



PROJECT TECHNICAL MEMORANDUM

Project : Victoria House, Manchester
Our Ref : 28367-PTM4-JLS-R3
Date : 20 May 2022
Author : Joe Sinker, Principal Consultant
Issued to : DOMIS & Design Team

Hann Tucker Associates

Consultants in Acoustics Noise & Vibration
346 Deansgate Manchester M3 4LY
(t) +44 (0) 161 832 7041
(e) enquiries@hanttucker.co.uk
(w) hanttucker.co.uk

Directors:
Stuart G Morgan CEng MIMechE MCIBSE FIOA (Chairman)
Simon R Hancock BEng(Hons) CEng MCIBSE FIOA (Managing)
John L Gibbs MIOA(D) MSEE CEnv
John R Ridpath BSc(Hons) MIOA
Andrew D Fermer BSc(Hons) MIOA
Andrew G Jameson BSc(Hons) MIOA MIET

RE: PLANNING CONDITION 16 FAÇADE SOUND INSULATION

1.0 Planning Condition 16

This memorandum outlines the project's scheme for acoustically insulating the residential accommodation against external noise in accordance with Planning Condition 16, which states:

"Before the development commences a scheme for acoustically insulating and mechanically ventilating the residential accommodation against noise from adjacent roads and the adjacent tram and any mitigating vibration and reradiated noise levels associated with the operation of the adjacent tram line shall be submitted to and approved in writing by the City Council as local planning authority.

The approved noise insulation scheme and vibration and reradiated noise mitigation measures shall be completed before any of the dwelling units are occupied.

The following noise criteria will be required to be achieved:

Bedrooms (night time - 23.00 - 07.00)	30 dB LAeq (individual noise events)
shall not exceed 45 dB LAmax,F by more than 15 times)	
Living Rooms (daytime - 07.00 - 23.00)	35 dB LAeq
Gardens and terraces (daytime)	55 dB LAeq

Prior to occupation a post completion report to verify that all of the recommended mitigation measures have been installed and effectively mitigate any potential adverse noise impacts in the residential accommodation shall be submitted and agreed in writing by the City Council as local planning authority. Prior to occupation any non compliance shall be suitably mitigated in accordance with an agreed scheme."

2.0 Prevailing Noise Climate

A detailed environmental noise and vibration survey of the site was undertaken by Hydrock in 2018 (pre COVID). The methodology and results are presented in the Noise Chapter of the Environmental Statement prepared for the scheme's full planning application.



Validation measurements were undertaken by Hann Tucker Associates at various street level positions around the site between 05:00 and 12:00 hours on Monday 8 March 2021. With consideration for the ongoing effects of COVID-19 it was found that the measured noise levels were congruent with those measured by Hydrock at planning stage.

The external noise climate was noted to be dominated by road traffic on Great Ancoats street and the surrounding road network. Through analysis of their vibration survey data Hydrock concluded that no specific mitigation measures should be required to control re-radiated noise from tram movements.

3.0 External Noise Intrusion Assessment

An assessment has been carried out in accordance with BS 8233's rigorous calculation method (as per below equation) to determine the sound reduction performance requirements of residential facades.

$$L_{eq,2} = L_{eq,ff} + 10\log_{10} \left(\frac{A_0}{S} 10^{-\frac{D_{n,e}}{10}} + \frac{S_{wi}}{S} 10^{-\frac{R_{wi}}{10}} + \frac{S_{ew}}{S} 10^{-\frac{R_{ew}}{10}} + \frac{S_{rr}}{S} 10^{-\frac{R_{rr}}{10}} \right) + 10\log_{10} \left(\frac{S}{A} \right) + 3$$

The assessment considers the habitable room layouts and façade dimensions of the latest architectural drawings at the time of writing.

Incident external noise levels onto facades have been determined by use of 3D noise mapping software, calibrated to surveyed noise levels presented in the Hydrock Acoustic Report. A screenshot of the model is presented below. Consideration is given to screening/reflections from neighbouring buildings, including those still under construction at time of writing.



CadnaA Site Noise Model (dB, Daytime LAeq,16hr)

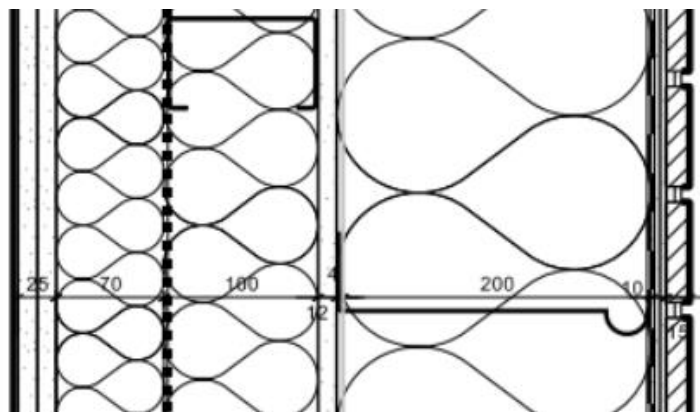
4.0 Design Proposals

Residential facades between Level 01 and Level 23 shall comprise aluminium-framed window systems (comprising vision glass, spandrels, louvres) punched in to brick/SFS walls, as below.





- Windows/Cladding:** Aluminium framed double-glazed windows/doors with louvred purge ventilation panel.
- Roofs:** 200mm+ in-situ concrete slab.
- Ventilation/Cooling:** MVHR whole dwelling ventilation. Minimal reliance on façade openings for ventilation / overheating control.
- External Walls:** Levels 01-23: Brick slip on metal frame, 200mm Rockwool insulated cavity, 12mm cemboard, 100mm SFS and 70mm Gypframe (both fully insulated with mineral wool), 2 x 12.5mm plasterboard lining. See below.



For the purpose of further calculation we have considered the following sound reduction performance for the external wall construction. These figures have been derived using INSUL 'sound reduction' software and our in-house database of published performance test results for similar build ups.

Element	Min. Sound Reduction, R (dB) at Octave Band Centre Frequency (Hz)					
	125	250	500	1k	2k	4k
External Wall	45	50	55	60	65	65

At Level 24 only residential facades will comprise full height curtain walling.

5.0 Sound Reduction Performance Specification for Framed (Window) & CW Systems

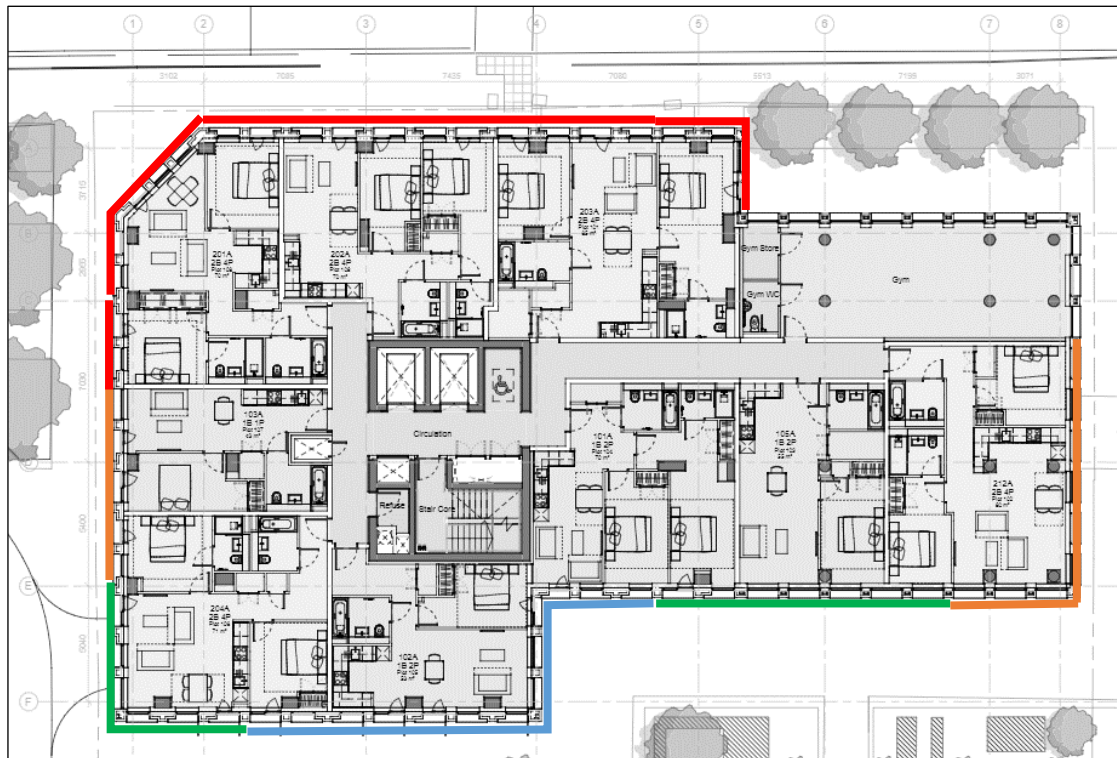
Residential Facades

The following table presents the minimum octave band sound reduction performance requirements for the window/cladding systems. In all cases, it is essential that the system is tested in accordance with BS EN ISO 10140-2 and that the octave band specifications are met by the system as a whole (i.e. the complete assembly – i.e. the frame, glass, spandrel panels, seals, etc. – and not just the glass).



Spec Ref.	Colour Zone*	Minimum Sound Reduction Index (dB) at Octave Band Centre Frequency (Hz)						
		63	125	250	500	1k	2k	4k
A	BLUE	20	20	24	31	35	38	38
B	GREEN	22	24	27	34	38	41	41
C	ORANGE	24	26	31	37	40	44	44
D	RED	26	28	34	40	43	46	46

*Ref. sketch zone plans below



Level 01



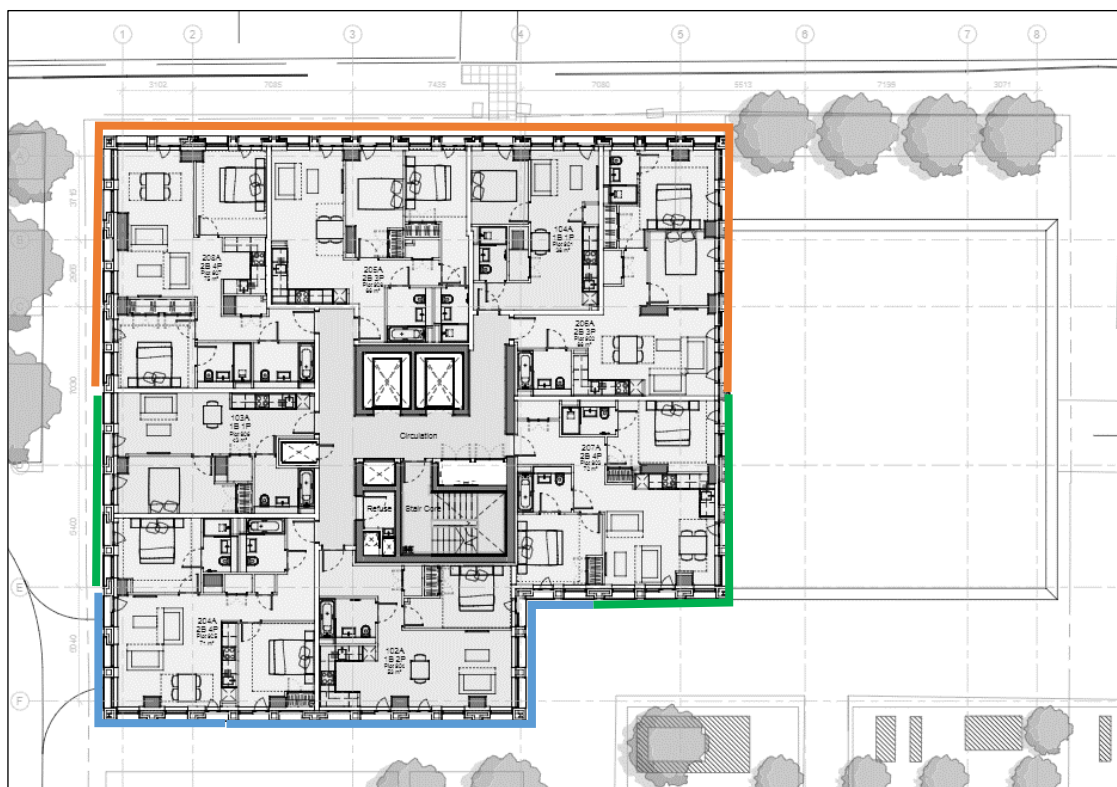
Level 02



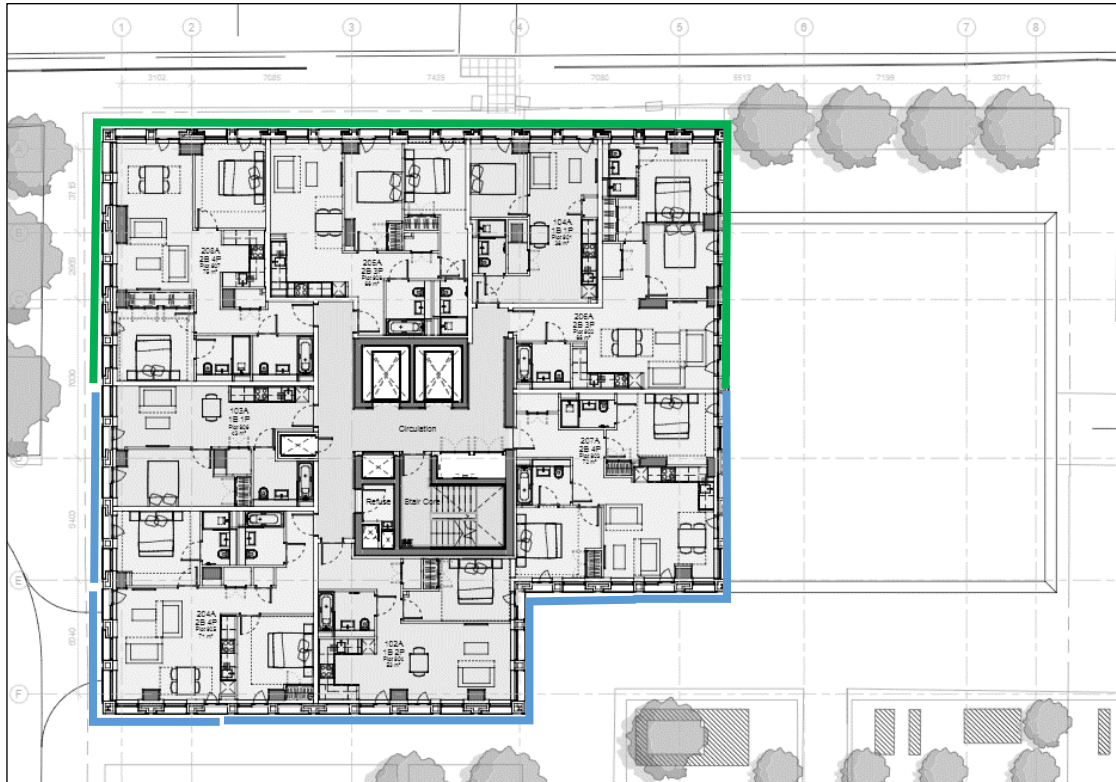
Level 03 – Level 06



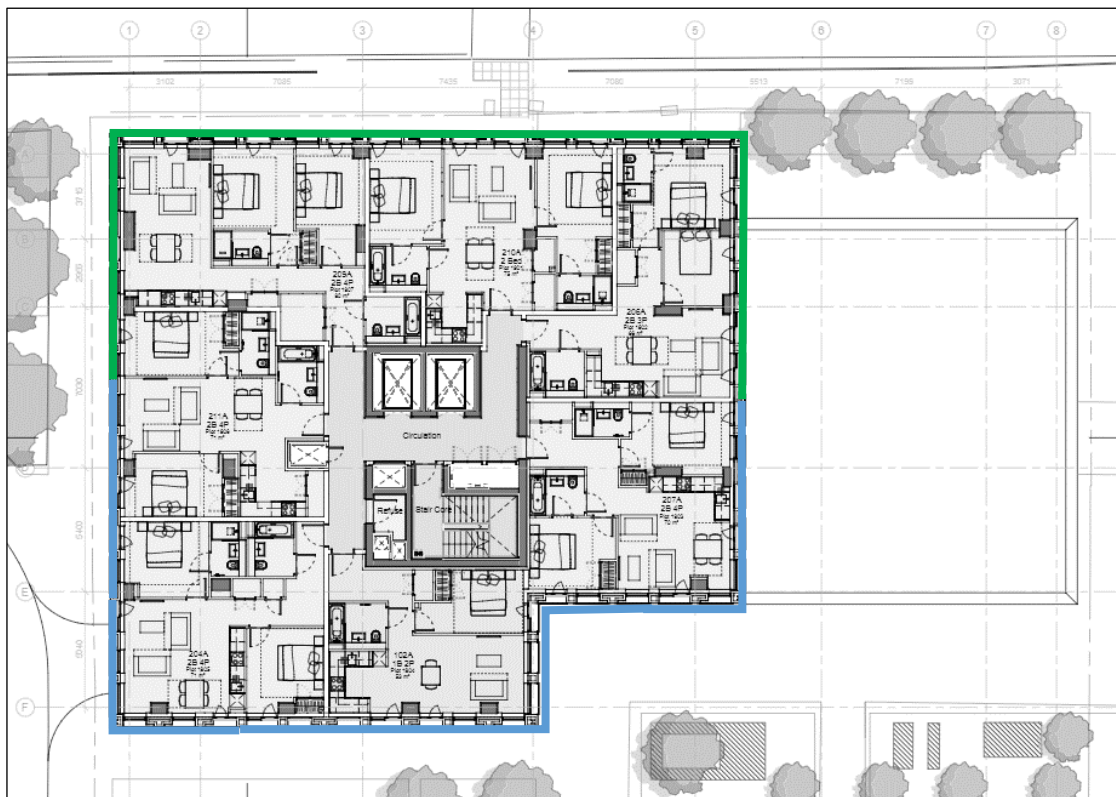
Level 07 – Level 08



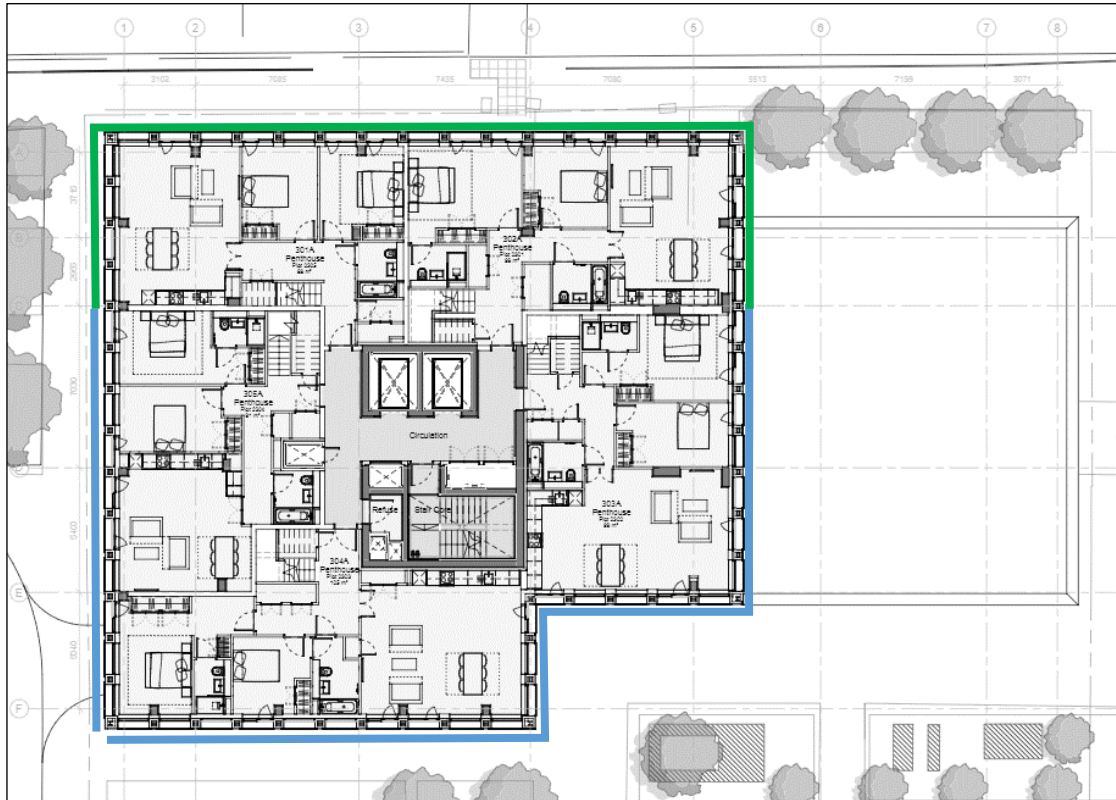
Level 09 – Level 14



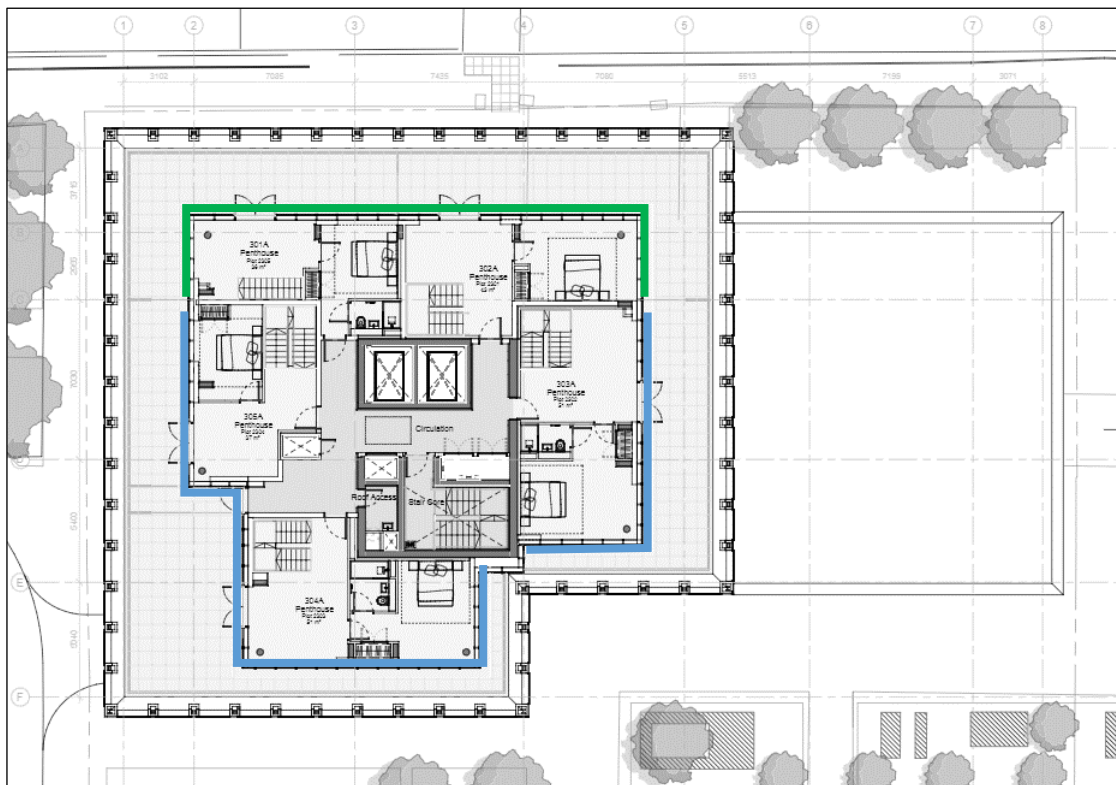
Level 15 – Level 18



Level 19 – Level 22



Level 23



Level 24



To non-residential areas, we would recommend the windows/cladding are designed to satisfy the relevant sound reduction indices as per the below.

Retail Units: Type C

Residential Entrance: Type C

Gym: Type C

BoH: N/A

6.0 Design Guidance

It is essential that prospective cladding/window system suppliers can demonstrate complete assemblies comply with the acoustic performance detailed in our specification rather than simply offering a generic frame and glazing configurations. However, for guidance, we would suggest that the following glass configurations could typically be expected to provide the required levels of sound insulation.

Spec Ref.	Colour Zone	Example Glazing Configuration
A	BLUE	8 mm / 16 mm / 4 mm
B	GREEN	8 mm / 16 mm / 6.4 mm (lam)
C	ORANGE	10 mm / 16 mm / 8.8 mm (Ac lam)
D	RED	10.8 mm (Ac lam) / 16 mm / 8.8 mm (Ac lam)

Purge vent door panels will be capable of maintaining the acoustic integrity of the complete cladding system when in the closed position, i.e. during normal ventilation conditions.

7.0 External Noise Intrusion

7.1 Noise Ingress through MVHR Openings

The following table demonstrates the worst-case noise intrusion via the façade openings for MVHR inlet and outlet in a typical apartment in the Red glazing zone.

Daytime $L_{Aeq,16hr}$

Description	Octave Band Centre Frequency (Hz)						Single Figure
	125	250	500	1k	2k	4k	
External noise level, $L_{eq,T}$	73	70	69	70	66	58	73 $L_{Aeq,16hr}$
SWL into duct	49	46	45	46	42	34	-
SWL Breakout of duct in room	33	29	28	29	25	12	-
Ceiling Loss	-9	-12	-17	-20	-20	-20	-
Internal noise level, $L_{eq,T}$	28	21	15	13	9	0	20 dB $L_{Aeq,16hr}$

**Night-time $L_{Aeq,8hr}$**

Description	Octave Band Centre Frequency (Hz)						Single Figure
	125	250	500	1k	2k	4k	
External noise level, $L_{eq,T}$	69	66	65	66	62	54	69 dB $L_{Aeq,8hr}$
SWL into duct	45	42	41	42	38	30	-
SWL Breakout of duct in room	29	25	24	25	21	8	-
Ceiling Loss	-9	-12	-17	-20	-20	-20	-
Internal noise level, $L_{eq,T}$	24	17	11	9	5	0	16 dB $L_{Aeq,8hr}$

Night-time $L_{Af,max}$

Description	Octave Band Centre Frequency (Hz)						Single Figure
	125	250	500	1k	2k	4k	
External noise level, $L_{eq,T}$	80	80	78	84	80	77	87 dB $L_{Af,max}$
SWL into duct	56	56	54	60	56	53	-
SWL Breakout of duct in room	40	39	37	43	39	31	-
Ceiling Loss	-9	-12	-17	-20	-20	-20	-
Internal noise level, $L_{eq,T}$	35	31	24	27	23	15	31 dB $L_{Af,max}$

It can be seen from the above calculations that the predicted internal noise level through the worst-case MVHR inlets/outlets is predicted to be well below (~10-15dB) the corresponding internal noise criteria.

7.2 Broadband Results

The table below summarises the worst case incident noise level (i.e. highest) in each façade zone and the resultant internal noise levels for the worst case apartment (i.e. largest façade/glazing area to room volume ratio) in each glazing zone.

Red Glazing Zone

Description	Daytime $L_{Aeq,16hr}$	Night-time $L_{Aeq,8hr}$	Night-time $L_{Af,max}$
Worst Case External Incident Noise Level	73 dB	69 dB	87 dB
Resultant Internal Noise Level	34 dB	30 dB	45 dB

Orange Glazing Zone

Description	Daytime $L_{Aeq,16hr}$	Night-time $L_{Aeq,8hr}$	Night-time $L_{Af,max}$
Worst Case External Incident Noise Level	69 dB	64 dB	84 dB
Resultant Internal Noise Level	33 dB	28 dB	44 dB

**Green Glazing Zone**

Description	Daytime $L_{Aeq,16hr}$	Night-time $L_{Aeq,8hr}$	Night-time $L_{A,f,max}$
Worst Case External Incident Noise Level	66 dB	61 dB	81 dB
Resultant Internal Noise Level	33 dB	28 dB	44 dB

Blue Glazing Zone

Description	Daytime $L_{Aeq,16hr}$	Night-time $L_{Aeq,8hr}$	Night-time $L_{A,f,max}$
Worst Case External Incident Noise Level	61 dB	58 dB	76 dB
Resultant Internal Noise Level	31 dB	28 dB	42 dB

7.3 Detailed Calculation (Red Zone)

We have calculated the resultant internal noise level within habitable rooms using the following equation (Equation G.1) contained within BS 8233:2014:

$$L_{eq,2} = L_{eq,ff} + 10 \log_{10} \left(\frac{A_0}{S} 10^{-\frac{D_{n,e}}{10}} + \frac{S_{wi}}{S} 10^{-\frac{R_{wi}}{10}} + \frac{S_{ew}}{S} 10^{-\frac{R_{ew}}{10}} + \frac{S_{rr}}{S} 10^{-\frac{R_{rr}}{10}} \right) + 10 \log_{10} \left(\frac{S}{A} \right) + 3$$

To inform our worst case assessment we have looked at the highest external Daytime $L_{Aeq,16hr}$ and Night-time $L_{Aeq,8hr}$ and L_{Amax} (with associated octave band spectra) and calculated the noise break-in through the worst affected apartment.

The parameters used within our assessment are presented below, for reference.

Term	Derivation	Bedroom (m ²)
S_f	Façade area	9.5
S_{wi}	Window area	6.5
S_{ew}	External wall area	$S_f - S_{wi}$
S	Floor area of dwelling	16.1



Based on the above, the following tables present our BS 8233:2014 assessment for worst case daytime $L_{Aeq,16hr}$, night-time $L_{Aeq,8hr}$, and night-time $L_{A,max}$ noise levels.

Daytime $L_{Aeq,16hr}$

Description	Octave Band Centre Frequency (Hz)						Single Figure
	125	250	500	1k	2k	4k	
External noise level, $L_{eq,ff}$	73	70	69	70	66	58	73 $L_{Aeq,16hr}$
External wall, R_{ew}	45	50	55	60	65	65	-
Glazing, R_{wi}	28	34	40	43	46	46	RED SPEC
Equivalent absorption area, A	14	14	14	14	14	14	14
Internal noise level, $L_{eq,2}$	45	36	29	27	20	12	34 dB $L_{Aeq,16hr}$

Night-time $L_{Aeq,8hr}$

Description	Octave Band Centre Frequency (Hz)						Single Figure
	125	250	500	1k	2k	4k	
External noise level, $L_{eq,ff}$	69	66	65	66	62	54	69 dB $L_{Aeq,8hr}$
External wall, R_{ew}	45	50	55	60	65	65	-
Glazing, R_{wi}	28	34	40	43	46	46	RED SPEC
Equivalent absorption area, A	14	14	14	14	14	14	14
Internal noise level, $L_{eq,2}$	41	32	25	23	16	8	30 dB $L_{Aeq,16hr}$

Night-time $L_{A,max}$

Description	Octave Band Centre Frequency (Hz)						Single Figure
	125	250	500	1k	2k	4k	
External noise level, $L_{eq,ff}$	80	80	78	84	80	77	87 dB $L_{A,max}$
External wall, R_{ew}	45	50	55	60	65	65	-
Glazing, R_{wi}	28	34	40	43	46	46	RED SPEC
Equivalent absorption area, A	14	14	14	14	14	14	14
Internal noise level, $L_{eq,2}$	52	46	37	41	33	31	45 dB $L_{Aeq,16hr}$



7.4 Detailed Calculation (Orange Zone)

Daytime $L_{Aeq,16hr}$

Description	Octave Band Centre Frequency (Hz)						Single Figure
	125	250	500	1k	2k	4k	
External noise level, $L_{eq,ff}$	71	67	65	65	62	56	69 $L_{Aeq,16hr}$
External wall, R_{ew}	45	50	55	60	65	65	-
Glazing, R_{wi}	26	31	37	40	44	44	ORANGE SPEC
Equivalent absorption area, A	14	14	14	14	14	14	14
Internal noise level, $L_{eq,2}$	45	36	28	25	18	12	33 dB $L_{Aeq,16hr}$

Night-time $L_{Aeq,8hr}$

Description	Octave Band Centre Frequency (Hz)						Single Figure
	125	250	500	1k	2k	4k	
External noise level, $L_{eq,ff}$	66	62	60	60	57	51	64 dB $L_{Aeq,8hr}$
External wall, R_{ew}	45	50	55	60	65	65	-
Glazing, R_{wi}	26	31	37	40	44	44	ORANGE SPEC
Equivalent absorption area, A	14	14	14	14	14	14	14
Internal noise level, $L_{eq,2}$	40	31	23	20	13	7	28 dB $L_{Aeq,16hr}$

Night-time $L_{A,max}$

Description	Octave Band Centre Frequency (Hz)						Single Figure
	125	250	500	1k	2k	4k	
External noise level, $L_{eq,ff}$	77	77	75	81	77	74	84 dB $L_{A,max}$
External wall, R_{ew}	45	50	55	60	65	65	-
Glazing, R_{wi}	26	31	37	40	44	44	ORANGE SPEC
Equivalent absorption area, A	14	14	14	14	14	14	14
Internal noise level, $L_{eq,2}$	51	46	37	41	32	30	44 dB $L_{Aeq,16hr}$

7.5 Detailed Calculation (Green Zone)

Daytime $L_{Aeq,16hr}$

Description	Octave Band Centre Frequency (Hz)						Single Figure
	125	250	500	1k	2k	4k	
External noise level, $L_{eq,ff}$	73	70	69	70	66	58	73 $L_{Aeq,16hr}$
External wall, R_{ew}	45	50	55	60	65	65	-
Glazing, R_{wi}	28	34	40	43	46	46	RED SPEC
Equivalent absorption area, A	14	14	14	14	14	14	14
Internal noise level, $L_{eq,2}$	45	36	29	27	20	12	34 dB $L_{Aeq,16hr}$

**Night-time $L_{Aeq,8hr}$**

Description	Octave Band Centre Frequency (Hz)						Single Figure
	125	250	500	1k	2k	4k	
External noise level, $L_{eq,ff}$	68	64	62	62	59	53	66 dB $L_{Aeq,8hr}$
External wall, R_{ew}	45	50	55	60	65	65	-
Glazing, R_{wi}	24	27	34	38	41	41	GREEN SPEC
Equivalent absorption area, A	14	14	14	14	14	14	14
Internal noise level, $L_{eq,2}$	41	32	25	23	16	8	28 dB $L_{Aeq,16hr}$

Night-time $L_{A,max}$

Description	Octave Band Centre Frequency (Hz)						Single Figure
	125	250	500	1k	2k	4k	
External noise level, $L_{eq,ff}$	74	74	72	78	74	71	81 dB $L_{A,max}$
External wall, R_{ew}	45	50	55	60	65	65	-
Glazing, R_{wi}	24	27	34	38	41	41	GREEN SPEC
Equivalent absorption area, A	14	14	14	14	14	14	14
Internal noise level, $L_{eq,2}$	50	47	37	40	32	30	44 dB $L_{Aeq,16hr}$

7.6 Detailed Calculation (Blue Zone)**Daytime $L_{Aeq,16hr}$**

Description	Octave Band Centre Frequency (Hz)						Single Figure
	125	250	500	1k	2k	4k	
External noise level, $L_{eq,ff}$	63	59	57	57	54	48	61 $L_{Aeq,16hr}$
External wall, R_{ew}	45	50	55	60	65	65	-
Glazing, R_{wi}	20	24	31	35	38	38	BLUE SPEC
Equivalent absorption area, A	14	14	14	14	14	14	14
Internal noise level, $L_{eq,2}$	43	35	26	22	16	10	31 dB $L_{Aeq,16hr}$

Night-time $L_{Aeq,8hr}$

Description	Octave Band Centre Frequency (Hz)						Single Figure
	125	250	500	1k	2k	4k	
External noise level, $L_{eq,ff}$	60	56	54	54	51	45	58 dB $L_{Aeq,8hr}$
External wall, R_{ew}	45	50	55	60	65	65	-
Glazing, R_{wi}	20	24	31	35	38	38	BLUE SPEC
Equivalent absorption area, A	14	14	14	14	14	14	14
Internal noise level, $L_{eq,2}$	40	32	23	19	13	7	30 dB $L_{Aeq,16hr}$

**Night-time $L_{A,max}$**

Description	Octave Band Centre Frequency (Hz)						Single Figure
	125	250	500	1k	2k	4k	
External noise level, $L_{eq,ff}$	69	69	67	73	69	66	76 dB $L_{A,f,max}$
External wall, R_{ew}	45	50	55	60	65	65	-
Glazing, R_{wi}	20	24	31	35	38	38	BLUE SPEC
Equivalent absorption area, A	14	14	14	14	14	14	14
Internal noise level, $L_{eq,2}$	49	45	35	38	30	28	42 dB $L_{Aeq,16hr}$

8.0 MVHR System Generated Noise**8.1 Casing Radiated (Unit) Noise Breakout**

All MVHR units will be located in utility cupboards. Units come with built-in anti-vibration mounts to mitigate vibration. The cupboards are accessed via a door off living rooms or a corridor.

Calculations of casing radiated noise transfer into a typical living room and bedroom from the selected MVHR unit at normal operating duty have been undertaken. These are detailed calculations using an in-house programme which considers the four types of direct/reverberant sound paths. The key information used to inform our calculations, as well as the results, are given below.

Living room

Desc.	Sound Level (dB) at Octave Band Centre Frequency (Hz)							Broadband
	63	125	250	500	1k	2k	4k	
Unit Breakout SWL L_w	47	44	42	39	31	27	16	-
Cupboard size: 1.5m x 0.8m x 2.5m								
Receive room size: 7m x 3m x 2.5m								
Cupboard/Receive room RT: 0.5 s								
Radiating area: 1.5m x 2.5m								
Door sound reduction, R'	10	16	19	21	21	19	22	-
Solid core door, well fitting, 10mm undercut								
Area: 3.75m ²								
Resultant Sound Level at 1.5m from door face in Living Room	39	30	25	21	13	11	0	23 dBA

**Bedroom**

Desc.	Sound Level (dB) at Octave Band Centre Frequency (Hz)							Broadband
	63	125	250	500	1k	2k	4k	
Unit Breakout SWL L_w	47	44	42	39	31	27	16	-
Cupboard size: 1.5m x 0.8m x 2.5m								
Receive room size: 3.5m x 3m x 2.5m								
Cupboard/Receive room RT: 0.5 s								
Radiating area: 1.5m x 2.5m								
Separating wall sound reduction, R'	12	18	25	33	42	45	48	-
1xPB, 70mm stud								
Area: 3.75m ²								
Resultant Sound Level at 1.5m from door face in Bedroom	38	29	20	10	0	0	0	17 dBA

8.2 Noise Breakout Through Ductwork

Noise generated by the operation of the MVHR will transmit into the ductwork and, before reaching the grille, will be radiate to some degree through the walls of the intermediate ductwork. This ductwork typically runs through ceiling voids and are thus separated from the habitable space by a layer of plasterboard which should mitigate any concerns of noise breakout through the ductwork.

8.3 Ductborne Noise to Rooms

Calculations of ductborne noise transfer into a typical living room and bedroom from the selected MVHR unit via supply and extract diffusers at normal operating duty have been undertaken. These are detailed calculations using an in-house programme which considers losses through the ductwork between the MVHR unit and diffuser. The key information used to inform our calculations, as well as the results, are given below.

Living room (Supply)

Desc.	Sound Level (dB) at Octave Band Centre Frequency (Hz)							Broadband
	63	125	250	500	1k	2k	4k	
Open Outlet Sound Power Level (dB)	45	51	47	49	43	41	30	-
Ductwork Losses	14	16	23	26	26	32	27	-
Resultant Sound Level in Living Room	25	28	15	15	10	4	0	17 dBA (NR 11)

**Living room (Extract)**

Desc.	Sound Level (dB) at Octave Band Centre Frequency (Hz)							Broadband
	63	125	250	500	1k	2k	4k	
Open Inlet Sound Power Level (dB)	38	42	44	36	33	26	16	-
Ductwork Losses	7	9.4	16	19	25	20	19	-
Resultant Sound Level in Living Room	24	26	20	9	7	0	0	15 dBA (NR 8)

Bedroom (Supply)

Desc.	Sound Level (dB) at Octave Band Centre Frequency (Hz)							Broadband
	63	125	250	500	1k	2k	4k	
Open Outlet Sound Power Level (dB)	45	51	47	49	43	41	30	-
Ductwork Losses	8	10	17	20	20	27	23	-
Resultant Sound Level in Bedroom	34	36	23	22	17	10	3	24 dBA (NR 18)

For and on behalf of
HANN TUCKER ASSOCIATES

Joe Sinker