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Stage 4 Acoustic Report

Phase 1

St Michaels, Manchester

Bowmer & Kirkland



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1.0 INTRODUCTION

A new build detached 10 storey office building with ground floor retail units and rooftop bar/restaurant unit is proposed for Phase 1 of the St Michael's mixed-use development in Manchester city centre. The 1st to 9th floor levels are speculative open plan office spaces to be finished to Cat A fit-out standards (excluding suspended ceilings). In addition, the existing former Police station is to be refurbished to form additional office space. The following subjects have been reviewed during the design process:

- Indoor ambient noise levels (due to environmental sound intrusion and building services)
- Sound insulation between internal spaces
- Reverberation times in internal spaces
- Atmospheric plant noise emissions.

This report summarises the acoustic requirements and reviews the current design proposals for the development.



2.0 ACOUSTIC REQUIREMENTS

The acoustic requirements for the development are taken from the Acoustics Stage 2+ Report Revision P02 dated 4 October 2021 produced by Hoare Lea Acoustics.

With regards to BREEAM, the New Construction requirements of BREEAM 2018 are to be achieved for the project.

Under section Hea 05 Acoustic Performance of the New Construction requirements of BREEAM 2018, 3 credits are available for offices. It is understood that the 3 available credits are to be targeted.

Under section Pol 05 Reduction of Noise Pollution of the New Construction requirements of BREEAM 2018, 1 credit is available. It is understood that the 1 available credit is to be targeted.



3.0 TENANT FIT-OUT ELEMENTS

It is understood that the Tenants of the various spaces will be responsible for the fit-out of the following elements.

Space	Element
Ground Floor Retail Units	Floor Finishes Suspended Ceiling / Absorbent Finishes Acoustic Upgrades (if required) Building Services
Speculative Open Plan Office Spaces	Floor Finishes Suspended Ceiling / Absorbent Finishes* Partitioning (if required)
Rooftop Bar / Restaurant	Floor Finishes Suspended Ceiling / Absorbent Finishes Acoustic Upgrades (if required) Building Services

**For the purposes of the assessments it is assumed that the absorbent finishes to the spaces will achieve the project requirements.*



4.0 INDOOR AMBIENT NOISE LEVELS

4.1 Requirements

4.1.1 Employer's Requirements

Appendix C of the Employer's Requirements Briefing Document ('Outline Offices Specification' dated June 2021) states the following in relation to intrusive noise:

"Noise break-in to office areas from typical environmental sources will be designed to comply with the design criteria for open plan offices as given in the BCO Guide 2009 'Best Practice in the Specification for Offices'".

BCO 2019 states the following external noise intrusion limits within office spaces (under Cat A fit-out standards including carpets):

Space	External Noise Intrusion Noise Rating Limit ($L_{Aeq,8hour}$)
Cellular Office*	NR35
Speculative Office	NR38
Open Plan Office*	NR40

**These spaces are not proposed as part of the CAT A fit-out works.*

In addition, maximum internal noise levels (due to external sources) should not exceed L_{AFmax} 55dB within open plan offices or L_{AFmax} 50dB within cellular office spaces.

Since carpets and ceilings/absorbent finishes are not proposed as part of the Cat A fit-out works it may be necessary to apply a correction to the noise levels measured at the commissioning stage to allow for the excessively reverberant spaces.

4.1.2 BREEAM 2018

BREEAM 2018 section Hea 05 refers to indoor ambient noise levels that comply with Section 7 of BS 8233:2014 within each type of space when unoccupied as detailed in the table below.

Space	Document Description	Design Range $L_{Aeq,T}$ (dB)
Cellular Office*	Executive office	35-40
Meeting Room*	Meeting / training room	35-45
Open Plan Office	Multiple occupancy offices	45-50
Entrance Lobby	Corridor, circulation	45-55
WC	Washroom, toilet	45-55
Bar / Restaurant	Restaurant	40-55
	Night club, public house	40-45
Retail	Department store	50-55

**These spaces are not proposed as part of the CAT A fit-out works.*

The indoor ambient noise levels include contributions from both environmental sound break-in and building services noise.

4.1.3 Office Space

Environmental sound break-in is proposed to achieve L_{Aeq} 40dB in speculative office space so as to achieve the most stringent requirements of BCO 2019 and BREEAM 2018.

However, this is below the lower design range limit for open plan offices of BREEAM 2018 (L_{Aeq} 45-50dB). As such, building services will be responsible for achieving the lower design range limits of BREEAM 2018 in speculative open plan office space.

It should be noted that the BREEAM 2018 design range for open plan offices (L_{Aeq} 45-50dB ~NR40-45) exceeds the BCO 2019 internal noise limit of NR38 in speculative open plan offices. **As such, it may be the case that one set of requirements is not achieved.**

In addition to the BCO 2019 and BREEAM 2018 requirements, a project requirement for amplified music/sound from the Level 10 bar/restaurant to the offices below is proposed as detailed in the table below.



Parameter	Maximum Noise Transfer Level Within Offices (dB) at Octave Band Centre Frequency (Hz)							
	63	125	250	500	1K	2K	4K	8K
Ambient Level, $L_{eq,1min}$	51	39	31	24	20	17	14	13
Maximum Level, L_{Fmax}	56	44	36	29	25	22	19	18

4.1.4 Reception

Environmental sound break-in is proposed to achieve L_{Aeq} 40dB in the reception space. However, this is below the lower design range limit for circulation space of BREEAM 2018 (L_{Aeq} 45-55dB). As such, building services will be responsible for achieving the lower design range limit of BREEAM 2018 in the reception space.

4.1.5 Retail Units

Environmental sound break-in is proposed to achieve L_{Aeq} 50-55dB in the retail units. Whilst this is in line with the design range for retail space of BREEAM 2018 (L_{Aeq} 50-55dB) it is unlikely that environmental sound break-in will achieve this level. As such, building services will be responsible for achieving the lower design range limit of BREEAM 2018 in the retail units.

4.1.6 Bar / Restaurant

Environmental sound break-in was not proposed at Stage 2+ for the bar/restaurant unit. As such, a design range of L_{Aeq} 40-45dB is proposed which is in line with the design range for a bar space of BREEAM 2018 (L_{Aeq} 40-45dB). However, it is unlikely that environmental sound break-in will achieve this level. As such, building services will be responsible for achieving the lower design range limit of BREEAM 2018 in the bar/restaurant unit.



4.1.7 Roof

The roof constructions should be capable of providing adequate levels of sound insulation performance to control the following within the office space below:

- Ambient sound, roof terrace amplified music/activity noise and rooftop plant noise
- Impacts from footfall and furniture movement
- Rain noise 'drumming' - BCO Guidance suggests that rain noise should be controlled so as not to exceed L_{Aeq} 60dB during 'heavy' rain.

4.1.8 External Doors

A minimum sound insulation performance of R_w 35dB is specified for external doors to offices and retail units.

This is based on the following:

- This assumes that installation of door lobbies would form a tenant fit-out requirement to enhance the sound insulation performance, for example if retail units wish to operate with high levels of amplified sound.

The external doors proposed between the offices and external terrace areas at Levels 8 and 9 may need to be upgraded to lobbied doors once the external terrace areas are accessible to the public via the hotel upon completion of Phase 2.

4.1.9 Façade Self-Noise

The construction of the facade should prevent rattling, whistling, resonating or other attention-catching noise internally and externally due to thermal movement and airflow over its surface.

4.2 Environmental Sound

4.2.1 New Build Offices

A minimum sound insulation performance of R_w+C_{tr} 38dB is specified for the cladding facade system (glass, frame, seals, etc.) to offices within the new build block of the development.

This is based on the following:



- Control of low-frequency activity noise from the Albert Hall during events and daytime sound checking. This assumes assumptions about the Albert Hall operating within the noise limits set out in their planning application as discussed in the HL base scheme Stage 2 acoustics report STM-HLE-ZZ-ZZ-RP-Y-003 Stage 2 - Section 8 - Acoustic Report.
- Allowance for the control of activity / music noise transfer from the rooftop terrace (based on the terrace noise limits provided in HL base scheme Stage 2 acoustics report). If it is considered acceptable to manage noise transfer to office occupants through consideration to operational times (e.g., enhanced music levels only to occur outside of typical office hours), the glazing performance to elevations facing away from the Albert Hall may reduce.

It is understood that a reduced minimum sound insulation performance of R_w+C_{tr} 33dB was agreed in November 2021 to all facades of Levels 1-4 and to the northern, eastern, and southern facades of Levels 5-7 on the basis that noise from the Albert Hall is not considered.

4.2.2 Refurbished Offices

A minimum sound insulation performance of R_w+C_{tr} 33dB is specified for the new windows (glass, frame, seals, etc.) to offices within the existing former Police station block of the development.

This is based on the following:

- It is understood the existing solid masonry building envelope is to be made good and retained, these are assumed to be capable of achieving a minimum sound insulation performance of at least R_w+C_{tr} 50 dB in line with the typical performance achieved by historical double cavity masonry constructions.
- A complete replacement of the existing windows and balcony doors along the retained elevations is understood to be proposed, and it is assumed at this stage that the existing façade openings will not be significantly enlarged on the facades facing Southmill Street.

4.2.3 Retail Units

A minimum sound insulation performance of R_w+C_{tr} 28dB is specified for the full height glazing systems with external access doors to retail units within the new build block of the development.

This is based on the following:

- To control noise intrusion to the retail units
- Does not take into account noise egress from potential future tenant fit outs, as this is dependent on specific tenant aspirations and would typically fall as part of their fit out works.

4.2.4 Temporary Façade

A minimum sound insulation performance of R_w+C_{tr} 38dB is specified for the temporary façade to the western elevation at Levels 3-7 of the new build block of the development.

4.2.5 Bar / Restaurant Unit

A minimum sound insulation performance is not specified for the full height glazing systems with external access doors to the bar/restaurant unit within the new build block of the development.

This is due to the specific sound insulation performance for the cladding being dependent on the desired level of amplified sound within the bar/restaurant unit. Noise breakout from the bar/restaurant unit is discussed in Section 7.0.

4.2.6 Façade Proposals

The Walsin Technical Submittal 63068-WSN-XX-TS-Y-0005-Glass Acoustic performance Revision P01 dated 30/06/2022 details the following proposals.

System Type	Glass Type	Configuration (mm)	R_w+C_{tr} (dB)	Space	Required R_w+C_{tr} (dB)
EWS-01 EWS-02 (Schuco Unitised)	G01 G08 G09	12.78/16/12.78	43	8 th – 9 th Office 3 rd – 7 th Temporary Facade	38
	G02*	10/22/10	34	2 nd – 9 th Office	33/38
	G03 G04	12.76/20/10	37	2 nd – 7 th Office	33
EWS-03 (Schuco FWS)	G06 G07	10.76/16/10.76	34 (R_w40)	Ground Retail 1 st Office	28 33
	G10* G11*	8/20/8	32 (R_w36)	10 th Bar/Restaurant	N/A
N/A	T.B.C.	T.B.C.	T.B.C.	Refurbished Office	33

**Insulated opaque glass.*

The sound insulation performance of the Schuco Unitised system type has been laboratory tested with the 12.78/16/12.78 glass and 10/22/10 insulated opaque glass configurations. The results detailed in the Vinci Technology Centre UK Limited Test Report 32775 indicate that the Schuco Unitised system type is capable of achieving the $R_w + C_{tr}$ 38dB requirement with the addition of Rockwool insulation and plasterboard to the rear of the spandrel panel to the insulated opaque glass.



The sound insulation performance of the Schuco FWS system type has previously been laboratory tested with numerous glass configurations as provided in the Walsin Technical Submittal. The results indicate that for glass with $R_w \leq 40\text{dB}$ the Schuco FWS system type is likely to reduce the overall sound insulation performance by 0-2dB. As such, the Schuco FWS system type is likely to be acceptable for use to the spaces indicated.

4.2.7 Roof Proposals

It is understood that the roof constructions at the various levels comprise the following constructions.

Roof Level	Construction
5	150mm concrete on composite metal deck ($\geq 2,200\text{kg/m}^3$)
7	150mm concrete on composite metal deck ($\geq 2,200\text{kg/m}^3$)
10	335mm post-tensioned concrete slab ($\geq 2,200\text{kg/m}^3$)
11	350mm post-tensioned concrete slab ($\geq 2,200\text{kg/m}^3$)

These constructions should provide adequate levels of airborne sound insulation performance to control ambient sound and Level 10 roof terrace amplified music/activity noise based on the limiting levels detailed in Section 7.0.

These constructions should provide adequate levels of sound insulation performance to control rain noise.

In order to provide adequate levels of impact sound insulation performance to control impacts from footfall and furniture movement a resilient layer is required. It is understood that roofing insulation is to be situated between the roof slab and pedestal system of the pavers to the external roof terraces. This is likely to provide adequate levels of impact sound insulation performance.

4.2.8 External Door Proposals

Assistance has been provided to the architect regarding the location and specification of external doors. A sound insulation performance of $R_w 35\text{dB}$ may prove difficult to achieve if acoustic seals cannot be fitted to the head, jambs, and threshold. Where this is not possible, lobbied doors may need to be considered where external doors open directly to occupied spaces.



4.3 Building Services Noise

4.3.1 Design Limits

In order to achieve the indoor ambient noise level requirements detailed in Section 4.1, the building services should be designed to achieve the following Noise Rating levels within each type of space when unoccupied (under Cat A fit-out standards):

BCO 2019 states the following building services noise limits in internal spaces (under Cat A fit-out standards):

Space	Building Services Noise Rating Limit
Cellular Office*	NR35
Speculative Office	NR38
Open Plan Office*	NR40
Entrance Lobbies	NR40
Circulation Spaces	NR40
Retail Units	NR45
Toilets	NR45
Loading Bays	NR55
Underground Car Parks	NR55
Plant Rooms	NR65

**These spaces are not proposed as part of the CAT A fit-out works.*

The above are in-line with the Employer's Requirements Briefing Document ('Outline Offices Specification' dated June 2021) and the requirements of BCO 2019 and BS 8233.

Since carpets and ceilings/absorbent finishes are not proposed as part of the Cat A fit-out works it may be necessary to apply a correction to the noise levels measured at the commissioning stage to allow for the excessively reverberant spaces.

Under no circumstances should building services noise be over attenuated since it contributes to background noise levels which are crucial in terms of obtaining suitable levels of speech privacy between the various spaces.

If building services noise is unable to achieve close to the proposed Noise Rating levels detailed in the table above, the installation of a sound-masking system may be required.



4.3.2 Plant Noise Data

Roomside building services noise levels have been assessed based on the manufacturers noise data detailed in the Plant Schedule detailed in Appendix A enclosed at the rear of the report.

4.3.3 Plant Drawings

The locations of the proposed plant items have been taken from the following drawings.

Author	Drawing No.	Revision	Date
Hoare Lea	63068-HOA-ZZ-R1-DR-M-57-00	-	08.08.22
	63068-HOA-ZZ-03-DR-M-57-00	P01	22.07.22
	63068-HOA-ZZ-B1-DR-M-57-00	-	26.05.22

This indicates that the 7No. AHUs, 37No. VRF condenser units, 2No. smoke extract fans and 1No. emergency standby generator are located at roof level with 1No. AHU, 1No. smoke intake fan, 1No. smoke extract fan, 1No. car park exhaust fan, 1No. waste room intake fan and 1No. waste room exhaust fan situated internally at basement level with intake and exhaust ducts terminating at street level. The FCUs are ceiling mounted throughout the office spaces.

4.3.4 Attenuation Measures

Calculations indicate that in order to achieve the building services noise limits in internal spaces, AHUs, extract fans and supply fans should be fitted with the Supply and Extract silencers specified in the Silencer Schedule detailed in Appendix B enclosed at the rear of the report.

Manufacturers noise data and layout drawings for the following building services items should be forwarded for review:

- Pumps
- Booster Sets
- Boilers.



4.3.5 Fan Coil Units

For the proposed ceiling mounted Fan Coil Units the Daikin information received only provides noise data measured directly beneath the units with a 1m length of duct connected to the inlet and a 2m length of duct connected to the discharge as opposed to other manufacturers which provide the open inlet/casing and ducted discharge separately. Separate inlet/casing and discharge noise data for the Daikin FCUs should be forwarded for review. Should this data not be available, the accuracy of the assessment will be limited and has the potential to underestimate the actual noise levels, particularly from the ducted discharge/supply grilles. Additionally, the FCU schedule should be forwarded for review so that the location of the various FCU sizes can be determined.

4.3.6 Ductwork

In order to achieve the indoor ambient noise level requirements all ductwork leading to grilles/diffusers/extract stub ducts should be sized so that the velocities do not exceed the following limits.

NR Design Level	Maximum Duct Velocity (m/s)				
	Risers	Main Branches	Ductwork to Grilles	Ductwork to Diffusers	Extract Stub Ducts
25	5	3	1.5	1	1.5
30	6	4	2	1.5	2
35	7.5	5	2.5	2	2.5
>40	10	6	3	2.5	3

4.3.7 Grilles

Regenerated noise levels from the proposed supply/extract grilles must be capable of achieving the indoor ambient noise level requirements based on the proposed volume flow rates and manufacturers data.

4.3.8 VAV Boxes

Breakout noise levels from the proposed VAV Boxes must be capable of achieving the indoor ambient noise level requirements based on the proposed volume flow rates and manufacturers data.



4.3.9 Diffusers

Regenerated noise levels from the proposed supply diffusers must be capable of achieving the indoor ambient noise level requirements based on the proposed volume flow rates and manufacturers data.

4.4 Building Services Vibration

All items of building services plant shall be fitted with suitable anti-vibration mounts (AVMs) in order to minimise structure borne noise transfer. The building services design shall be such that the 16-hour VDV in office space does not exceed 0.8ms-1.75 which corresponds to the upper range of a 'low probability of adverse comment' as detailed in BS 6472-1:2008.

Ductwork and pipework to plant items on AVMs should feature flexible connections and should be supported on anti-vibration hangers within plantrooms to maintain isolation.

4.5 Pipe Noise

Soil Vent Pipes (SVPs) and rainwater pipes should be routed away from noise sensitive spaces wherever possible. Where this is unavoidable, pipes should feature minimal transitions and be wrapped with mineral fibre insulation (25mm thick) and boxed in with a plasterboard construction (min. 10kg/m²) with both board and studwork independent of the pipe. Alternatively a suitable proprietary product may be used to lag the pipes (e.g. Muftilag lagging 30mm thick (R101) with a mass per unit area of 11.8kg/m²).

4.6 Lifts

All lift equipment shall be installed such that the noise/vibration limits specified in BCO guidance as detailed below are achieved.

4.6.1 Lift Car

Noise	-	$L_{Amax,F} \leq 55dB$	In accordance with BS ISO 18738:2003 "Lifts (elevators) – Measurement of lift ride quality"
Vibration	Jerk (z axis)	$\leq 1.8 \text{ m/s}^3$	
	Acceleration (z axis)	$\leq 1.2 \text{ m/s}^2$	
	Vertical Vibration (z axis)	$\leq 0.15 \text{ m/s}^2$ peak-to-peak	
	Horizontal Vibration (x/y axis)	$\leq 0.12 \text{ m/s}^2$ peak-to-peak	



4.6.2 Adjacent Areas

Noise	Other	Lift Lobby	$L_{Amax,F} \leq 55\text{dB}$	1m from lift doors
		Offices no Lobby	$L_{Amax,F} \leq 50\text{dB}$	1m from lift doors
		Offices	$L_{Amax,F} \leq 35\text{dB}$	1m from lift shaft wall
Vibration	Vertical Vibration	Offices	$\leq 0.36 \text{ ms}^{-1.75}$ 8-hour VDV	on floor slab

The noise/vibration limits specified above relate to the highest levels during any part of the lift cycle including announcements/audible signals and with any occupancy level between zero and the recommended maximum number of people for the lift car.

All lift equipment shall be installed on suitable anti-vibration mountings such that the noise/vibration limits specified above are achieved.

Where the core walls are unable to achieve the requirement of $L_{Amax,F} \leq 35\text{dB}$ in adjacent offices an independent wall lining will be required typically comprising 2No. layers of plasterboard with 25mm mineral fibre insulation in the cavity. **Where lining to the core walls are not part of the Cat A fit-out works this requirement should be specified as part of the Cat B fit-out works.**



5.0 SOUND INSULATION

5.1 Requirements

5.1.1 Airborne Sound Insulation

Based on BCO Guidance, demise walls and floors shall achieve a minimum airborne sound insulation performance of $D_{nT,w}$ 45dB at shell and core stage or $D_{nT,w}$ 48dB with Category A fit-out when tested in accordance with BS EN ISO 16283-1:2014 and rated in accordance with BS EN ISO 717-1:2013.

BREEAM 2018 section Hea 05 refers to sound insulation performances that comply with Section 7.5 of BS 8233:2014 where testing is to be carried out where the office is not yet furnished.

Based on a confidential privacy requirement, typical activity noise and medium sensitivity, a minimum airborne sound insulation performance of $D_{nT,w}$ 47dB is required for demise walls and floors to offices. Based on a moderate privacy requirement, high activity noise and medium sensitivity, a minimum airborne sound insulation performance of $D_{nT,w}$ 42dB is required for demise walls and floors between retail units.

At Level 1 between the retail units and office space the in-situ sound insulation performance of the floor (and cladding) will dictate the permissible operational noise levels within the retail units. Should higher operational noise levels be desired within the retail units, an acoustic mass barrier ceiling, acoustic linings to columns and secondary glazing may be required as part of the Tenant fit-out works.

At Level 10 between the bar/restaurant unit and office space the in-situ sound insulation performance of the floor will dictate the permissible operational noise levels within the unit. Noise breakout is discussed in Section 7.0.

5.1.2 Impact Sound Insulation

No performance requirement is stated for impact sound insulation, but it is noted that impact sound transmission from footfall should be controlled.

5.2 Floors

The table below details the minimum airborne sound insulation performance required between the various spaces along with the proposed floor constructions.



Location	Adjacencies	Required $D_{nT,w}$ (dB)	Construction
Level 1	Retail to Office	48*	275mm post-tensioned concrete slab ($\geq 2,200\text{kg/m}^3$)
Levels 2 - 9	Office to Office	48	275mm post-tensioned concrete slab ($\geq 2,200\text{kg/m}^3$)
Level 10	Bar/Restaurant to Office	48*	335mm post-tensioned concrete slab ($\geq 2,200\text{kg/m}^3$)
Levels 0 - 4	Office to Office (Within Existing Block)	48	Beam & clay pot
Levels 5 - 6	Office to Office (Above Existing Block)	48	150mm concrete on composite metal deck ($\geq 2,200\text{kg/m}^3$)

**Increased performance may be required dependent on desired operational noise levels within the retail and bar/restaurant units.*

The post-tensioned concrete slab constructions should achieve the airborne sound insulation performance requirement of $D_{nT,w}$ 48dB (subject to suitable flanking details at the façade).

The existing beam and clay pot construction was tested by Hoare Lea Acoustics in January 2022 and found to achieve between $D_{nT,w}$ 47-48dB (excluding tests with flanking via door openings/risers) with exposed concrete/screed or parquet floor and plaster ceiling. This construction is therefore likely to achieve the airborne sound insulation performance requirement of $D_{nT,w}$ 48dB in conjunction with a new suspended ceiling.

The concrete on composite metal deck construction is likely to achieve the airborne sound insulation performance requirement of $D_{nT,w}$ 48dB in conjunction with the raised office floor (subject to suitable flanking details at the façade). **It should be noted that this construction may be borderline without a suspended ceiling below.**

In order to provide adequate levels of impact sound insulation performance to control impacts from footfall a resilient layer is recommended for areas without a carpet floor finish. This may be situated between the floor slab and pedestal system of the raised office floor or between the raised office floor and floor finish. **Where floor finishes are not part of the Cat A fit-out works this requirement should be specified as part of the Cat B fit-out works.**



5.3 Partitions

The table below details the minimum airborne sound insulation performance required to the various spaces.

Space	Partition Minimum Sound Insulation Performance (dB)
Demise Wall	$D_{nT,w}$ 48
Shell & Core Wall to Ground Floor Retail	$D_{nT,w}$ 45
Internal Core Walls (Plasterboard)	R_w 47*
Mechanical / Public Health Riser	R_w 45
Electrical Riser	R_w 42

**Assumes cisterns and hand driers are not fixed to office partition.*

The following wall type drawings have been reviewed:

Author	Drawing No.	Revision	Date
Hodder+Partners	63068-HOD-ZZ-ZZ-DR-Z-2200	P01	14.04.2022
	63068-HOD-ZZ-B1-DR-A-2201	P01	14.04.2022
	63068-HOD-ZZ-00-DR-A-2202	P01	14.04.2022
	63068-HOD-ZZ-00-DR-A-2203	P01	14.04.2022
	63068-HOD-ZZ-01-DR-A-2204	P01	14.04.2022
	63068-HOD-ZZ-02-DR-A-2205	P01	14.04.2022
	63068-HOD-ZZ-03-DR-A-2206	P01	14.04.2022
	63068-HOD-ZZ-04-DR-A-2207	P01	14.04.2022
	63068-HOD-ZZ-05-DR-A-2208	P01	14.04.2022
	63068-HOD-ZZ-06-DR-A-2209	P01	14.04.2022
	63068-HOD-ZZ-07-DR-A-2210	P01	14.04.2022
	63068-HOD-ZZ-08-DR-A-2211	P01	14.04.2022
	63068-HOD-ZZ-09-DR-A-2212	P01	14.04.2022
	63068-HOD-ZZ-10-DR-A-2213	P01	14.04.2022

The proposed partition constructions have been reviewed and the sound insulation performance has been established as detailed in the table below.



NBS Type ID	Construction	Sound Insulation R _w (dB)
B1-A	140mm Medium Density Blockwork	49
B1-B	140mm Medium Density Blockwork	49
B2-A	140mm Medium Density Blockwork + 160mm Thermal Insulation (Rockwool) + 100mm Medium Density Blockwork	55
L1-A	12.5mm Sound Board + 50mm Independent I Stud + 25mm Acoustic Insulation	-
L1-B	12.5mm Wall Board + 50mm Independent I Stud	-
L1-C	12.5mm Wall Board + 50mm Independent I Stud (+18mm WBP Plywood)	-
L1-D	12.5mm Wall Board + 50mm Independent I Stud (+18mm WBP Plywood) + 25mm Acoustic Insulation	-
L1-E	2 x 12.5mm Wall Board + 50mm Independent Metal Stud + Acoustic Insulation	-
P4-A	2x12.5mm Fire Board + 70mm C Stud + 25mm Acoustic Insulation + 2x12.5mm Fire Board	49
P4-B	2x12.5mm Fire Board + 90mm C Stud + 50mm Acoustic Insulation + 2x12.5mm Fire Board	55
P4-C	2x12.5mm Sound Board + 70mm C Stud + 50mm Acoustic Insulation + 2x12.5mm Sound Board	53
P4-D	2x12.5mm Sound Board + 70mm C Stud + 2x12.5mm Sound Board	49
S2-A	15mm Sound Board + 60mm Independent I Stud + 19mm Core Board	39
S4-A	3x15mm Fire Board + 40mm Acoustic Insulation + 60mm Independent I Stud + 19mm Core Board	45

Assistance has been provided to the architect regarding the location and specification of wall constructions required to provide the required levels of sound insulation between adjacent spaces. Revised wall type drawings will be issued as required.

Suitable flanking details will be required in order to achieve the required levels of sound insulation.

Wall constructions between adjacent spaces should be built full height to the underside of the floor/roof construction.



The omission of the suspended ceilings from the open plan office spaces will provide no additional sound insulation to the head detail of partitions. This may therefore require additional attenuation measures (e.g., bulkheads) to the head detail of partitions in order to achieve the project requirements.

5.4 Moveable Partition

The sound insulation performance for the movable wall between the Office Reception and Retail Unit is not stated. It is understood that these two spaces are to be treated as one single space and as such the moveable wall is not required to achieve a minimum airborne sound insulation performance. It should be noted that should the required airborne sound insulation performance of $D_{nT,w}$ 48dB between demises be desired, the moveable wall should achieve at least R_w 60dB.

5.5 Doors

For doors the following sound insulation performances are proposed between adjacent spaces.

Door Separating Adjacent Spaces		Door Minimum Sound Insulation Performance (dB)
Office	Reception	R_w 35
	Mechanical/Public Health Riser	R_w 35
	Electrical Riser	R_w 35
	Corridor/Lift Lobby	R_w 32
Corridor/Lift Lobby	Toilet/Changing	R_w 32
Corridor/Toilet	Mechanical/Public Health Riser	R_w 32
	Electrical Riser	R_w 25
Corridor/Stairwell	Lift Lobby	R_w 25
Corridor/Lift Lobby	Car Park	R_w 25

5.6 Flanking Performance

In order to minimise the flanking of sound around wall/floor constructions the following requirements shall be achieved by the various elements.



5.6.1 Façade Horizontal Flanking

The cladding shall achieve a minimum flanking sound transmission performance of $D_{nf,w}$ 45dB when tested in accordance with EN ISO 10848-2:2006 (with the proposed glazing configuration) and rated in accordance with BS EN ISO 717-1:2013.

It should also be capable of being upgraded to achieve $D_{nf,w}$ 53dB when over clad with plasterboard or a proprietary product during Cat B fit-out.

The horizontal flanking performance of the Schuco Unitised system type has been laboratory tested with the 12.78/16/12.78 glass and 10/22/10 insulated opaque glass configurations. The results detailed in the Vinci Technology Centre UK Limited Test Report 32773 indicate that the Schuco Unitised system type is capable of achieving the $D_{nf,w}$ 45dB requirement with exposed mullions and the $D_{nf,w}$ 53dB requirement with the addition of Rockwool insulation and 2No. layers of plasterboard to each side of the mullion and firestop.

The horizontal flanking performance of the Schuco FWS system type has previously been laboratory tested with numerous glass and mullion configurations. The results indicate that the Schuco FWS system type is capable of achieving the $D_{nf,w}$ 45dB requirement with exposed mullions and the $D_{nf,w}$ 53dB requirement with the addition of insulation and 2No. layers of plasterboard to each side of the mullion.

5.6.2 Façade Vertical Flanking

The cladding (and slab edge interface) shall achieve a minimum flanking sound transmission performance of $D_{nf,w}$ 53dB when tested in accordance with EN ISO 10848-2:2006 (with the proposed glazing and allowance for the proposed suspended ceiling/raised floor arrangement where applicable) and rated in accordance with BS EN ISO 717-1:2013.

The vertical flanking performance of the Schuco Unitised system type has been laboratory tested with the 12.78/16/12.78 glass and 10/22/10 insulated opaque glass configurations. The results detailed in the Vinci Technology Centre UK Limited Test Report 32774 indicate that the Schuco Unitised system type is capable of achieving the $D_{nf,w}$ 53dB requirement with the firestop extended to the bottom of the concrete slab level and 100mm of insulation on top of the firestop.



At Level 1 between the retail units and office space this should be increased to $D_{nf,w}$ 60dB to allow for increased permissible operational noise levels within the retail units. Should higher operational noise levels be desired within the retail units, secondary glazing may be required as part of the Tenant fit-out works. It is understood that this only occurs at the Chotto entrance and Loading bay as the Level 1 floor slab steps out at all other locations. A plasterboard bulkhead is likely to be required in order to achieve the $D_{nf,w}$ 60dB requirement. **The proposed detail is to be reviewed upon receipt.**

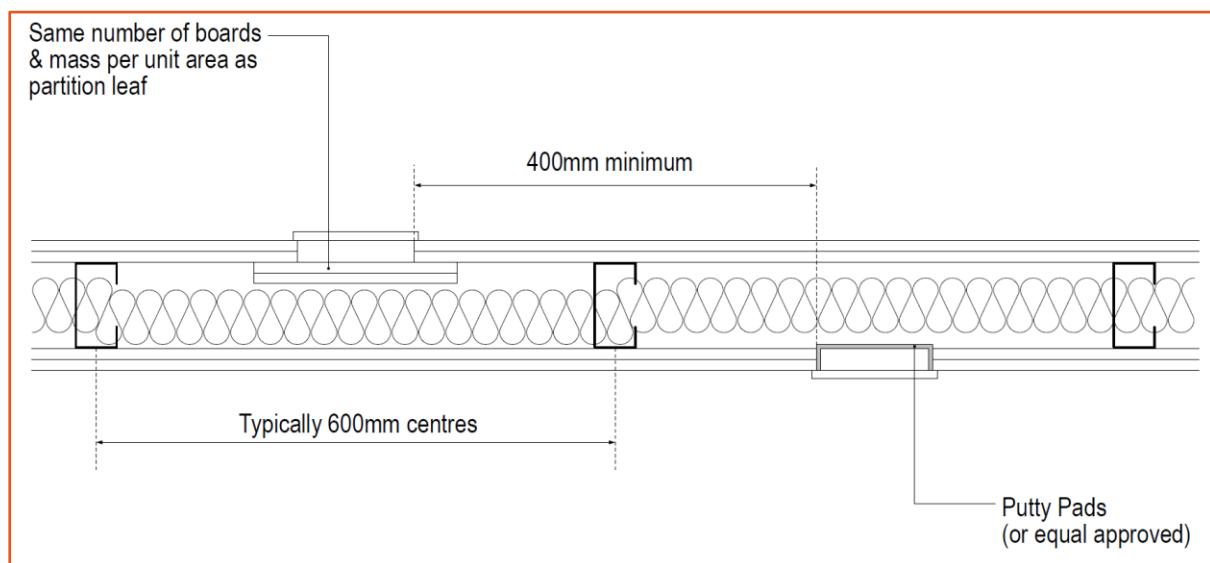
The vertical flanking performance of the Schuco FWS system type has previously been laboratory tested with numerous glass and mullion configurations. The results indicate that the Schuco FWS system type is capable of achieving the $D_{nf,w}$ 53dB requirement in conjunction with a raised office floor and suspended ceiling.

5.6.3 Raised Office Floor

The raised office floor shall achieve a minimum flanking sound transmission performance of $D_{nf,w}$ 45dB when tested in accordance with EN ISO 10848-2:2006 (without the presence of a floor void barrier) and rated in accordance with BS EN ISO 717-1:2013. **The test results for the proposed system are to be reviewed upon receipt.**

5.7 Sockets and Switches

Sockets and switches should ideally not be situated in separating partitions between rooms. Where unavoidable, they must not be situated back-to-back and should be staggered by at least one stud width (e.g. 600mm) as indicated in the sketch below.

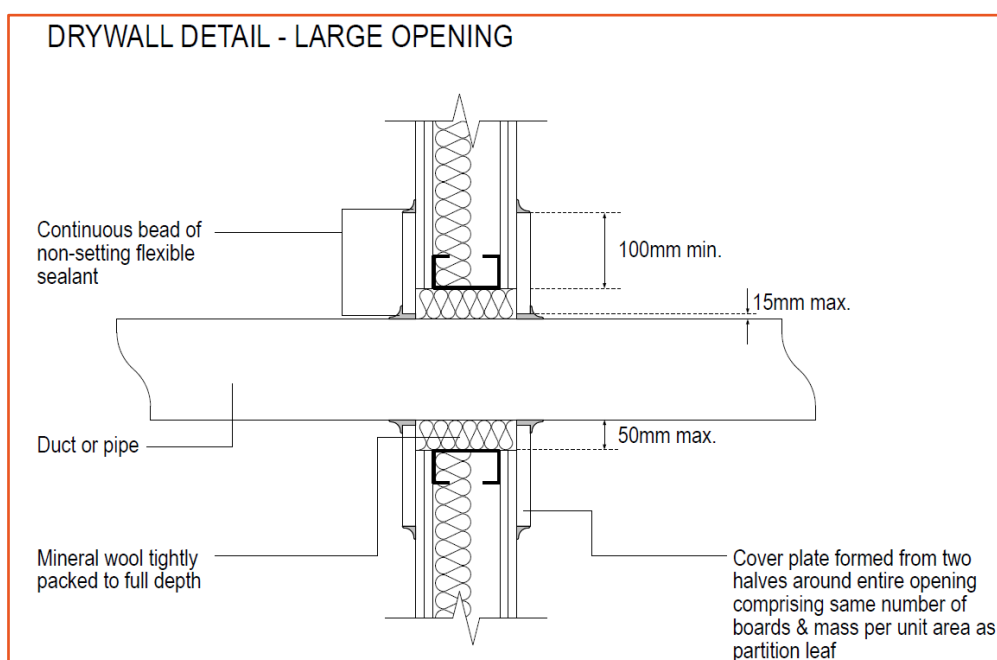
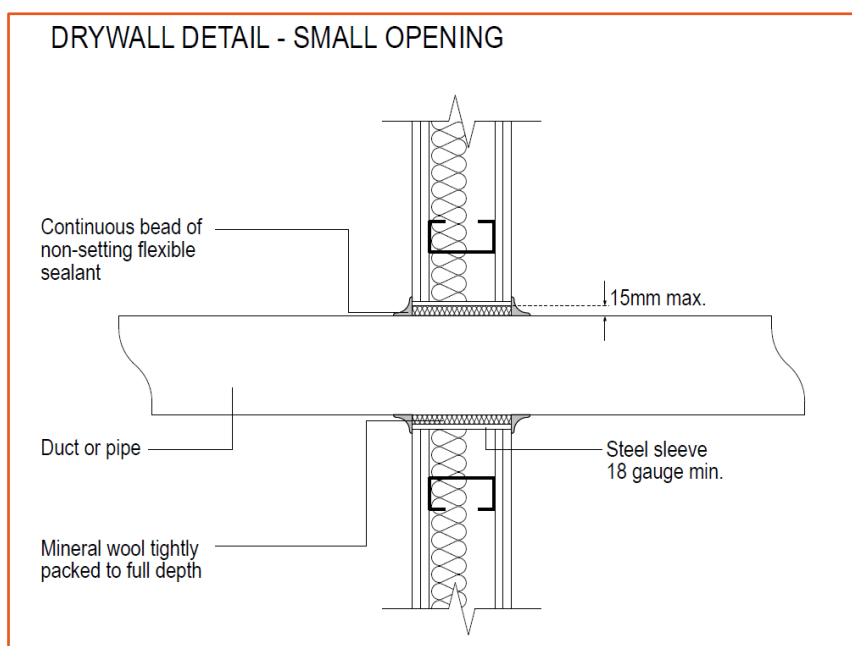




Sockets and switches should be boxed into the rear with a material having the same mass per unit area as the wall leaf in which they are inserted. These socket boxes may either be constructed on-site or pre-manufactured products.

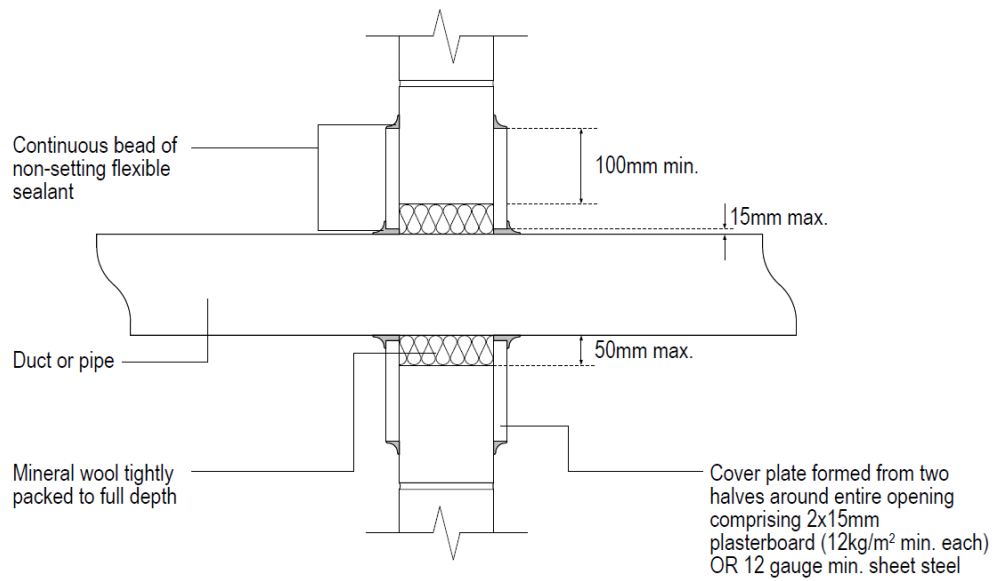
5.8 Penetrations

All penetrations of walls, partitions and floors by ducts, pipework and cables must be adequately sealed in order to minimise flanking as detailed in the sketches below. Penetrations to rooms should ideally be situated above the door and not to situated in separating walls between rooms.

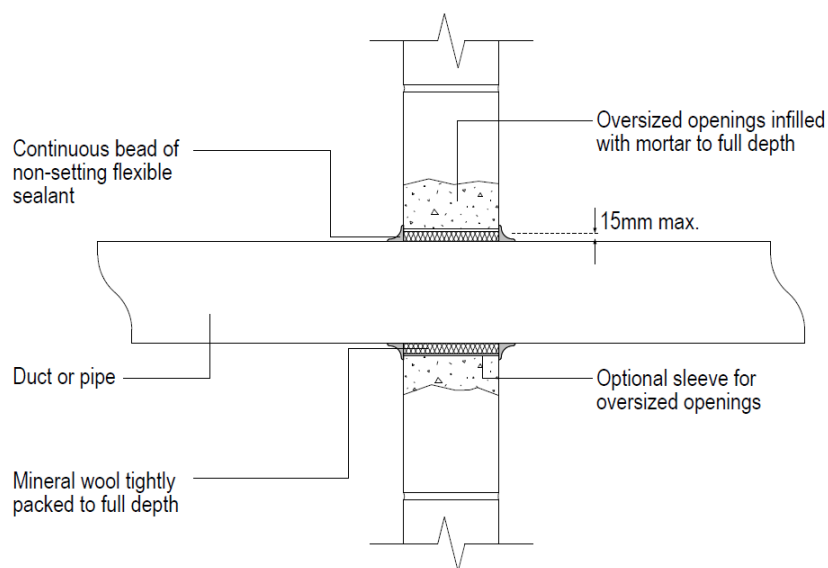




MASONRY/CONCRETE DETAIL - LARGE OPENING



MASONRY/CONCRETE DETAIL - SMALL OPENING





6.0 REVERBERATION

6.1 Requirements

Based on the requirements of BREEAM 2018 section Hea 05, spaces should achieve the requirements relating to sound absorption and reverberation times, where applicable, set out in Section 7 of BS 8233:2014.

Based on BS 8233:2014 guidance, the suspended ceiling within open plan office space should be less than 3m in height and achieve Class A sound absorption when tested in accordance with BS EN ISO 354:2003 and rated in accordance with BS EN ISO 11654:1997.

Based on BCO guidance, the suspended ceiling within open plan office space should achieve Class A sound absorption when tested in accordance with BS EN ISO 354:2003 and rated in accordance with BS EN ISO 11654:1997. The ceiling should cover all areas except lights, grilles, and plasterboard margins. Additionally, a carpet is desirable in office areas to control footfall and provide additional absorption.

6.2 Office Space

Since the speculative office space does not feature any suspended ceilings as part of the Cat A fit-out, it is understood that it is to be treated as shell and core space under BREEAM 2018 section Hea 05. As such, the speculative office space does not need to comply with the relevant reverberation requirements, and it is understood that that the third credit available under Hea 05 may be awarded where the building complies with the indoor ambient noise levels and sound insulation requirements.

The omission of the suspended ceilings from the open plan office spaces resulting in an exposed soffit will provide practically no absorption to the open plan office spaces.

The Tenant would therefore be responsible for providing absorptive treatment to the open plan office spaces (and future meeting rooms, cellular offices if proposed) in order to achieve/approach the guidance of BS 8233:2014/BCO. This may be in the form of acoustic panels to the underside/suspended from the soffit or freestanding acoustic panels.



6.3 Meeting Suite

The following finishes are understood to be proposed to the conference/multi-purpose rooms.

Space	Surface	Proposed Finish
Conference Rooms	Floor	Carpet Tile
	Ceiling	Hunter Douglas Solid Wood Grill with 25mm Polyester Wool (~8m ²) / Plasterboard
	Walls	Wood Wall Panelling/Glass
Multi-Purpose Rooms	Floor	Wooden
	Ceiling	Hunter Douglas Solid Wood Grill with 25mm Polyester Wool (~16m ²) / Plasterboard
	Walls	Wood Wall Panelling/Glass

The proposed finishes are considered to be insufficient to control reverberation times within the spaces. In order to control reverberation times within the conference rooms an additional 16m² of Class A acoustic absorbent treatment is recommended within each space.

In order to control reverberation times within the multipurpose rooms an additional 22m² of Class A acoustic absorbent treatment is recommended within each space.

The acoustic absorbent treatment should ideally be equally distributed throughout the space. Acoustic wall panels are likely to be the most suitable form of treatment to the spaces if the current ceiling proposals are to be retained.

6.4 Entrance Lobby

Entrance lobbies typically have hard reflective finishes and large volumes which can result in long reverberation times. Whilst this can create a “prestigious” sound field it can also result in poor speech intelligibility.

Whilst there are no specific requirements for reverberation times within entrance lobbies, the introduction of acoustically absorbent finishes/furnishings is desirable in order to control reverberation times.



The following finishes are understood to be proposed to the entrance lobby.

Surface	Proposed Finish
Floor	Polished Concrete Entrance Barrier Mat
Ceiling	Baffled Wood Panels Hunter Douglas Nano Perforated Acoustic Wood Panels Hunter Douglas
Walls	Green Wall GSky Versa Interior Wall System VTEC Slatted Wood Wall Panels Supaslat 1 or 4

The proposed finishes will control reverberation times within the space and assist with speech intelligibility at the reception desk.



7.0 LEVEL 10 BAR / RESTAURANT

7.1 Requirements

7.1.1 Level 9 Offices

A project requirement for amplified music/sound from the Level 10 bar/restaurant unit to the offices below is proposed as detailed in the table below.

Parameter	Maximum Noise Transfer Level Within Offices (dB) at Octave Band Centre Frequency (Hz)							
	63	125	250	500	1K	2K	4K	8K
Ambient Level, $L_{eq,1min}$	51	39	31	24	20	17	14	13
Maximum Level, L_{Fmax}	56	44	36	29	25	22	19	18

7.1.2 Nearest Noise Sensitive Receptors

With regards to amplified music/sound from the Level 10 external roof terrace Manchester City Council (MCC) have imposed the following condition.

"32. No amplified sound or any music shall be produced or played in any part of external areas in the development, other than in accordance with a scheme detailing the levels at which any music shall be played and the hours during which it shall be played which has been submitted to and approved in writing by the City Council as local planning authority."

With regards to amplified music/sound from within the Level 10 bar/restaurant unit MCC have imposed the following condition.

"35. Before any A1, A3 A4 or A5 use hereby approved commences, the premises shall be acoustically insulated and treated to limit the break out of noise in accordance with a noise study of the development and a scheme of acoustic treatment that has been submitted to and approved in writing by the City Council as local planning authority. The scheme shall be implemented in full before the use commences."



Where entertainment noise is proposed the L_{Aeq} (entertainment noise) should be controlled to 10dB below the L_{A90} (without entertainment noise) at the facade of the nearest noise sensitive location, and internal noise levels at structurally adjoined residential properties in the 63Hz and 125Hz octave frequency bands should be controlled so as not to exceed (in habitable rooms) 47dB and 41dB, respectively."

Based on the results of the environmental noise survey and the above requirement the following amplified music/sound limits are permissible at the nearest noise sensitive receptors.

Nearest Noise Sensitive Receptor	Period	Amplified Music/Sound Limits L_{eq} (dB) at Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
Radisson Edwardian Hotel	Daytime	48	48	45	42	40	35	28	22
	Night-time	48	48	44	41	39	33	26	20
Old Nag's Head	Daytime	50	46	44	42	41	35	26	14
	Night-time	47	44	43	40	38	32	24	12

Based on the above requirements the following internal noise levels are permissible in the adjoining Phase 2 hotel bedrooms/apartments which overlook the Level 10 roof terrace and bar/restaurant unit.

Adjoining Receptor	Amplified Music/Sound Limits L_{eq} (dB) at Octave Band Centre Frequency (Hz)	
	63	125
Phase 2 Hotel Bedrooms / Apartments	47	41

7.2 Limiting Levels

7.2.1 Level 9 Offices

Based on the sound insulation performance offered by the Level 10 335mm post-tensioned concrete slab the following guideline amplified music/sound levels are permissible within the Level 10 bar/restaurant unit whilst achieving the requirements in the Level 9 offices below.



Parameter	Guideline Amplified Music/Sound Level (dB) at Octave Band Centre Frequency (Hz)							
	63	125	250	500	1K	2K	4K	8K
Ambient Level, $L_{eq,1min}$	75	71	64	69	72	73	76	75
Maximum Level, L_{Fmax}	80	76	69	74	75	78	81	80

Note: Actual amplified music/sound level limits would need to be set on site during a commissioning visit.

These amplified music/sound levels may be considered typical for a bar with background music. If these amplified music/sound levels are acceptable within the Level 10 bar/restaurant unit between 08:00 to 18:00 hours (when the offices below are occupied) then no further acoustic treatment is likely to be required as part of the Tenant fit-out works to the offices below.

This is on the understanding that between 18:00 and 03:30 hours (when the offices below are not occupied) there is no requirement to achieve in the offices below and therefore amplified music/sound levels within the Level 10 bar/restaurant unit may be increased to those permissible to achieve the requirements at the nearest noise sensitive receptors (see Section 7.2.2).

Should higher amplified music/sound levels be desired within the Level 10 bar/restaurant unit between 08:00 to 18:00 hours when the offices below are occupied then a combination of the following acoustic treatment is likely to be required within the space as part of the Tenant fit-out works:

- Acoustic floating floor
- Acoustic linings to columns
- Mass barrier ceiling
- Secondary glazing/lobbied doors
- Up-rated acoustic doors to risers.

7.2.2 Nearest Noise Sensitive Receptors

Based on the sound insulation performance offered by the Level 10 glazing (R_w+C_{tr} 34dB) the following guideline amplified music/sound levels are permissible within the Level 10 bar/restaurant unit (with external doors/windows closed) whilst achieving the requirements at the nearest noise sensitive receptors.



Parameter	Guideline Amplified Music/Sound Level (dB) at Octave Band Centre Frequency (Hz)							
	63	125	250	500	1K	2K	4K	8K
Ambient Level, Leq,1min	90	95	90	90	90	90	90	90

Note: Actual amplified music/sound level limits would need to be set on site during a commissioning visit.

These amplified music/sound levels may be considered typical for a bar with loud music.

With external doors/windows open the requirements at the nearest noise sensitive receptors are likely to be exceeded. Careful consideration therefore needs to be given to access between the internal space and external terrace areas. This is likely to require a lobbied area (with lower/no amplified music levels) between internal spaces and external terrace areas with at least one set of doors closed at all times.

The following guideline amplified music/sound levels are permissible within the Level 10 roof terrace whilst achieving the requirements at the nearest noise sensitive receptors (between 19:00 to 23:00 hours).

Parameter	Guideline Amplified Music/Sound Level (dB) at Octave Band Centre Frequency (Hz)							
	63	125	250	500	1K	2K	4K	8K
Ambient Level, Leq,1min	67	64	60	58	55	50	45	45

Note: Actual amplified music/sound level limits would need to be set on site during a commissioning visit.

These amplified music/sound levels may be considered typical for a terrace with background music.

Should higher amplified music/sound levels be desired within the Level 10 roof terrace a relaxation would need to be agreed with MCC and an assessment of the proposed glazing to the Phase 2 hotel bedrooms/apartments would need to be undertaken.



8.0 ATMOSPHERIC PLANT NOISE EMISSIONS

8.1 Requirements

The requirements of BREEAM 2018 section Pol 05 state that plant noise levels must be at least 5dB lower than the background noise throughout the day and night at the nearest noise sensitive development.

With regards to atmospheric plant noise emissions from proposed plant items Manchester City Council (MCC) have imposed the following condition.

"34. 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 noise level of 5dB below the existing background (L_{A90}) in each octave band at the nearest noise sensitive location.

The scheme should be submitted to and approved in writing by the City Council as local planning authority prior to the first occupation of each part of the development, in order to secure a reduction in the level of noise emanating from the site."

As such, the requirements of the Local Authority are in line with that required by BREEAM 2018 Pol 05.

Based on the results of the environmental noise survey and the above requirements the following atmospheric plant noise emission limits are permissible at the nearest noise sensitive receptors.

Nearest Noise Sensitive Receptor	Period	Atmospheric Plant Noise Emission Limits L _{eq} (dB)* at Octave Band Centre Frequency (Hz)								dBA
		63	125	250	500	1k	2k	4k	8k	
Radisson Edwardian Hotel	Daytime	53	53	50	47	45	40	33	27	50
	Night-time	53	53	49	46	44	38	31	25	49
Old Nag's Head	Daytime	55	51	49	47	46	40	31	19	50
	Night-time	52	49	48	45	43	37	29	17	48

**Character correction to be applied for tonal or impulsive characteristics in line with BS 4142:2014.*



In addition, cumulative atmospheric plant noise emissions from proposed emergency plant items (standby generator, smoke extract fans) shall achieve a noise level of up to 5dB above the existing background (L_{A90}) at the nearest noise sensitive location. This is on the basis that maintenance testing of the proposed emergency plant items is limited to weekday daytime hours only.

The above limits are subject to final approval by Manchester City Council. Plant noise emissions should be assessed in terms of BS 4142: 2014.

In addition to the BREEAM 2018 and MCC requirements, a project requirement is proposed for atmospheric plant noise emissions to the Level 10 roof terrace of L_{Aeq} 50dB.

8.2 BS 4142:2014

BS 4142: 2014 "Methods for rating and assessing industrial and commercial sound", describes methods for rating and assessing sound of an industrial and/or commercial nature, which includes:

- sound from industrial and manufacturing processes
- sound from fixed installations which comprise mechanical and electrical plant and equipment
- sound from the loading and unloading of goods and materials at industrial and/or commercial premises
- sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes, such as that from forklift trucks, or that from train or ship movements on or around an industrial and/or commercial site.

Sound of an industrial and/or commercial nature does not include sound from the passage of vehicles on public roads and railway systems. It should be noted that the determination of noise amounting to a nuisance is beyond the scope of BS 4142.

The likely impact is indicated by subtracting the existing background sound level from the rating level of the industrial and/or commercial sound. The standard states that:

"a) Typically, the greater this difference, the greater the magnitude of the impact.

b) A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context.

c) A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context.



d) 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.

Note 2 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."

The industrial and/or commercial sound is expressed as the specific sound level and given as a L_{Aeq,T_r} sound level. Should the specific sound level exhibit any acoustic features (i.e. tonality, irregularity or impulsiveness) a character correction is applied. The rating level is the specific sound level with character correction applied (if applicable) and is given as a L_{A,r,T_r} sound level.

The existing background sound level is given as a $L_{A90,T}$ sound level.

The reference time interval, T_r , is 1 hour during the daytime period (07:00 to 23:00 hours) and 15 minutes during the night-time period (23:00 to 07:00 hours).

8.3 Plant Noise Data

Atmospheric building services noise levels have been assessed based on the manufacturers noise data detailed in the Plant Schedule detailed in Appendix A enclosed at the rear of the report.

Whilst it is not possible to assess plant irregularity or impulsiveness based on manufacturer's sound data, BS 4142: 2014 provides an objective method for assessing the audibility of tones in sound. The one-third octave method states that if the level of a one third octave band exceeds the level of both adjacent one third octave bands by the following amounts, then a tonal component may be identified as present:

- 15dB in the low-frequency one-third-octave bands (25Hz to 125Hz)
- 8dB in the mid-frequency one-third-octave bands (160Hz to 400Hz)
- 5dB in the high-frequency one-third-octave bands (500Hz to 10kHz).

However, one third octave band sound data is rarely available from manufacturers as is the case in this instance.

By applying the same principal to the octave band sound data in the enclosed Plant Schedule, a review indicates that these items are unlikely to exhibit a tonal component. As such, no character correction has been applied to the specific sound level for these items.



Should one third octave band sound data become available a revised assessment should be undertaken.

8.4 Operating Hours

It is understood that the proposed plant items have the potential to operate simultaneously at up to 100% duty over a 24-hour period.

It is understood that the emergency standby generator will only operate upon loss of mains power to the building and during maintenance testing which will be limited to weekday daytime hours only.

It is understood that the smoke extract fans will only operate during an emergency and during maintenance testing which will be limited to weekday daytime hours only.

8.5 Plant Locations

The locations of the proposed plant items have been taken from the following drawings.

Author	Drawing No.	Revision	Date
Hoare Lea	63068-HOA-ZZ-R1-DR-M-57-00	-	08.08.22
	63068-HOA-ZZ-B1-DR-M-57-00	-	26.05.22

This indicates that the 7No. AHUs, 37No. VRF condenser units, 2No. smoke extract fans and 1No. emergency standby generator are located at roof level with 1No. AHU, 1No. smoke intake fan, 1No. smoke extract fan, 1No. car park exhaust fan, 1No. waste room intake fan and 1No. waste room exhaust fan situated internally at basement level with intake and exhaust ducts terminating at street level.

8.6 Nearest Noise Sensitive Receptors

The nearest existing noise sensitive receptors to the locations of the proposed plant items are the Radisson Edwardian Hotel situated approximately 60m to the south of the Level 11 rooftop plant area. The nearest future noise sensitive receptors to the locations of the proposed plant items are the Phase 2 hotel bedrooms/apartments situated approximately 25m to the west of the Level 11 rooftop plant area. The Level 10 roof terrace is situated adjacent to the north, south and west of the Level 11 rooftop plant area.



8.7 Attenuation Measures

Calculations indicate that in order to achieve the proposed atmospheric plant noise emission limits at the various receptors, AHUs, extract fans and supply fans should be fitted with the FAI and Exhaust silencers specified in the Silencer Schedule detailed in Appendix B enclosed at the rear of the report.

It is understood that the 3m high architectural louvred perimeter screen to the Level 11 rooftop plant area is to be blanked off to the rear with aluminium panels (min. 2mm thick), with the exception of where the AHU duct terminations connect directly to the rear.

Calculations indicate that this should provide sufficient screening between the VRF condenser units (all below the top of the 3m high screen) to the Radisson Edwardian Hotel and Level 10 roof terrace.

However, it will provide no attenuation to the future Phase 2 hotel/apartments which will overlook the Level 11 rooftop plant area. Calculated sound levels at the facade of the future Phase 2 hotel/apartments are in the region of 50-57dBA (depending on the floor level) which is up to 8dBA in excess of the target level at the Radisson Edwardian Hotel. This therefore means that the specification of the facade of the future Phase 2 hotel/apartments needs to take account of the Phase 1 Level 11 rooftop plant sound.

It should be noted that if any future tenant plant is situated close to the perimeter screen, and therefore requires additional ventilation, the tenant would be responsible for the replacement of the aluminium blanking panel with an appropriate acoustic louvre (potentially 300-600mm deep).



9.0 WORKMANSHIP

The majority of acoustic requirements are specified in terms of an on-site acoustic performance being achieved. The acoustic performance of individual elements is specified, along with examples of suitable constructions where applicable, which should be capable of achieving the acoustic requirements with the implementation of the advice provided.

The actual on-site acoustic performance achieved will also be highly dependent on the standard of workmanship including build quality, sealing of junctions/penetrations and avoidance of flanking paths. In order to maximise the standard of workmanship regular site inspection visits are recommended. Ultimately, the standard of workmanship is the responsibility of the contractor.

10.0 ACOUSTIC TESTING

In order to demonstrate compliance with the acoustic criteria and obtain the relevant BREEAM credits the testing requirements and schedule of evidence are detailed within Appendix C.

APPENDIX A: PLANT SCHEDULE

Plant Ref.	Description	Location	Duty		Data (Inlet/Outlet/Casing)	L _w / L _p at dist. (m)	Sound Level (dB) at Octave Band Centre Frequency (Hz)							
			m ³ /s	Pa			63	125	250	500	1k	2k	4k	8k
AHU 01	Supply & Extract AHU	Level 11 Rooftop Plant Area	-	-	FAI	L _w	70	80	75	73	69	66	64	63
			-	-	Supply	L _w	74	87	78	81	78	74	71	66
			-	-	Extract	L _w	73	78	74	72	68	65	62	61
			-	-	Exhaust	L _w	76	84	78	80	77	72	69	65
			-	-	Casing	L _w	63	76	60	61	58	52	39	30
AHU 02	Supply & Extract AHU	Level 11 Rooftop Plant Area	-	-	FAI	L _w	69	79	73	70	67	64	62	61
			-	-	Supply	L _w	74	86	77	80	76	73	69	65
			-	-	Extract	L _w	71	77	74	71	68	64	62	61
			-	-	Exhaust	L _w	75	83	78	80	77	72	69	64
			-	-	Casing	L _w	63	75	59	60	56	51	37	29

Plant Ref.	Description	Location	Duty		Data (Inlet/Outlet/Casing)	L _w / L _p at dist. (m)	Sound Level (dB) at Octave Band Centre Frequency (Hz)							
			m ³ /s	Pa			63	125	250	500	1k	2k	4k	8k
AHU 03	Supply & Extract AHU	Level 11 Rooftop Plant Area	-	-	FAI	L _w	72	83	79	75	69	67	63	62
			-	-	Supply	L _w	76	88	81	83	80	77	74	69
			-	-	Extract	L _w	73	79	73	71	68	64	62	59
			-	-	Exhaust	L _w	78	85	77	79	76	71	68	62
			-	-	Casing	L _w	65	77	63	63	60	55	42	33
AHU 04	Supply & Extract AHU	Level 11 Rooftop Plant Area	-	-	FAI	L _w	72	80	75	74	70	66	64	64
			-	-	Supply	L _w	76	87	79	81	79	74	71	67
			-	-	Extract	L _w	70	80	76	73	67	64	61	57
			-	-	Exhaust	L _w	74	85	79	80	77	74	71	66
			-	-	Casing	L _w	65	76	61	61	59	52	39	31

Plant Ref.	Description	Location	Duty		Data (Inlet/Outlet/Casing)	L _w / L _p at dist. (m)	Sound Level (dB) at Octave Band Centre Frequency (Hz)							
			m ³ /s	Pa			63	125	250	500	1k	2k	4k	8k
AHU 05	Supply & Extract AHU	Level 11 Rooftop Plant Area	-	-	FAI	L _w	71	79	72	70	67	63	61	59
			-	-	Supply	L _w	75	84	76	78	76	71	68	62
			-	-	Extract	L _w	72	76	70	65	63	59	55	54
			-	-	Exhaust	L _w	75	83	74	76	72	68	65	59
			-	-	Casing	L _w	64	73	58	58	56	49	36	26
Landlord AHU	Supply & Extract AHU	Level 11 Rooftop Plant Area	-	-	FAI	L _w	74	80	76	74	70	66	64	64
			-	-	Supply	L _w	78	86	80	82	79	75	71	68
			-	-	Extract	L _w	71	81	77	73	67	65	61	58
			-	-	Exhaust	L _w	74	86	80	81	78	75	72	67
			-	-	Casing	L _w	67	75	62	62	59	53	39	32

Plant Ref.	Description	Location	Duty		Data (Inlet/Outlet/Casing)	L _w / L _p at dist. (m)	Sound Level (dB) at Octave Band Centre Frequency (Hz)							
			m ³ /s	Pa			63	125	250	500	1k	2k	4k	8k
Southmill AHU	Supply & Extract AHU	Level 11 Rooftop Plant Area	-	-	FAI	L _w	67	81	76	72	66	64	59	57
			-	-	Supply	L _w	72	87	78	80	77	74	71	65
			-	-	Extract	L _w	67	78	73	70	64	62	58	55
			-	-	Exhaust	L _w	71	82	77	78	75	72	69	63
			-	-	Casing	L _w	61	76	60	60	57	52	39	29
Basement AHU	Supply & Extract AHU	Basement	-	-	FAI	L _w	65	77	73	68	65	62	58	56
			-	-	Supply	L _w	70	84	79	78	76	72	67	63
			-	-	Extract	L _w	66	72	69	69	65	62	59	56
			-	-	Exhaust	L _w	69	79	74	78	75	71	66	62
			-	-	Casing	L _w	59	73	61	58	56	50	35	27

Plant Ref.	Description	Location	Duty		Data (Inlet/Outlet/Casing)	L _w / L _p at dist. (m)	Sound Level (dB) at Octave Band Centre Frequency (Hz)							
			m ³ /s	Pa			63	125	250	500	1k	2k	4k	8k
-	Smoke Extract Fan 1	Level 11 Rooftop Plant Area	-	-	Extract	L _w	89	84	92	92	92	90	86	84
			-	-	Exhaust	L _w	89	84	92	92	92	90	86	84
			-	-	Casing	L _w	81	68	72	72	72	69	71	65
-	Smoke Extract Fan 2	Level 11 Rooftop Plant Area	-	-	Extract	L _w	89	84	92	92	92	90	86	84
			-	-	Exhaust	L _w	89	84	92	92	92	90	86	84
			-	-	Casing	L _w	81	68	72	72	72	69	71	65
-	Standby Generator	Level 11 Rooftop Plant Area	-	-	Casing	L _p at 1m	85dBA							
-	1No. VRF Condenser Unit Daikin REYA20A	Level 11 Rooftop Plant Area	-	-	Casing	L _w	-	90	88	89	83	78	79	71
-	2No. VRF Condenser Unit Daikin REYA8A	Level 11 Rooftop Plant Area	-	-	Casing	L _w	-	81	81	79	71	70	65	60
-	3No. VRF Condenser Unit Daikin REYA14A	Level 11 Rooftop Plant Area	-	-	Casing	L _w	-	84	81	83	76	72	71	66
-	16No. VRF Condenser Unit Daikin REYA12A	Level 11 Rooftop Plant Area	-	-	Casing	L _w	-	85	82	82	78	73	72	66
-	15No. VRF Condenser Unit Daikin REYA14A	Level 11 Rooftop Plant Area	-	-	Casing	L _w	-	86	84	86	79	76	76	69

Plant Ref.	Description	Location	Duty		Data (Inlet/Outlet/Casing)	L _w / L _p at dist. (m)	Sound Level (dB) at Octave Band Centre Frequency (Hz)							
			m ³ /s	Pa			63	125	250	500	1k	2k	4k	8k
-	Smoke Intake Fan (Duty/Standby)	Basement	-	-	FAI	L _w	81	81	85	86	82	79	73	68
			-	-	Supply	L _w	82	82	86	86	82	80	74	69
			-	-	Casing	L _w	72	61	60	61	57	53	55	45
-	Smoke Extract Fan (Duty/Standby)	Basement	-	-	Extract	L _w	79	84	82	85	83	81	76	73
			-	-	Exhaust	L _w	80	87	83	85	83	81	77	74
			-	-	Casing	L _w	70	69	61	62	58	53	55	50
-	Car Park Exhaust Fan (Duty/Standby)	Basement	-	-	Extract	L _w	100	100	99	100	98	93	88	83
			-	-	Exhaust	L _w	101	101	100	101	99	94	90	85
			-	-	Casing	L _w	91	78	72	74	72	65	69	62
-	Waste Room Intake Fan & Exhaust Fan	Basement	-	-	FAI/Extract	L _w	49	57	65	60	57	58	53	48
			-	-	Supply/Exhaust	L _w	50	58	62	57	56	56	51	49
			-	-	Casing	L _w	46	49	45	44	42	40	33	28

APPENDIX B: SILENCER SCHEDULE

Plant Ref.	Description	Inlet/Outlet	Vol. (m ³ /s)	Typical Length (mm)	Face Velocity (m/s)	Pressure Drop (Pa)	Insertion Loss (dB) at Octave Band Centre Frequency (Hz)							
							63	125	250	500	1k	2k	4k	8k
AHU 01	Supply & Extract AHU Level 11 Rooftop Plant Area	FAI	-	1200	<4.5	<55	7	12	19	35	40	36	28	17
		Supply	-	1800	<3.5	<55	10	19	29	45	48	47	42	28
		Extract	-	1500	<3.5	<55	9	17	25	43	47	46	39	24
		Exhaust	-	1200	<4.5	<55	7	12	19	35	40	36	28	17
AHU 02	Supply & Extract AHU Level 11 Rooftop Plant Area	FAI	-	900	<4.5	<55	5	9	15	29	34	30	22	14
		Supply	-	1800	<3.5	<55	10	19	29	45	48	47	42	28
		Extract	-	1500	<3.5	<55	9	17	25	43	47	46	39	24
		Exhaust	-	1200	<4.5	<55	7	12	19	35	40	36	28	17
AHU 03	Supply & Extract AHU Level 11 Rooftop Plant Area	FAI	-	1500	<4.5	<55	8	15	23	40	46	41	33	20
		Supply	-	2100	<3.5	<55	11	20	33	47	49	47	45	31
		Extract	-	1200	<3.5	<55	7	14	21	38	43	41	33	20
		Exhaust	-	1200	<4.5	<55	7	12	19	35	40	36	28	17

Plant Ref.	Description	Inlet/Outlet	Vol. (m³/s)	Typical Length (mm)	Face Velocity (m/s)	Pressure Drop (Pa)	Insertion Loss (dB) at Octave Band Centre Frequency (Hz)							
							63	125	250	500	1k	2k	4k	8k
AHU 04	Supply & Extract AHU Level 11 Rooftop Plant Area	FAI	-	1200	<4.5	<55	7	12	19	35	40	36	28	17
		Supply	-	2100	<3.5	<55	11	20	33	47	49	47	45	31
		Extract	-	1200	<3.5	<55	7	14	21	38	43	41	33	20
		Exhaust	-	1500	<4.5	<55	8	15	23	40	46	41	33	20
AHU 05	Supply & Extract AHU Level 11 Rooftop Plant Area	FAI	-	900	<4.5	<55	5	9	15	29	34	30	22	14
		Supply	-	1500	<3.5	<55	9	17	25	43	47	46	39	24
		Extract	-	900	<3.5	<55	5	10	16	32	38	35	26	16
		Exhaust	-	1200	<4.5	<55	7	12	19	35	40	36	28	17
Landlord AHU	Supply & Extract AHU Level 11 Rooftop Plant Area	FAI	-	1200	<4.5	<55	7	12	19	35	40	36	28	17
		Supply	-	2100	<3.5	<55	11	20	33	47	49	47	45	31
		Extract	-	1200	<3.5	<55	7	14	21	38	43	41	33	20
		Exhaust	-	1500	<4.5	<55	8	15	23	40	46	41	33	20

Plant Ref.	Description	Inlet/Outlet	Vol. (m ³ /s)	Typical Length (mm)	Face Velocity (m/s)	Pressure Drop (Pa)	Insertion Loss (dB) at Octave Band Centre Frequency (Hz)							
							63	125	250	500	1k	2k	4k	8k
Southmill AHU	Supply & Extract AHU Level 11 Rooftop Plant Area	FAI	-	1200	<4.5	<55	7	12	19	35	40	36	28	17
		Supply	-	2100	<3.5	<55	11	20	33	47	49	47	45	31
		Extract	-	1200	<3.5	<55	7	14	21	38	43	41	33	20
		Exhaust	-	1200	<4.5	<55	7	12	19	35	40	36	28	17
Basement AHU	Supply & Extract AHU Basement	FAI	-	900	<6.0	<55	5	7	13	23	25	20	15	10
		Supply	-	900	<6.0	<55	5	7	13	23	25	20	15	10
		Extract	-	900	<6.0	<55	5	7	13	23	25	20	15	10
		Exhaust	-	900	<6.0	<55	5	7	13	23	25	20	15	10
-	Smoke Extract Fan 1 Level 11 Rooftop Plant Area	Extract	-	1500	<3.5	<55	9	17	25	43	47	46	39	24
		Exhaust	-	1500	<3.5	<55	9	17	25	43	47	46	39	24
-	Smoke Extract Fan 2 Level 11 Rooftop Plant Area	Extract	-	1500	<3.5	<55	9	17	25	43	47	46	39	24
		Exhaust	-	1500	<3.5	<55	9	17	25	43	47	46	39	24

Plant Ref.	Description	Inlet/Outlet	Vol. (m ³ /s)	Typical Length (mm)	Face Velocity (m/s)	Pressure Drop (Pa)	Insertion Loss (dB) at Octave Band Centre Frequency (Hz)							
							63	125	250	500	1k	2k	4k	8k
-	Smoke Intake Fan (Duty/Standby) Basement	FAI	-	900	<6.0	<55	5	7	13	23	25	20	15	10
		Supply	-	900	<3.5	<55	5	10	16	32	38	35	26	16
-	Smoke Extract Fan (Duty/Standby) Basement	Extract	-	900	<6.0	<55	5	7	13	23	25	20	15	10
		Exhaust	-	900	<3.5	<55	5	10	16	32	38	35	26	16
-	Car Park Exhaust Fan (Duty/Standby) Basement	Extract	-	3000	<3.5	<55	13	25	42	49	52	50	49	41
		Exhaust	-	3000	<3.5	<55	13	25	42	49	52	50	49	41
-	Waste Room Intake Fan Basement	Extract	-	900	<6.0	<55	5	7	13	23	25	20	15	10
		Exhaust	-	900	<6.0	<55	5	7	13	23	25	20	15	10
-	Waste Room Exhaust Fan Basement	Extract	-	900	<6.0	<55	5	7	13	23	25	20	15	10
		Exhaust	-	900	<6.0	<55	5	7	13	23	25	20	15	10

APPENDIX C: TESTING REQUIREMENTS & SCHEDULE OF EVIDENCE

BREEAM 2018 Testing Requirements

Hea 05 Acoustic Performance, Office Buildings - Credit 1		
Room Function	Criteria	Testing Requirement
Acoustically sensitive rooms	Sound insulation	A programme of pre-completion acoustic testing is carried out by a compliant test body in accordance with the acoustic testing and measurement procedures outlined in the Methodology section of this BREEAM issue.

Hea 05 Acoustic Performance, Office Buildings - Credit 2		
Room Function	Criteria	Testing Requirement
All room functions	Indoor ambient noise levels	A programme of acoustic measurements is carried out by a compliant test body in accordance with the acoustic testing and measurement procedures outlined in the Methodology section of this BREEAM issue.

Hea 05 Acoustic Performance, Office Buildings - Credit 3		
Room Function	Criteria	Testing Requirement
Rooms/areas used for speech	Reverberation times	A programme of acoustic measurements is carried out by a compliant test body in accordance with the acoustic testing and measurement procedures outlined in the Methodology section of this BREEAM issue. For spaces where the acoustic environment is controlled through the use of defined amounts of sound absorption, installation of a specification compliant with the BS 8233:2014 criteria demonstrates compliance. A site inspection by the developer or SQA is required to confirm that a compliant specification has been installed.

BREEAM 2018 Schedule of Evidence

Hea 05 Acoustic Performance - Credits 1, 2 & 3		
Criteria	Interim Design Stage	Final Post-Construction Stage
All	One or more of the appropriate evidence types listed in The BREEAM evidential requirements section can be used to demonstrate compliance with these criteria.	

Pol 05 Reduction of Noise Pollution - Credit 1		
Criteria	Design Stage	Post-Construction Stage
All	One or more of the appropriate evidence types listed in The BREEAM evidential requirements section can be used to demonstrate compliance with these criteria.	