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Premier House, Manchester

Internal Sound Insulation Design

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1.0 INTRODUCTION

Fisher Acoustics Ltd has been commissioned by Deansgate SOF Alliance LeaseCo Limited, a joint venture between Property Alliance Group (PAG) and an affiliate of Starwood Capital (SCG), to provide acoustic design advice relating to the proposed redevelopment and extension of Premier House, Deansgate, Manchester with a view to identifying and satisfying appropriate internal sound insulation performance requirements.

This report discusses the recommended construction of internal walls, floors and associated building elements to achieve appropriate acoustic conditions within the building.

This report must be read in conjunction with the following document:

- Environmental Noise Study, PR0657-rep01A-mpf, dated 25 June 2021

Others must advise on the fire requirements of the building and internal building elements.

2.0 DESCRIPTION OF PROPOSED DEVELOPMENT

The proposal is for the redevelopment and extension of Premier House to provide high quality business space with new retail/ leisure floorspace at ground floor level fronting Deansgate. Premier House in its existing form is significant in scale with a long frontage which does not allow for any interaction with Deansgate. The northern half of the building is proposed for demolition.

It is proposed that the part-retained building be stripped back to its core structure as part of the redevelopment. The existing concrete facade will be removed on the south and east elevations and the floorplate extended towards Deansgate. A new improved entrance is proposed to the building at the corner of Deansgate and Blackfriars Street. Beyond the new office entrance, the rest of the business floorspace will be provided across the upper floors. The new retail/ leisure floorspace will be situated at ground floor level creating a new active frontage to the street.

As the building is to be stripped back to its core, the proposal includes new facades across all elevations. The roof will also be reconfigured to include new landscaping and breakout space for occupiers of the lower floor business space.

The offices are to be fully air conditioned and will not rely on the opening of windows for ventilation.

The proposed uses within the redeveloped Premier House are as follows:

- Lower Ground Floor: Office Amenity, Cycle Storage, Elec Switch room, Generator room, Boiler room, Refuse
- Ground floor: Retail/ Leisure Area, Retail units (4 number), Reception Office, Reception area, Electric Switch room
- Level 1: Comms room, WCs, Office space
- Level 2 : Office space, WCs
- Level 3/Roof: Plant

3.0 INTERNAL SOUND INSULATION GUIDANCE

BS8233: 2014 'Guidance on sound insulation and noise reduction for buildings' gives recommendations relating to the sound insulation between offices.

Section 7.7.6.1 of BS8233: 2014 states

- 'Privacy between offices and between an office and an occupied space requires effective insulation and moderate background noise to mask intruding speech. In order to achieve unintelligible speech from another office, the minimum sound insulation between two offices needs to be approximately $D_w = 38$ dB. Where privacy is important the minimum sound insulation should be $D_w = 48$ dB. It is possible that voices can be heard, but the conversation is not usually understood. Where the internal ambient noise level is low it might be necessary to design for higher insulation values'.

As stated in BS8233, the audibility of voices or other noise from an adjacent office will depend to a degree on the ambient noise in the 'sensitive' office (the ambient noise is the relatively constant level of noise that exists in the absence of time-varying noise such as voices, telephones etc, and is usually governed by air supply and extract systems, external noise intrusion (where external noise levels are relative constant), computer fans etc).

In particular, section 7.7.6.3 of BS8233: 2014 states:

- When considering the sound insulation of a partition between two areas, the following factors should be taken into account:
 - a) The required function of the two rooms. Is conversation required to be inaudible in one room or is some audible speech acceptable, not intrusive or intelligible?
 - b) The background sound level present in the critical area due to the air conditioning systems and other sources. The intelligibility of speech and the perception of extraneous noise are controlled by the masking created by this background sound level. The higher the background sound level, the more effective it is in masking unwanted sounds. However, the background noise should not become intrusive in itself, so a balance should be achieved between the background sound level and the partition sound reduction.

An internal noise level range of 45dB LAeq to 50dB LAeq is required by Hea05 of BREEAM 2018 for open plan offices. The M&E systems must therefore be carefully designed to achieve noise levels that fall within this range.

Given an ambient internal noise level of 45dB LAeq, the party floors and any future party walls between separate office tenancies would need to achieve a sound insulation of at least 30dB Dw in order for normal speech from an adjacent tenancy to be audible but not intelligible.

To provide greater privacy, such that normal speech from one tenancy is inaudible in an adjacent tenancy, the addition of the ambient noise level and the sound insulation of the party construction would need to be at least 80 to 85. Thus, given an ambient internal noise level of 45dB LAeq within office spaces, the party floors and any future party walls between separate tenancies would need to achieve a minimum sound insulation of 35dB Dw to 40dB Dw.

The British Council for Offices Guide to Specification 2019 recommends that the sound level difference between vertically between individual office floors is at least 45dB DnT,w at shell and core stage.

Recommended acoustic performance between potential tenancies via walls

Although party walls between tenancies are not currently proposed, it is understood that there is to be provision for the future sub-division of floor plates to allow two tenants per floor. It is therefore recommended that the building design caters for a sound level difference between offices via walls of not less than 45dB Dw.

Recommended acoustic performance of floors

The recommended minimum sound level difference between offices due to vertical sound transmission is 45dB Dw.

Give the potential for disturbance of the offices due to elevated levels of activity noise within the proposed retail units at ground floor, the recommended minimum sound level difference between retail units and offices is 55dB Dw.

4.0 WALLS

In order to achieve appropriate levels of sound insulation between the various spaces, it is recommended that separating walls achieve the weighted sound reduction index values given in Table 1. Weighted sound reduction index is measured in a laboratory in accordance with BS EN ISO 10140-2: 2021 and rated in accordance with BS EN ISO 717-1: 2020.

Wall	Weighted Sound Reduction Index R_w
Lower Ground floor	
Changing Facility to Changing Facility	45 dB
Changing Facility to Acc S&C	45 dB
Changing Facility to GN S&C	45 dB
Acc S&C to GN S&C	45 dB
Changing Facility to Boiler Room	45 dB
Changing Facility to Electric Switch	45 dB
Changing Facility to Corridor	45 dB
Changing Facility to Cycle Store	35 dB
Drying Room to Cycle Store	25 dB
Boiler Room to Generator	40 dB
Generator to Refuse	40 dB
Ground Floor	
Retail Unit to Office Reception	50 dB if blockwork 60 dB if drylined studwork
Retail Unit to Retail Unit	50 dB if blockwork 60 dB if drylined studwork
Retail Unit to stairwell within unit	35 dB
Riser	46 dB
Retail Unit to Reception Office/Store	55 dB
Reception Office/Store to WC	50 dB
Reception Office/Store to circulation	35 dB
Office Reception to WC	50 dB
Mezzanine	
Riser	46 dB
WC to Office	50 dB
WC to WC	45 dB
WC to lift lobby	45 dB

Wall	Weighted Sound Reduction Index R _w
Level 01 & 02	
Riser	46 dB
WC to Office	50 dB
WC to WC	45 dB
WC to lift lobby	45 dB
Roof	
Plant Room to lift lobby	50 dB

Table 1: Minimum recommended weighted sound reduction index of walls

If applicable, it is recommended that riser access doors within the office areas achieve a minimum weighted sound reduction of 30dB R_w.

The minimum recommended sound insulation performances identified in Table 1 can be achieved by the wall constructions identified in Table 2. It should be noted that thermal considerations may require additional insulation and or greater cavity sizes.

Weighted Sound Reduction Index R _w (see Table 1)	Blockwork	Metal Stud partition
25 dB	Standard grade blockwork of minimum mass 100 kg/m ² , drylined on one side with plasterboard on dabs, or plastered on one side OR Paint grade blockwork of minimum mass 100 kg/m ²	1 x 12.5 mm wallboard each side of 70 mm metal studs
35 dB	Standard grade blockwork of minimum mass 140 kg/m ² , drylined on one side with plasterboard on dabs, or plastered on one side OR Paint grade blockwork of minimum mass 100 kg/m ²	1 x 12.5 mm wallboard each side of 70 mm metal studs
45 dB	Standard grade blockwork of minimum mass 145 kg/m ² , drylined on both sides with plasterboard on dabs, or plastered both sides OR Paint grade blockwork of minimum mass 145 kg/m ²	1 x 12.5 mm dense plasterboard (830 kg/m ³) each side of 70 mm metal studs, 25 mm mineral wool in cavity
46 dB (shaft wall)	-	Shaftwall construction of 60 mm Shaftwall studs drylined with two layers of 15 mm dense plasterboard (minimum density 830 kg/m ³) on the room-side of the wall, and 19 mm Core Board secured between the studs, 25 mm mineral wool in the cavity.
50 dB	Standard grade blockwork of minimum mass 180 kg/m ² , drylined on both sides with plasterboard on dabs, or plastered both sides OR Paint grade blockwork of minimum mass 180 kg/m ²	2 x 12.5 mm wallboard each side of 70 mm metal studs, 50 mm mineral wool in cavity
60 dB	-	2 x 15 mm dense plasterboard (830 kg/m ³) each side of 92 mm Acoustic studs (e.g. Gyframe AcouStuds), 100 mm mineral wool in cavity OR 2 x 12.5 mm dense plasterboard (830 kg/m ³) each side of twin frame metal studs, 50 mm mineral wool within cavity of minimum depth 160 mm

Table 2: Suggested wall constructions to achieve acoustic requirements of walls

5.0 PARTY FLOORS

The composition of the structural floor slabs is understood to be as follows:

- Lower Ground: existing RC beams and slab - thickness not known
- Ground floor: To office reception – 250 mm RC slab
- Ground floor: To retail units – 150 mm concrete slab on void former
- Mezzanine Level: 275 mm RC flat slab (proposed new slab)
- Level 1: existing RC slab - thickness not known
- Level 2: existing RC slab - thickness not known
- Roof: existing RC slab - thickness not known

Office to Office floors - airborne sound insulation

As no ceilings are proposed within the offices, the recommended sound insulation of the separating floors between offices must be achieved by the floor slabs alone. A concrete slab that exhibits a minimum mass of 300 kg/m² would be able to achieve the recommended sound insulation performance of 45dB Dw between offices.

The composition and mass of the existing floor slabs between offices should be checked to ensure that the minimum recommended mass is achieved.

Care will need to be taken with flanking noise transmission between offices via the curtain wall and slab edge. This is discussed in Section 7.

Retail Units to Office - airborne sound insulation

As the retail unit shells will not include ceilings, the recommended sound insulation of the separating floors between the retail units and offices must be achieved by the floor slab alone. The proposed 275 mm flat concrete slab is expected to provide a minimum sound insulation of 60dB DnT,w. The proposed slab therefore provides the basis for compliance with the recommended minimum sound insulation between the retail units and offices.

Care will need to be taken with flanking noise transmission between the retail units and offices via the curtain wall and slab edge. This is discussed in Section 7.

Recommended maximum allowable noise levels in retail units

Given compliance with the recommended sound insulation performance between the retail units and offices, Table 3 identifies the maximum allowable noise levels in the retail units to avoid disturbance of the office areas above.

Space	Sound Pressure Level (dB) @ Octave Band Centre Frequency (Hz)						
	63	125	250	500	1k	2k	4k
Retail Units	85	83	80	84	78	83	85

Table 3: Maximum recommended sound levels in spaces

The noise levels identified in Table 3 would be able to accommodate a lively bar or restaurant with reasonably high levels of background music.

As discussed in Fisher Acoustics report 'Environmental Noise Study', report reference PR0657-rep01A-mpf, dated 25 June 2021, the maximum allowable noise level in the proposed retail units is also governed by noise egress to the external environment, as identified below:

Table 4 identifies the daytime noise levels that could be generated in each commercial unit without exceeding the applicable daytime external noise limits, on the assumption that the outer entrance door to the commercial units is closed or that door lobbies are installed, such that during access and egress of patrons, one of the doors of the lobby is closed to prevent intermittent increases in external noise.

Location	Spatially averaged sound pressure level (dB Leq) @ Octave Band Centre Frequency (Hz)						
	63	125	250	500	1k	2k	4k
Commercial Unit	82	81	84	87	89	82	77

Table 4: Maximum allowable daytime internal noise levels within the commercial units, doors closed

Table 5 identifies the noise levels that could be generated in each commercial unit without exceeding the applicable night time external noise limits, on the assumption that the outer entrance door to the commercial units is closed or that door lobbies are installed.

Location	Spatially averaged sound pressure level (dB Leq) @ Octave Band Centre Frequency (Hz)						
	63	125	250	500	1k	2k	4k
Commercial Unit	77	76	79	82	84	77	72

Table 5: Maximum allowable night time internal noise levels within the commercial units, doors closed

The noise levels detailed in Table 4 and Table 5 would allow typical retail outlets or a 'lively' restaurant with background music replay to be accommodated.

If the external doors to the commercial units are opened without the benefit of an internal lobby, then the sound insulation of the facade will be reduced. Therefore, the maximum allowable noise levels in the units would be reduced.

Table 6 identifies the noise levels that could be generated in the commercial units without exceeding the applicable daytime external noise limits if the entrance doors to the units are open.

Location	Spatially averaged sound pressure level (dB Leq) @ Octave Band Centre Frequency (Hz)						
	63	125	250	500	1k	2k	4k
Commercial Unit	76	73	72	70	71	65	55

Table 6: Maximum allowable daytime internal noise levels within the commercial units, doors open

Table 7 identifies the noise levels that could be generated in the commercial units without exceeding the applicable night time external noise limits if the entrance doors to the units are open.

Location	Spatially averaged sound pressure level (dB Leq) @ Octave Band Centre Frequency (Hz)						
	63	125	250	500	1k	2k	4k
Commercial Unit	71	68	67	65	66	60	50

Table 7: Maximum allowable night time internal noise levels within the commercial units, doors open

The noise levels detailed in Table 6 and Table 7 would allow a typical retail outlet or relatively quiet restaurant with low-level background music replay to be accommodated.

However, a lively restaurant with music replay is likely to exceed the allowable internal noise levels given in Table 6 and Table 7, particularly at night time. It is therefore expected that a lively restaurant or similar operation whose opening hours extend beyond 11pm would need to introduce a door lobby in order to comply with the requirements of Manchester City Council.

6.0 FUTURE-PROOFING FOR POTENTIAL TENANCY SPLITS

It is understood that the potential division of the office floor plates will need to be catered for in the building design at shell and core stage.

Where a party wall between separate tenancies meets the floor, soffit and perimeter walls, the detailing of the individual elements must be such that flanking transmission of noise does not compromise the achieved sound insulation between tenancies.

The individual circumstances are discussed below.

1) Interface of potential party wall with external wall

- To control flanking noise transfer in the plasterboard drylining to the columns at the external wall, the plasterboard to the column must be discontinuous on the potential line of the future party wall. This can be achieved by the provision of a 3mm wide expansion gap between plasterboards, with the gap sealed with non-hardening acoustic sealant. The expansion gap could be built-in at the time of the shell and core drylining installation.

2) Interface of Tenancy splits with ductwork

- Where ductwork crosses the potential lines of the tenancy splits, the duct will be a flanking path for noise between separate tenancies. Therefore, crosstalk attenuators should be located within ductwork at the location of any potential future wall between tenancies. At this early design stage, it is suggested that 600 mm long crosstalk attenuators should be allowed for.
- Wherever possible, the number of M&E items on the line of the potential Tenancy splits should be kept to a minimum to ease the installation of the potential party walls between tenancies.

3) Interface of potential party wall with continuous slot diffusers

- If continuous slot diffusers are proposed at the perimeters of the offices, these will present a potential flanking path for noise between offices. Any slot diffusers would therefore need to be fully blanked off at the potential locations of the Tenancy splits, such that the sound insulation achieved by the party wall is maintained.

4) Interface of potential party wall with external wall

- It is understood that no raised access floors are proposed within the offices and therefore any party wall would be constructed directly off the structural floor. If the existing structural slabs are screeded, it is recommended that the screeds be inspected to ensure that they are fully bonded to the slab. If a screed has delaminated, horizontal flanking transmission of noise within the screed may compromise the sound insulation between offices on the same floor.
- If new screeds are to be provided, it is recommended that the screed is discontinuous on the potential line of the future party wall. This can be achieved by the provision of a 5mm wide expansion gap for the full depth of the screed.

7.0 SOUND TRANSMISSION VIA SLAB EDGE & CURTAIN WALL

Vertical Flanking Sound Transmission - Curtain walling

Achievement of the vertical sound insulation performance requirements between the office floors will be influenced by the sound insulation achieved at the slab edge and by flanking sound transmission within the curtain wall frame. Figure 1 shows the situation in relation to vertical sound transmission.

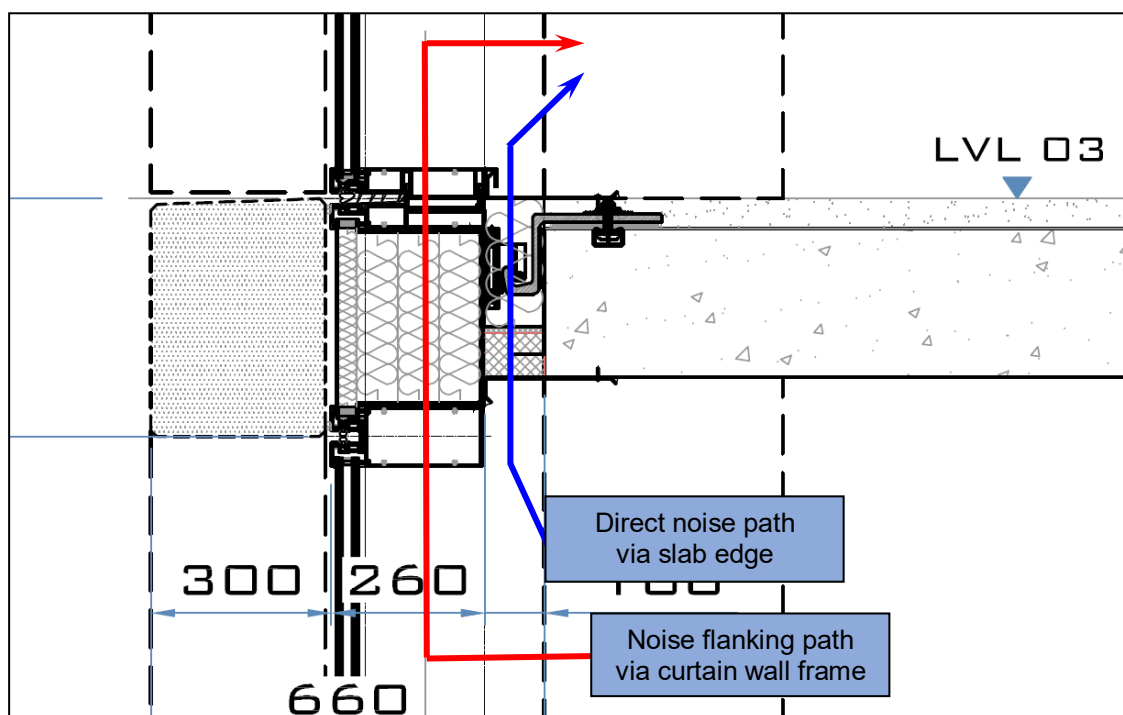


Figure 1: Noise transmission paths at junction of curtain wall and slab

Noise transmission via the direct noise path highlighted in Figure 1 will be influenced by the fire barrier at the slab edge and the gap closer between the slab and the curtain wall elements.

Two separated transoms are proposed within the party floor zone. This is acoustically beneficial when compared to a single transom solution. It is initially recommended that the slab edge barrier achieves a weighted sound reduction index of 25dB R_w . This can be achieved by a proprietary product such as 120 mm thick Siderise CW-FS120 by Siderise Insulation Limited.

The interface of the gap closer and the curtain wall and and transom must be acoustically sealed, with thought given as to how any potential movement of the curtain wall elements (e.g. due to wind loading) will be accommodated.

The proposed arrangement of the external curtain wall frame is such the mullions will act as a flanking noise transmission path past the party floor slab.

It is recommended that the airborne vertical flanking transmission of the curtain wall when measured in accordance with BS EN ISO 10848-2: 2017 'Acoustics–Laboratory and field measurement of flanking transmission for airborne, impact and building service equipment sound between adjoining rooms' is no less than the values given in Table 4. The assumed length of the curtain wall panel to be tested is 2.25m.

Room pairings	D _{n,f,w}
Office to Office	50 dB
Retail Unit to Office	57 dB

Table 8: Minimum vertical flanking sound insulation of curtain wall

In order to achieve the performances of Table 8, it is expected that a stick curtain wall system would need to incorporate acoustic infills within the mullions.

The junction detail at the interface of the party floors and the curtain wall will need to be carefully considered to take into account the acoustic requirement, the deflection tolerances and the fire resistance requirements.

8.0 SOIL & VENT PIPES AND RAINWATER PIPES

If soil pipes or rainwater pipes drop into office areas or into the ground floor areas, noise from the pipe can be expected to be audible. It is therefore recommended that exposed pipework is either encased in plasterboard or acoustically lagged.

A pipe encasement of two layers of 12.5 mm wallboard with 25 mm thick unfaced (i.e. not foil-faced) mineral wool within the encasement would provide an appropriate reduction of pipe flow noise.

To reduce noise breakout from horizontal or offset runs of pipework within the office and reception areas, it is suggested that the pipework is acoustically lagged with a proprietary heavy duct lagging with a minimum mass of 10kg/m^2 as an alternative to plasterboard encasement. A suitable product is 50 mm thick 'Technowrap 2' by CMS Danskin.

Pipe penetrations through floors slabs must be acoustically sealed. This can be achieved with fire rated expanding foam such as FM410 by Illbruck.

9.0 ROOM ACOUSTICS – OPEN PLAN OFFICES

The provision of sound absorption to the open plan office areas would be appropriate to control the reverberant build-up of noise in the spaces and to assist in achieving reasonable speech privacy across the office areas. In addition, one credit is available under section Hea05 of BREEAM New Construction 2018 where the requirements relating to sound absorption and reverberation times are achieved, where applicable, as set out in Section 7 of BS8233:2014.

As speech intelligibility across an open plan office is not a typical concern, the principle reason to introduce sound absorption to such a space is to control the build-up of noise and to increase speech privacy by, for instance reducing the reflection of noise from an otherwise acoustically reflective soffit.

Section 7.7.6.2 of BS8233: 2014 'Controlling noise in open-plan offices' states 'Low ceilings and absorbent ceilings can assist in reducing sound transmission between workstations. Where ceilings are higher than 3 m, it is more difficult to provide acceptable acoustic conditions in open-plan offices with absorption coverage lower than Class A. Where exposed soffits are used additional absorption might be required. Carpet having good sound-absorbent properties is a desirable floor finish'.

It is understood that given the relatively low slab-to-soffit heights in the offices, at least on Levels 1 and 2, a traditional ceiling is not proposed for the office spaces.

Therefore to achieve one credit under Hea 05 of BREEAM 2018, the following is recommended:

- Introduction of acoustic ceiling rafts across the open plan office floor plates to an area of at least 70 % of the soffit area. Ceiling rafts to exhibit a minimum Noise Reduction Coefficient (NRC) of 0.90.
- Carpeted floor to the full open plan office area