment, there is always an element of uncertainty despite best efforts to make the calculations as accurate as possible.

4.13 An assessment of uncertainty in measurement and calculation is undertaken following guidance in University of Salford document 'A good practice guide on the sources and magnitude of uncertainty arising in the practical measurement of environmental noise' (2007).

-
- 4.14 The assessment has been undertaken against the measured background sound levels, to which the uncertainty of noise survey measurements is expected to be ± 1 dB. This is based on the allowable uncertainty for a calibrated Class 1 precision integrating sound level meters, quoted by BS 61672-1:2003 as ± 1.1 dB at 1 kHz.
- 4.15 Sound data for plant equipment has been taken from manufacturer quoted noise measurements. In accordance with BS EN ISO 3740:2001, the uncertainty of source measurements is expected to be between 1 dB and 2 dB in each octave band.
- 4.16 The uncertainty in a distance attenuation calculation over a distance between 100 m and 1 km is quoted by ISO 9613-2:2024 as ± 3 dB for sources up to a height of 30 m.
- 4.17 It is considered that the maximum uncertainty in measurement and calculation is ± 4 dB. Addition of the calculated uncertainty to the predicted rating sound level does not change the outcome of the assessment.

5. Conclusion

- 5.1 Stroma Built Environment (SBE) has been appointed by Winvic Construction (Client) to provide acoustic consultancy services for the Orchard House SEND School in Manchester, M40 8EF with regard to satisfying Planning Condition 21 set by the Local Planning Authority (LPA).
- 5.2 The purpose of this report is to consider the acoustic impact of all new fixed building services plant associated with the new development on the existing noise climate at the nearest noise sensitive receptors (NSR).
- 5.3 The LPA set a planning condition which requires noise emissions from all building services plant associated with the development to be 5 dB or below the background noise level when measured at the NSR.
- 5.4 A desktop noise assessment has been carried out to assess the building services rating level at the nearby NSRs by using a three-dimensional Datakustik CadnaA noise model, using manufacturers noise specifications including operational times clarified by the Client for the new fixed plant building services equipment associated with the development.
- 5.5 The rating levels predicted at the NSRs are below the planning condition noise level limits and therefore complies with the requirements of Planning Condition 21.
- 5.6 It is noted that the planning condition also states that post-completion testing shall be completed to confirm the noise criteria is met, this will be completed separately and prior to the building handover completion date as per the requirements of Condition 21.

Appendix I. Plant Layouts

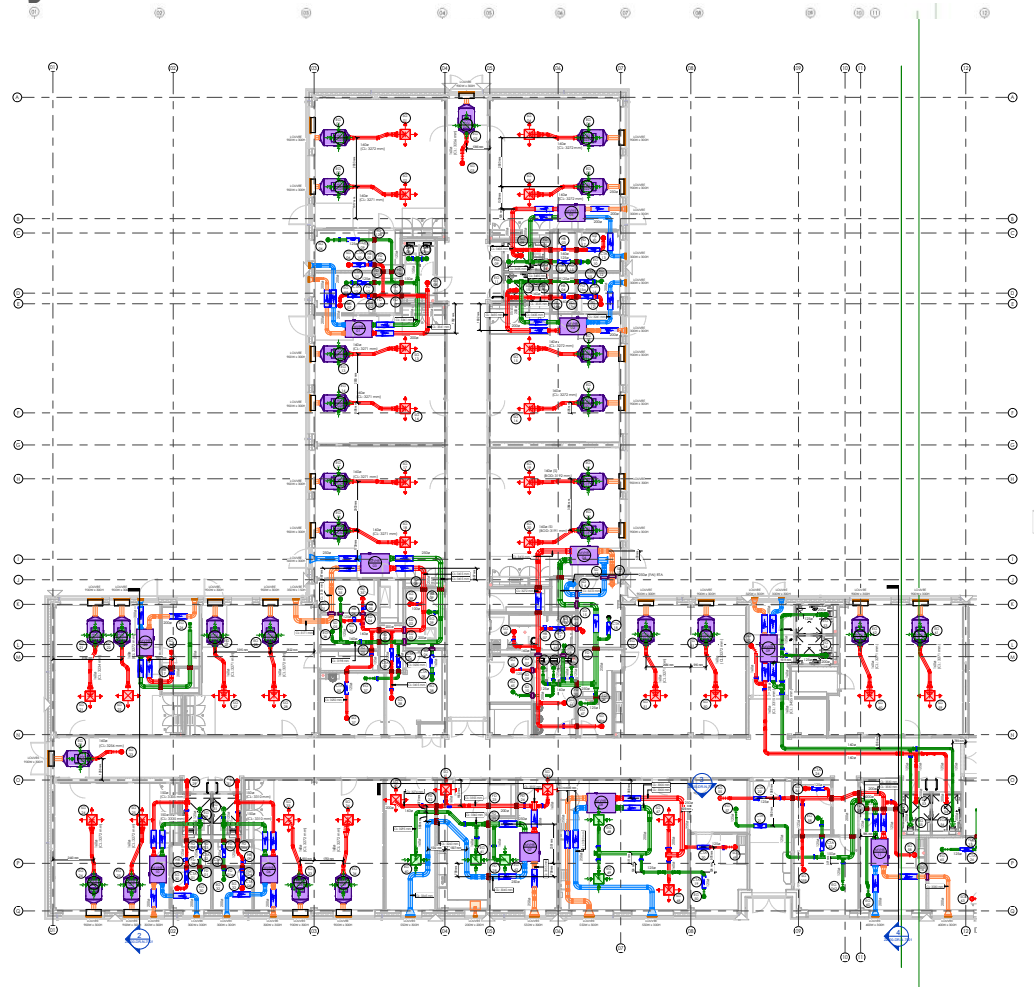


Figure 2: Ground floor ventilation layout (Sheet 1 of 2)

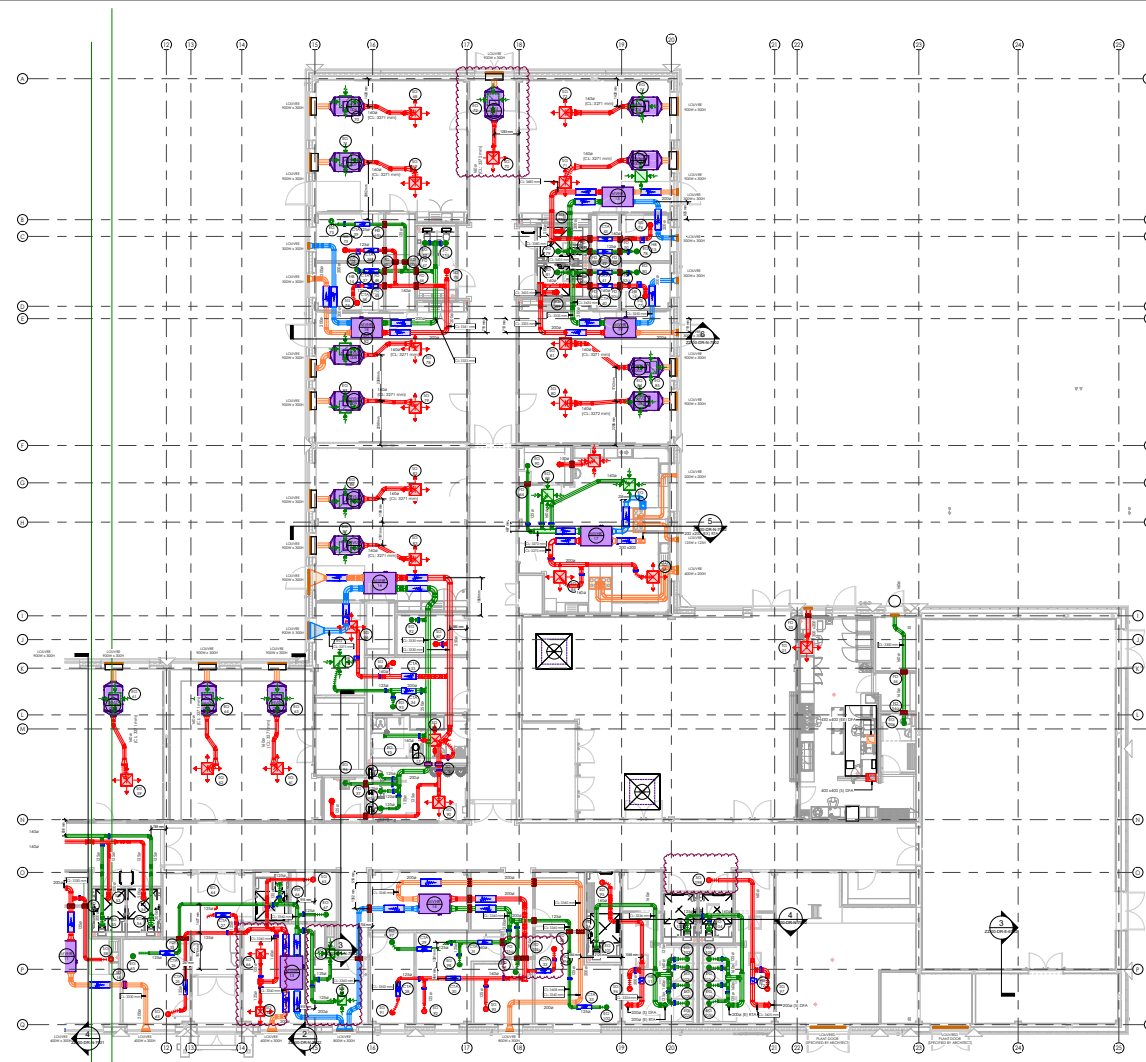


Figure 3: Ground floor ventilation layout (Sheet 1 of 2)

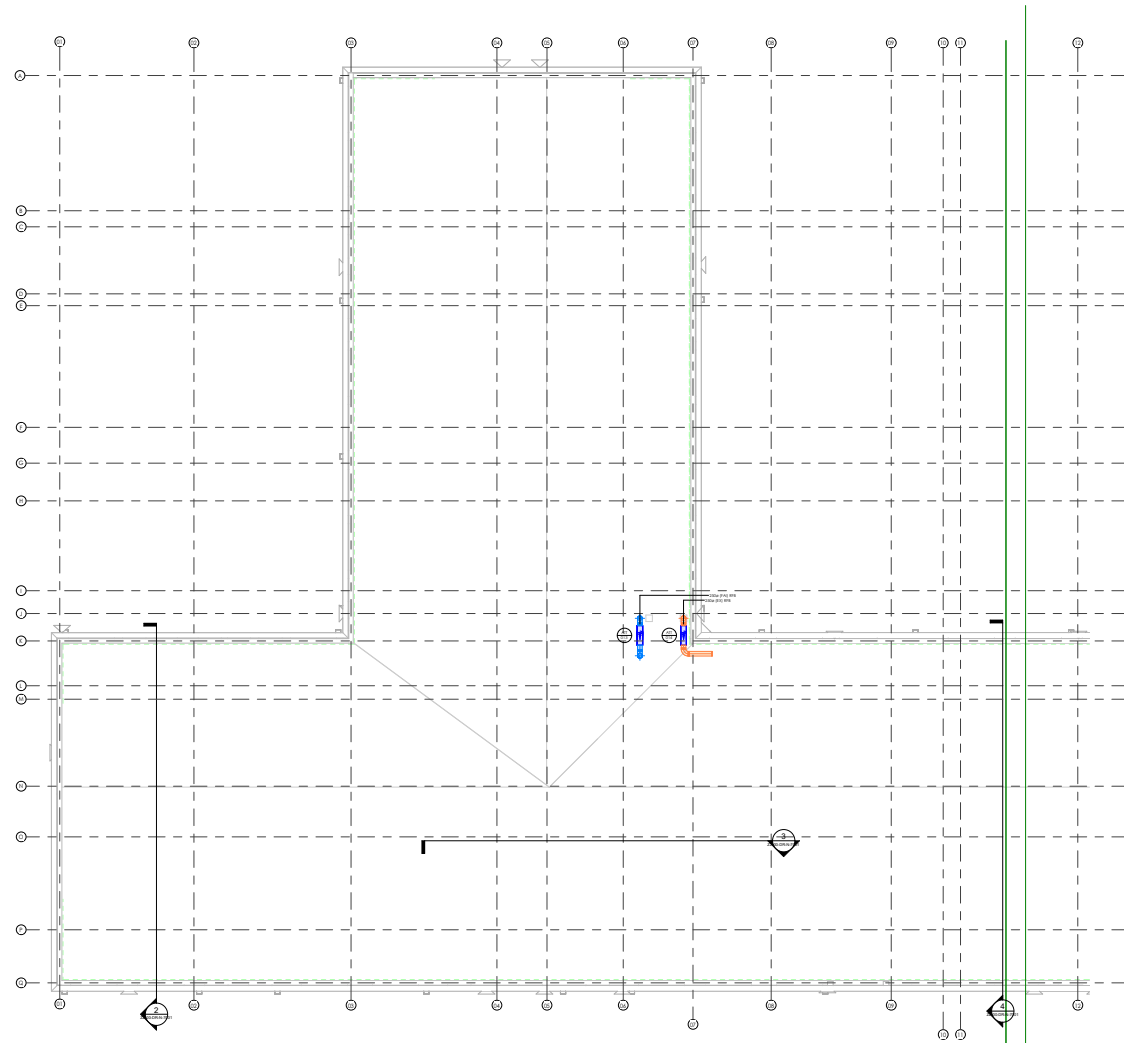


Figure 4: Roof ventilation layout (sheet 1 of 2)

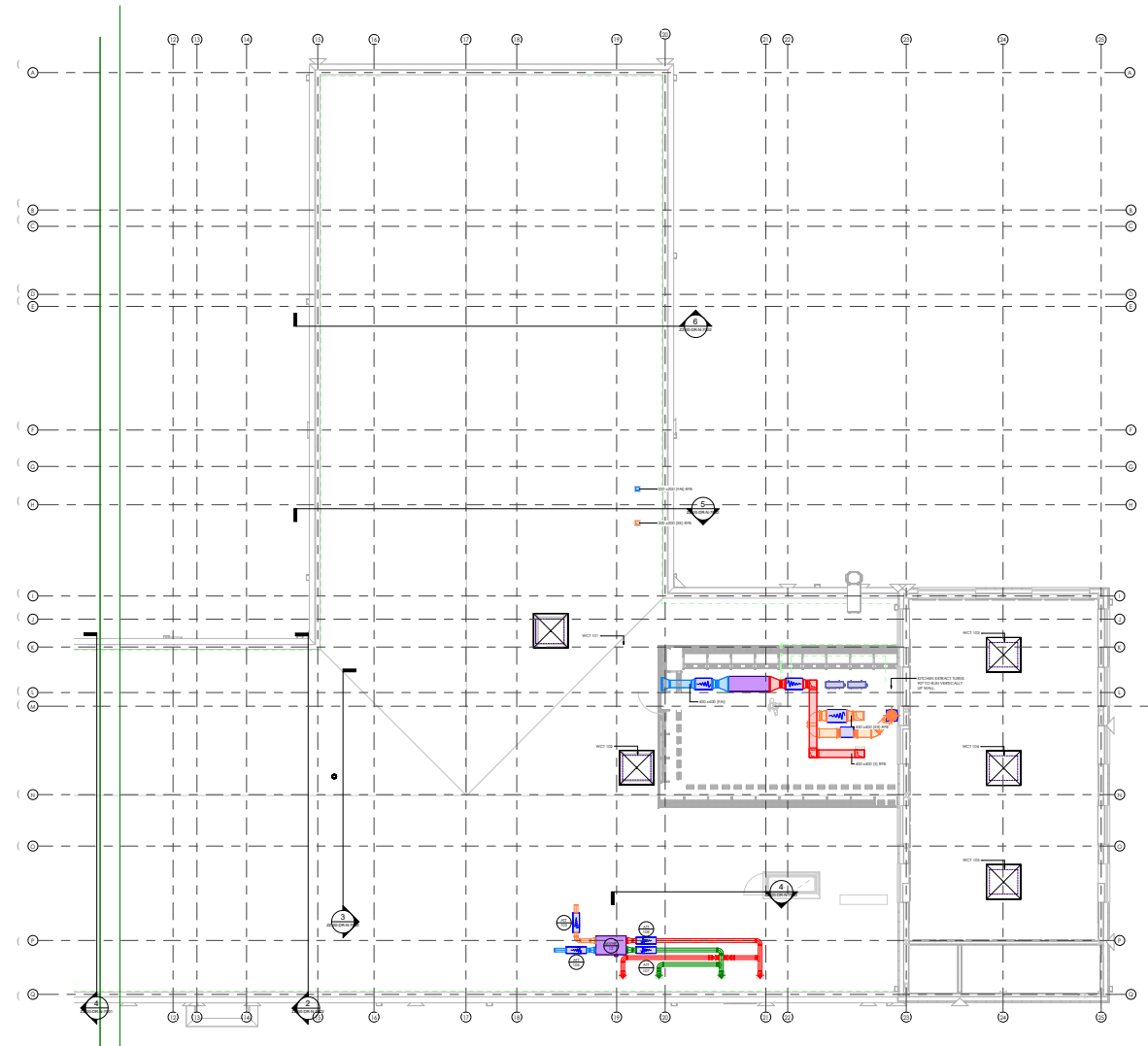


Figure 5: Roof ventilation layout (sheet 2 of 2)

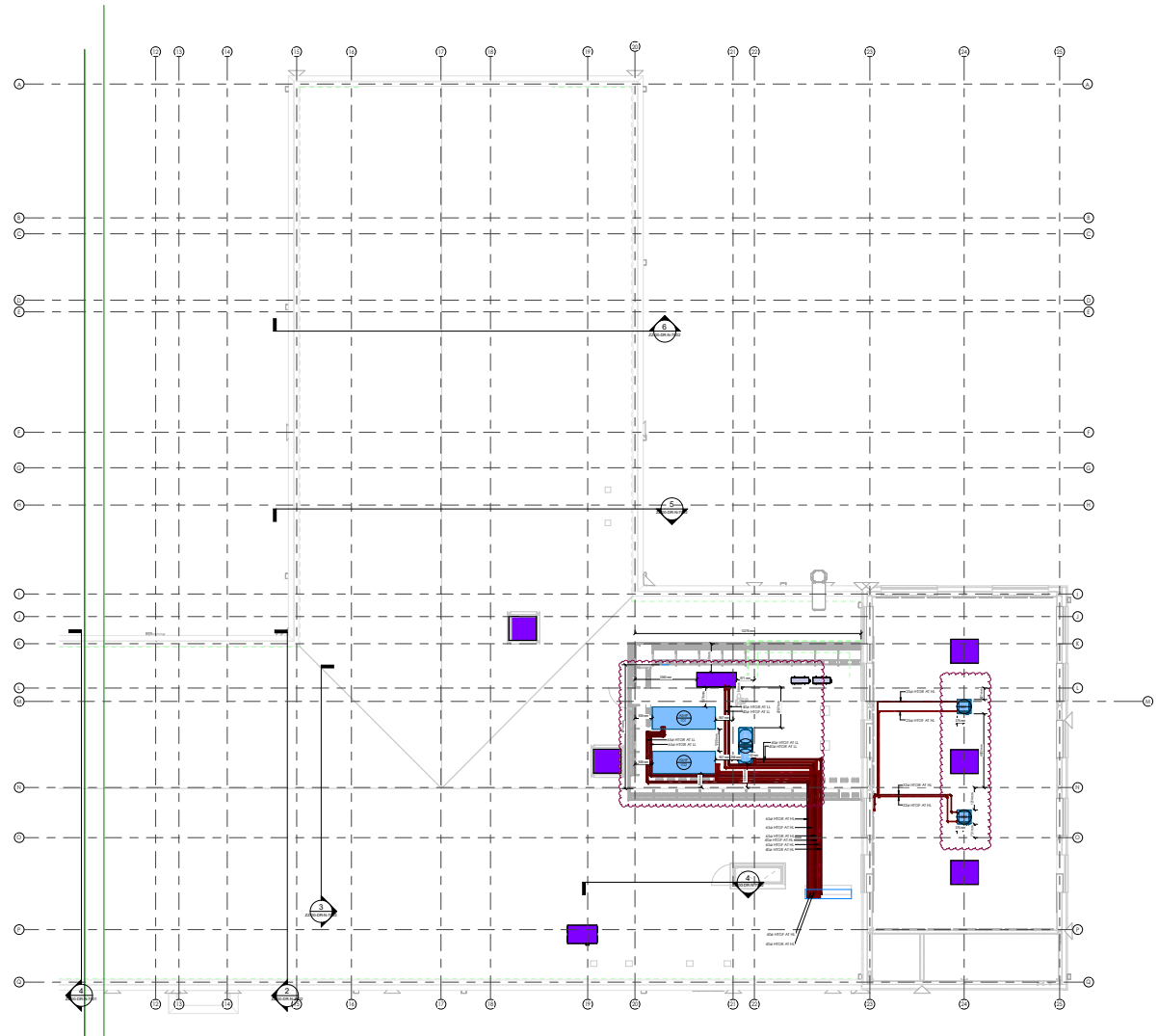


Figure 6: Roof heating layout (sheet 2 of 2)

Appendix II. Plant Sound Levels

ACOUSTIC DATA

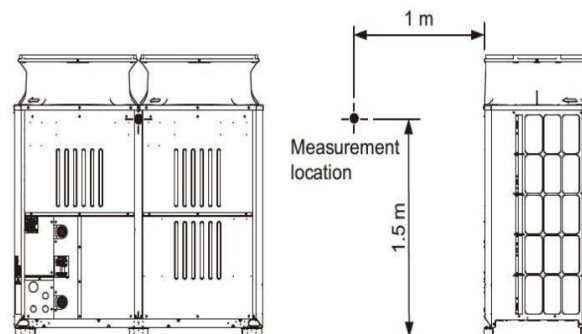
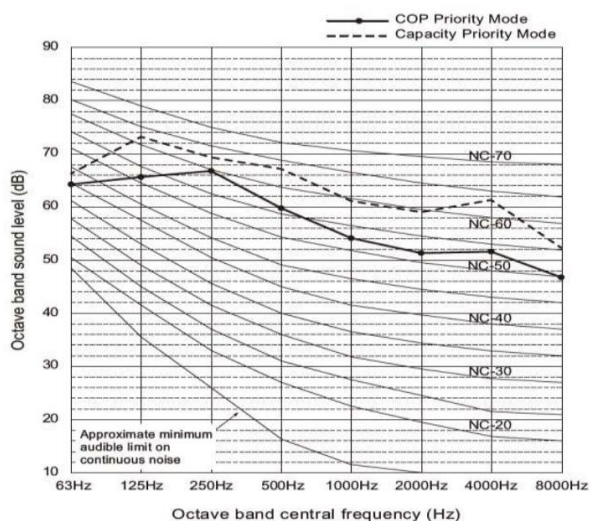
Sound power level Lw	to the air ducts		to surrounding
	Supply air flow [dB]		[dB]
F[Hz]	Inlet	Outlet	
63	60,8	65,4	56,8
125	57,2	64,2	52,8
250	62,1	72,3	52,5
500	60,1	70,7	45,0
1000	56,4	73,0	47,9
2000	53,1	69,0	40,7
4000	50,2	65,2	33,8
8000	45,1	58,9	31,2
dB(A)	62	76	51

Figure 7: AHU sound power level data

HVR Zero X+ (& HVR Zero XC+)

Sound power measurements for a single exposed system									
Airflow (l/s)	Octave Band (Hz) Sound Power Level dB re. 1pW								LwA
	63	125	250	500	1000	2000	4000	8000	
100	47.8#	36.0*	39.6	37.9	30.8*	22.6*	18.3#	23.2#	37.7
130	46.0#	36.5*	41.0	39.9	33.3*	25.0*	18.8#	21.9#	39.6
180	51.7#	45.2*	48.4	47.7	44.0*	39*	28.2#	24.1#	48.7
*denotes figures corrected for background					#denotes background levels				
System tested with a standard 50mm external louvre arrangement									
Predicted in room noise of 33dB with two units in a 55m² room @ 130 l/s per unit									

Figure 8: HVU sound power level data



Measurement Position for Sound Pressure Level

Figure 9: Mitsubishi CAHV-R450YA-HPB ASHP sound pressure level data



EWYT175B-SRA1+OP204

Performances calculated according to EN14511-3

Technical Data Sheet

Acoustic information

Sound pressure level at 1 m from the unit (rif. 2 x 10⁻⁵ Pa)

63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	db(A)
66.0	67.0	62.0	62.0	63.0	61.0	54.0	46.0	67.2

Values referred to Evap. IN/OUT 12/7°C and 35°C Amb., full load operation, standard unit configuration without options. Sound pressure level calculated from sound power level. Sound pressure in octave band is for information only and not considered binding.

Physical information

Evap. connections size	88.9 mm	Length	3426 mm
Weight shipping/operating	1206 kg / 1214 kg	Width	1211 mm
		Height	1801 mm

Information referred to standard unit configuration without options, refer to certified unit drawing.

Figure 10: Daikin EWYT175B ASHP sound pressure level data

PUZ-ZM OUTDOOR UNITS		PUZ-ZM60VHA2
SOUND PRESSURE LEVEL (dBA)	Heating/Cooling	49 / 47
SOUND POWER LEVEL (dBA)	Cooling	67
WEIGHT (kg)		67
DIMENSIONS (mm)	Width x Depth x Height	950 x 330 + 25 x 943
ELECTRICAL SUPPLY		220-240v, 50Hz
PHASE		Single
SYSTEM POWER INPUT (kW)	Heating/Cooling (nominal)	1.732 / 1.560
	Heating/Cooling (UK)	1.25 / 1.65
STARTING CURRENT (A)		5.3
SYSTEM RUNNING CURRENT (A)	Heating/Cooling [MAX]	7.41 / 6.65 [19.4]
FUSE RATING (BS88) - HRC (A)		25
MAINS CABLE No. CORES		3
MAX PIPE LENGTH (m)		55
MAX HEIGHT DIFFERENCE (m)		30
CHARGE REFRIGERANT (kg) / CO ₂ EQUIVALENT (t) - R32 (GWP 675) - 30m		2.80 / 1.89 (30m)
MAX ADDITIONAL REFRIGERANT (kg) / CO ₂ EQUIVALENT (t) - R32 (GWP 675)		0.80 / 0.54

Figure 11: Mitsubishi R32 PUZ-ZM60VHA2 sound power and sound pressure level data

Product Code	Speed r/min		Sound Power Level dBW @ Octave Band Hz								Total dB
			63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
SB250-CON2-3	2780	Inlet	83	81	79	78	77	75	73	69	88
SB250-CON4-3	1370	Inlet	77	74	71	64	62	60	57	47	80
SB315-CON2-3	2780	Inlet	90	86	82	81	80	77	77	71	93
SB315-CON4-3	1370	Inlet	80	77	74	68	66	64	62	53	83
SB400-CON2-3	2800	Inlet	94	87	86	90	84	83	80	73	97
SB500-CON2-3	2840	Inlet	98	93	90	96	96	95	93	89	104

Figure 12: KEF Biflow SB400-Con2-3 sound power level data

ACOUSTICS DATA

Frequency	[Hz]	63	125	250	500	1000	2000	4000	8000	dB(A)
Outdoor Lw	[dB]	50	44	49	43	42	40	40	35	48
Supply Lw	[dB]	54	51	61	54	56	57	55	47	62
Extract Lw	[dB]	48	44	48	42	42	40	40	35	48

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Exhaust Lw	[dB]	53	50	60	53	55	57	55	48	62
Casing Lw	[dB]	48	43	47	32	31	28	20	14	40
Casing Lp 1 m	[dB]	44	40	42	27	27	24	16	10	36
Casing Lp 3 m	[dB]	40	35	34	20	21	17	10	4	28

Figure 13: MVHR Komfovent DOMEKT-CF-500 sound power level data

ACOUSTICS DATA

Frequency	[Hz]	63	125	250	500	1000	2000	4000	8000	dB(A)
Outdoor Lw	[dB]	52	53	53	53	52	44	39	35	55
Supply Lw	[dB]	62	65	68	68	65	59	55	49	69
Extract Lw	[dB]	51	51	52	51	51	44	39	34	54
Exhaust Lw	[dB]	61	63	66	66	63	59	55	49	68

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DOMEKT-CF-700-F-L1-F7/M5-C6M-X

Casing Lw	[dB]	55	55	54	44	41	35	26	21	49
Casing Lp 1 m	[dB]	52	52	50	40	37	30	22	17	45
Casing Lp 3 m	[dB]	47	47	41	32	31	23	16	10	37

Figure 14: MVHR Komfovent DOMEKT-CF-700 sound power level data

Item	System Reference	Code	Suffix	DWG	L1 mm	L2/ID mm	W mm	H mm	Vol m³/s	PD Pa	Wt kg	No. Off.		Performance, dB							
														63	125	250	500	1k	2k	4k	8k
1	ATT-101 AHU FRESH	SL	GJ	A02G	900		400	400	0.792	50	30	1	IL	4	7	14	22	29	22	19	11
2	ATT-102 AHU SUPPLY	SL	GJ	A02G	900		400	400	0.792	50	30	1	IL	4	7	14	22	29	22	19	11
3	ATT-103 KEF EXHAUST	SL	GM	A02G	900		450	400	0.932	50	33	1	IL	6	9	14	18	22	16	14	9
4	ATT-104 KEF EXTRACT	SL	GM	A02G	900		450	400	0.932	50	33	1	IL	6	9	14	18	22	16	14	9
5	ATT-001 MVHR 001 EXHAUST	PL	G	A13G	900	200			0.101	5	10	1	IL	1	3	7	19	28	23	20	15
6	ATT-002 MVHR 001 FRESH AIR	PL	G	A13G	900	200			0.101	5	10	1	IL	1	3	7	19	28	23	20	15
7	ATT-003 MVHR 001 EXTRACT	PL	G	A13G	900	200			0.101	5	10	1	IL	1	3	7	19	28	23	20	15
8	ATT-004 MVHR 001 SUPPLY	PL	G	A13G	900	200			0.101	5	10	1	IL	1	3	7	19	28	23	20	15
9	ATT-005 MVHR 002 EXTRACT	PL	G	A13G	900	200			0.055	5	10	1	IL	1	3	7	19	28	23	20	15
10	ATT-006 MVHR 002 SUPPLY	PL	G	A13G	900	200			0.055	5	10	1	IL	1	3	7	19	28	23	20	15
11	ATT-007 MVHR 002 EXHAUST	PL	G	A13G	900	200			0.055	5	10	1	IL	1	3	7	19	28	23	20	15
12	ATT-008 MVHR 002 INTAKE	PL	G	A13G	900	200			0.055	5	10	1	IL	1	3	7	19	28	23	20	15
13	ATT-009 MVHR 003 EXHAUST	PL	G	A13G	900	250			0.131	5	12	1	IL	2	3	7	18	25	19	17	13
14	ATT-010 MVHR 003 FRESH AIR	PL	G	A13G	900	250			0.131	5	12	1	IL	2	3	7	18	25	19	17	13
15	ATT-011 MVHR 003 EXTRACT	PL	G	A13G	900	250			0.131	5	12	1	IL	2	3	7	18	25	19	17	13
16	ATT-012 MVHR 003 SUPPLY	PL	G	A13G	900	250			0.131	5	12	1	IL	2	3	7	18	25	19	17	13
17	ATT-013 MVHR 004 EXHAUST	SL	GJ	A02G	900		250	250	0.241	25	18	1	IL	2	4	9	21	36	30	27	16
18	ATT-014 MVHR 004 FRESH AIR	SL	GJ	A02G	900		250	250	0.241	25	18	1	IL	2	4	9	21	36	30	27	16
19	ATT-015 MVHR 004 EXTRACT	PL	G	A13G	900	250			0.241	5	12	1	IL	2	3	7	18	25	19	17	13
20	ATT-016 MVHR 004 SUPPLY	PL	G	A13G	900	250			0.241	5	12	1	IL	2	3	7	18	25	19	17	13
21	ATT-021 MVHR 005 EXHAUST	PL	G	A13G	900	200			0.059	5	10	1	IL	1	3	7	19	28	23	20	15
22	ATT-022 MVHR 005 FRESH AIR	PL	G	A13G	900	200			0.059	5	10	1	IL	1	3	7	19	28	23	20	15
23	ATT-023 MVHR 005 EXTRACT	PL	G	A13G	900	200			0.059	5	10	1	IL	1	3	7	19	28	23	20	15
24	ATT-024 MVHR 005 SUPPLY	PL	G	A13G	900	200			0.059	5	10	1	IL	1	3	7	19	28	23	20	15
25	ATT-025 MVHR 006 EXHAUST	PL	G	A13G	900	200			0.059	5	10	1	IL	1	3	7	19	28	23	20	15
26	ATT-026 MVHR 006 FRESH AIR	PL	G	A13G	900	200			0.059	5	10	1	IL	1	3	7	19	28	23	20	15
27	ATT-027 MVHR 006 EXTRACT	PL	G	A13G	900	200			0.059	5	10	1	IL	1	3	7	19	28	23	20	15
28	ATT-028 MVHR 006 SUPPLY	PL	G	A13G	900	200			0.059	5	10	1	IL	1	3	7	19	28	23	20	15
29	ATT-029 MVHR 007 EXHAUST	PL	G	A13G	900	250			0.175	5	12	1	IL	2	3	7	18	25	19	17	13
30	ATT-030 MVHR 007 FRESH AIR	PL	G	A13G	900	250			0.175	5	12	1	IL	2	3	7	18	25	19	17	13
31	ATT-031 MVHR 007 EXTRACT	PL	G	A13G	900	250			0.175	5	12	1	IL	2	3	7	18	25	19	17	13
32	ATT-032 MVHR 007 SUPPLY	PL	G	A13G	900	250			0.175	5	12	1	IL	2	3	7	18	25	19	17	13
33	ATT-033 MVHR 008 EXHAUST	PL	G	A13G	900	250			0.155	5	12	1	IL	2	3	7	18	25	19	17	13
34	ATT-034 MVHR 008 FRESH AIR	PL	G	A13G	900	250			0.155	5	12	1	IL	2	3	7	18	25	19	17	13
35	ATT-035 MVHR 008 EXTRACT	PL	G	A13G	900	250			0.155	5	12	1	IL	2	3	7	18	25	19	17	13
36	ATT-036 MVHR 008 SUPPLY	PL	G	A13G	900	250			0.155	5	12	1	IL	2	3	7	18	25	19	17	13

Figure 15: Attenuator insertion loss data (1 of 2)

Item	System Reference	Code	Suffix	DWG	L1	L2/ID	W	H	Vol	PD	Wt	No.		Performance, dB							
37	ATT-037 MVHR 009 EXHAUST	PL	G	A13G	900	200			0.128	5	10	1	IL	1	3	7	19	28	23	20	15
38	ATT-038 MVHR 009 FRESH AIR	PL	G	A13G	900	200			0.128	5	10	1	IL	1	3	7	19	28	23	20	15
39	ATT-039 MVHR 009 EXTRACT	PL	G	A13G	900	200			0.128	5	10	1	IL	1	3	7	19	28	23	20	15
40	ATT-040 MVHR 009 SUPPLY	PL	G	A13G	900	200			0.128	5	10	1	IL	1	3	7	19	28	23	20	15
41	ATT-041 MVHR 010 EXHAUST	PL	G	A13G	900	200			0.059	5	10	1	IL	1	3	7	19	28	23	20	15
42	ATT-042 MVHR 010 FRESH AIR	PL	G	A13G	900	200			0.059	5	10	1	IL	1	3	7	19	28	23	20	15
43	ATT-043 MVHR 010 EXTRACT	PL	G	A13G	900	200			0.059	5	10	1	IL	1	3	7	19	28	23	20	15
44	ATT-044 MVHR 010 SUPPLY	PL	G	A13G	900	200			0.059	5	10	1	IL	1	3	7	19	28	23	20	15
45	ATT-045 MVHR 011 EXHAUST	PL	G	A13G	900	200			0.145	5	10	1	IL	1	3	7	19	28	23	20	15
46	ATT-046 MVHR 011 FRESH AIR	PL	G	A13G	900	200			0.145	5	10	1	IL	1	3	7	19	28	23	20	15
47	ATT-047 MVHR 011 EXTRACT	PL	G	A13G	900	200			0.145	5	10	1	IL	1	3	7	19	28	23	20	15
48	ATT-048 MVHR 011 SUPPLY	PL	G	A13G	900	200			0.145	5	10	1	IL	1	3	7	19	28	23	20	15
49	ATT-049 MVHR 013 EXHAUST	PLP	G	A13G	900	355			0.446	15	24	1	IL	4	11	17	27	32	32	30	25
50	ATT-050 MVHR 012 FRESH AIR	PLP	G	A13G	900	355			0.446	15	24	1	IL	4	11	17	27	32	32	30	25
51	ATT-051 MVHR 012 EXTRACT	PLP	G	A13G	900	355			0.446	15	24	1	IL	4	11	17	27	32	32	30	25
52	ATT-052 MVHR 012 FRESH AIR	PLP	G	A13G	900	355			0.446	15	24	1	IL	4	11	17	27	32	32	30	25
53	ATT-053 MVHR 013 EXHAUST	PL	G	A13G	900	200			0.155	5	10	1	IL	1	3	7	19	28	23	20	15
54	ATT-054 MVHR 013 FRESH AIR	PL	G	A13G	900	200			0.155	5	10	1	IL	1	3	7	19	28	23	20	15
55	ATT-055 MVHR 013 EXTRACT	PL	G	A13G	900	200			0.155	5	10	1	IL	1	3	7	19	28	23	20	15
56	ATT-056 MVHR 014 SUPPLY	PL	G	A13G	900	200			0.155	5	10	1	IL	1	3	7	19	28	23	20	15
57	ATT-057 MVHR 014 EXHAUST	PL	G	A13G	900	200			0.155	5	10	1	IL	1	3	7	19	28	23	20	15
58	ATT-058 MVHR 014 FRESH AIR	PL	G	A13G	900	200			0.155	5	10	1	IL	1	3	7	19	28	23	20	15
59	ATT-059 MVHR 014 EXTRACT	PL	G	A13G	900	200			0.155	5	10	1	IL	1	3	7	19	28	23	20	15
60	ATT-060 MVHR 014 SUPPLY	PL	G	A13G	900	200			0.155	5	10	1	IL	1	3	7	19	28	23	20	15
61	ATT-061 MVHR 015 EXHAUST	PL	G	A13G	900	200			0.059	5	10	1	IL	1	3	7	19	28	23	20	15
62	ATT-062 MVHR 015 FRESH AIR	PL	G	A13G	900	200			0.059	5	10	1	IL	1	3	7	19	28	23	20	15
63	ATT-063 MVHR 015 EXTRACT	PL	G	A13G	900	200			0.059	5	10	1	IL	1	3	7	19	28	23	20	15
64	ATT-064 MVHR 015 SUPPLY	PL	G	A13G	900	200			0.059	5	10	1	IL	1	3	7	19	28	23	20	15
65	ATT-065 MVHR 016 EXHAUST	PL	G	A13G	900	250			0.251	5	12	1	IL	2	3	7	18	25	19	17	13
66	ATT-066 MVHR 016 EXHAUST	PL	G	A13G	900	250			0.251	5	12	1	IL	2	3	7	18	25	19	17	13
67	ATT-067 MVHR 016 EXTRACT	PL	G	A13G	900	250			0.251	5	12	1	IL	2	3	7	18	25	19	17	13
68	ATT-068 MVHR 016 SUPPLY	PL	G	A13G	900	250			0.251	5	12	1	IL	2	3	7	18	25	19	17	13
69	ATT-069 MVHR 017 EXHAUST	SL	GJ	A02G	900		200	200	0.145	25	14	1	IL	2	5	11	24	46	42	36	22
70	ATT-070 MVHR 017 FRESH AIR	SL	GJ	A02G	900		200	200	0.145	25	14	1	IL	2	5	11	24	46	42	36	22
71	ATT-071 MVHR 017 EXTRACT	SL	GJ	A02G	900		200	200	0.145	25	14	1	IL	2	5	11	24	46	42	36	22
72	ATT-072 MVHR 017 SUPPLY	SL	GJ	A02G	900		200	200	0.145	25	14	1	IL	2	5	11	24	46	42	36	22
73	ATT-073 MVHR 018 EXHAUST	PL	G	A13G	900	200			0.116	5	10	1	IL	1	3	7	19	28	23	20	15
74	ATT-074 MVHR 018 FRESH AIR	PL	G	A13G	900	200			0.116	5	10	1	IL	1	3	7	19	28	23	20	15
75	ATT-075 MVHR 017 EXTRACT	PL	G	A13G	900	200			0.116	5	10	1	IL	1	3	7	19	28	23	20	15
76	ATT-076 MVHR 017 SUPPLY	PL	G	A13G	900	200			0.116	5	10	1	IL	1	3	7	19	28	23	20	15
77	ATT-077 MVHR 019 EXHAUST	PL	G	A13G	900	200			0.058	5	10	1	IL	1	3	7	19	28	23	20	15
78	ATT-078 MVHR 019 FRESH AIR	PL	G	A13G	900	200			0.058	5	10	1	IL	1	3	7	19	28	23	20	15
79	ATT-079 MVHR 019 EXTRACT	PL	G	A13G	900	200			0.058	5	10	1	IL	1	3	7	19	28	23	20	15
80	ATT-080 MVHR 019 SUPPLY	PL	G	A13G	900	200			0.058	5	10	1	IL	1	3	7	19	28	23	20	15
81	ATT-081 MVHR 020 EXHAUST	PL	G	A13G	900	200			0.058	5	10	1	IL	1	3	7	19	28	23	20	15
82	ATT-082 MVHR 020 FRESH AIR	PL	G	A13G	900	200			0.058	5	10	1	IL	1	3	7	19	28	23	20	15
83	ATT-083 MVHR 020 EXTRACT	PL	G	A13G	900	200			0.058	5	10	1	IL	1	3	7	19	28	23	20	15
84	ATT-084 MVHR 020 SUPPLY	PL	G	A13G	900	200			0.058	5	10	1	IL	1	3	7	19	28	23	20	15

Figure 16: Attenuator insertion loss data (2 of 2)

Appendix III. Noise Survey Time History Plot

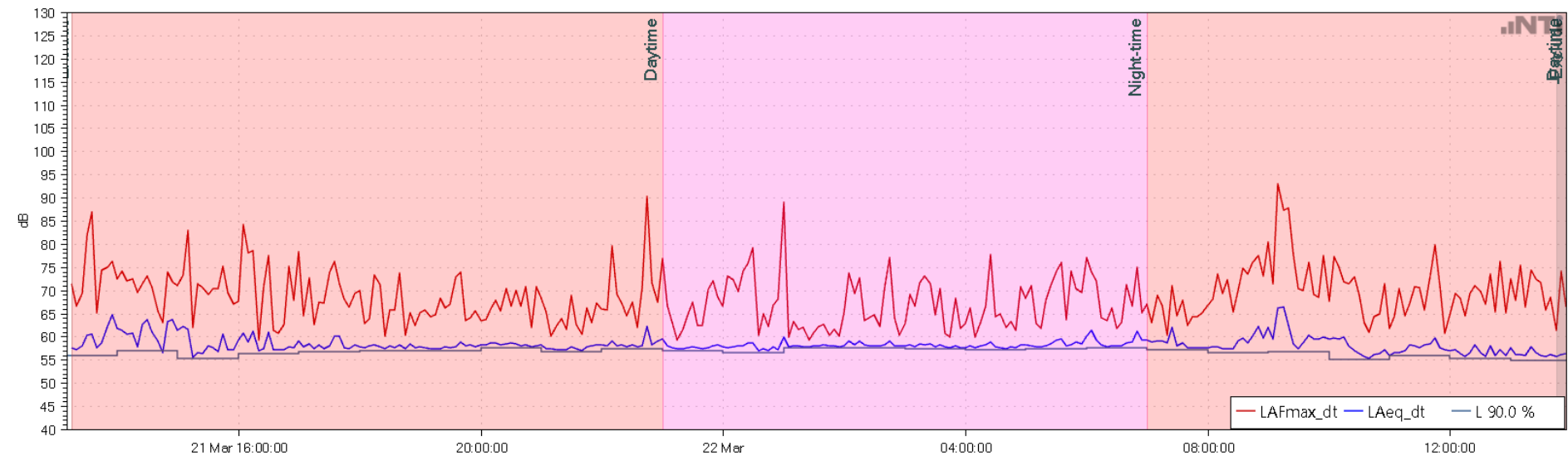


Figure 17: LT1 time history plot

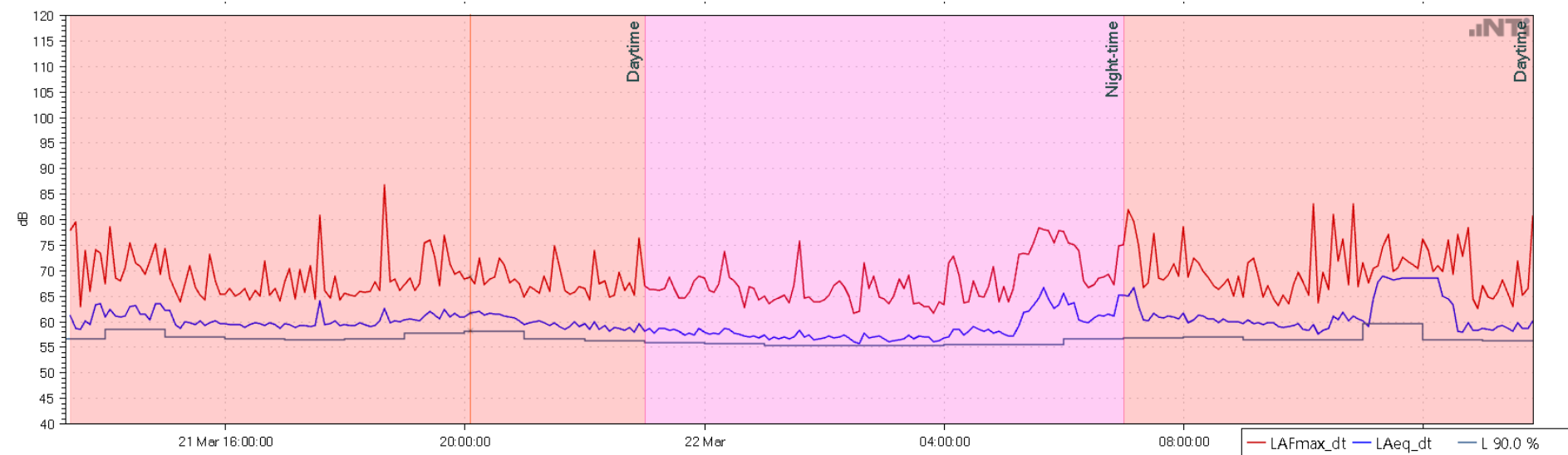


Figure 18: LT2 time history plot

Appendix IV. Acoustic Glossary

Sound pressure level and the decibel, dB

A sound wave is a small fluctuation of atmospheric pressure. The human ear responds to these variations in pressure, producing the sensation of hearing. The ear can detect a very wide range of pressure variations. In order to cope with this wide range of pressure variations, a logarithmic scale is used to convert the values into manageable numbers. The decibel is the logarithmic unit used to describe sound (or noise) levels. The usual range of sound pressure levels is from 0 dB (threshold of hearing) to 120 dB (threshold of pain).

Frequency and hertz, Hz

Frequency is a measure of the rate of fluctuation of a sound wave. The unit used is cycles per second, or hertz (Hz). Sometimes large frequency values are written as kilohertz (kHz), where 1 kHz = 1000 Hz. The human range of hearing is commonly accepted to be 20 Hz to 20,000 Hz. Additionally, an octave can be used to describe the interval between a frequency in Hz and either half or double that frequency.

Frequency weighting

Different weighting networks can be applied to a given sound level in each stated octave band by a specified amount, in order to better represent the response of the human ear. The most commonly used weighting network is the 'A' weighting, and the letter 'A' will be included within a descriptor to indicate that the value has been 'A' weighted, e.g. $L_{Aeq,T}$ or L_{A90} . An 'A' weighted noise level may also be written as dB(A). Other weightings less commonly used are 'C' and 'D' weighting.

Noise indices

When a noise level varies with time, the measured 'A' weighted dB level will vary as well. In this case it is therefore not possible to represent the noise climate with a simple 'A' weighted dB value. In order to describe noise where the level is continuously varying, a number of other indices, including statistical parameters, are used. The various indices used are described as below:

$L_{Aeq,T}$	The 'A' weighted 'equivalent continuous noise level' which is an average of the total sound energy measured over a specified time period, T
L_{Amax}	The maximum 'A' weighted noise level that was recorded during the monitoring period.
L_{A10}	The 'A' weighted noise level that was recorded for at least 10% of the monitoring period.
L_{A90}	The 'A' weighted noise level that was recorded for at least 90% of the monitoring period, usually taken as the underlying 'background' noise level.

Sound level difference, D

The sound level difference between two internal spaces, or between internal and external spaces. The ' D ' value is used to denote the differences at each third octave or octave band, with a single figure 'weighted' value to

describe an overall performance. Note that the 'D' value will always describe an in-situ or on-site acoustic performance. All values are described using the decibel.

D_w	Single figure weighted sound level difference, simply the measured source noise level minus receiver noise level, not adjusted to reference conditions
$D_{nT,w}$	Weighted normalised sound level difference – a single, weighted sound insulation value, normalised to a reference reverberation time using the measured reverberation time in the receive room
$D_{nT,w} + C_{tr}$	As above, with a spectral adaptation term applied to account for the effects of low frequency noise, and based on urban traffic noise
$D_{nf,w}$	Overall flanking normalised level difference - A parameter that defines the flanking transmission of sound from room to room where a dividing partition or floor construction abuts a flanking building element common to both rooms, such as the building façade or ceiling
$D_{n,e,w}$	Element normalised level difference. A level difference level derived transmission through the small technical element only, irrespective of area. This value is used to represent the sound insulation of façade ventilators.
$D_{n,e,w} + C_{tr}$	As above, with a spectral adaptation term applied to account for the effects of low frequency noise, and based on urban traffic noise

Sound reduction index, R

This describes the sound transmitted through a material or building element, such as a wall, door or window. It is measured in a laboratory with suppressed flanking transmission. The 'R' value is used to denote the differences at each third octave or octave band, with a single figure 'weighted' value to describe an overall performance. All values are described using the decibel.

R_w	Weighted single figure sound reduction index
$R_w + C_{tr}$	As above, with a spectral adaptation term applied to account for the effects of low frequency noise, and based on urban traffic noise
R'_w	The 'apparent sound reduction index', a field measurement to obtain the sound reduction index of a material or element, with all effects of site installation accepted.

Standardised impact sound pressure level, $L'_{nT,w}$

$L'_{nT,w}$ is the single figure used to characterise the impact sound pressure level in a receiving room, normalised to a reference reverberation time. Impact noise can be classified as (but is not limited to) the result of footfall impact on a separating floor to a habitable space below. All values are described using the decibel.

Reverberation time, T and T_{mf}

The reverberation time of a space is a measure of the rate at which sound decays, measured in seconds. It is defined as the time taken for the sound pressure level to reduce by 60 dB from its original impulse level.

Reverberation time is commonly quoted in terms of the mid-frequency reverberation time, T_{mf} , the arithmetic average of the reverberation times in the 500 Hz, 1 kHz and 2 kHz octave bands.

Absorption Coefficient

The acoustic absorption provided by a surface is defined as the sound absorption coefficient α , which denotes the fraction of sound energy absorbed between 0 (no absorption) and 1 (no reflection). The absorption coefficient of a material varies with the frequency of incident sound waves, therefore is considered for different frequencies.

Absorption Class

Based on the absorption coefficients, the overall sound absorption of a material is classified from Class A to Class E as defined in BS EN ISO 11654:1997, with Class A providing the highest level of acoustic absorption.

Noise rating, NR

The noise rating or NR system is commonly used in the design of noise emitted by internal building services systems. The system is frequency dependent, and was empirically derived to prevent disturbance to occupants in habitable or working areas from building services noise that exhibits 'tonal' elements, e.g. rumbles, whines, whistles etc. There is no direct relationship between the average 'A' weighted noise level in dB and the NR. However, as a guide, and assuming the absence of strong low frequency content in a given noise, the NR could generally be said to be 6 dB less than the average 'A' weighted dB value.

Privacy

Privacy is the addition of the level of sound insulation between two rooms and the background noise within a receiving room. It can be used to assess the level of privacy afforded in the 'receiving room' for speech from the 'source room'. The 'privacy factor' is a unit-less value that is the combination of the average 'A' weighted background noise level in dB and the weighted sound level difference (D_w) in dB.

Appendix V. SBE Acoustic Credentials

SBE have specialised in providing the UK Construction Industry with a range of acoustics services since 2006. Specialising in Building Acoustics, all SBE acousticians are members of the Institute of Acoustics.

SBE is accredited for on-site acoustic testing by United Kingdom Accreditation Service (UKAS) (Testing Laboratory Number 2731).

SBE meet the relevant acoustic requirements typically required in the UK, including for sound insulation testing as defined in Approved Document E for the purposes of testing for Part E to the Building Regulations 2010.

This report has been authorised by Ben Reed, Senior Acoustic Consultant, who meets the BREEAM requirements for a suitably qualified acoustician (SQA) as follows;

1. Holds a BEng(Hons) degree in Acoustics from the University of Salford
2. Has been an Acoustic Consultant for more than three year's (within the last five years). This experience includes a practical understanding of factors affecting acoustics in relation to construction and the built environment; including, acting in an advisory capacity to provide recommendations for suitable acoustic performance levels and mitigation measures.
3. Holds Membership of the Institute of Acoustics - MIOA membership.

This report has been read and reviewed and has been found to;

1. Represent sound industry practice
2. Be appropriate given the building being assessed and scope of works proposed
3. Avoid invalid, biased and exaggerated recommendations.

Appendix VI. Report Conditions

This document has been prepared for the sole use, benefit and information of the Client. The liability of Stroma Built Environment Ltd. in respect of the information contained herein will not extend to any third party unless prior agreement is obtained in writing from Stroma Built Environment Ltd.

This report is limited to addressing the specific acoustic issues contained herein. Advice has been provided for acoustic reasons only and it is recommended that appropriate expert advice be sought on all the ramifications, e.g. safety, fire, structural, CDM etc., associated with any proposals contained herein.

The in-situ performance of acoustic measures is influenced to a large extent by the quality of workmanship and compliance with the specifications on-site during construction, as such, Stroma Built Environment Ltd. accepts no liability for issues with acoustic performance arising from such factors.

Acoustic survey and testing work carried out for the project is representative of the prevailing conditions at the time of the work. Conditions can vary and no warranty is given as to the possibility of changes in the environment of the site and surrounding area at differing times.

In particular, it should be noted that where calculations are carried out that are based on assumptions regarding certain aspects where information has not been supplied, these are provided for indicative purposes only and should be treated as such.