



## **ACOUSTICS**

CD9 Properties

Rylands Building,  
Manchester

### **RIBA Stage 3**

Acoustic Design Report

MCP2087



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## 1. INTRODUCTION

- 1.1 This detailed design phase report has been prepared by BWB Consulting (BWB) on behalf of CD9 Properties (Client) to inform the design team of the applicable acoustic requirements in aiding the design proposal to renovate and reuse parts of the building which includes retail spaces allocated on the ground floor and offices above with a rooftop extension at the proposed Rylands Building in Manchester.
- 1.2 The purpose of the report is to inform the design team of the proposed acoustic requirements in aiding design proposals. This report takes into account our understanding of the client brief and relevant guidance documents in order to deliver a comfortable and acoustically appropriate environment, whereby acoustic solutions are well integrated with the architectural and engineering designs. It should be however considered as a document for discussion and an agreed basis on which the design can be progressed.
- 1.3 A glossary of the acoustic terminology used in this report is presented in **Appendix A**.

## 2. DESIGN GUIDANCE

- 2.1 This report outlines the acoustic scheme design in accordance with the criteria and guidelines set out within British Standard (BS) 8233:2014<sup>1</sup>. References have also been made to relevant guideline criteria set out within British Council for Offices 'Guide to Specification 2014' (BCO Offices Guide 2019)<sup>2</sup>, and the Finishes Interiors Sector (FIS) 2015 'A guide to office acoustics'<sup>3</sup> document, as stipulated within the employer's requirement specification.
- 2.2 The following key design issues have been considered along with the design proposals to ensure the acoustic performances of the proposed development are appropriate to its intended use:
- Airborne Sound Insulation (separating wall/floor construction);
  - Internal Ambient Noise Levels (façade requirements); and
  - Control of Reverberation Noise with the Office Demise.

### Sound Insulation Performance (Separating Elements)

- 2.3 For office developments tested prior to furnishing, the following criteria for sound insulation between acoustically sensitive rooms and other occupied areas are given in Section 7.5 of BS8233:2014 in **Table 2.1**, as reproduced.

**Table 2.1: Example on-site sound insulation matrix (dB  $D_{nT,w}$ ) (source: Table 3 BS8233:2014)**

| Airborne Sound Insulation Matrix ( $D_{nT,w}$ ) |                               |                            |        |           |
|-------------------------------------------------|-------------------------------|----------------------------|--------|-----------|
| Privacy                                         | Noise Activity in Source room | Receiving room sensitivity |        |           |
|                                                 |                               | Low                        | Medium | Sensitive |
| Confidential                                    | Very high                     | 47                         | 52     | 57        |
|                                                 | High                          | 47                         | 47     | 52        |
|                                                 | Typical                       | 47                         | 47     | 47        |
|                                                 | Low                           | 42                         | 42     | 47        |
| Moderate                                        | Very high                     | 47                         | 52     | 57        |
|                                                 | High                          | 37                         | 42     | 47        |
|                                                 | Typical                       | 37                         | 37     | 42        |
|                                                 | Low                           | -                          | -      | 37        |
| Not private                                     | Very high                     | 47                         | 52     | 57        |
|                                                 | High                          | 37                         | 42     | 47        |
|                                                 | Typical                       | -                          | 37     | 42        |
|                                                 | Low                           | -                          | -      | 37        |

**Note:** Background noise can also influence privacy. See also 7.7.6.3.

<sup>A)</sup>  $D_{nT,w}$  55dB or greater is difficult to obtain on site and room adjacencies requiring these levels should be avoided wherever practical.

- 2.4 Further discussions should be had with the client and/or design team with regards to the level of privacy required to specify the airborne sound insulation performance afforded by the partition.
- 2.5 It should be noted that there is strictly no requirement to achieve an impact noise transmission performance between separating office floor demises. However, it would be recommended, as a matter of good practice, to provide resilient treatment to the office floor. The most effective method to control noise from footfall is to use a good quality carpet and/or underlay to reduce footfall impact at source.
- 2.6 With regards to the proposed raised access floor, it is important to choose a suitable floor covering to maintain good absorption of the incident sound and reduce the transmission of noise i.e., carpets and textile coverings.
- 2.7 In addition to the above, the FIS guidance document also provides a matrix for determining privacy of speech from adjoining rooms in the context of the background noise levels, as represented in **Table 2.2**.

<sup>1</sup> British Standards Institution (BSI) (2014); British Standard (BS) 8233 'Sound insulation and noise reduction for buildings', BSI.

<sup>2</sup> British Council for Offices 'Guide to Specification 2019' (BCO Offices Guide 2019)

<sup>3</sup> Finishes Interiors Sector (2015) 'A guide to office acoustics' (FIS)

**Table 2.2: Privacy of speech (loud speech level) from the next office, depending on weighted sound level difference and background noise level in receiving room**

| Weighted sound level difference, Dw | Privacy of speech from next room with a background level of... |                                            |                                            |                                            |
|-------------------------------------|----------------------------------------------------------------|--------------------------------------------|--------------------------------------------|--------------------------------------------|
|                                     | 25 dBA                                                         | 30 dBA                                     | 35dBA                                      | 40dBA                                      |
| 32 dB                               | Very poor                                                      | Very poor                                  | Poor                                       | Poor                                       |
| 37 dB                               | Very poor                                                      | Poor                                       | Fair                                       | Words intelligible but not whole sentences |
| 42 dB                               | Poor                                                           | Fair                                       | Words intelligible but not whole sentences | Good                                       |
| 47 dB                               | Fair                                                           | Words intelligible but not whole sentences | Good                                       | Very Good                                  |
| 52 dB                               | Words intelligible but not whole sentences                     | Good                                       | Very Good                                  | Very Good                                  |

#### Flanking Requirements

- 2.8 To provide enough acoustic separation between different user spaces, separating walls and floors will need to provide enough level of sound insulation, having regard to likely activity level in the source room and the tolerance level in the receiving room.
- 2.9 The office design shall comply with the guidance provided in the BCO 2014 in that:
- “Sound level difference vertically between individual office floors should be at least  $D_{nTw}$  45dB at shell and core stage, or at least  $D_{nTw}$  48dB if fitted to Cat A standards”.
- 2.10 This is also translatable to horizontal adjacencies as part of the shell and core build:
- “...where an adjacent office occupier demise is separated by a wall constructed as part of the shell and core or Cat A fit-out, then the same sound insulation standards as set for the floors shall be achieved.”
- 2.11 The façade flanking transmission shall also comply with BCO Guidance for speculative offices in that:
- “Within offices flanking transmission horizontally across cladding mullions at the potential fit out partitions should be capable of demonstrating a weighted normalised flanking difference of at least  $D_{n,Fw}$  45dB” and “...should be capable of being upgraded in the fit out to at least  $D_{n,Fw}$  53dB”.
- 2.12 The above is also translatable to vertical flanking transmission across transoms between floors of the development.
- 2.13 Flanking sound transmission is unlikely to be generally significant where the facade is discontinuous across separating floors and walls, i.e., it extends from slab to slab. However, it will be an important

consideration where lightweight cladding (e.g., curtain walling) extends past separating floors and walls.

- 2.14 Where internal partitions abut the facade, the sound insulation provided between horizontally and vertically adjacent rooms needs to be such that it does not undermine the sound insulation provided by internal walls and floors.

#### Indoor Ambient Noise Levels (Façade Requirements)

- 2.15 To help in the design of the building and the control of noise outside and in the building, reference has been made to relevant and credited guidance documents, notably BS 8233:2014, which recommends suitable internal ambient noise level (IANL) to be met within commercial buildings to ensure the acoustic environment within different room spaces are appropriate to their function. The noise level criteria relevant to the development are presented in **Table 2.3**.

**Table 2.3: Internal Noise Criteria in Unoccupied Spaces**

| Room Space         | BS8233 $L_{Aeq,T}$ Criteria | Criterion                                    |
|--------------------|-----------------------------|----------------------------------------------|
| Open Plan Offices  | 45-50                       | Reasonable acoustic privacy in shared spaces |
| Reception Rooms    | 45-40                       |                                              |
| Corridors, Toilets | 45-55 <sup>1</sup>          | Reasonable speech or telephone conversations |

- 2.16 In addition, maximum noise intrusion levels should not normally exceed 55dB  $L_{A_{Fmax}}$  in open plan/speculative offices or 50dB  $L_{A_{Fmax}}$  in cellular offices.

#### Sound Absorption (Reverberation Control)

- 2.17 Office spaces require good acoustic conditions for comfort and clarity of speech, with control of reverberant (reflected) noise an integral component. Although some reverberation within a space is desirable in aiding speech distribution, longer reverberation times will cause a build-up of noise and degrade speech intelligibility.
- 2.18 BS 8233:2014 references the Sound Research Laboratory book ‘Noise control in building services’ to provide guidance on reverberation times (the time taken for sound to decay) for rooms of different volumes that are intended for speech. The recommended values relate to the reverberation time at 500 Hz when the rooms are unoccupied and are presented below in **Table 2.4**.

**Table 2.4: Optimum Reverberation Times for Standard Offices**

| Room Volume (m <sup>3</sup> ) | Reverberation Time (seconds) |
|-------------------------------|------------------------------|
| 50                            | 0.6-0.7                      |
| 100                           | 0.7-0.8                      |
| 200                           | 0.8-0.9                      |

- 2.19 BCO recommends that the total absorption provided across the office space should provide an average absorption co-efficient of 0.9 when averaged over the frequency range 500Hz to 2000Hz.

- 2.20 For the Atrium space, the typical recommended target reverberation time for a space of this scale is <1.5 seconds.
- 2.21 In addition to the above, the FIS document provides guidance on reverberation time in unoccupied rooms for speech.

**Table 2.5: Guide to reverberation time RT at 500Hz in unoccupied rooms for speech**

| Room Volume (m3) | RT (s) |
|------------------|--------|
| 50               | 0.4    |
| 100              | 0.5    |
| 200              | 0.6    |
| 500              | 0.7    |
| 1000             | 0.9    |
| 2000             | 1      |

- 2.22 In conjunction with the above, the FIS guidance document also sets out requirements on room acoustics in relation to speech transmission Index (STI), as represented in **Table 2.6**.

**Table 2.6: Room acoustics requirements**

| Space     | If privacy is important                                                    | If communication is important                                             |
|-----------|----------------------------------------------------------------------------|---------------------------------------------------------------------------|
| Open Plan | STI $\leq$ 0.4                                                             | STI $\geq$ 0.6                                                            |
|           | Ceiling $\alpha_w \geq$ 0.9 across speech frequencies / Soft floorcovering | Ceiling $\alpha_w$ 0.5-0.7 across speech frequencies / Soft floorcovering |

- 2.23 The above has been considered in determine the requirements for absorption within the open plan office space and meeting rooms.

### 3. ENVIRONMENTAL NOISE LEVELS

- 3.1 A baseline noise survey was undertaken between Thursday 30<sup>th</sup> July and Friday 31<sup>st</sup> July 2020, full details of which can be found in the original standalone planning noise impact assessment report (dated September 2020, document ref: 'MCP2087 – Rylands Building, Manchester – Noise and Vibration Impact Assessment').

### 4. FAÇADE REQUIREMENTS

#### External Wall and Glazing

- 4.1 To meet the internal ambient noise levels (IANL) within noise sensitive room spaces of the development, it is important to consider the acoustic performance of all elements of the façade. Consideration must therefore be given to the composite make-up of the proposed external wall and glazing/window elements of the façade.

- 4.2 The sound reduction performance rating for the proposed façades is presented as **Table 4.1**, which has been determined based upon the current environmental noise climate in the area and proposed on-site operations.

**Table 4.1: Minimum Facade Performance Specification**

| Façade      | Composite $R_w+C_{tr}$ <sup>1</sup> | Example Configuration (Equal or Approved)                                                                                                                  |
|-------------|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| All facades | 33                                  | External Wall & Glazing/windows<br>(e.g., Standard double leaf masonry wall construction & double-glazing package - 6mm pane / 12-16mm airgap / 10mm pane) |

**Notes:** <sup>1</sup> The minimum single figure weighted sound insulation performance specification is stated as a laboratory tested value (in dB  $R_w+C_{tr}$ ), which as a general rule of thumb is 5dB greater than the site tested value (in dB  $D_w+C_{tr}$ ) due to reductions in acoustic performance on site due to variances in workmanship, flanking transmission, etc. The  $C_{tr}$  correction factor used to take in to account the low frequency noise spectrum characteristics of dominating road traffic noise in the locality.

- 4.3 The sound insulation performance of the specified glazing units assumes that windows remain closed to achieve the internal ambient noise level requirements under BS8233.
- 4.4 It is understood that the intention is to replace the existing windows with Crittall W20 sections (apart from on the 7th floor where they will be retained). The performance stipulated above are likely to be achieved through the new windows. The retaining window are also likely to achieve the required performances, subject to the existing frame being in good condition, as to not undermine the performance of the glazing package.

#### Ventilation

- 4.5 It is understood the building is to utilise a mixed-mode ventilation solution. Such methods can be used to meet the requirements for ventilation and temperature regulation purposes. As such, the future occupants would then have the option of keeping windows closed for most of the time and opening windows for rapid ventilation and summer cooling. The required sound insulation may need to be increased depending on whether there will be inlet fans installed or passive ventilation to draw in enough air to meet the requirements set out in Approve Document F.

### 5. INTERNAL SEPARATING ELEMENTS

#### Internal Wall Partition Constructions

- 5.1 The critical sound insulating architectural elements in an office are the separating walls between noise sensitive spaces i.e., cellular offices and particularly meeting rooms. These partitions would form part of the office fit out works and would not be included when providing CAT A open plan office space. However, the design team has a duty to review typical office fit-out configurations and assess how the fit-out works would interface with the building elements provided. A common issue is internal partitions abutting the cladding, which has not been correctly specified to provide high flanking sound insulation. In cases like this, noise is able to transfer from room to room via the cladding, bypassing the partition, resulting in poor levels of speech privacy within the adjacent rooms.

- 5.2 The BCO guidance document requires offices fitted out to Cat A. A standard to provide a floor to floor sound insulation level difference of at least 48 dB  $D_{nT,w}$ , typical party wall construction is shown below in **Table 5.1**.

**Table 5.1: Indicative Acoustic Performance of Party Wall Constructions**

| Partition Performance | Wet Constructions                                                                                                                          | Dry Constructions (Refer to British Gypsum White Book for alternatives)                                                                                                                                                                 |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| R <sub>w</sub> 40     | 100mm block (medium density 1400 kg/m <sup>3</sup> ). Nominal mass ≥100kg/m <sup>2</sup> .                                                 | 1x layer 12.5mm Soundbloc (min. mass 10.6kg/m <sup>2</sup> per layer) each side of 70mm metal studs, 25mm Isowool Acoustic Partition Roll (APR) 1200 (min. density of 12kg/m <sup>3</sup> ) in cavity. Total nominal thickness of 95mm. |
| R <sub>w</sub> 45     | 100mm block (medium density 1400 kg/m <sup>3</sup> ) plastered/rendered 12mm on both sides. Nominal surface mass ≥150kg/m <sup>2</sup> .   | 2x layers 12.5mm Soundbloc (min. mass 10.6kg/m <sup>2</sup> per layer) each side of 70mm metal studs, 25mm APR1200 (min. density 12kg/m <sup>3</sup> ) in cavity. Total nominal thickness of 120mm.                                     |
| R <sub>w</sub> 50     | 140 mm block (high density 2000 kg/m <sup>3</sup> ) plastered/rendered 12mm on both sides. Nominal surface mass ≥210kg/m <sup>2</sup> .    | 2x layers 15mm Soundbloc (min. mass 12.6kg/m <sup>2</sup> per layer) each side of 70mm metal studs, 25mm APR1200 (min. density 12kg/m <sup>3</sup> ) in cavity. Total nominal thickness of 130mm.                                       |
| R <sub>w</sub> 55     | 215mm blockwork (high density of 2000 kg/m <sup>3</sup> ) plastered/rendered 12mm both sides. Nominal surface mass ≥315kg/m <sup>2</sup> . | 2x layers 15mm Soundbloc (min. mass 12.6kg/m <sup>2</sup> per layer) each side of 70mm metal studs, 50mm APR1200 (min. density 12kg/m <sup>3</sup> ) in cavity. Total nominal thickness of 130mm.                                       |

### Stairwells and Core Circulation areas

- 5.3 For stairwells and core circulation areas a minimum of at least 48 dB  $D_{nT,w}$  should be achieved in order to demonstrate the performance in accordance with the BCO guidance, though it is not possible to test this properly on-site.
- 5.4 For the existing retained stairs which are not isolated from the walls, the following should be considered in order to achieve noise reduction:
- Increasing the insulating mass between the staircase and the walls,
  - The addition of carpet or acoustic underlay.

### Floor construction (Between Office Demises)

- 5.5 In order to comply with the requirements, it is recommended that an airborne sound insulation performance rating of **50-55dB R<sub>w</sub>** is targeted.
- 5.6 It is understood that the existing floors within Rylands Building are cast insitu concrete (170mm thick), and the proposed floors to the extension will consist of precast concrete planks with screed above.

### Service Penetrations

- 5.7 Any penetrations through floors or partitions by building services such as ductwork, pipework and cable trays should be formed with the minimum practicable clearance. Any holes or breakage occurring as a result should be made good using material of the same mass per unit area as the

surrounding structure from the penetration. The remaining gap should be packed tightly with mineral wool and sealed using a collar of material (equal to a mass per unit area of 20 kg/m<sup>2</sup>) extending at least 50mm past the edge of the penetration. This should be sealed to the surrounding structure and building services using a non-hardening flexible acoustic sealant. The contractor should ensure that any penetrations will be suitably sealed so that the overall sound insulation performance of any separating wall/floor construction is not degraded.

### Enclosure of Services

- 5.8 If any pipes internal to habitable rooms, e.g., soil pipes, water pipes, rainwater pipes etc. are to be run in risers, then these need to be boxed out with material of at least 15kg/m<sup>2</sup>, e.g., two layers of 12.5mm plasterboard. The boxed-out enclosure is to be mechanically independent of the pipes. The pipes either need to be wrapped in 25mm unfaced mineral-fibre or the enclosure should be lined with 25mm unfaced mineral-fibre.

### Junction Details (Flanking)

- 5.9 To minimise flanking sound transmission via the floor junction and to ensure the optimum acoustic performance, careful consideration should be taken with regards to the construction detailing and workmanship.
- 5.10 Generally, a resilient joint (minimum 5mm) should be incorporated between the floor construction and the wall to isolate the floor surface layer from the perimeter walls and skirting, thereby ensuring discontinuity at the partition line and avoiding bridging.
- 5.11 Further consideration on flanking in accordance with BCO requirements will be given at the detailed design specification phase.

### Toilets, Bathrooms and Kitchens/Canteen Areas

- 5.12 Metal pipework or soil pipes etc. should not be rigidly fixed to any wall, floor or riser internal wall and resilient fixings should always be used. Where pliable plastic water-pipes etc. are used then normal fixings may be used.
- 5.13 Basins, toilets, baths, or showers should not be rigidly fixed to masonry walls and should be mounted either on separate stud walls off the masonry or mounted using resilient fixings. Pipes or ductwork in the risers or partitions should not be rigidly fixed to any wall that is common to a sensitive room, or any concrete floor soffit.

### Internal Glazing

- 5.14 All internal glazing should provide airborne sound insulation performance equivalent to that of the partition in which it is located. In corridor walls, the glazing sound insulation performance can be relaxed slightly but should ensure that the overall rating of the partition (including the door) is not degraded. The following rule of thumb can be applied to set the minimum performance for glazing:

**Table 5.2: Internal glazing sound insulation performance**

| % of wall area which comprises glazing | Maximum reduction in R <sub>w</sub> permitted |
|----------------------------------------|-----------------------------------------------|
| < 10 %                                 | -3 dB                                         |
| 10-20 %                                | -2 dB                                         |
| 25 - 45 %                              | -1 dB                                         |

### Internal Door-sets

- 5.15 Although there is no strict requirement with regards to the performance of doors to circulation and office space, it is recommended that the doors provide, as a minimum, an acoustic rating of 30dB R<sub>w</sub>.
- 5.16 Where there are door openings between office spaces, it is recommended that the doors provide, as a minimum, an acoustic rating of 35dB R<sub>w</sub> or greater is installed.
- 5.17 The following guidance provides recommendations for the construction and detailing of the acoustically rated doorsets:
- 30 dB R<sub>w</sub> – This is typically achieved using a 45 mm solid-core timber door closing onto a rebated frame with full perimeter seals along the head, jambs, and threshold. The door would need to be side hinged rather than pivoted. For double doors, meeting jambs need to be rebated and fitted with seals to meet the requirements. The door leaf would typically have a weight of at least 30 kg/m<sup>2</sup>.
  - 35 dB R<sub>w</sub> – This would typically be achieved by a 54 mm solid-core timber door closing onto a rebated frame with full perimeter seals along the head, jambs, and threshold. The door would need to be side hinged rather than pivoted. For double doors, meeting jambs need to be rebated and fitted with seals to meet the requirements. Door leaf weights are typically around 50 to 65 kg/m<sup>2</sup>. Lighter doors with composite constructions are available from some suppliers. Vision panels could be used but would likely consist of thick acoustic laminate glass (e.g., 12.8 mm acoustic laminate).

## 6. REVERBERATION CONTROL

- 6.1 A material's sound absorbing properties are expressed by the sound absorption co-efficient,  $\alpha$  (alpha), as a function of frequency. A range from 0 (total reflection) to 1.0 (total absorption).
- 6.2 The sound absorptive properties of a material are defined in EN ISO 11654: 1997<sup>4</sup>, which gives five categories of sound absorption ranging from Class A to Class E, with Class A offering the higher level of sound absorption. Where there is a requirement for improved absorption, the easiest way to apply this absorption would be in to applying a suspended ceiling system.
- 6.3 The acoustic performance specification for Class A and C (as identified within the standard) absorber types are provided in **Table 6.1** for reference, allowing the absorptive performance of supplier/manufacturer products to be confirmed.

**Table 6.1: Type Performances of Class A and C Absorbers**

| Absorption Class | Octave Band Centre Frequency (Hz) |     |     |     |     |
|------------------|-----------------------------------|-----|-----|-----|-----|
|                  | 250                               | 500 | 1k  | 2k  | 4k  |
| Class A          | 0.6                               | 0.9 | 0.9 | 0.9 | 0.6 |
| Class C          | 0.4                               | 0.6 | 0.6 | 0.6 | 0.5 |

**Note:** Absorption co-efficient of various materials/products may differ across the octave band frequencies.

- 6.4 The most important element of a room space for controlling reverberation time is typically the ceiling finish, since it is often impracticable to apply soft absorbent finishes to walls and floors.
- 6.5 Higher rated more efficient absorptive finishes (Class A and B) typically allow a reduced area of treatment (e.g., 40% coverage) and therefore greater design flexibility, whilst providing more beneficial absorption at low frequencies. The most straightforward method of compliance is typically provision of a suspended grid ceiling system with lay-in perforated mineral tiles (e.g., British Gypsum), however, an array of seamless acoustic board options exists (such as StoSilent Acoustic Panel) to acoustic rafts with task down/up lighting, providing endless design choice.
- ### Office spaces
- 6.6 It is understood that the design intent is to have exposed soffit. The need for acoustic treatment to control reverberation time (RT) within office demises is therefore critical, and consideration will also need to be taken for noise emissions from internal service equipment (i.e., ducts, fan coil units or MVHRs etc.), requirements of which are also stipulated within BCO guidance.
- 6.7 The general method of applying acoustic absorption would therefore be to attach absorptive panels at a high level to the walls or hung as rafts panels or baffles in accordance with the manufacture/supplier installation manual, as may be the design aspirations. Indicative solutions are presented in **Figures 6.1** and **6.2** overleaf. Any provision for the use of wall absorption should be reasonably evenly distributed to achieve the best acoustic environment and prevent undesirable local variations in the acoustics.
- 6.8 Careful detailing and product selection is also vital to ensuring compliance, but also important to maintain a space compliant with wider design requirements (such as lighting / thermal etc.,).

<sup>4</sup> EN ISO 11654: 1997; Acoustics -- Sound absorbers for use in buildings -- Rating of sound absorption, GB

Figure 6.1: Absorptive Raft Panels



Figure 6.2: Suspended Absorptive Raft Panels with Recessed Light Fittings

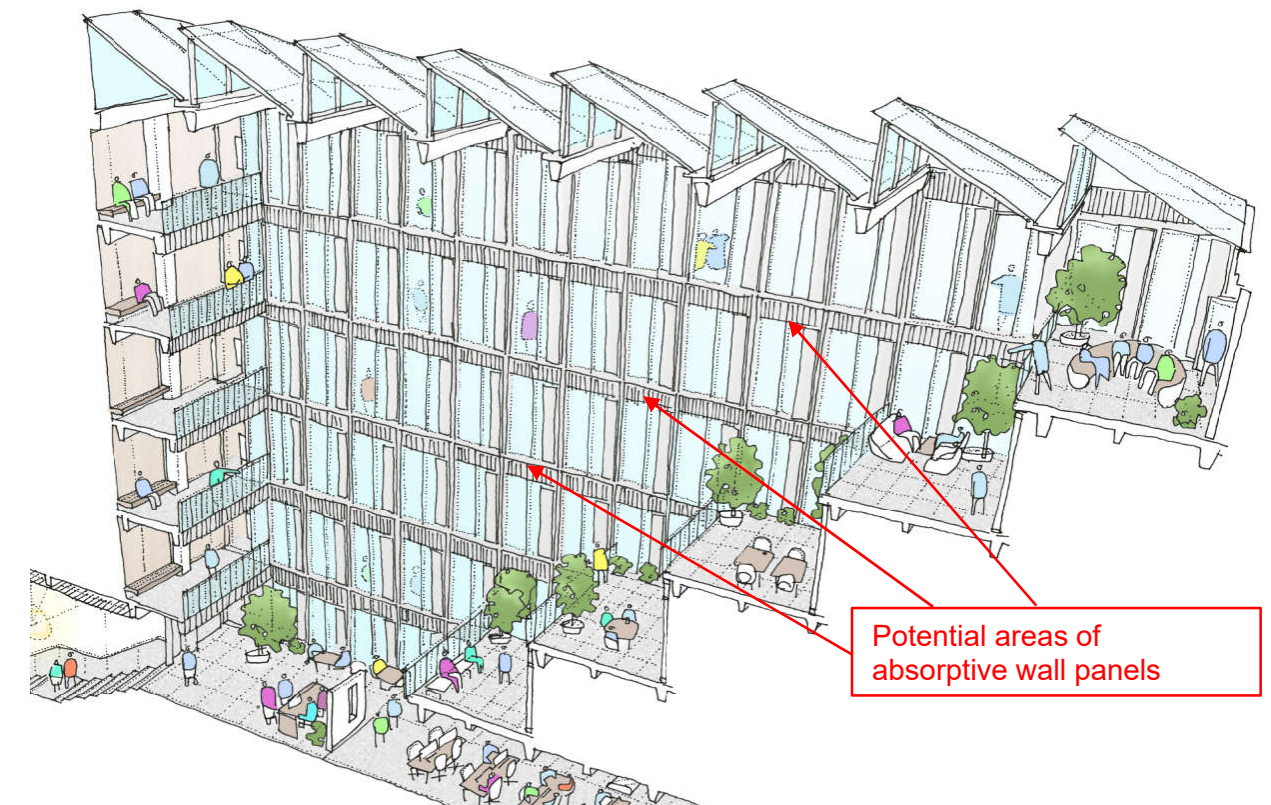


- 6.9 In addition to the above, the office areas of the building can benefit with incorporating localised absorption around break-out areas with Furniture, Fittings and Equipment (FF&E), which will assist in controlling reverberation in these spaces.

## Atrium Space

- 6.10 By their very nature, atria tend to have high room volume and poor acoustic absorption capabilities. RT can be high, often up to four or five seconds, which can lead to poor speech intelligibility and, if open to other office areas, cause distractions to workers.
- 6.11 There is normally limited opportunity to introduce absorptive treatments to control RT in atria, but measures should be considered wherever possible. It is recommended that absorption be applied to available wall surfaces, underside of stairs/walkways etc. and localised wall panels around areas where speech is likely to take place (i.e., around reception or seating areas).
- 6.12 It is understood that there are wall surfaces available in areas with the atrium space, as illustrated in the architect's sketch in **Figure 6.3** below.

Figure 6.3: Artists Impressions of Atrium Space



- 6.13 The area of acoustic absorption introduced into the space will likely be dictated by the area available and the cost of installing large areas of acoustic absorption. Where possible it would be recommended that any absorption be installed at a low level (head height where practical).
- 6.14 It should also be noted that the control of RT is critical when voice alarm systems are used for building evacuation in the event of a fire or other emergency. It is the responsibility of the PAVA designers to consider implications of absorption (or lack thereof) in their design.
- 6.15 The amount of absorption required within the atrium space, and the potential use of PAVA systems, with the use of acoustic modelling will be identified within the next stage of development.

## Arcade Area

- 6.16 Allowance for absorptive treatment should be made, where possible, within the Arcade area to target a reverberation time criterion of <1.5 second. We will be looking to model the Arcade area to target the criterion at stage 4 design. However, potential areas for absorptive treatment can be implemented on the ceilings or areas above the retail fronts, as annotated on **Figure 6.4** below.

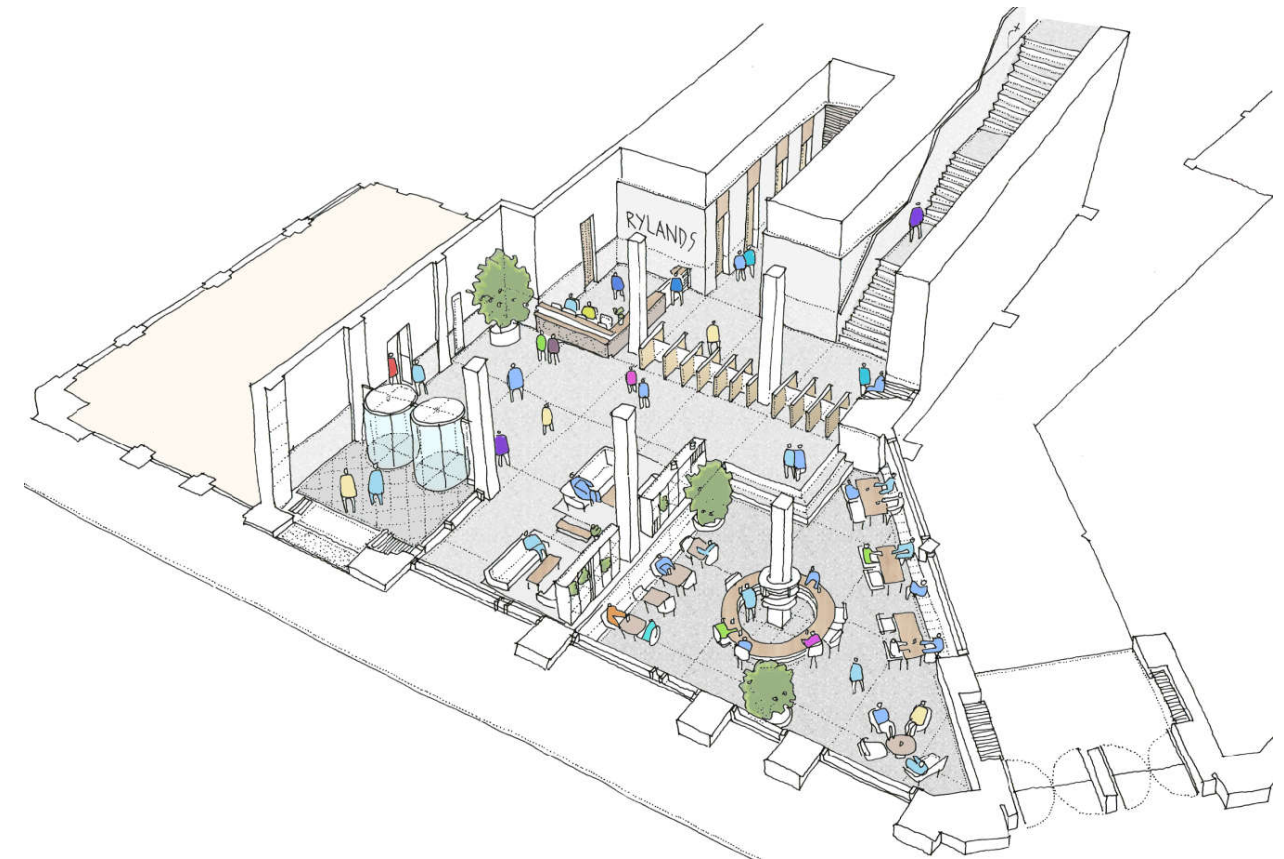
**Figure 6.4: Artists Impressions of Arcade Space**



## Reception Area

- 6.17 Allowance for absorptive treatment should be made, where possible, within the reception area to target a reverberation time criterion of <1.0 second. We will be looking to model the reception area (as depicted in **Figure 6.5**) to target the criterion at stage 4 design.

**Figure 6.5: Artists Impressions of Reception Area**



- 6.18 Though there is a risk that the target IANL would not be met in the reception area during peak periods of activity (people entering and departing the building), where external ambient noise levels in the high 70s dB LAeq,T were recorded. Anticipated frequent operation allows such environmental noise to intrude into the reception space, interfering with communication (speech/telephone).
- 6.19 We do however support the inclusion of a rotating entrance lobby design as this would greatly assist in meeting the target IANL criteria within the reception area, except during peak periods of activity. This would also address energy conservation and comfort issues for occupants located near the main entrance doors.

## 7. BUILDING SERVICES

7.1 This section of the report provides some generic advice with regards to internal fixed building services plant generated noise.

### System Generated Noise

7.2 The general parameters for ductwork or pipework design, fabrication and installation are outlined in the relevant codes of practice (HVCA and CIBSE). In order to alleviate the most commonly occurring problems with duct services, the following items represent a list of good acoustic practices:

- Bends and bifurcations - 90° bends should either be radiused type or be fitted with equally short-cord turning vanes.
- All branches should be fitted with boots or coned as per standard practice.
- Transitions should be as gradual as possible within the physical limitations, and it is preferred that one pair of sides remain parallel.
- Duct velocities should be limited appropriately.
- The aspect ratio in all main and branch duct runs for rectangular and flat oval ductwork should ideally not exceed 3:1. It is recommended that ductwork having higher aspect ratios be stiffened.
- All duct penetrations should be resiliently sleeved to prevent vibrational energy in ducts being transmitted to structures.

7.3 Volume control dampers near duct terminations should only be used to provide fine trimming of the air flow. If dampers are likely to be used beyond fine trimming purposes (20% closed for 5m/s velocity), 'damper attenuators' may be required between the damper and the duct terminal.

7.4 The level of noise generated by airflow across an opposed blade volume control damper is proportional to the airflow through the damper and the pressure drop across it. **Table 7.1** details the recommended guideline maximum values for the product of airflow velocity through the fitting and the pressure drop across the fitting, for various damper locations.

**Table 7.1: Guideline maximum values for the product of air flow velocity and pressure drop for various damper locations**

| VCD Location                                | Maximum Recommended Values Airflow Velocity (m/s) x Pressure Drop (Pa) |
|---------------------------------------------|------------------------------------------------------------------------|
| Extract stud duct (above suspended ceiling) | 200                                                                    |
| Supply duct in main branch                  | 600                                                                    |
| Supply duct in terminal branch              | 60                                                                     |

7.5 If for any damper its specific duty is such that the maximum values above are exceeded, then an attenuator will be required on the room-side of the damper.

7.6 To reduce the possibility of any dampers causing excessive noise, it is recommended that they are located as far from terminal as is practicable. If this approach is followed, the requirements for damper attenuators can often be negated.

7.7 Any dampers located at terminals must be used strictly for fine trimming only.

7.8 Manufacturers should specify the insertion losses expected from the attenuators offered, under the operating conditions, with the data derived from testing conducted in accordance with BS 4718:1971<sup>5</sup>.

7.9 It is unlikely that the piped services associated with the building services plant will, if designed in accordance with HVCA/CIBSE guidance, produce any flow generated noise problems. It should however be noted that the overall friction loss in pipework should be limited to 280 Pa/m across the range of pipes to be used.

7.10 All items of building services plant should be fitted with vibration isolators to control the transmission of vibration to the building structure.

### External Building Services Plant

7.11 Manchester City Council's (MCC) policy on plant noise requiring that plant should achieve a rating level of 5dB ( $L_{Ar,T}$ ) below the typical background ( $L_{A90}$ ) level at the nearest noise sensitive location, it follows that the maximum plant emission levels ( $L_{Aeq,T}$ ) for fixed mechanical plant presented in Table 4.4 of the 'Noise Impact Assessment' published on 1<sup>st</sup> September 2020 must be met 1m from the façade of the closest noise sensitive properties. The nearest sensitive receptors are considered to be the dwellings at Bridgewater Place (NSR1), Light Aparthotel (NSR2), the Residential development currently under construction on Tib St /Bridgewater Place/Joiner St/ (planning ref: 114146/FO/2016) (NSR3), and Sacha's Hotel, Tib Street/Back Piccadilly (NSR4).

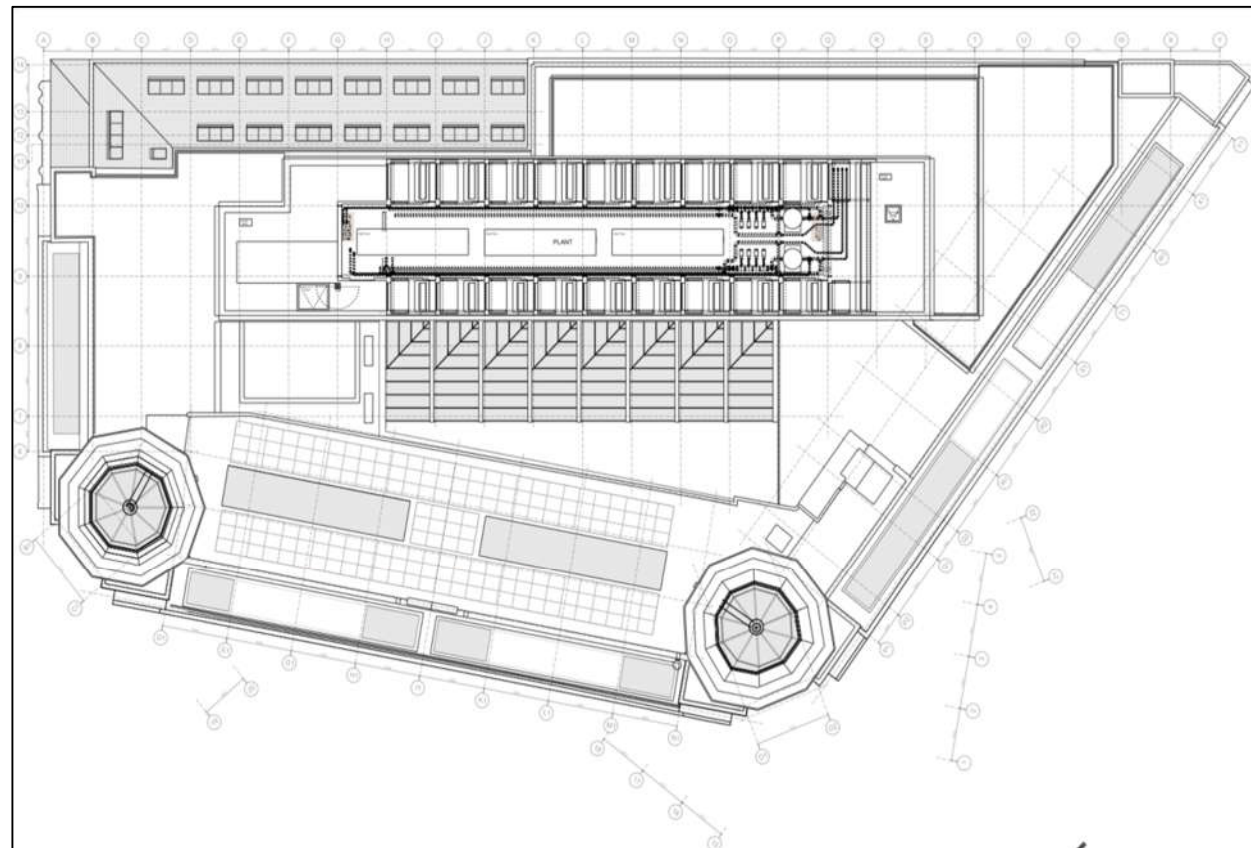
**Table 7.2: Plant Noise Limits at Nearest Noise Sensitive Premises**

| Location   | Period     | Typical Measured $L_{A90,T}$ | Plant Noise Emission Limit ( $L_{Ar,T}$ ) |
|------------|------------|------------------------------|-------------------------------------------|
| NSRs 1 - 3 | Daytime    | 50                           | 45                                        |
|            | Night-time | 44                           | 39                                        |
| NSR 4      | Daytime    | 53                           | 48                                        |
|            | Night-time | 50                           | 45                                        |

7.12 It is understood that the current proposals are to install an outdoor HVAC and heat pump system (FOCS-N-G05 / SL-CA 4822 - Super Low Noise (in heating)). **Figure 7.1** presents the indicative rooftop plant locations.

<sup>5</sup> BS 4718:1971: 'Methods of test for silencers for air distribution systems', GB

**Figure 7-1: Indicative Rooftop Plant Location Plan**



- 7.13 The rooftop plant scheme is predicted to be compliant with the plant noise requirements of the MCCs (i.e., plant  $L_{Aeq,T} = -5\text{dB } L_{A90,T}$ ), is achieved. As such, no specific mitigation measures are required.

#### Plant noise egress – external noise

- 7.14 The following attenuation measures shall be incorporated into the installation of any external or externally affecting plant, as a minimum, to ensure the criteria in **Table 7.2** are not exceeded:
- Locate plant where its noise is less likely to disturb noise sensitive receivers;
  - Optimise plant operation specifications to ensure low-noise levels;
  - Provide appropriately sized duct silencers in the intake and exhaust air paths;
  - Ensure slabs separating plant from dwellings are minimum 200mm normal-weight concrete with all plant mounted on appropriate anti-vibration mounts;
  - Provide emergency fans with atmospheric-side attenuators and upgraded casings.

#### Internal plant noise

- 7.15 The following attenuation measures shall be incorporated into the installation of any item of plant to control plant noise inside the buildings, as a minimum:
- Provide adequate room-side duct attenuators within the duct near each AHU or fan. Acoustically lag the outside of the duct between the fan and the attenuator;

- Run ventilation duct work in occupied rooms only above plasterboard soffits, and with sufficient duct length between facade openings and the fan.
- Provide low-noise transmission cabinets to motorised equipment such as ventilation fans;
- Provide crosstalk attenuators where ducts connect acoustically sensitive rooms;

#### Control of Vibration Transfer

- 7.16 All plant, equipment and associated service pipe and ductwork should be provided with appropriately designed and installed anti-vibration mounts to mitigate vibration transfer into the building structure. This may include springs, rubber mounts, air mounts, inertia bases or spring hangers. The type of isolator that is most appropriate will depend on, among other factors, the mass of the plant item and the lowest forcing frequency of vibration to be isolated.

It is expected that the supplier/sub-contractor of building services plant will be responsible for its isolation. However, a minimum 90% isolation efficiency (i.e., 10% transmissibility) should be achieved. Supporting evidence should be provided in the form of efficiency graphs and calculations.

## 8. QUALITY CONTROL

- 8.1 Please note that achieving performance standards requires strict adherence to best practice construction methodology on site. A checklist of acoustic requirements for quality control is presented in **Appendix B**.

## 9. GENERAL

- 9.1 It is noted that all the recommendations given in this report are for acoustic purposes only. All recommendations must be checked for compliance in other areas e.g., fire, structure, thermal etc.

APPENDIX A: GLOSSARY OF TERMS

| Term               | Description                                                                                                                                                                                                                                                                                                                                                                                                               |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| dB (decibel)       | The scale on which sound pressure level is expressed. Sound pressure level is defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and a reference pressure (2x10 <sup>-5</sup> Pa).                                                                                                                                                                                   |
| dB(A)              | A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e. 'A' - weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.                                                                                                                                                                           |
| L <sub>Aeq,T</sub> | L <sub>Aeq,T</sub> is defined as the notional steady sound level which, over a stated period of time (T), would contain the same amount of acoustical energy as the A - weighted fluctuating sound measured over that period.                                                                                                                                                                                             |
| L <sub>Amax</sub>  | L <sub>Amax</sub> is the maximum A - weighted sound pressure level recorded over the period stated. L <sub>Amax</sub> is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the overall L <sub>eq</sub> noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response. |
| D <sub>nT,w</sub>  | A single number quantity characterising the on-site airborne sound insulation performance of a construction, including transmission of sound via flanking paths (e.g. adjoining floors/walls).<br>The higher the D <sub>nT,w</sub> of a construction, the better its airborne sound insulation performance; the higher the D <sub>nT,w</sub> requirement, the more stringent the criteria.                                |
| R <sub>w</sub>     | A single number quantity characterising the laboratory based airborne sound insulation performance of a construction, independent of transmission of sound via flanking paths.<br>As with D <sub>nT,w</sub> , the higher the R <sub>w</sub> , the better the sound insulation performance; the higher the R <sub>w</sub> requirement, the more stringent the criterion.                                                   |
| C <sub>tr</sub>    | C <sub>tr</sub> is a correction term applied against weighted sound insulation values (R <sub>w</sub> , D <sub>nT,w</sub> etc.) which describes low frequency performance.                                                                                                                                                                                                                                                |
| RT, RT60, T or T60 | The time, in seconds, for a sound to decay by 60dB.                                                                                                                                                                                                                                                                                                                                                                       |

## APPENDIX B: NOTES FOR QUALITY CONTROL

### 1. Blockwork

All blockwork is to be mortared to an almost fair faced standard both horizontally and vertically. Only perfect blocks may be used with no pitting or cracks. The blockwork must seal effectively to the underside of the soffit.

Where blockwork walls form a cavity wall, care should be taken to avoid rubble and snots from bridging the cavity. This is especially important where one or more of the leaves is floating.

### 2. Plasterboard

All plasterboard joints are to be butted tight. The rule of thumb is that the joint should be tight enough over its entire length to prevent a normal business card from being inserted. Multiple layers should be fitted with staggered joints.

Base details and deflection heads are to be as per the British Gypsum White Book unless otherwise stated, and copious amounts of mastic to be used when fitting to the walls, floor and ceiling respectively.

### 3. Mineral Fibre

Mineral fibre slabs are to be butted tightly together and to boundary structures, to form a homogeneous layer.

### 4. Windows

All window frames are to be a good tight fit into the building structure with any gaps to be filled both internally and externally with a non-setting mastic in addition to the usual weather proofing seal to the exterior. Any gaps between the frame and building that are greater than 5 mm are to be packed with a dense mineral fibre prior to mastic sealing.

### 5. Electrical Sockets

Electrical sockets must not be fitted back-to-back and removed areas of blockwork and plasterboard should be kept to an absolute minimum.

### 6. Water Pipes

All water pipes (and any other pipework) are to be resiliently mounted to avoid "water hammer". This is particularly important for plasterboard walls.

### 7. Penetrations

Penetrations are to be dealt with as described in this report. Details for specific services penetrations may be supplied upon request.

### 8. Approved Samples and Inspections

Samples of each individual acoustic element should be provided for inspection at the beginning of its installation. Once approved, the Clerk of Works must ensure that the same level of quality continues throughout construction.

