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Owen Street, Manchester

Internal Sound Insulation Design Review,

Block E and Ancillary spaces

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1.0 INTRODUCTION

Fisher Acoustics Ltd has been commissioned by Renaker Build Ltd to provide acoustic design advice relating to a primarily residential development at Owen Street, Manchester, with a view to identifying appropriate internal sound insulation performance requirements between the non-residential spaces.

This report identifies the recommended numerical performance requirements relating to the airborne and impact sound insulation between adjacent non-residential uses. Suggested wall and floor constructions are also given.

The recommended sound insulation targets between various spaces presented in this report are incorporated in the acoustic strategy plans issued by Simpson Haugh and Partners.

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

- Noise & Vibration Chapter of Environmental Statement for Owen Street, Manchester
- Owen Street – Internal Sound Insulation Review, report reference Z3-FAC-A180-Rp-XX-003, dated 26 February 2017
- UCW Acoustic Performance Specification rev D, Z3-FAC-A180-Sp-XX-001, dated 14 October 2016, final revision 3 May 2017
- UCW Acoustic Performance Specification-ancillary spaces, Z3-FAC-A180-Sp-XX-002, dated 11 October 2017

As identified above, this report concentrates on sound insulation between non-residential areas and the directly adjacent non-residential areas. Reference should be made to 'Owen Street – Internal Sound Insulation Review', report reference Z3-FAC-A180-Rp-XX-003, dated 26 February 2017 for guidance relating to the sound insulation properties between residential areas and adjacent non-residential spaces.

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

2.0 DESCRIPTION OF DEVELOPMENT

The Development includes the construction of four new apartment buildings targeted at the Private Rented Sector (PRS) market. The buildings will also include associated amenity provision, commercial and retail units, car parking and associated landscaping and access.

Basement levels are to be constructed which extend below and between the four distinct residential towers.

The proposed uses within the Development are as follows:

Basement 2:

- Car parking, Bin Stores, Wet Riser Plant, Storage rooms, Vent plant

Basement 1:

- Car parking, Domestic Tank rooms, Sprinkler Tank rooms, Comms Room, Storage rooms, Vent plant, Emergency Power Switch

Lower Ground floor:

- Retail 5, Retail 5 Plant Room, Plant room, Lobby (Tower D), Changing Room (Tower D), WCs (Tower D), car parking, Cycle Store, Storage rooms, Vent plant

Ground floor:

- Reception Building: Entrance Lobby, Reception, Tea Point, Parcel/Laundry, Store, Bin Store, TX1, TX2, TX3
- Tower A: Retail 6A, Retail 6B, Store, Post Boxes, Staff Facilities, Managers Office, WCs, Cleaner's Store
- Tower B: Retail 7, Generator Room, Emergency Switch Room, Tower B Residents Lounge, Post Boxes
- Tower C: Retail 3A, Retail 3B, Post Boxes, Store
- Tower D: Tower D Lobby, Retail 4, Reception, Store Rooms, Post Boxes, Changing Room
- Building E: Lobby, Retail 1, Retail 2A, Retail 2B, AHU Plant for Retail, Car Part Vent Riser

Mezzanine:

- Reception Building: void over Entrance Lobby, Residents Lounge, Seminar Rooms, Switch Room

- Tower A: Apartments, void over Entrance Lobby, Residents Quiet Lounge/Library, WCs, Store, Cleaners Store
- Tower B: Apartment, void over Residents Lounge, void over Generator Room, Cinema, Store
- Tower C: Retail 3A-Mezzanine, Retail B-Mezzanine, void over Entrance Lobby, Studio (gym), Beauty Cabins
- Tower D: Apartments
- Building E: Sports Hall, Gym, Lobby, Pool Plant, Car Park Vent

Level 1:

- Tower A: Apartments
- Tower B: Apartments
- Tower C: Apartments, Dance Studio, Female Changing Room, Office, First Aid, Storage, WCs
- Tower D: Apartments
- Building E: Lobby, Reception, Swimming Pool, Sauna, Steam Room, Gym, Male Changing Room, WC, void over Sports Hall

Level 2:

- Tower A: Apartments
- Tower B: Apartments
- Tower C: Apartments, Plant
- Tower D: Apartments
- Building E: AHU Plant for Gym, void over Lobby, void over Swimming Pool, void over Gym, void over Sports Hall

Level 3:

- Tower A: Apartments
- Tower B: Apartments
- Tower C: Apartments, Residents Lounge, Lobby to Residents Lounge, WCs, Storage
- Tower D: Apartments
- Building E: Roof Garden

Levels 4 to 38:

- Tower A: Apartments

- Tower B: Apartments
- Tower C: Apartments
- Tower D: Apartments

Level 39 to 43:

- Tower A: Apartments
- Tower B: Apartments
- Tower D: Apartments

Levels 44 to 45:

- Tower A: Apartments, Plant
- Tower B: Apartments
- Tower D: Apartments

Levels 46 to 51:

- Tower A: Apartments
- Tower B: Apartments

Levels 52 to 65:

- Tower A: Apartments

3.0 ACOUSTIC PERFORMANCE REQUIREMENTS

There are no statutory requirements in relation to the sound insulation between non-residential spaces. For non-residential spaces, reference can be made to guideline sound insulation criteria given in BS8233: 2014 'Guidance on sound insulation and noise reduction for buildings'. In line with BS8233: 2014, it is normal practice to establish sound insulation criteria based on the potential activity noise levels within a space and the acceptable levels of noise intrusion to adjacent spaces.

Noise transfer between Landlord's areas

The airborne sound insulation of the walls and floors between the Landlord's Areas must take into account the potential activity noise levels within the non-residential areas such that noise is controlled to acceptable levels in adjacent areas.

The need to control potentially high levels of impact noise to adjacent spaces from the sports hall, gyms and dance studios will need to be considered.

Noise transfer from commercial units

The fit-out of the commercial units will be the responsibility of the tenants. With regard to noise transfer from the commercial units to apartments, it is recommended that a clause be included in the respective leases that states that noise due to activities and equipment within each commercial unit must be inaudible within the apartments. The tenants of the commercial units will need to carry out a detailed assessment of the potential levels of noise transfer from their respective demises to the residential areas, both due to airborne noise and structureborne noise transfer, to ensure that the fit-out of the demises is capable of achieving inaudibility of operational noise in the apartments.

With regard to noise transfer from the commercial units to non-residential areas, it is recommended that a clause be included in the respective leases that states that noise due to activities and equipment within each commercial unit must not exceed the noise levels identified in Table 1 in the adjacent areas.

Area	Noise Rating (NR) (Maximum values)
Adjacent commercial unit	NR 35
Landlord's areas (non-residential)	NR 25

Table 1: Maximum allowable noise rating in adjacent areas due to commercial units

As above, the tenants of the commercial units will need to carry out a detailed assessment of the potential levels of noise transfer from their respective demises to the adjacent areas, both due to airborne noise and structureborne noise transfer, to ensure that the fit-out of each unit is capable of controlling noise transfer to the adjacent non-residential areas such that compliance with the requirements of Table 1 is achieved.

4.0 WALLS

Table 2 identifies the recommended minimum weighted sound reduction index values of separating walls between the various non-residential spaces. Weighted sound reduction index is measured in a laboratory in accordance with BS EN ISO 10140-2: 2010 and rated in accordance with BS EN ISO 717-1: 2013.

Wall	Sound Reduction Index R _w
Tower D – Lower Ground Floor	
DDA WC to WC	45 dB
WC to Changing Room	45 dB
Building E/Podium - Lower Ground Floor	
Retail 5 Plant Room to Retail 5	49 dB
Plant Room to Retail 5	49 dB
Riser to Retail 5	49 dB
Riser to Plant Room	45 dB
Building E - Ground Floor	
Retail 1 to BE Lobby	60 dB
AHU Plant for Retail to Retail 1	49 dB
Retail 1 to Car Park Vent	49 dB
AHU Plant for Retail to Retail 2A	49 dB
AHU Plant for Retail to BE Lobby	49 dB
AHU Plant for Retail to Escape Stairs	49 dB
AHU Plant to Chemical Stores	49 dB
Retail 2A to Escape Stairs	49 dB
Retail 2A to Retail 2B	49 dB
Retail 2B to Escape Stairs	49 dB
Tower A - Ground Floor	
Retail 6A to Retail 6B	49 dB
Retail 6A to Post Boxes	60 dB
Retail 6B to Store	49 dB

Wall	Sound Reduction Index Rw
Retail 6B to Lift Lobby	60 dB
Staff Facilities to Corridor	45 dB
Managers Office to Staff Facilities	50 dB
Managers Office to Ramp	45 dB
Staff Facilities to Staff WCs	50 dB
DDA WC to Staff WCs	45 dB
Cleaners Store to Staff WCs	45 dB
DDA WC to Cleaner Store	45 dB
DDA to Lobby	45 dB
Common Areas (Podium) – Ground Floor	
Bin Store to TX1	30 dB
Bin Store to TX2	30 dB
Bin Store to TX3	30 dB
TX1 to TX2	30 dB
Bin Store to Ramp Area/ BOH Corridor	50 dB
Bin Store to Store	50 dB
Bin Store to Parcel/ Laundry	50 dB
Bin Store to Post Boxes	50 dB
Bin Store to Emergency Switch Room	30 dB
Bin Store to entrance lobby from Post Boxes	40 dB
Store to Corridor	30 dB
Tea Point to Reception Area	40 dB
Parcel/ Laundry to Reception Area	45 dB
Parcel/ Laundry to Post Boxes	45 dB
Generator Room to TX3	49 dB
Generator Room to Bin Store	49 dB
Generator Room to Emergency Switch Room	49 dB
Tower B – Ground Floor	
Retail 7 to TB Residents Lounge	60 dB

Wall	Sound Reduction Index R _w
Retail 7 Store to BOH corridor	49 dB
Retail 7 to external lobby	55 dB
Retail 7 to riser access corridor	49 dB
External to Generator Room	49 dB
Generator Room to BOH Corridor	60 dB
Tower C – Ground Floor	
Post Boxes to BOH Corridor	45 dB
Post Boxes to Store	45 dB
Retail 3A store to Retail 3A	35 dB
Retail 3A store to BOH Corridor	49 dB
Retail 3A store to Building E Lobby	49 dB
Retail 3A to Retail 3B	49 dB
Retail 3B to Reception Area	60 dB
Retail 3A to Building E Lobby	60 dB
Retail 3A to Riser	46 dB
Tower D – Ground Floor	
Retail 4 to Tower D Lobby	60 dB
Retail 4 to Tower D Core	60 dB
Retail 4 to Post Boxes	60 dB
Post Boxes to Store Room	40 dB
Office to Store Room	40 dB
Office to Reception/TD Lobby	45 dB
Store Room to Reception/TD Lobby	40 dB
Building E – Mezzanine	
Pool Plant to Lobby	49 dB
Pool Plant to Dance Studio	49 dB
Pool Plant to Sports Hall	49 dB
Pool Plant to Escape Lobby	49 dB
Pool Plant to Sports Hall Lobby	49 dB

Wall	Sound Reduction Index R _w
Pool Plant to Car Park Vent	49 dB
Pool Plant to Escape Stairs	49 dB
Gym to BE Lobby (glazed screen)	39 dB
Gym to Sports Hall	49 dB (blockwork) (35 dB to 39 dB glazed screen)
Gym to Escape Stair	49 dB
Gym to Escape Lobby (includes door)	49 dB
Sports Hall to Sports Hall Lobby	49 dB
Tower A (Mezzanine)	
Dis WC to Mixed WCs	45 dB
Mixed WCs to Store	40 dB
Cleaners Store to Store	35 dB
Store to Store	35 dB
Mixed WCs to Corridor	45 dB
Dis. WC to Corridor	45 dB
Residents Quiet Lounge/ Library to Breakout Area (glazed)	39 dB
Residents Quiet Lounge/ Library to void over Lobby	50 dB
Common Areas (Podium) – Mezzanine	
Seminar Room to Seminar Room	55 dB
Seminar Room to Switch Room entrance lobby	55 dB
Seminar Room to Breakout	50 dB
Switch Room to Seminar Room	60 dB
Switch Room to Cinema	65 dB
Tower B – Mezzanine	
Void over Generator Room to Switch Room	49 dB
Void over Generator Room to Store	55 dB
Void over Generator to Void over External	49 dB
Cinema to Residents Lounge	65 dB
Cinema to entrance lobby	50 dB
Cinema to Plant / BOH	65 dB

Wall	Sound Reduction Index Rw
Tower C – Mezzanine	
Dance Studio to BE Lobby (glazed screen)	39 dB
Dance Studio to Podium	60 dB
Dance Studio to Beauty Cabin	55 dB
Beauty Cabin to Store	45 dB
Beauty Cabin to Accessible WC	50 dB
Accessible WC to Storage	50 dB
Beauty Cabin to Beauty Cabin	45 dB
Beauty Cabin to Lobby	45 dB
Beauty Cabin to Riser	46 dB
Retail 3A MZ to Beauty Cabin	60 dB
Retail 3A MZ to Riser	46 dB
Retail 3A MZ to Lobby	60 dB
Retail 3B-MZ to Podium	60 dB
Retail 3B-MZ to Retail 3A-MZ	49 dB
Building E - Level 01	
Sauna to Steam Room	45 dB
Sauna to Pool Area	35 dB
Steam Room to Pool Area	35 dB
Steam Room to Lobby	45 dB
Swimming Pool to Lobby	30 dB
Storage to Male Changing Room	35 dB
Showers for Jacuzzi to Male Changing Room	35 dB
Male WC to Lobby	49 dB
Accessible WC to Lobby	49 dB
Male WC to Accessible WC	40 dB
Storage to Lobby	35 dB
Storage to Corridor	25 dB
Accessible WC to Corridor	40 dB

Wall	Sound Reduction Index Rw
Male WC to Male Changing Room	40 dB
Male Wet WC to Showers	40 dB
Male Wet WC to Escape Lobby	40 dB
Male Wet WC to Escape Stairs	40 dB
Escape Lobby to Male Showers	25 dB
Sports Hall to Male Changing Areas	49 dB
Male Disabled Changing to Male Changing Room	40 dB
Gym to BE Lobby (glazed screen)	39 dB
Gym to Escape Stair	49 dB
Gym to Escape Lobby	49 dB
Gym to Sports Hall (glazed screen)	39 dB
Group Training Room to Gym	40 dB
Group Training Room to Sports Hall	45 dB
Group Training Room to Escape Lobby	49 dB
Tower C - Level 01	
Female Changing to Corridor	35 dB
Female Changing to Storage	45 dB
Female Changing Shower to WC	45 dB
Female Shower to Wet WC	40 dB
Female WC to Sauna	49 dB
Accessible WC to Steam Room	49 dB
Accessible WC to Corridor	45 dB
Reception to Office	35 dB
Office to Storage	35 dB
First Aid to Lobby/ Waiting Area	45 dB
First Aid to Riser	46 dB
Dance Studio to Riser	46 dB
Waiting Area to Dance Studio	45 dB
Dance Studio to Lobby (glazed screen)	39 dB

Wall	Sound Reduction Index Rw
Building E – Level 02	
AHU Plant For Gym to void over Swimming Pool	49 dB
AHU Plant For Gym to void over Sports Hall	49 dB
AHU Plant For Gym to Escape Stairs	49 dB
Void over Swimming Pool to Void over Lobby	35 dB
Tower C - Level 02	
Plant to void over Lobby	49 dB
Plant to Lift Shaft	49 dB
Tower C - Level 03	
Residents Lounge to Storage	25 dB
Residents Lounge to Male WC	45 dB
Residents Lounge to Lobby	50 dB
Residents Lounge to Circ.	45 dB
Female WC to Lobby & Circ.	45 dB
Male WC to Lobby & Circ.	45 dB

Table 2: Minimum recommended weighted sound reduction index of separating walls

The minimum recommended sound insulation performances identified in Table 2 can be achieved by the wall constructions identified in Table 3. Blockwork and drylined solutions are given. It should be noted that thermal considerations may require additional insulation and or greater cavity sizes.

Weighted Sound Reduction Index R_w	Blockwork	Metal Stud partition
25 dB	Blockwork of minimum mass 100 kg/m ²	1 x 12.5 mm wallboard each side of 70 mm metal studs
30 dB	Standard grade blockwork of minimum mass 100 kg/m ² , drylined on both sides with plasterboard on dabs, or plastered both sides 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 100 kg/m ² , drylined on both sides with plasterboard on dabs, or plastered both sides OR Paint grade blockwork of minimum mass 100 kg/m ²	1 x 12.5 mm wallboard each side of 70 mm metal studs
39 dB	Proprietary Glazed screen (glass specification to be advised by supplier)	
40 dB	Standard grade blockwork of minimum mass 100 kg/m ² , drylined on both sides with plasterboard on dabs, or plastered both sides OR Paint grade blockwork of minimum mass 120 kg/m ²	1 x 12.5 mm wallboard each side of 70 mm metal studs, 25 mm mineral wool in cavity OR 1 x 12.5 mm dense plasterboard (830 kg/m ³) 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 (Riser wall)	n/a	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.

Weighted Sound Reduction Index R_w	Blockwork	Metal Stud partition
49 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	n/a
50 dB	n/a	2 x 12.5 mm wallboard each side of 70 mm metal studs, 50 mm mineral wool in cavity OR 1 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 200 mm
55 dB	Paint grade blockwork of minimum mass 180 kg/m^2 , drylined on one side with one layer of 12.5 mm wallboard fixed to GypLyner channels to create minimum cavity of 50 mm, 50 mm mineral wool in cavity	2 x 15 mm dense plasterboard (830 kg/m^3) each side of 70 mm metal studs, 50 mm mineral wool in cavity OR 2 x 12.5 mm wallboard (630 kg/m^3) each side of twin frame metal studs, 50 mm mineral wool within cavity of minimum depth 120 mm
60 dB	Paint grade blockwork of minimum mass 180 kg/m^2 , drylined on one side with two layers of 12.5 mm dense plasterboard (830 kg/m^3) fixed to independent studs to create minimum cavity of 70 mm, 50 mm mineral wool in cavity	2 x 15 mm dense plasterboard (830 kg/m^3) each side of 70 mm metal stud with a Resilient Bar fixed horizontally to one side of the studs, with 50 mm mineral wool (minimum density 10 kg/m^3) in the 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
65 dB	Paint grade blockwork of minimum mass 180 kg/m^2 , drylined on one side with two layers of 15 mm dense plasterboard (830 kg/m^3) fixed to independent studs to create minimum cavity of 70 mm, 50 mm mineral wool in cavity	2 x 15 mm dense plasterboard (830 kg/m^3) each side of twin frame metal studs, 50 mm mineral wool within cavity of minimum depth 150 mm

Table 3: Suggested wall constructions to achieve acoustic requirements of walls to ancillary areas

Detailing considerations

The following recommendations must be followed to maximise the acoustic performance of the walls on site:

Drylined walls

1. The full perimeter of the plasterboard drylined walls must be acoustically sealed using non-hardening acoustic sealant. The preferred location for the acoustic sealant is at the outer layer of plasterboard, rather than below the metal frame components.
2. Walls must extend full-height to the structural soffit.
3. Where two or more layers of plasterboard are incorporated in a wall, plasterboard joints must be staggered.
4. The plasterboards of the separating wall must break the plasterboard drylining of the 'flanking' walls (e.g. external wall & wall to access corridors) to minimise flanking transmission of noise at the interface of the separating wall and the flanking walls (i.e. the plasterboards of the inner leaf of the flanking wall must be discontinuous on the line of separating wall).
5. The separating walls must be drylined and acoustically sealed against any concrete element prior to the drylining of the concrete, such that the concrete drylining plasterboards are discontinuous on the line of the separating wall.
6. Penetrations in plasterboard party walls to accommodate mains sockets and switches must be acoustically treated to maintain the sound insulation of party walls. It is recommended that putty pads (intumescent if required) (e.g. Knauf Putty Pads, Hilti CP617 etc) are installed within all electrical back-boxes in separating walls that are required to achieve a sound insulation performance greater than 50 dB Rw to maintain the acoustic integrity of walls. Care must be taken to ensure that the acoustic and fire integrity of the putty pads is maintained following the installation of mains cables.
7. Cable trays or other service penetrations through plasterboard walls that are required to achieve a weighted sound reduction of 40dB Rw or greater should be avoided where possible. Where this is not possible, the acoustic integrity of the wall must be maintained. Proprietary products are available, such as Hilti CP670. A single or double layer of CP670 may be required, depending upon the sound insulation performance requirement of the wall.

Blockwork walls

1. All perimeters of the blockwork walls must be acoustically sealed using non-hardening acoustic sealant (intumescent if required) to ensure compliance with the criteria of Section 4. Particular attention should be paid to the head of blockwork walls that are required to achieve a weighted sound reduction of 40dB Rw or greater.
2. Walls must extend full-height to the structural soffit, with an appropriate allowance for structural deflection.
3. Where a separating wall is required to achieve a sound insulation performance greater than 55dB Rw and is to be formed by a masonry cavity wall, at least one leaf of blockwork must be built off a proprietary acoustic membrane that is bonded to the structural slab. (If the two leaves of the blockwork wall are built off a continuous slab, acoustic coupling of the blockwork leaves will occur via the slab and the acoustic performance of the cavity wall will be reduced). A suitable product is 3 mm Bridgestop High Performance Membrane by Monarfloor.
4. Where a separating wall is required to achieve a sound insulation performance greater than 55dB Rw and the wall is to be formed by a masonry cavity wall, only Type A wall ties must be used (e.g. Staifix HRT4), subject to approval by the structural engineer.
5. All vertical and horizontal mortar joints in blockwork walls shall be completely filled so that no air gaps exist.
6. Cable trays or other service penetrations through blockwork walls that are required to achieve a weighted sound reduction of 40dB Rw or greater should be avoided where possible. Where this is not possible, the acoustic integrity of the wall must be maintained. Proprietary products are available, such as Hilti CP670. A single or double layer of CP670 may be required, depending upon the sound insulation performance requirement of the wall.

5.0 PARTY FLOORS

The structural design of the building has determined that the structural slab between the great majority of non-residential areas is 250 mm thick in-situ concrete. The only exceptions to this are as follows:

- Towers A, B & C, Level 0: 300 mm thick in-situ concrete.
- Building E, Level 0: 300 mm thick in-situ concrete.
- Tower C, Mezzanine: 300 mm thick in-situ concrete.

The expected sound reduction index of the 250 mm structural slabs is 60dB R_w . The expected sound reduction index of the 300 mm structural slabs is 63dB R_w . This performance provides the basis for appropriate sound insulation between a number of the non-residential spaces such that no additional acoustic measures would be required.

This advice is on the basis that the acoustic integrity of the slab is maintained at penetrations through the slab and at junctions of the slab with the external curtain wall. Reference must be made to the curtain wall acoustic performance specification for the non-residential areas, report reference Z3-FAC-A180-Sp-XX-002, dated 11 October 2017.

It is recommended that a number of separating floors between non-residential areas achieve a sound insulation performance that is greater than that achieved by the structural slab alone.

Table 4 identifies the recommended minimum weighted sound reduction index values of the floors in question. Weighted sound reduction index is measured in a laboratory in accordance with BS EN ISO 10140-2: 2010 and rated in accordance with BS EN ISO 717-1: 2013.

Floor	Minimum Sound Reduction Index R_w
Tower B	
Cinema (Mezz) to Ground floor spaces	68 dB
Tower C	
Dance Studio (Mezz) to Lobby (Ground floor)	65 dB
Dance Studio (Mezz) to 1st floor rooms	68 dB
Dance Studio (1st flr) to Retail 3A-MZ	65 dB
Building E	
Sports Hall to Retail 2A	65 dB
Sports Hall to Retail 2B	65 dB
Gym to Retail 2A	65 dB
Gym to Retail 2B	65 dB

Table 4: Minimum recommended weighted sound reduction index of separating floors

Where no specific sound insulation performance is identified in Table 4 for vertical room adjacencies, a weighted sound reduction index of 58 dB R_w would be acceptable between non-residential areas, achievable by the non-perforate structural slabs.

Table 5 gives the recommended impact sound insulation of floors to the non-residential rooms to achieve appropriate internal conditions in the vertically adjacent non-residential areas.

Floor	Weighted standardised impact sound pressure level $L'_{nT,w}$ dB (Maximum values)
Tower C	
Dance Studio (Mezz) to Lobby (Ground floor)	35 dB
Dance Studio (1st flr) to Retail 3A-MZ	35 dB
First Aid to Beauty Cabin	62 dB
Office to Beauty Cabin	62 dB
Changing Rooms to Dance Studio (Mezz)	65 dB
Building E	
Gym to Retail	See text below
Sports Hall to Retail	See text below
Gym to Gym	See text below

Table 5: Minimum weighted standardised impact sound pressure level of floors

Airborne sound insulation

In order to achieve the airborne sound insulation requirements identified in Table 4, a plasterboard ceiling must be installed within certain rooms, as follows:

Ground floor spaces below Cinema

- Two layers of 12.5 mm dense plasterboard (minimum density 830 kg/m³, e.g. Knauf Soundshield Plus), fixed to a metal frame to create a minimum cavity of 150 mm, 50 mm mineral wool of minimum density 22 kg/m³ in the ceiling void.

Building E Lobby below Dance Studio

- One layer of 12.5 mm dense plasterboard (minimum density 830 kg/m³, e.g. Knauf Soundshield Plus), fixed to a metal frame to create a minimum cavity of 150 mm, 50 mm mineral wool of minimum density 22 kg/m³ in the ceiling void.

Dance Studio (Mezzanine Level)

- Two layers of 12.5 mm dense plasterboard (minimum density 830 kg/m³, e.g. Knauf Soundshield Plus), fixed to a metal frame to create a minimum cavity of 150 mm, 50 mm mineral wool of minimum density 22 kg/m³ in the ceiling void.

The full perimeters of the above ceilings must be acoustically sealed using non-hardening acoustic sealant.

Where a weighted sound reduction index of 58 dB *R_w* is acceptable between non-residential areas, the structural slab alone would be suitable. The ceiling specification to these areas need not therefore be influenced by sound insulation considerations.

In order to achieve the recommended airborne sound insulation performance between the Dance Studio and the retail unit below, it would be necessary to either install a suitably-designed floating floor within the Dance Studio or a specific acoustic ceiling within the retail unit.

In relation to impact noise to the apartment above, it has previously been recommended that the proposed Dance Studio that lies above the retail space is provided with a floating floor that achieves a particular impact sound performance. It is therefore suggested that the floating floor is designed to achieve both the airborne and impact sound insulation performance requirements (see section on impact sound insulation below).

Similarly, with regard to achievement of the recommended airborne sound insulation between the Gym & Sports Hall and the retail units below, consideration could be given to the installation of a floating timber floor that allows the achievement of the requirement without the need for a specific acoustic ceiling within the retail units.

Recommended maximum allowable noise levels in non-residential areas

Given the above-recommended provision of ceilings and floors, Table 6 identifies the maximum allowable noise levels in the non-residential areas to avoid disturbance of the adjacent areas.

Room	Sound Pressure Level (dB) @ Octave Band Centre Frequency (Hz)						
	63	125	250	500	1k	2k	4k
Cinema	86	84	82	87	90	90	92
Dance Studio	86	84	82	87	90	90	92
Gym	86	84	82	87	90	90	92
Sports Hall	86	84	82	87	90	90	92
Residents Lounge	76	70	67	71	77	80	80
Residents Quiet Lounge/ Library	83	75	70	71	77	82	85
Plant rooms	83	75	70	71	77	82	85
Commercial Units	76	70	67	71	77	80	80

Table 6: Maximum recommended sound levels in rooms

The noise levels identified in Table 6 represent reasonably loud listening levels for the Cinema and Dance Studio. Subjectively, the noise levels are substantially higher than would be deemed to be 'normal' living room listening levels. For instance, in relation to televisions, an external sound system with a subwoofer would be needed to generate the noise levels detailed. Televisions with in-built loudspeakers would not be capable of generating the noise levels identified within the Cinema.

If a sound system with a subwoofer is to be provided in the Cinema or Dance Studio, then it would be possible to exceed the above noise levels with a reasonably powerful amplifier set to high volume when watching music videos or films with low-frequency sound effects or when playing music. In this case, it may be necessary to install an electronic noise limiter on any amplifier to prevent noise nuisance to the adjacent apartments.

If the tenant of a commercial unit wishes to or expects to generate greater operational noise levels than those identified in the last row of Table 6, then the fit-out of the unit to be undertaken by the Tenant must include appropriate measures to further improve the sound insulation between the commercial unit and the adjacent areas, such as an appropriately designed acoustic ceiling and drylining to separating walls, concrete shear walls and columns.

The internal noise levels generated by any Tenant must also take into account the maximum allowable noise levels relating to noise egress to the noise-sensitive receptors at and around the site, as detailed in the Noise & Vibration Chapter of the Environmental Statement submitted for Planning purposes.

Impact sound insulation

Drawings current at the time of writing indicate that the floor finishes in certain rooms are as indicated in Table 7.

Floor	Weighted standardised impact sound pressure level $L'_{nT,w}$ dB (Maximum values)
Tower C	
Dance Studios	Timber flooring
First Aid	Vinyl flooring
Office	Carpet
Changing Rooms	Ceramic Tiles
Building E	
Gym	Rubber sports flooring
Sports Hall to Retail	Timber flooring

Table 7: Proposed floor coverings

On this basis, it is recommended that the following measures are carried out to achieve the impact sound insulation criteria identified in Table 5.

Mezzanine Floor Dance Studio (above Building E Lobby)

- Engineered timber floor on 18 mm V313 moisture resistant T&G ply on CDM-LAT resiliently-mounted rails to create a minimum floor void depth of 30 mm, 25 mm mineral wool of minimum density 22 kg/m³ within the floor void.

Contact between the flooring boards and any wall, column or curtain wall frame must be avoided. An appropriate soft joint strip must be installed around all perimeters of the floor. The perimeter of the floor must be acoustically sealed with non-hardening acoustic sealant.

1st Floor Dance Studio

It is understood that the Dance Studio that is located directly below apartments is to be provided with a sprung timber floor.

In relation to impact noise to the apartment above, it has previously been recommended that the proposed Dance Studio that lies above the retail space is provided with a sprung floor that achieves a weighted impact sound improvement of 22dB dLw and an impact sound improvement at 100 Hz of 5dB.

In order to achieve this performance and to achieve the recommended airborne and impact sound insulation to Retail 3A-MZ, it is recommended that consideration be given to the installation of the following floating floor build-up within the Dance Studio:

- Engineered timber floor (minimum 18mm thick) on 5 mm damping sheet on 18 mm V313 moisture resistant T&G ply on CDM-LAT resiliently-mounted rails to create a minimum floor void depth of 50 mm, 50 mm mineral wool of minimum density 22 kg/m³ in the floor void.

If at all possible, it is recommended that that floor void depth is increased to improve the low-frequency sound insulation performance of the separating floor.

Contact between the flooring boards and any wall, column or curtain wall frame must be avoided. An appropriate soft joint strip must be installed around all perimeters of the floor. The perimeter of the floor must be acoustically sealed with non-hardening acoustic sealant.

First Aid

Given the proposed vinyl flooring within the First Aid room, the recommended impact sound insulation between the First Aid room and Beauty Cabin below can be achieved by the installation of a plasterboard ceiling of 12.5 mm wallboard fixed to a suspended metal frame to create a minimum cavity of 120 mm.

Office

Given the proposed carpet within the office, the recommended impact sound insulation between the office and Beauty Cabin below can be achieved with no further treatment in the Beauty Cabin. The installation of a plasterboard ceiling of 12.5 mm wallboard fixed to a suspended metal frame to create a minimum cavity of 80 mm would be fine acoustically.

Female Changing Room

Given the recommended plasterboard ceiling within the Dance Studio at Mezzanine level, no acoustic treatment within the female changing room would be required to achieve the recommended impact sound insulation between the female changing room and dance studio would be required.

Gym

In order to reduce impact noise at source due to the dropping of free weights or weight stacks, it is recommended that a high performance floating timber floor is constructed on the floor slab in any free weights area and in areas under any weights machine. In particular, the following build-up is suggested:

- Proprietary resilient gym flooring of minimum thickness 30 mm on 18 mm thick V313 moisture resistant T&G ply on 5 mm damping sheet on two layers of 18 mm V313 moisture resistant T&G ply on CDM-LAT resiliently-mounted rails to create a minimum floor void depth of 50 mm, 50 mm mineral wool of minimum density 22 kg/m³ in the floor void.

In addition, it is recommended that any running machine that is not located on the floor build-up given above is installed on TVS Impact absorbers (<http://www.totalvibrationsolutions.com>).

It is recommended that a full acoustic review of the proposed gym layout is carried out once the layout has been finalised.

Sports Hall

Given an appropriate floor height, we would recommend that the Sports Hall is provided with the same timber floor build-up as that recommended within the first floor dance studio.

However, it is understood that a dimension of only 20 mm is available within the Sports Hall to accommodate the flooring.

It is therefore suggested that in order to gain a subjective understanding of the potential impact noise levels within the retail units due to use of the sports hall, an on-site listening test is conducted. This test would involve the generation of impact noise within the sports hall by bouncing a basketball on the slab and on the potential floor coverings within the sports hall. Noise levels within a ground floor retail unit would then be both objectively measured and subjectively assessed to determine if the potential floor coverings achieve an appropriate reduction of impact noise.

If appropriate noise levels are not achieved, consideration would need to be given to alternative floor coverings and/or the installation of an appropriately-designed imperforate ceiling within the retail units.

If the above-suggested tests cannot be carried out at an appropriate time due to the incomplete nature of the retail unit shells (e.g. curtain wall not installed such that the ground floor spaces are not acoustically closed spaces), it would be necessary to carry out the assessment by measuring the vibration levels induced in the slab during the bouncing ball tests. This method would only lead to an estimate of the potential noise levels within the retail units due to basketball impacts to a tolerance of perhaps +/- 5dB. This tolerance level should be sufficient to determine the potential level of disturbance to the retail units if additional mitigation measures are not taken.

6.0 DOORS

Table 8 identifies the minimum recommended weight sound reduction index of doors to non-residential rooms.

Room	Sound Reduction Index R _w
Cinema (each door of lobby)	32 dB
Dance Studio to Tower C Residential Core (each door of lobby)	42 dB
Female Changing Room to Tower C Core (each door of lobby)	35 dB
Plant rooms within Residential Towers	38 dB
WCs to lobbies/common areas	32 dB
Parcel/Laundry to Reception	25 dB
Generator Room to Emergency Switch Room	38 dB
Generator Room to External	38 dB
Retail to External lobby	38 dB
Retail 4 to Tower D lift lobby (each door of lobby)	35 dB
AHU Plant to Retail to BE Lobby	45 dB
Sports Hall to Escape Lobby	25 dB
Sports Hall to Sports Hall Lobby	25 dB
Gym to Escape Lobby	25 dB
Gym to BE Lobby	30 dB
Dance Studio to BE Lobby	35 dB
Beauty Cabin	30 dB
Seminar Room	30 dB
First Aid	30 dB
Residents Lounge to Lobby	35 dB
Residents Lounge to Tower C core (each door of lobby)	38 dB

Table 8: Minimum weighted sound reduction index of doors

Common Areas

It is recommended that all doors within common areas are fitted with slow closers to reduce impact noise.

7.0 SOIL & VENT PIPES AND RAINWATER PIPES

Waste pipes drop into the non-residential areas from the apartments above and then run horizontally and vertically within these ancillary areas.

If noise radiation from the pipes is not reduced, noise from the pipes would be easily audible in the ancillary areas unless there was a very high level of background noise in the space. It is therefore recommended that the both SVPs and RWP pipes are acoustically treated in spaces that may be occupied and in which the acoustic quality of the space is a consideration.

There are two principal options for the acoustic treatment of waste pipework as follows:

Encasement

Where possible, the pipework can be encased as follows:

- Two layers of 15 mm plasterboard of minimum density 830 kg/m³ (e.g. Gyproc SoundBloc, Knauf Soundshield Plus) fixed to studwork to create a minimum distance between the pipework and plasterboard of 75 mm. The studwork must not come into contact with any part of the pipework or any pipe support.
- 50 mm unfaced mineral wool of minimum density 15 kg/m³ must be installed within the encasement. The mineral wool can either be lagged around the pipework or can be installed with the studwork. Others must advise on potential condensation issues.

The full perimeter of the plasterboard encasement must be acoustically sealed with non-hardening acoustic sealant (i.e. gunned mastic).

Acoustic Lagging

As an alternative to encasement, the pipework could be acoustically lagged with a proprietary heavy duct lagging. Suitable products include:

- Muftilag R102 by Tap Acoustic. This product is 52mm thick and has a total mass of 13.6 kg/m². Reference can be made to: <http://tapacoustic.com/webedit/uploaded-files/All%20Files/Oct%202018/Muftilag%20R.pdf>

- Technowrap 2/10 by CMS Danskin. This product includes a polymeric barrier of mass 10 kg/m². It is recommended that the 50 mm thick product is selected. (Reference can be made to: <http://www.cmsdanskin.co.uk/wp-content/uploads/2013/07/SuperLag-Type-Technowrap-2.pdf>).

All manufacturer's installation instructions must be followed.

If access to SVPs is required from within the ancillary spaces via an access hatch then it is recommended that the access hatch exhibits a minimum mass of 15 kg/m² and achieves a minimum weighted reduction index, as tested in an accredited acoustic laboratory, of 32dB Rw.

8.0 REVERBERATION TIMES WITHIN NON-RESIDENTIAL SPACES

RECOMMENDED REVERBERATION TIMES

The recommended reverberation times in the sports hall and swimming pool are governed by comfort of users of the facilities and the ability to hear audible fire alarms, public address and evacuation calls. Reference has been made to guidance published by Sports England. The recommended reverberation time in the concierge area is related to achieving a relatively calm acoustic quality within the space and to provide a reasonable level of control of reverberant noise without losing the perception of the scale of the space.

Table 9 identifies the recommended mid-frequency (500 Hz to 2 kHz) reverberation times within the sports hall, swimming pool and concierge area.

Space	Mid-frequency Reverberation Time
Sports Hall (Sports England guidance)	1.5 seconds to 2.0 seconds
Swimming Pool (Sports England guidance)	1.5 seconds to 2.0 seconds
Concierge	2.5 seconds

Table 9: Recommended maximum reverberation times

CALCULATED REVERBERATION TIMES

Calculations have been carried out to determine the potential reverberation times in the sports hall, swimming pool and concierge based on the proposed room sizes, main surface finishes and potential acoustic treatment within the spaces as discussed with Simpson Haugh & Partners. With regard to the latter, the calculations of reverberation time are based on the following:

Swimming Pool

- 1) Provision of Barrisol A20 acoustic stretch ceiling with 40 mm thick mineral wool (minimum density 15 kg/m³) within a ceiling void of approximate depth 100 mm to an area of approximately 240 m².

OR

- 2) Provision of Barrisol A15 Nanoperf acoustic stretch ceiling with no mineral wool within the ceiling void and 65 m² of 12.5 mm thick Sonaspray K13 Special acoustic plaster applied to the bulkheads at the perimeters of the room.

Sports Hall

- 1) Provision of 37 mm thick SuperPhon High Impact acoustic panel to the ceiling and/or walls to a total area of approximately 500 m².

Concierge

- 1) Provision of approximately 600 m² of perforated or slotted timber panels and metal panels with open celled foam or unfaced mineral of minimum density 15 kg/m³ and of minimum thickness 25 mm directly behind the perforations in the panels.

The minimum recommended sound absorption co-efficients of the potential surface treatments are given in Table 10.

Element	Sound Absorption coefficient @ Octave Band Centre Frequency (Hz)						
	63	125	250	500	1k	2k	4k
Barrisol A20 with 40 mm mineral wool in ceiling void (Swimming Pool)	0.05	0.20	0.60	0.85	0.85	0.75	0.65
Barrisol A15 Nanoperf (Swimming Pool)	0.05	0.10	0.60	0.70	0.65	0.60	0.60
Sonaspray K13 Special (Swimming Pool)	0.03	0.09	0.20	0.55	0.75	0.80	0.80
SuperPhon High Impact (Sports Hall)	0.05	0.10	0.45	0.95	0.95	0.95	0.85
Slotted or perforated timber or metal panels (Concierge)	0.10	0.30	0.60	0.65	0.50	0.35	0.25

Table 10: Minimum recommended sound absorption coefficient

Table 11 identifies the calculated reverberation times in the spaces identified above

Space	Mid-frequency Reverberation Time
Sports Hall	1.8 seconds
Swimming Pool	1.9 seconds
Concierge	2.4 seconds

Table 11: Calculated reverberation times

It can be seen that given the above provision of acoustically absorptive materials, the reverberation times in the spaces are expected to be achieved. As the interior design of the above spaces develops, it is recommended that the potential reverberation times are re-assessed.

9.0 ACOUSTIC TREATMENT OF CINEMA

In order to provide appropriate listening conditions, consideration may need to be given to acoustic treatment of the Cinema to achieve appropriate reverberation times and to control adverse acoustic effects such as flutter echoes.

The furniture within the Cinema will provide a certain level of acoustic absorption, but additional acoustic treatment may be required to achieve sufficient control of acoustic reflections.

Such acoustic treatment would normally take the form of wall-hung panels of approximate depth 50 mm to 100 mm. The panels can be finished with a variety of surface treatments, such as fabric (plain or screen-printed), perforated metal or slotted timber.

Where curtains are to be provided to the Cinema, it is recommended that only directly adjacent walls are curtained to avoid flutter echoes between two parallel and acoustically reflective walls. If curtains are to be installed to only one wall, then it may be necessary to introduce absorptive or sound diffusing elements to the adjacent wall to avoid flutter echoes. To provide reasonable acoustic absorption, the area of curtain fabric per wall should be at least twice the area of that wall. The curtain fabric should exhibit a minimum mass of 0.5 kg/m². A serge or velour fabric would be preferred.

As acoustic panels can be retro-fitted, it may be appropriate to assess the acoustic quality of the Cinema after final furnishing to determine if additional acoustic treatment is necessary.

10.0 COMMON DUCTWORK

Common ductwork that serves adjacent spaces provides a secondary route for noise between the rooms. In order to achieve the required sound insulation targets between the ancillary rooms and amenity spaces it may be necessary to introduce crosstalk silencers within certain ductwork runs to noise sensitive or noise-producing rooms.

An assessment of crosstalk noise transfer between rooms and areas must be carried out by the M&E contractor to determine the required specification of any crosstalk attenuation such that the recommended sound insulation of walls and floors is not compromised.