PREPARED: Wednesday, 08 May 2024

46 AVENUE ROAD, LONDON

ACOUSTIC DESIGN REVIEW

CONTENTS

LIST OF ATTACHMENTS

Project Ref:	AS13192	**Title:**	46 Avenue Road, London
Report Ref:	AS13192.240321.R1	**Title:**	Acoustic Design Review
Client Name:	Culena London Ltd		
Project Manager:	Ben Dymock		
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Clarke Saunders Acoustics Winchester SO22 5BE	This report has been prepared in response to the instructions of our client. It is not intended for and should not be relied upon by any other party or for any other purpose.		

1.0 INTRODUCTION

1.1 Clarke Saunders Acoustics have been appointed to review the architectural and mechanical services design of the residential refurbishment scheme at 46 Avenue Road, London.

1.2 In the absence of specific Employer's Requirements, this review is based on targeting acoustic conditions appropriate for a dwelling of this quality.

1.3 A summary of the acoustic terminology used throughout this report is provided at Appendix A.

2.0 TARGETED ACOUSTIC CONDITIONS

2.1 SOUND INSULATION

Airborne Sound Insulation

2.1.1 Airborne sound insulation targets for internal building fabric (IBF) elements have been developed based on Clarke Saunders Acoustics' previous experience of special projects of this nature. The required performance of a partition separating two spaces is dependent on the sensitivity to extraneous noise, the privacy requirements of the space and the likely levels of noise expected in adjacent rooms.

2.1.2 The following table provides laboratory test specifications for separating walls and floors, based on the 'source level' and 'receive sensitivity'.

2.1.3 The source level categories are 'High', 'Medium' and 'Low'. Examples of room types in the three categories include Kitchen, Lounge and Bedroom, respectively. An additional category of 'Very high' is also included for areas where particularly high noise level may be expected, such as the cinema or plant rooms. These areas may require more specific attention where it would be more appropriate to set a holistic design specification incorporating partition design, structural isolation or other bespoke noise and vibration control treatments.

2.1.4 Receive sensitivity categories include 'High', 'Medium' and 'Low', with an additional 'None' category for rooms such as storage spaces that are not usually occupied.

<table>
<tr><th colspan="2" rowspan="2">R_w SPECIFICATION</th><th colspan="4">SOURCE LEVEL</th></tr>
<tr><th>Low</th><th>Medium</th><th>High</th><th>Very high</th></tr>
<tr><td rowspan="4">Receive sensitivity</td><td>None</td><td>40 dB*</td><td>40 dB*</td><td>40 dB*</td><td rowspan="4">Design specification</td></tr>
<tr><td>Low</td><td>40 dB*</td><td>45 dB</td><td>50 dB</td></tr>
<tr><td>Medium</td><td>45 dB</td><td>50 dB</td><td>55 dB</td></tr>
<tr><td>High</td><td>50 dB</td><td>55 dB</td><td>60 dB</td></tr>
</table>

Table 1 – Proposed airborne sound insulation targets

*Minimum performance standard required for compliance with Building Regulations for internal walls between bedrooms or rooms containing and water closet and other rooms, and internal floors

Impact Sound Insulation

2.1.5 In addition to airborne noise transmission, floor-to-floor impact noise transmission from footfall or similar can disturb occupants. Whilst there are typically no requirements for impact sound insulation within a dwelling, given the intended quality of development, it may be prudent to target an in-situ performance of $L'_{nT,w} \leq 52$ dB between most habitable areas.

2.1.6 Particular attention may also be required for the cinema, which sits directly below the reception. If use of the cinema may coincide with periods of increased foot traffic through the reception, a higher performance may be desirable to minimise audible footfall noise in the cinema space.

2.2 INTERNAL AMBIENT NOISE LEVELS

2.2.1 Internal ambient noise levels within mechanically ventilated/cooled rooms are generally determined by a combination of external noise break-in through windows and building services noise. The glazing specification is currently based on the control of external noise to typical guideline levels for residential settings. It should be noted that low levels of audible anonymous noise such as from building services systems can be desirable to mask other noise sources and increase privacy between spaces. The noise levels outlined below should, therefore, be considered an appropriate target level, rather than a maximum. Further guidance from the client on particular sensitivities with regard to audible external and mechanical services noise would be required to inform any amendments to the specified performance

2.2.2 Table 2 shows appropriate Noise Rating (NR) values for the MEP system, which should be achieved when mechanical services are operating at the typical operating duty.

ROOM	TYPICAL OPERATING DUTY TARGET, NR $L_{eq,T}$
Cinema Room	15 - 25
Bedrooms, Study	25
WCs, En-Suites, Lounge, Reception Room	30
Kitchen	35
Gym	35

Table 2 – Building services noise level targets

2.3 LIFT NOISE AND VIBRATION CRITERIA

2.3.1 Acceleration/deceleration rates of the lift cars should not exceed 1.5 m/s^2 at any time during a complete cycle. This should preferably be below 1.2 m/s^2. The rate of change of acceleration/deceleration of the car (jerk) should not exceed 0.8 m/s^3 at any time during the cycle for lifts.

2.3.2 In addition, door noise, when measured with a precision grade sound level meter set to "fast" meter response at 1.5 m from the floor and 1 m from the door face, should not exceed L_{max} 55 dB(A).

2.3.3 Noise levels in the car at the maximum car velocity in the cycle should not exceed L_{max} 55 dB(A).

2.3.4 In-car announcements should not exceed L_{max} 65 dB(A) when measured as described above.

2.3.5 In the lift lobby or landing, lift noise, when measured with a precision grade sound level meter set to "fast" response at 1.5 m from the floor and 1 m from the door face, should generally not exceed L_{max} 55 dB(A) at any time during the lift cycle. This does not include lift arrival indication sounders, which should operate at a level generally below L_{max} 65 dB(A).

2.3.6 Noise levels from lifts in habitable areas of the property should not exceed those set out in Table 3.

ROOM	MAXIMUM NOISE LEVEL $L_{Amax,F}$
Bedroom	25
Living room	30
Other areas	35

Table 3 – Lift noise limits in habitable areas

2.3.7 The maximum vibration level measured on the floor of habitable spaces within dwellings shall not exceed a peak weighted acceleration level as defined in BS6472-1:2008 of 0.01m/s^2 in the vertical axis using the w_b weighting network.

2.4 ROOM ACOUSTICS

2.4.1 Appropriate control of reverberation time within standard spaces, such as bedrooms, is normally achieved by means of typical finishes and furnishings.

2.4.2 Specific room acoustic targets are, therefore, provided for spaces with high requirements, or in spaces that would benefit from specific consideration due to a tendency for particularly high reverberation times. Table 4 provides a summary of typical rooms acoustics targets for such spaces.

ROOM	REVERBERATION TIME, T_{mf}
Pool	≤ 1.5 seconds
Cinema Room	0.2 – 0.5 seconds
Reception	≤ 1.5 seconds
Dining	≤ 1.2 seconds
Lobby/stairwell	≤ 1.5 seconds

Table 4 – Proposed reverberation time control targets

2.5 CINEMA

2.5.1 It is understood that a cinema design specialist will not be appointed to provide detailed design advice on cinema fitout and audio systems. While the intention is to provide conditions suitable for a high-quality system, a high specification private cinema design is understood not to be targeted. Nevertheless, guidance is provided below for a high specification space as a benchmark against which to assess the resulting performance of the space.

2.5.2 Control of room acoustics within the Cinema Room can be achieved by considering the guidance within ITU-R BS.1116-1 *Methods for the subjective assessment of small impairments in audio systems*, which has been referred to by Dolby in relation to high quality private cinema rooms.

2.5.3 The acoustic design criteria stated within this report are intended to be achieved at the front row, centre seating position, 1.2m above the floor. This position is referred to as the 'reference position' throughout this report.

2.5.4 The following dimensional conditions should be observed to ensure the potential for unwanted build-up or cancellation of low frequency sound at any particular point in the room is minimised:

$$\frac{1.1l}{w} \leq \frac{l}{h} \leq \frac{4.5w}{h} - 4$$

where: l=length, w=width; h=height

2.5.5 A mid-frequency reverberation time, T_{mf}, for this room of between 0.2 and 0.5 seconds is targeted. The reverberation, measured at the reference position in 1/3 octave bands, is targeted not to exceed the greater of either the tolerance limits shown at Figure 1, or +100 % T_{mf} at 63 Hz, ±30 % T_{mf} between 200 Hz and 4 kHz; and ±50 % T_{mf} between 4 kHz and 8 kHz.

2.5.6 Reflections reaching the reference position within 15ms of the direct sound should be attenuated by at least 6 dB relative to the direct sound level.

2.5.7 To prevent unwanted flutter echoes, parallel acoustically reflective surfaces are to be avoided within the space.

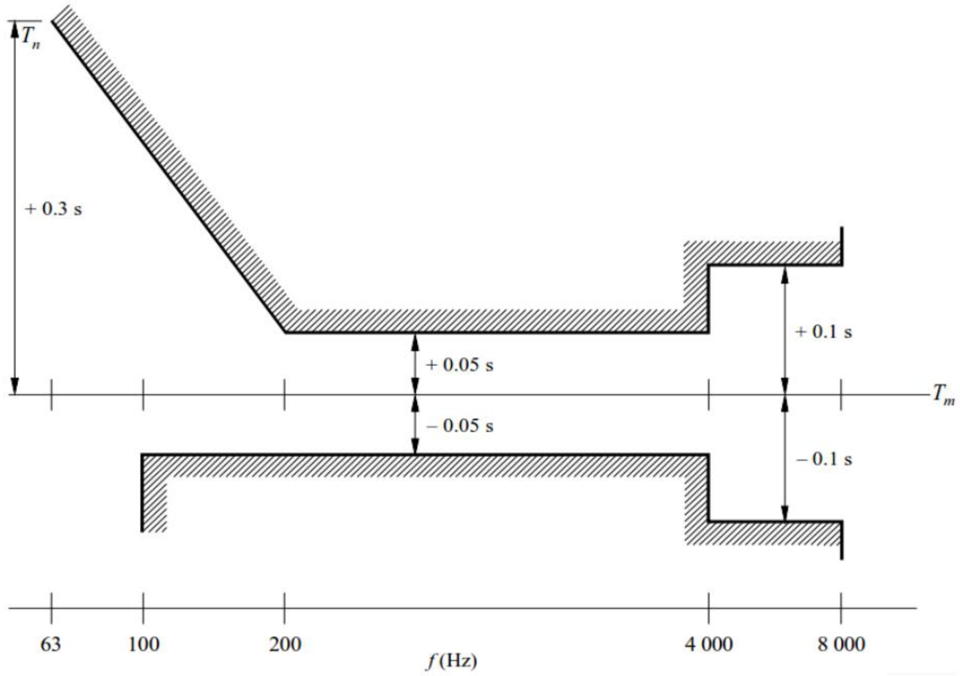


Figure 1 – Tolerance limits for reverberation time in the cinema space.

3.0 ACOUSTIC DESIGN REVIEW

3.1 A review of the AU Architects Ltd drawing package issued in January 2024 has been undertaken.

3.2 INTERNAL BUILDING FABRIC

Floors

3.2.1 The floor construction between lower ground and ground floor spaces is shown as follows:

- 30mm floor finish zone;
- 65mm sand and cement screed;
- Approx 39mm underfloor heating system;
- 5mm foam polyethylene layer;
- 255mm concrete slab;
- 60mm Kooltherm plus soffit board;
- Casoline metal frame ceiling forming cavity of 264mm;
- 2 layers 15mm SoundBloc.

3.2.2 This floor is expected to provide a high level of airborne sound insulation performance between high sensitivity - high source noise adjacencies as shown in Table 1. This is, therefore, expected to be sufficient for all spaces in this respect, however, the cinema and plant rooms at lower ground floor should be considered separately.

3.2.3 Dependent on the Client's expectations of the concurrent use of Cinema Room and Reception, it may be prudent to upgrade the suspended ceiling in the cinema. An improvement could be achieved by suspending the 2no layers of SoundBloc from appropriately specified resilient hangers, with at least 100mm medium density mineral wool insulation in the cavity. Further improvement could be achieved by increasing the cavity depth between the underside of the slab and the secondary ceiling. In general, the larger the cavity, the better the acoustic performance, though this would need to be balanced against minimum ceiling heights.

3.2.4 The system may not, however, achieve the targeted impact sound insulation performance of $L'_{nT,w} \leq 52$ dB. The build-up is noted to include a 5mm "foamed polyethylene layer", though details of this product and its acoustic performance is not provided. It would be advisable to ensure that a resilient layer providing a minimum impact sound insulation performance ΔL_w 23dB is used throughout the floor build-up on the ground floor slab, which must be appropriately coordinated with the UFH system. This may be best incorporated between the slab and screed layers and may be achieved with a suitably specified circa. 6mm thick product. Product selections would need to be confirmed with CSA prior to procurement to confirm this performance is achievable.

3.2.5 The above specification would be expected to provide a level of impact noise control significantly above typical residential design targets, providing a high level of acoustic separation for most adjacencies such as bedrooms. For context, separating floors between separate dwellings (i.e. apartments) are required to achieve a minimum sound insulation performance of $D_{nT,w}+C_{tr}$ 45dB and $L'_{nT,w}$ 62 dB for airborne and impact noise, respectively, for compliance with Building Regulations. Although Building Regulations do not apply here (since these are internal floors within a single dwelling), this does demonstrate the significant level of acoustic separation integrated into the project design for floors at 46 Avenue Road; far exceeding minimum performance values typically adopted for partitions within and between dwellings.

3.2.6 Some audible noise from impact sources, such as footfall, moving of furniture, etc., may, however, still be present, albeit at a low level and in most cases only occasionally. An increased amount of activity may be expected in the reception room during parties or social gatherings, for example. If the cinema room is likely to be used concurrently with these gatherings, it may be desirable to minimise these impacts even further. If so, a higher performing resilient layer to provide a minimum performance of ΔL_w 30dB within the reception room floor build-up may be prudent. This could typically be achieved with a circa. 10mm resilient layer product.

3.2.7 Detailing is critical to ensure this resilient layer performs as expected. All supplier guidance should be followed, including the use of appropriate perimeter detailing and fixing methods to ensure there is no bridging between the screed and slab below as well as the walls.

3.2.8 Where building services systems are to be suspended from the underside of the structural slab, these should be resiliently mounted. It may be appropriate to mount these on the same acoustic hanger where this is included; in this case an appropriate hangar should be specified to isolate the driving frequency of the vibration from building services systems and to efficiently isolate the ceiling system. Combined loads from each hanger would also need to be considered to ensure they are within the design range of maximum isolation efficiency.

3.2.9 The floor construction between at all other levels is shown generally as follows:

- 30mm floor finish zone;
- Approx 39mm underfloor heating system;
- 255mm concrete slab;
- 60mm Kooltherm plus soffit board;
- Casoline metal frame ceiling forming cavity of 315mm;
- 2 layers 15mm SoundBloc.

3.2.10 This floor is expected to provide a high level of airborne sound insulation performance between high sensitivity - high source noise adjacencies as shown in Table 1 and is, therefore, appropriate for the locations shown.

3.2.11 For the separating floor between the ground floor areas (kitchen, reception, dining, entrance and study) and 1st floor bedrooms, a resiliently suspended mass barrier ceiling, as described above for the cinema room, may be advisable, particularly if higher noise levels are expected at ground floor (e.g. music, large gatherings, etc) during concurrent use of the 1st floor bedrooms for resting.

3.2.12 No resilient layer to control impact sound transfer is shown. It is recommended that a resilient layer is included on all floor build-ups between noise sensitive habitable areas providing a minimum performance of ΔL_w 23dB. If floor finishes are carpeted with a good quality underlay, a resilient layer may not be required, however, it may be prudent to include the layer to futureproof any carpeted areas being changed to a hard floor finish in the future.

Walls - bedrooms

3.2.13 A majority of the internal walls between habitable rooms are shown to be Wall Type 09, as described below:

- 215 / 140 / 100mm medium dense blockwork;
- 8mm render on each side;
- 15mm SoundBloc on plaster dabs.

3.2.14 Where there is a door in the wall, the door performance will be the determining factor and any of the blockwork sizes listed above would be more than sufficient to match the achievable performance of the door.

3.2.15 Where there is no door in the wall, confirmation would be required on the blockwork thickness in the various areas of use, in addition to the actual numerical density prior to confirming acceptability.

3.2.16 On inspection of the architectural drawings, bedroom suites generally share party walls only between en-suites where nominal 140mm blockwork walls appear to be shown. It is expected that this construction would provide a medium level of acoustic separation for medium sensitivity - medium source level adjacencies as shown in Table 1 and therefore is expected to be sufficient where shown.

3.2.17 The exceptions to this are the bedrooms on the south corner (e.g. 1F 05 to 1F 08, 2F 06 to 2F 09) which share a party wall between the main bedroom space. Here the drawings appear to indicate a 215mm blockwork wall. This construction is expected to achieve a performance in excess of R_w 60dB, providing a high level of acoustic separation as shown in Table 1 and would, therefore, be suitable for this adjacency.

3.2.18 If it is desirable to enhance the performance of the Wall Type 09 further, the achievable performance on site would benefit from removing the dot and dab plasterboard to one side such that one side is render only to reduce the risk of potential interaction between matched small cavities on dot and dab plasterboard linings,.

3.2.19 Internal Wall Type 10 is generally shown between the central stairwell/landings and surrounding areas such as bedrooms, which comprises a single stud partition with two layers of plasterboard each side. Although not expected to provide a medium or high level of acoustic separation, this type is primarily used where there are doors in the wall, which would limit the acoustic potential of the wall and, therefore, the lower level of performance may be considered appropriate.

Walls - plantrooms

3.2.20 Walls between basement plantrooms/boiler rooms and adjacent spaces are shown generally to be 215mm blockwork. This construction provides an appropriate base level of acoustic performance; however, it is noted that a staff bedroom is located adjacent to the LG 10 plantroom. The plant to be installed here has not been confirmed, however, careful consideration to noise levels, vibration isolation and reverberation control may be necessary here. Confirmation of all plant to be located in this area, along with expected noise emission levels and vibration isolation proposals should be provided to CSA for review and comment.

Walls – liftshaft

3.2.21 LIftshaft walls are shown to be approximately 200mm reinforced concrete with a plasterboard on dabs lining on the outer face. This would be considered sufficient for control of noise from appropriately specified, high quality, residential lift systems.

Walls – cinema

3.2.22 On three sides the cinema walls are Wall Type 01 external walls, comprising:

- Reinforced concrete perimeter wall (spec TBC);
- 100mm cavity with 90mm thermal insulation;
- 140mm medium density blockwork;
- Plasterboard on dabs.

3.2.23 Blockwork is shown to be on the internal face on the retaining wall (east) and on the external face of the party wall with the gym.

3.2.24 The cinema room also shares walls with the liftshaft, the shower room associated with the adjoining lounge (Wall Type 09 – 140mm), the corridor to the gym/swimming pool (wall type 10 – see below description) and the lobby (wall type 10 with door). The door to the cinema opens directly to the lobby.

3.2.25 The following outline design measures should be incorporated to enhance control of high noise levels from the cinema room transmitting to the surrounding spaces.

- Fully independent lining on the internal face of all walls except the retaining wall, comprising:
    - 2 layers 15mm Soundbloc
    - 70mm I-studs
    - Minimum 100mm cavity to masonry wall
    - Minimum 50mm high density rockwool in cavity
- Internal blockwork on retaining wall to be fully independent of RC wall;
- Lobbied entrance door (doors to required specification – see section below). Lobby to comprise 2 layers plasterboard either side of minimum 70mm C-stud with 50mm mineral wool insulation in the cavity;
- All loudspeakers to be isolated from the surrounding structure by appropriately specified resilient mounts, as required;
- If the lobby to the cinema room can encompass all areas of wall type 10 then this wall will be acceptable, subject to suitable design of the lobby walls. Wall type 10 areas would need to be replaced with wall type 09 if this area is exposed to noise from the cinema.

3.2.26 Internal Wall Type 10 is generally shown between the central stairwell/landings and surrounding areas and comprises a single metal stud partition with two layers of plasterboard each side. This wall type is primarily used where there are doors in the wall, which is appropriate. It would not provide a high level of acoustic separation around the cinema room and, therefore, may not be appropriate unless a lobbied entrance is used as described above.

3.2.27 Particular attention will need to be paid at junctions of this wall with other building elements. There must be no continuous exposed elements that cross the separating wall lines. Typical areas where wall linings will need to be discontinued either side of the partition are the external wall linings, and the lift core lining.

Walls – risers

3.2.28 The separating wall between the principal ventilation riser and adjacent bedrooms/ensuites is shown as wall type 09 using 140mm blockwork with dot and dab linings. Further shaftwall constructions within this riser are not shown, though this is often required for fire safety measures. This construction is expected to provide adequate control of duct breakout noise, provided specified duct attenuators are fitted close to the plant unit.

3.2.29 Wall type 10 is shown between the riser and landing/stairwell. This is expected to be sufficient provided the assumptions outlined above are followed. Riser doors must achieve a minimum performance of R_w35dB.

3.3 DOORS

3.3.1 Door schedules have not yet been received. The following section provides general advice on the sound reduction of doorsets.

To put the following advice in context, the table below provides a subjective description of what can be achieved with varying door acoustic ratings. The typical performance achieved by a solid timber door with seals as might be found in most residential settings (e.g. circa R_w30dB) may provide adequate control of noise such as moderate speech, low-level music, etc. Raised voices and moderately loud music will still be audible in adjacent spaces unless heavy duty steel doorsets and/or more visually intrusive seal arrangements are used.

Wall SI specification	Minimum Indicative Door SI Spec (depending on adjacency sensitivity)	Subjective perception of acoustic separation†
R_w40dB	R_w30dB	Normal level conversation will be audible and intelligible, particularly if receive room is quiet. Raised voices, music or other louder activity will be audible and distinct and likely to be considered intrusive.
R_w45dB	R_w30 - 35dB	Normal level conversation will be audible and intelligible at the lower end of the performance range, particularly if receive room is quiet. Still audible but less intelligible at the higher end. Raised voices, music or other louder activity will be audible and distinct and could be considered intrusive, depending on sensitivity.
R_w50dB	R_w35 – 40dB*	Normal level conversation will be audible but mostly unintelligible. Raised voices, music or other louder activity will be audible but increasingly less distinct with a lower likelihood of being considered intrusive.
R_w55dB	>R_w40dB*	Normal level conversation approaches inaudibility. Raised voices, music or other louder activity will be audible but will be decreasingly intrusive.
R_w60dB	High specification walls not consistent with door openings	-

Table 5 – Door performance and subjective perception of resulting privacy

Doorsets achieving a performance higher than R_w40dB will generally require additional elements to maintain adequate seals such as threshold plates and bolt seals

3.3.2 Typically for such luxury settings, a compromise must be found between the acoustic performance of doors and aesthetics.

3.3.3 Where it is desirable to achieve a relatively high degree of acoustic separation between spaces connected by doors, design features required to achieve a reasonable acoustic performance are provided below.

3.3.4 The limiting factor in the acoustic performance of solid core timber doors of at least >45mm (or greater for higher performance doors), as would be expected in a development of this type, is generally the seals at the head, jamb, threshold and meeting stile (in the case of double doors).

3.3.5 In general, to achieve an acoustic performance ≥R_w 30dB, seals will need to be provided around the entire perimeter of the door. Some typical details are provided for systems that can reliably achieve a reasonable performance rating of up to around ~R_w 40-43dB below. Note that the examples below are commercially available "off the shelf" solutions. Given the likely bespoke nature of the doors for this project, it may be possible to incorporate these details more discretely into the door architecture; the images below, therefore, are merely intended to illustrate the design principles required to maintain the performance of the doors.

3.3.6 However, it should not be assumed that incorporation of these features will automatically provide the intended acoustic performance. Confirmation that a bespoke doorset is capable of achieving the desired acoustic performance should be sought from the supplier, either by laboratory testing or by on-site measurements at an early stage of the installation.

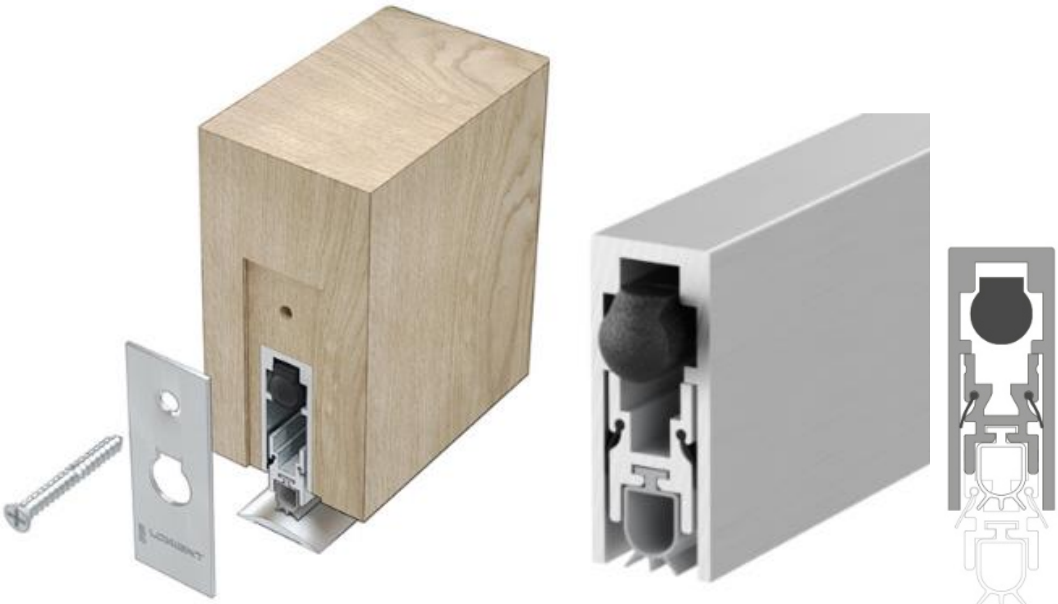
SEALS – ACOUSTICALLY RATED DOORS ≥ R_w 30dB

Head and Jamb

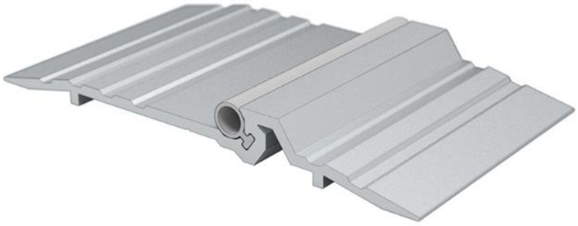
3.3.7 In terms of seals at the head and jamb, generally relatively discrete seals located within the reveal of the door frame can be used such that they are less noticeable on the door leaf itself when the doors are open. Two typical arrangements are shown in the figures below. For doors rated in excess of R_w 40dB, a double seal may be required (e.g. both of the below arrangements or two of the second example).

Threshold

3.3.8 As a minimum for any acoustically rated door, an automatic drop seal is likely to be required. An example arrangement is shown below. Some manufacturers specify doors achieving ratings up to R_w 40dB without a threshold plate, however, the performance is then heavily dependent on achieving a good compression seal connection to the floor finish. The use of a threshold plate provides a more reliable surface against which the rubber seal can compress when the door is closed.

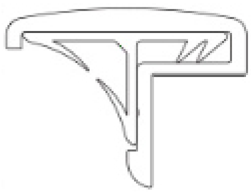


3.3.9 Threshold seals can also be achieved by a stepped threshold plate with the compression seal located on the plate itself, as shown below. This would clearly be more visually intrusive but could be incorporated in to changes in floor finishes between rooms.



Centre Meeting Stile

3.3.10 For the seals at the meeting stile of double doors, the same single or double perimeter seals as for the head and jamb could be used, although these would clearly be visible when the doors are open. Other options, such as the below could also be used. While these are more visible when the doors are closed, they could be worked into the architectural detail of the door finish. Manufacturer test information indicates that seals of this type are typically limited to achieving ~R_w 35dB, although this is for a seal on one side of the stile only (as shown below). Manufacturers may have further information on combinations of seals that could achieve a higher performance.



SEALS – ACOUSTICALLY RATED DOORS >R_w 43dB DOORS

3.3.11 To achieve an even greater acoustic performance from non-lobbied doors, increasingly engineered solutions are required that would be less appropriate for a residential setting, such as heavy steel rather than timber door leaves and mechanical seals. Typically for doorsets that are rated up to higher performance values, suppliers pre-fabricate and assemble the door leaves, frames, hinges and seals off-site such that the whole unit can be shipped to site as a whole. This allows for a greater reliability of achieving a good seal between the door leaf and the frame.

3.3.12 Some suppliers rate timber doors up to a higher performance rating, for example the Huet ISA DX 49, which is rated up to R_w 51dB. The higher performance is achieved by increasing the mass of the door leaf by incorporating steel layers sandwiched between timber layers and by the use of multiple seals within rebated door frames.

3.4 PENETRATION DETAILING

3.4.1 Proposed detailing around services penetrations have not been provided for review.

3.4.2 General principles of appropriate penetration detailing are provided in Appendix B. Proposed penetration details should be provided to CSA for review when available.

3.5 ARCHITECTURAL DETAILING – GENERAL

3.5.1 AU Architects Ltd detail drawings issued in January 2024 have been reviewed. Details of junctions at the base of separating walls and junctions of the separating floors are shown.

3.5.2 Junctions of new separating floors with the retained façade appear to indicate the slab edge abutting the masonry façade. It is assumed the slab does not penetrate the façade elements. Suspended plasterboard ceiling and floor finish elements as shown are expected to be sufficient to adequately control potential flanking paths via the slab edge, provided all are appropriately sealed.

3.5.3 Perimeter detailing is critical for the acoustic performance of the resilient layer within the floor build-up. All supplier installation guidance should be followed. The resilient layer should return up around the perimeter and underneath the skirting to ensure no rigid connection between the floor finish and adjacent spaces.

3.5.4 Detail 312, showing internal wall base and head junctions, and coordination with ceiling elements, indicate an appropriate design intent. Walls are shown to run from slab to slab, splitting the floor finishes between rooms. In general, between internal rooms within suites (i.e. between en-suites and bedrooms), this is not necessary for the acoustic design. However, for partitions between suites and unconnected rooms, splitting floor finishes (including the resilient later) is required.

3.5.5 An appropriate deflection head detail is shown. It is noted that no plasterboard or timber packers are shown in the headtrack. This is acceptable, provided suspended plasterboard ceilings are on both sides of the wall to control noise flanking via the deflection head. Where a higher acoustic performance for separating wall is required, an appropriate drywall deflection head detail including packer and seals should be considered.

3.5.6 It is noted that only drywall construction detail is shown. A corresponding detail should be developed for masonry blockwork walls, indicating the design intent for flanking noise control via the deflection head. Typically, this would require an appropriate flexible cavity stop to full depth of the partition thickness, sealed with a non-hardening sealant.

3.6 EXTERNAL BUILDING FABRIC

3.6.1 The site is primarily affected by road traffic noise on Avenue Road, though noise levels to the rear are not insignificant. The external building fabric performance has been designed to achieve the recommended maximum levels as defined in BS8233:2014. In most cases, these internal noise levels are deemed acceptable by occupants in urban environments, however, if the client or their family members are particularly sensitive to noise, or require external noise levels to be reduced further, glazing specifications may need to be increased.

3.6.2 The minimum required glazing performance specification for rooms on the primary facades are summarised in the table below.

FAÇADE/ROOM	MINIMUM REQUIRED GLAZING PERFORMANCE (dB)
Front/Main Bedroom	Rw38
Front/Secondary Bedroom & Ensuite	Rw30
Rear/Bedroom & W.I.C	Rw33

Table 6 – Lift noise limits in habitable areas

3.7 ROOM ACOUSTICS

3.7.1 Exact room finishes are not yet known, though it is assumed, based on internal wall and floor types, that walls will be plasterboard on blockwork, floors will be hard floor finish rather than carpeted and ceilings will be suspended plasterboard.

3.7.2 Reverberation times in most habitable areas such as reception rooms, dining room and bedrooms will largely depend on the furnishings. It should be noted that the currently proposed surface finishes described above are hard, reflective surfaces which do not provide a significant amount of absorption. Reverberation times in unfurnished rooms are, therefore, likely to be higher than typical design targets for these spaces. Furnishings, such as rugs, furniture, curtains, bookshelves, etc, tend to combine to provide an adequate room acoustic environment. However, if lower reverberation times are desirable, such as to create a more intimate feel in dining rooms or reception/lounge areas, then further absorptive finishes may be required.

3.7.3 Additional absorptive finishes may include wall or ceiling mounted panels, suspended rafts, or decorative uneven wall finishes to provide diffusion of reflected sound. Acoustic plaster systems can also be used, which provide additional absorption while maintaining a monolithic plaster appearance.

3.7.4 Should this be required, the client's expectations would need to be further defined and a more detailed analysis of proposed finishings would need to be undertaken. To provide an indication of possible room acoustic control products, some examples can be found on the CSA Pinterest page on the following links.

- https://www.pinterest.co.uk/clarkesaunders/acoustic-panels/
- https://www.pinterest.co.uk/clarkesaunders/suspended-acoustic-treatments/
- https://www.pinterest.co.uk/clarkesaunders/acoustic-ceiling-treatments/
- https://www.pinterest.co.uk/clarkesaunders/acoustic-plaster-finishes/
- https://www.pinterest.co.uk/clarkesaunders/wall-diffusers/

Pool

3.7.5 The pool room is anticipated to necessarily comprise primarily hard finishes. The curved suspended ceiling provides a degree of breakup of the parallel reflective surfaces and is also an opportunity to incorporate acoustically absorptive finishes, if desired. The selected product will need to be appropriate for use in a humid environment. Diffusive wall and ceiling finishes could also be used. Again, some indicative designs and finishes can be found on the CSA Pinterest site:

- https://www.pinterest.co.uk/clarkesaunders/swimming-pool-acoustics/

3.7.6 It would be advisable to seek further guidance from the client on particular requirements for the acoustic design of the pool before undertaking detailed design work on finishes. Typically, a more reverberant atmosphere is expected and tolerated in swimming pool areas, in which case additional required treatments would likely be limited. However, if the client has any specific requirements in this respect then further advice can be provided.

Cinema Room

3.7.7 The dimensions of the cinema room do not comply with the dimensional conditions outlined in Section 2.5 and thus some undesirable low frequency effects may occur at some positions within the room. The room also comprises parallel reflective walls which may result in other unwanted effects such as flutter echoes. These dimensions are not dissimilar to a typical domestic setting and so if the client's expectations are that the Cinema Room be used as a high-quality television viewing room, then these effects may be considered acceptable. Where a more specialist private cinema viewing experience is desired, further mitigation should be considered.

3.7.8 There may be opportunities to mitigate these effects within the fitout design. The lobbied door arrangement and wall linings present opportunities to reduce the prevalence of parallel reflective surfaces and optimise room dimensions, for example.

3.7.9 In terms of the more high-level reverberation time criteria, a combination of carpet, Cinema Room furniture and absorptive/diffusive wall treatments typically adopted within high-end cinema/listening room/studio design should be capable of providing suitable reverberant conditions (assuming a solid plasterboard ceiling). If a Class A product is used, calculations show that this could be used on around half the wall area and suitable reverberant conditions achieved, provided it is relatively evenly distributed and there are no significant areas of hard parallel surfaces.

3.8 BUILDING SERVICES NOISE

3.8.1 CSA has reviewed the proposed standard operational and emergency plant selections together with the mechanical and ventilation services drawings supplied by Edward Pearce and Partners Ltd.

3.8.2 Based on the current design, the following acoustic elements have been considered:

- Fan noise via duct to internal and external areas;
- Fan noise via duct breakout through ceilings to internal areas; and
- Casing radiated noise to internal areas.

3.8.3 Noise emission levels provided by the manufacturers and, where necessary, independent laboratory test data for each plant unit are provided in the attached Plant Noise Schedule (AS13192/PNS).

3.8.4 The following schedules detail the silencer insertion losses required in order to achieve the necessary internal noise design criteria:

- Atmospheric Side Silencer Schedule (AS13192/ASS);
- Room Side Silencer Schedule (AS13192/RSS);

3.8.5 With reference to the atmospheric side plant noise emissions, noise data for the current selection is not considered to be tonal.

3.8.6 For each system, silencer insertion losses have been specified in order that the acoustic design criteria are achieved. To provide assistance in selection of suitable silencers, an indicative length of silencer required has been stated in the schedules.

3.8.7 The calculations do not account for turbulent flow conditions that may arise through poor ductwork design or installation and expect laminar flow. See comments on System Generated Noise below for guidance.

3.8.8 It is understood that all ductwork comprises galvanised steel and that all ductwork in plant rooms between the plantroom structure penetration and the silencer is to be acoustically lagged with a proprietary product, such as 10kg/m^2 Muftilag (or equivalent).

3.8.9 Fancoil unit attenuation schedules have been calculated based upon the following assumptions, which are understood to be incorporated into the design as a minimum:

- All supply or return air plenums will be internally lined with acoustic foam of minimum thickness 50% internal dimension;
- Plenums are assumed to be minimum 600mm wide x 250mm high x 250mm deep;
- All vertical FCU discharge and return air paths are ducted to plenums of minimum dimensions 1500mm wide x 250mm high x 250mm deep, internally lined with acoustic foam with thickness of a minimum 50% internal dimension;
- FCU sound power levels have been determined from currently available in-duct sound power level test data from Daikin (see attached plant noise schedule AS13192/PNS;
- The assumed duty for the basis of silencer selection is operating at medium speed and pressure setting.

3.8.10 Indicative silencer specifications have been provided in AS13192/RSS for sizing purposes. An appointed supplier may be able to advise on the use of alternative specifications; however, these should meet the minimum insertion losses provided.

3.8.11 In some cases, a significant amount of attenuation is likely to be required, including on the FCUs. It should be confirmed via laboratory test data from the manufacturer that the discharge and inlet/casing radiated noise levels provided in schedule AS13192/PNS are correct. Attenuation requirements can be revisited, if required, if any significant variations in expected noise emission levels are expected. This requirement could also be balanced against the aspirations of the client with regard to desirable internal noise levels.

System Generated Noise

3.8.12 Good practice guidance on this issue generally assumes maximum ductwork aspect ratios of approximately 3:1. Where aspect ratios are in excess of this limit, CSA has referred to other guidance, such as that from CIBSE and textbooks, to derive velocity limits that should also maintain the noise criteria of the rooms through which the ductwork passes. These limits are summarised below.

DUCT LOCATION	DUCT TYPE	MAXIMUM FACE VELOCITY, M/S			
		NR 40	NR 35	NR 30	NR 25
Riser or above intact plasterboard ceiling	Rectangular	8.5	7.5	6	5
	Circular	13.5	12.5	11	10
Above suspended lay in grid ceiling or plasterboard ceiling with perforations/return grilles/shadow gaps	Rectangular	5.5	4.5	3.5	3
	Circular	8.5	7	6	5
Extract stub duct above ceiling		3.5	3	2.5	1.5
Grilles and Diffusers		2.5	1.7	1.5	1.2

Table 7 – Guideline maximum duct velocities
Note: higher velocities may be permitted if ductwork is acoustically lagged using a mass loaded barrier product. Suitable product to be approved by CSA.

3.8.13 Regenerated noise as a result of ductwork components such as dampers, grilles, diffusers, etc. should be designed out. It must be ensured that components are selected in the context of the appropriate conditions within the room being served. A review of all components using relevant schedules and manufacturers' data is advisable prior to procurement and installation to maintain a compliant design.

Vibration Isolation

3.8.14 All plant should be isolated from the surrounding structure using appropriate anti-vibration mountings.

3.8.15 All air handling units, fan coil units and ventilation ductwork should be supported using resiliently isolated hangers or fixings.

3.8.16 Please note that until the vibration isolation design has been reviewed by Clarke Saunders Acoustics, the design is at risk of non-compliance.

3.8.17 A schedule of required isolation can be issued once the plant selection is complete.

Plantroom structures

3.8.18 The basement plantroom lies adjacent to a bedroom, which is assumed to be staff accommodation. Depending on the plant to be installed here, careful attention must be paid to the separating partitions in this area. It is understood that Wall Type 09 is proposed here with a 215mm medium density blockwork used. This is expected to be sufficient for typical domestic services systems. As noted above, Wall Type 09 would benefit from the removal of dot and dab plasterboard to one side, leaving plasterboard on one side and render only on the other. This may be particularly relevant where low frequency noise sources, such as large items of plant are present. If noisier plant is proposed within internal plantrooms, an increased performance to walls and ceilings in the plantroom may be required. This may comprise a fully independent plasterboard lining on the internal plantroom wall and a resiliently suspended ceiling. A further specification can be provided following a review of the proposed plant.

3.8.19 It must be ensured that plant is resiliently mounted wherever required to ensure structural transmission of noise and vibration is adequately controlled.

3.9 HYDRAULIC SYSTEMS

3.9.1 Hydraulic pipe systems, such as waste and drainage, should be designed and wrapped to control emitted noise to a level 5 dB below the project design criteria for building services plant, or lower, within any occupied rooms.

3.9.2 Pipework enclosures and penetrations should be designed to ensure that airborne sound insulation performance of the partition is not compromised.

3.9.3 All reasonable controls shall be adopted to minimise noise emissions from hydraulic systems. Hydraulic systems should be designed and installed to minimise audibility of water/waste noise within the residential areas of the apartment and adjoining residences. The following are typical good acoustic design principles for hydraulic systems.

- The risk of water hammer should be minimised by lowering operating pressures and/or through use of pressure snubbers. As a general guide at this stage, water pressures should be regulated to the minimum satisfactory working pressure and, in any case, do not exceed 350 kPa;
- Cistern fill times shall be adjusted, particularly in toilets adjacent to quiet areas, to approximately 90 to 120 seconds;
- Hard grouting and chasing of water pipes in masonry walls shall be avoided, particularly where walls are common with noise sensitive areas;
- In noise sensitive areas, pipes should be supported with clamps having a soft neoprene sleeve;
- Cast iron or acoustically-treated plastic soil and waste pipes shall be used in preference to lightweight pipes such as standard plastic and copper in noise sensitive areas;
- Pipework should not be supported from lightweight constructions.

Relevant research indicates that fluid velocities in pipework, i.e. supply systems, are controlled to 1.25 m/s or less within NR25 areas provided that:

- Elbows and tees are avoided within low noise areas, i.e. use of bends is recommended, and;
- Pipework is fixed to heavy structures, i.e. concrete/masonry with soft-sleeved clamps
- Velocities of 1.5 m/s would be acceptable elsewhere.

3.9.4 Where it is unavoidable that hydraulic systems pass through adjacent residential spaces, i.e. other than the room served, they should be concealed. As a minimum, bulkheads should consist of minimum two layers of 12.5 mm plasterboard with staggered and sealed joints. When concealing waste systems, the bulkhead should also be lined internally with 50 mm mineral fibre insulation (30 – 40 kg/m^3).

Waste systems behind lightweight constructions within apartments should also be treated as follows when not in the room being served:

- Cast iron or acoustically-treated plastic pipework – no treatment;
- Copper pipework – wrap in minimum 25 mm thick acoustic insulation/foam and lag with 5 kg/m^2 loaded vinyl sound barrier material, or similar;

- Standard plastic pipework – wrap in minimum 50 mm thick acoustic insulation/foam and lag with 5 kg/m^2 loaded vinyl sound barrier material, or similar.

3.9.5 Plastic pipework to taps would require no treatment.

3.9.6 Where pipework passes through separating or internal floors, penetrations should ensure effective acoustic sealing around the pipes. This would be achieved by initially providing all pipework with a resilient sleeve detail. Large floor openings can be in-filled using a proprietary cementitious fire-stopping compound to the depth of the slab, whilst smaller openings can be loosely packed with mineral fibre insulation and closed-off with plasterboard pattresses above and below the slab. If using fire-stopping compound, it should be ensured that pipework holes in the formwork are cut oversize to prevent contact with the pipes.

3.9.7 Any gaps remaining around pipework penetrations should be sealed with a continuous bead of non-hardening sealant.

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CLARKE SAUNDERS ACOUSTICS

Acoustic Terminology

The human impact of sounds is dependent upon many complex interrelated factors such as 'loudness', its frequency (or pitch) and variation in level. In order to have some objective measure of the annoyance, scales have been derived to allow for these subjective factors.

Sound	Vibrations propagating through a medium (air, water, etc.) that are detectable by the auditory system.
Noise	Sound that is unwanted by or disturbing to the perceiver.
Frequency	The rate per second of vibration constituting a wave, measured in Hertz (Hz), where 1Hz = 1 vibration cycle per second. The human hearing can generally detect sound having frequencies in the range 20Hz to 20kHz. Frequency corresponds to the perception of 'pitch', with low frequencies producing low 'notes' and higher frequencies producing high 'notes'.
dB(A):	Human hearing is more susceptible to mid-frequency sounds than those at high and low frequencies. To take account of this in measurements and predictions, the 'A' weighting scale is used so that the level of sound corresponds roughly to the level as it is typically discerned by humans. The measured or calculated 'A' weighted sound level is designated as dB(A) or L_A.
L_{eq} :	A notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the actual, fluctuating sound measured over that period (e.g. 8 hour, 1 hour, etc). The concept of L_{eq} (equivalent continuous sound level) has primarily been used in assessing noise from industry, although its use is becoming more widespread in defining many other types of sounds, such as from amplified music and environmental sources such as aircraft and construction. Because L_{eq} is effectively a summation of a number of events, it does not in itself limit the magnitude of any individual event, and this is frequently used in conjunction with an absolute sound limit.
L_{10} & L_{90} :	Statistical L_n indices are used to describe the level and the degree of fluctuation of non-steady sound. The term refers to the level exceeded for n% of the time. Hence, L_{10} is the level exceeded for 10% of the time and as such can be regarded as a typical maximum level. Similarly, L_{90} is the typical minimum level and is often used to describe background noise. It is common practice to use the L_{10} index to describe noise from traffic as, being a high average, it takes into account the increased annoyance that results from the non-steady nature of traffic flow.
L_{max} :	The maximum sound pressure level recorded over a given period. L_{max} is sometimes used in assessing environmental noise, where occasional loud events occur which might not be adequately represented by a time-averaged L_{eq} value.
R	*Sound Reduction Index.* Effectively the *Level Difference* of a building element when measured in an accredited laboratory test suite in accordance with the procedures laid down in BS EN ISO 10140-2:2010 and corrected for its size and the reverberant characteristics of the receive room.
D	The sound insulation performance of a construction is described in terms of the difference in sound level on either side of the construction in the presence of a sound source on one side and the reverberant characteristics of the adjoining 'receive' space. *D* is the arithmetic *Level Difference* in decibels between the source and receive sound levels when filtered into frequency bands.

D_{nT}	*Weighted Standardised Level Difference.* As defined in BS EN ISO 717-1, representing the *Weighted Level Difference*, when standardised for reference receiving room reverberant characteristics.
$D_{n,e}$	Normalised sound insulation of small building elements of fixed dimensions, such as vents, measured in an accredited laboratory test suite in accordance with the procedures laid down in BS EN ISO 10140-2:2010.
$D_{n,f}$	Flanking sound insulation of lightweight elements, such as curtain wall mullions, measured in an accredited laboratory test suite in accordance with the procedures laid down in ISO 10848-2:2006
R_w D_w $D_{nT,w}$ $D_{n,e,w}$ $D_{n,f,w}$	Value of parameter, determined as above, but weighted in accordance with the procedures laid down in BS EN ISO 717-1 to provide a single-figure value.
C, C_{tr}	Spectral adaptation terms to be added to a single number quantity such as $D_{nT,w}$, to take account of the sound insulation within frequency ranges of particular interest.
$L'_{nT,w}$	*Weighted Standardised Impact Sound Pressure Level* as defined in BS EN ISO 717-2, representing the level of sound pressure when measured within a space where the floor above is under excitation from a calibrated tapping machine, standardised for the receiving room reverberant characteristics.
ΔL_w	Change in impact sound pressure level when a floor is fitted with a 'soft' or resilient covering, as measured in an accredited laboratory test suite in accordance with the procedures laid down in BS EN ISO 10140-3:2010.

Octave Band Frequencies

In order to determine the way in which the energy of sound is distributed across the frequency range, the International Standards Organisation has agreed on "preferred" bands of frequency for sound measurement and analysis. The widest and most commonly used band for frequency measurement and analysis is the Octave Band. In these bands, the upper frequency limit is twice the lower frequency limit, with the band being described by its "centre frequency" which is the average (geometric mean) of the upper and lower limits, e.g. 250 Hz octave band extends from 176 Hz to 353 Hz. The most commonly used octave bands are:

Octave Band Centre Frequency Hz	63	125	250	500	1000	2000	4000	8000

Human Perception of Broadband Noise

Because of the logarithmic nature of the decibel scale, it should be borne in mind that sound levels in dB(A) do not have a simple linear relationship. For example, 100dB(A) sound level is not twice as loud as 50dB(A). It has been found experimentally that changes in the average level of fluctuating sound, such as from traffic, need to be of the order of 3dB before becoming definitely perceptible to the human ear. Data from other experiments have indicated that a change in sound level of 10dB is perceived by the average listener as a doubling or halving of loudness. Using this information, a guide to the subjective interpretation of changes in environmental sound level can be given.

INTERPRETATION

Change in Sound Level dB	Subjective Impression	Human Response
0 to 2	Imperceptible change in loudness	Marginal
3 to 5	Perceptible change in loudness	Noticeable
6 to 10	Up to a doubling or halving of loudness	Significant
11 to 15	More than a doubling or halving of loudness	Substantial
16 to 20	Up to a quadrupling or quartering of loudness	Substantial
21 or more	More than a quadrupling or quartering of loudness	Very Substantial

Earth Bunds and Barriers - Effective Screen Height

When considering the reduction in sound level of a source provided by a barrier, it is necessary to establish the "effective screen height". For example if a tall barrier exists between a sound source and a listener, with the barrier close to the listener, the listener will perceive the sound as being louder if he climbs up a ladder (and is closer to the top of the barrier) than if he were standing at ground level. Equally if he sat on the ground the sound would seem quieter than if he were standing. This is explained by the fact that the "effective screen height" is changing with the three cases above. In general, the greater the effective screen height, the greater the perceived reduction in sound level.

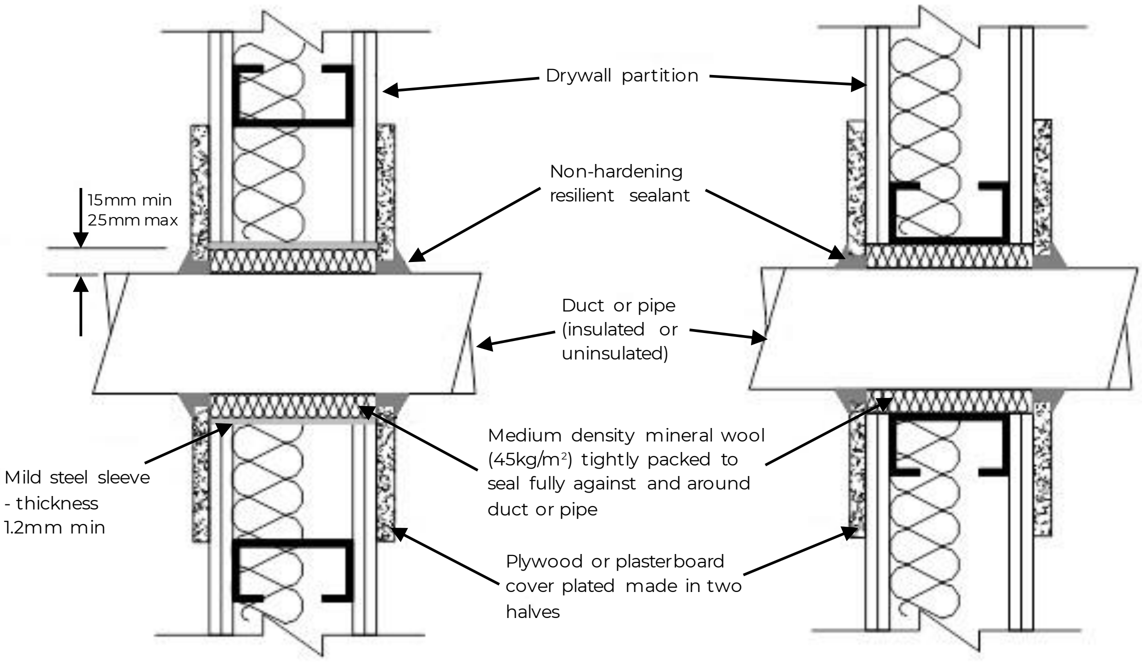
Similarly, the attenuation provided by a barrier will be greater where it is aligned close to either the source or the listener than where the barrier is midway between the two.

APPENDIX B

TYPICAL SERVICES PENETRATION DESIGN PRINCIPLES

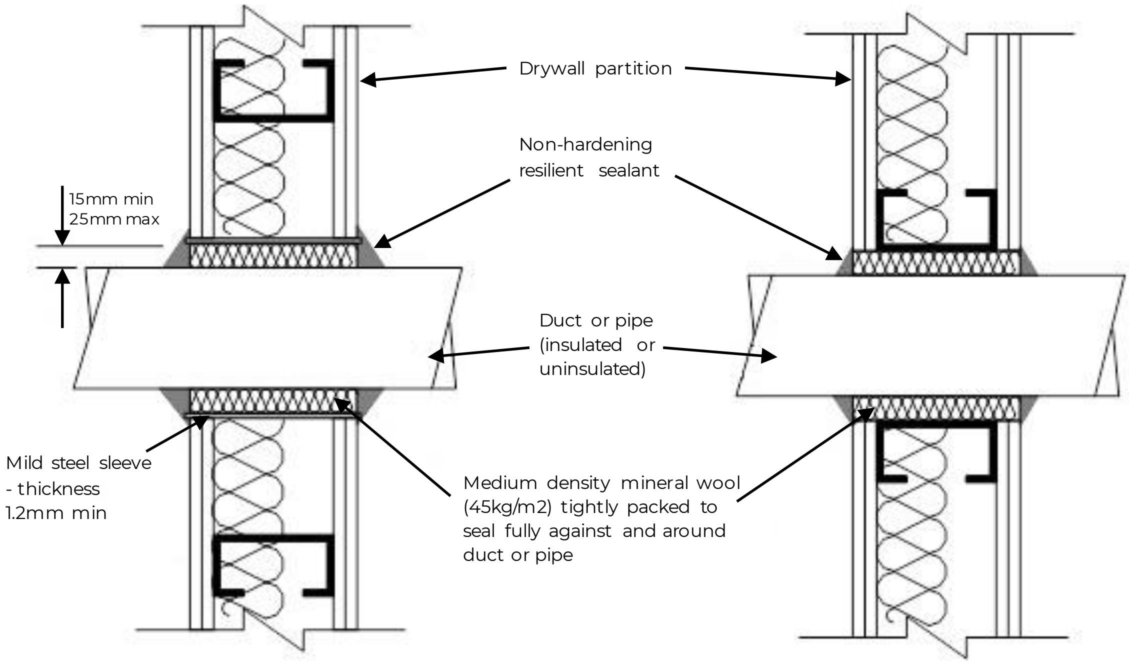
Method A

Method B

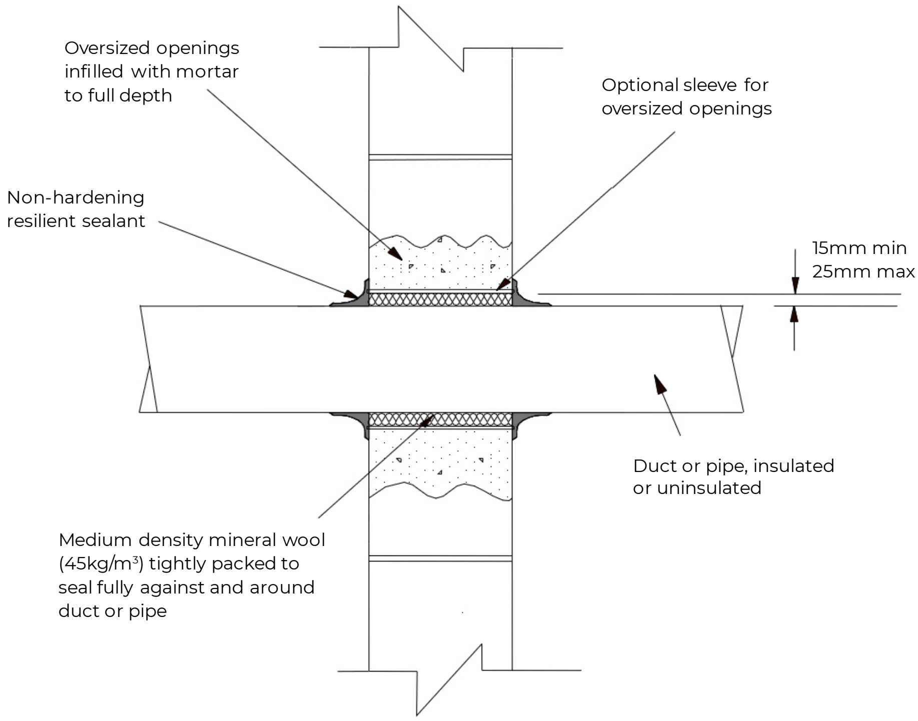


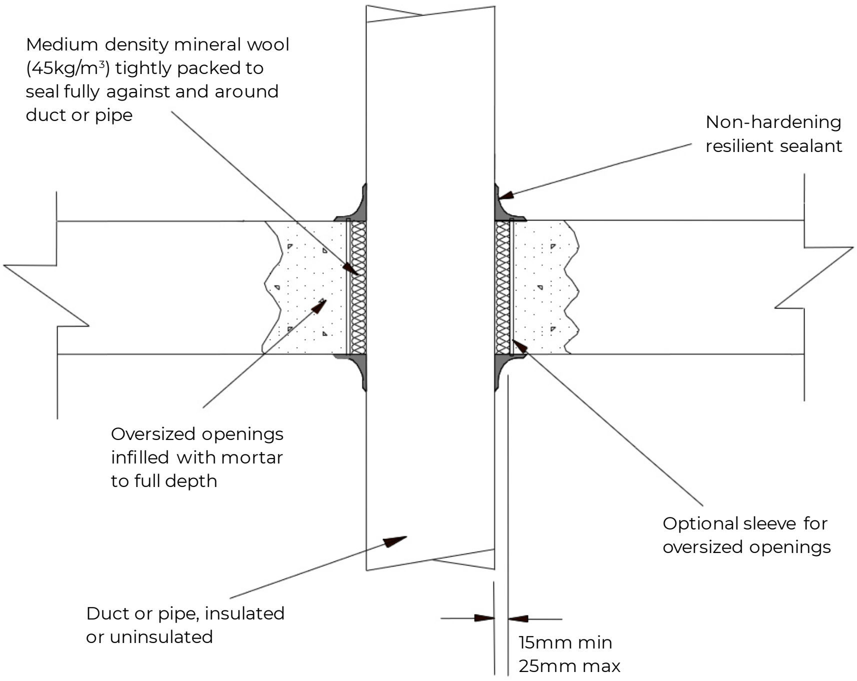
Method C

Method D



APPENDIX B


Oversized openings infilled with mortar to full depth
Optional sleeve for oversized openings
Non-hardening resilient sealant
15mm min
25mm max
Duct or pipe, insulated or uninsulated
Medium density mineral wool (45kg/m³) tightly packed to seal fully against and around duct or pipe


Medium density mineral wool (45kg/m³) tightly packed to seal fully against and around duct or pipe
Non-hardening resilient sealant
Oversized openings infilled with mortar to full depth
Optional sleeve for oversized openings
Duct or pipe, insulated or uninsulated
15mm min
25mm max

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AS13192 46 AVENUE ROAD LONDON

PLANT NOISE SCHEDULE

Ref:	AS13192/PNS	Revision:	*0*	Date:	08 May 2024	Engineer	Ravee Long					
Plant Reference/Location				Description		Octave Band Mid Frequency (Hz)						
						63	125	250	500	1k	2k	4k	8k	dB(A)
ASHP-01/Roof Level Vaillant aroTHERM plus 7kW				Breakout		-	-	-	-	-	-	-	-	55
ASHP-02/Roof Level Vaillant aroTHERM plus 7kW				Breakout		-	-	-	-	-	-	-	-	55
ASHP-03/Roof Level Vaillant aroTHERM plus 7kW				Breakout		-	-	-	-	-	-	-	-	55
CU-01/Roof Level Daikin RXYSCQ6TV1				Breakout (L_p @ 1m)		54	55	52	52	48	43	37	24	53
CU-02/Roof Level Daikin RXYSCQ6TV1				Breakout (L_p @ 1m)		54	55	52	52	48	43	37	24	53
CU-03/Roof Level Daikin RXYSCQ6TV1				Breakout (L_p @ 1m)		54	55	52	52	48	43	37	24	53
CU-04/Roof Level Daikin RXYSCQ6TV1				Breakout (L_p @ 1m)		54	55	52	52	48	43	37	24	53
CU-05/Roof Level Daikin RXYSCQ6TV1				Breakout (L_p @ 1m)		54	55	52	52	48	43	37	24	53
HRU-01/Basement Laundry Nuaire XBC45HA-ELN-E-LS1S				In-duct Intake		75	67	67	56	56	54	46	37	63
				In-duct Supply		79	72	77	63	64	63	58	54	72
				In-duct Exhaust		80	73	77	63	64	64	58	56	72
				In-duct Extract		76	67	68	55	56	55	45	36	63
				Breakout		66	57	54	39	37	36	32	21	49

Notes: Noise data presented as sound power level (L_w) unless stated otherwise.

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AS13192 46 AVENUE ROAD LONDON

PLANT NOISE SCHEDULE

Ref:	AS13192/PNS	Revision:	*0*	Date:	08 May 2024	Engineer	Ravee Long					

Plant Reference/Location	Description	Octave Band Mid Frequency (Hz)								
		63	125	250	500	1k	2k	4k	8k	dB(A)
HRU-02/Roof Level Nuaire XBC65HA-ELN-E-LS1W	In-duct Intake	71	71	64	58	56	51	40	26	62
	In-duct Supply	75	77	71	66	64	60	53	46	70
	In-duct Exhaust	77	77	71	67	64	61	53	47	70
	In-duct Extract	73	71	62	59	56	52	40	27	62
	Breakout	63	61	48	43	37	33	27	16	48
FCU-B.01/Basement – Lightwell Bed 1 Daikin FXDQ32A	In-duct Outlet	37	40	43	40	34	31	24	17	41
	In-duct Inlet & Breakout	48	48	51	44	43	39	33	24	48
FCU-B.02/Basement – Lightwell Bed 2 Daikin FXDQ32A	In-duct Outlet	37	40	43	40	34	31	24	17	41
	In-duct Inlet & Breakout	48	48	51	44	43	39	33	24	48
FCU-B.03/Basement – Lounge Daikin FXNQ32A	In-duct Outlet	37	40	43	40	34	31	24	17	41
	In-duct Inlet & Breakout	48	48	51	44	43	39	33	24	48
FCU-B.04/Basement – Cinema Room Daikin FXNQ32A	In-duct Outlet	37	40	43	40	34	31	24	17	41
	In-duct Inlet & Breakout	48	48	51	44	43	39	33	24	48
FCU-B.05/Basement – Cinema Room Daikin FXNQ32A	In-duct Outlet	37	40	43	40	34	31	24	17	41
	In-duct Inlet & Breakout	48	48	51	44	43	39	33	24	48
FCU-B.06/Basement – Gym Daikin FXDQ50A	In-duct Outlet	39	44	47	43	38	35	29	20	45
	In-duct Inlet & Breakout	50	53	53	48	46	43	40	30	52
FCU-B.07/Basement – Gym Daikin FXDQ50A	In-duct Outlet	39	44	47	43	38	35	29	20	45
	In-duct Inlet & Breakout	50	53	53	48	46	43	40	30	52
FCU-G.01/Ground Fl. – Kitchen/Breakfast Daikin FXDQ50A	In-duct Outlet	39	44	47	43	38	35	29	20	45
	In-duct Inlet & Breakout	50	53	53	48	46	43	40	30	52

Notes: Noise data presented as sound power level (L_w) unless stated otherwise.

AS13192 46 AVENUE ROAD LONDON

PLANT NOISE SCHEDULE

Ref:	AS13192/PNS	Revision:	*0*	Date:	08 May 2024	Engineer	Ravee Long						

Plant Reference/Location	Description	Octave Band Mid Frequency (Hz)								
		63	125	250	500	1k	2k	4k	8k	dB(A)
FCU-G.02/Ground Fl. – Dining Room Daikin FXDQ32A	In-duct Outlet	37	40	43	40	34	31	24	17	41
	In-duct Inlet & Breakout	48	48	51	44	43	39	33	24	48
FCU-G.03/Ground Fl. – Dining Room Daikin FXDQ32A	In-duct Outlet	37	40	43	40	34	31	24	17	41
	In-duct Inlet & Breakout	48	48	51	44	43	39	33	24	48
FCU-G.04/Ground Fl. – Reception Room Daikin FXDQ40A	In-duct Outlet	37	45	44	42	37	33	26	17	43
	In-duct Inlet & Breakout	48	51	51	46	44	41	37	28	49
FCU-G.05/Ground Fl. – Reception Room Daikin FXDQ40A	In-duct Outlet	37	45	44	42	37	33	26	17	43
	In-duct Inlet & Breakout	48	51	51	46	44	41	37	28	49
FCU-G.06/Ground Fl. – Office/Study Daikin FXDQ40A	In-duct Outlet	37	45	44	42	37	33	26	17	43
	In-duct Inlet & Breakout	48	51	51	46	44	41	37	28	49
FCU-F.01/First Fl. – Dhruv's Bedroom Daikin FXDQ32A	In-duct Outlet	37	40	43	40	34	31	24	17	41
	In-duct Inlet & Breakout	48	48	51	44	43	39	33	24	48
FCU-F.02/First Fl. – Child's Bedroom Daikin FXDQ32A	In-duct Outlet	37	40	43	40	34	31	24	17	41
	In-duct Inlet & Breakout	48	48	51	44	43	39	33	24	48
FCU-F.03/First Fl. – Master WIC 1 Daikin FXDQ32A	In-duct Outlet	37	40	43	40	34	31	24	17	41
	In-duct Inlet & Breakout	48	48	51	44	43	39	33	24	48
FCU-F.04/First Fl. – Master Bedroom Daikin FXDQ50A	In-duct Outlet	39	44	47	43	38	35	29	20	45
	In-duct Inlet & Breakout	50	53	53	48	46	43	40	30	52
FCU-F.05/First Fl. – Master WIC 2 Daikin FXDQ32A	In-duct Outlet	37	40	43	40	34	31	24	17	41
	In-duct Inlet & Breakout	48	48	51	44	43	39	33	24	48
FCU-S.01/Second Fl. – Guest Bedroom 1 Daikin FXDQ32A	In-duct Outlet	37	40	43	40	34	31	24	17	41
	In-duct Inlet & Breakout	48	48	51	44	43	39	33	24	48

Notes: Noise data presented as sound power level (L_w) unless stated otherwise.

clarke saunders acoustics

AS13192 46 AVENUE ROAD LONDON

PLANT NOISE SCHEDULE

Ref:	AS13192/PNS	Revision:	*0*	Date:	08 May 2024	Engineer	Ravee Long

Plant Reference/Location	Description	Octave Band Mid Frequency (Hz)								
		63	125	250	500	1k	2k	4k	8k	dB(A)
FCU-S.02/Second Fl. – Guest Bedroom 2 Daikin FXDQ32A	In-duct Outlet	37	40	43	40	34	31	24	17	41
	In-duct Inlet & Breakout	48	48	51	44	43	39	33	24	48
FCU-S.03/Second Fl. – Master 2 WIC 1 Daikin FXDQ32A	In-duct Outlet	37	40	43	40	34	31	24	17	41
	In-duct Inlet & Breakout	48	48	51	44	43	39	33	24	48
FCU-S.04/Second Fl. – Master Bed 2 Daikin FXDQ50A	In-duct Outlet	39	44	47	43	38	35	29	20	45
	In-duct Inlet & Breakout	50	53	53	48	46	43	40	30	52
FCU-S.05/Second Fl. – Master 2 WIC 2 Daikin FXDQ32A	In-duct Outlet	37	40	43	40	34	31	24	17	41
	In-duct Inlet & Breakout	48	48	51	44	43	39	33	24	48

Notes: Noise data presented as sound power level (L_w) unless stated otherwise.

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ATMOSPHERE SIDE SILENCER SCHEDULE

Ref:	AS13192/ASS	Revision: 0	Date:	8 May 2024	Engineer	Ravee Long						
Silencer Ref.	Description	Plant Location	Indicative length (mm)	Indicative free area (%)	Octave Band Mid Frequency (Hz)							
					63	125	250	500	1k	2k	4k	8k
ATT-B.01	HRU-01 Exhaust	Laundry Room	1500	35	6	13	23	37	43	44	35	20
ATT-B.02	HRU-01 Intake	Laundry Room	900	45	2	5	11	17	20	19	12	10
ATT-R.01	HRU-02 Intake	Roof	600	50	1	2	7	10	11	9	8	7
ATT-R.02	HRU-02 Exhaust	Roof	600	50	1	2	7	10	11	9	8	7

Sheet: 1 of 1

Notes:

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ROOMSIDE SILENCER SCHEDULE

Ref:	AS13192/RSS	Revision:	0	Date:	08 May 2024		Engineer	Ravee Long						
Silencer Ref.	Description	Plant Location			Indicative length (mm)	Indicative free area (%)	Octave Band Mid Frequency (Hz)							
							63	125	250	500	1k	2k	4k	8k
ATT-B.03	HRU-01 Supply	Laundry Room			1500	20	14	25	39	50	50	50	50	49
ATT-B.04	HRU-01 Extract	Laundry Room			1200	20	11	21	31	49	50	50	50	44
ATT-B.05	FCU-B.01 Outlet	LG Lightwell Bedroom 1			600	50	1	2	7	10	11	9	8	7
ATT-B.06	FCU-B.01 Inlet	LG Lightwell Bedroom 1			900	40	4	7	13	19	23	23	16	13
ATT-B.07	FCU-B.02 Outlet	LG Lightwell Bedroom 2			600	50	1	2	7	10	11	9	8	7
ATT-B.08	FCU-B.02 Inlet	LG Lightwell Bedroom 2			900	40	4	7	13	19	23	23	16	13
ATT-B.09	FCU-B.03 Outlet	LG Lounge			600	50	1	2	7	10	11	9	8	7
ATT-B.10	FCU-B.03 Inlet	LG Lounge			600	50	1	2	7	10	11	9	8	7
ATT-B.11	FCU-B.04 Outlet	LG Cinema			600	35	3	6	10	14	20	19	14	13
ATT-B.12	FCU-B.04 Inlet	LG Cinema			900	25	7	11	18	32	40	40	36	33
ATT-B.13	FCU-B.05 Outlet	LG Cinema			600	35	3	6	10	14	20	19	14	13
ATT-B.14	FCU-B.05 Inlet	LG Cinema			900	25	7	11	18	32	40	40	36	33
ATT-B.15	FCU-B.06 Outlet	LG Gym			600	50	1	2	7	10	11	9	8	7
ATT-B.16	FCU-B.06 Inlet	LG Gym			600	50	1	2	7	10	11	9	8	7
ATT-B.17	FCU-B.07 Outlet	LG Gym			600	50	1	2	7	10	11	9	8	7
ATT-B.18	FCU-B.07 Inlet	LG Gym			600	50	1	2	7	10	11	9	8	7
ATT-G.01	FCU-G.01 Outlet	GF Kitchen			600	50	1	2	7	10	11	9	8	7
ATT-G.02	FCU-G.01 Inlet	GF Kitchen			600	50	1	2	7	10	11	9	8	7
ATT-G.03	FCU-G.02 Outlet	GF Dining Room			600	50	1	2	7	10	11	9	8	7
ATT-G.04	FCU-G.02 Inlet	GF Dining Room			900	40	4	7	13	19	23	23	16	13
ATT-G.05	FCU-G.03 Outlet	GF Dining Room			600	50	1	2	7	10	11	9	8	7

Notes:

ROOMSIDE SILENCER SCHEDULE

Ref:	AS13192/RSS	Revision: 0 Date:	08 May 2024		Engineer	Ravee Long						
Silencer Ref.	Description	Plant Location	Indicative length (mm)	Indicative free area (%)	Octave Band Mid Frequency (Hz)							
					63	125	250	500	1k	2k	4k	8k
ATT-G.06	FCU-G.03 Inlet	GF Dining Room	900	40	4	7	13	19	23	23	16	13
ATT-G.07	FCU-G.04 Outlet	GF Reception	600	50	1	2	7	10	11	9	8	7
ATT-G.08	FCU-G.04 Inlet	GF Reception	600	50	1	2	7	10	11	9	8	7
ATT-G.09	FCU-G.05 Outlet	GF Reception	600	50	1	2	7	10	11	9	8	7
ATT-G.10	FCU-G.05 Inlet	GF Reception	600	50	1	2	7	10	11	9	8	7
ATT-G.11	FCU-G.06 Outlet	GF Office/Study	600	50	1	2	7	10	11	9	8	7
ATT-G.12	FCU-G.06 Inlet	GF Office/Study	900	40	4	7	13	19	23	23	16	13
ATT-F.01	FCU-F.01 Outlet	1F Druv's Bedroom	600	50	1	2	7	10	11	9	8	7
ATT-F.02	FCU-F.01 Inlet	1F Druv's Bedroom	900	40	4	7	13	19	23	23	16	13
ATT-F.03	FCU-F.02 Outlet	1F Child's Bedroom	600	50	1	2	7	10	11	9	8	7
ATT-F.04	FCU-F.02 Inlet	1F Child's Bedroom	900	40	4	7	13	19	23	23	16	13
ATT-F.05	FCU-F.03 Outlet	1F Walk-in Closet 1	600	50	1	2	7	10	11	9	8	7
ATT-F.06	FCU-F.03 Inlet	1F Walk-in Closet 1	600	50	1	2	7	10	11	9	8	7
ATT-F.07	FCU-F.04 Outlet	1F Master Bedroom	600	50	1	2	7	10	11	9	8	7
ATT-F.08	FCU-F04 Inlet	1F Master Bedroom	900	35	4	8	14	21	27	27	21	16
ATT-F.09	FCU-F.05 Outlet	1F Walk-in Closet 2	600	50	1	2	7	10	11	9	8	7
ATT-F.10	FCU-F.05 Inlet	1F Walk-in Closet 2	600	50	1	2	7	10	11	9	8	7
ATT-S.01	FCU-S.01 Outlet	2F Guest Bedroom 1	600	50	1	2	7	10	11	9	8	7
ATT-S.02	FCU-S.01 Inlet	2F Guest Bedroom 1	900	40	4	7	13	19	23	23	16	13
ATT-S.03	FCU-S.02 Outlet	2F Guest Bedroom 2	600	50	1	2	7	10	11	9	8	7
ATT-S.04	FCU-S.02 Inlet	2F Guest Bedroom 2	900	40	4	8	14	21	27	27	21	16
ATT-S.05	FCU-S.03 Outlet	2F Walk-in Closet 1	600	50	1	2	7	10	11	9	8	7

Notes:

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ROOMSIDE SILENCER SCHEDULE

Ref:	AS13192/RSS	Revision: 0	Date:	*08 May 2024*		Engineer *Ravee Long*							
Silencer Ref.	Description	Plant Location	Indicative length (mm)	Indicative free area (%)	Octave Band Mid Frequency (Hz)								
					63	125	250	500	1k	2k	4k	8k	
ATT-S.06	FCU-S.03 Inlet	2F Walk-in Closet 1	600	50	1	2	7	10	11	9	8	7	
ATT-S.07	FCU-S.04 Outlet	2F Master Bedroom 2	600	50	1	2	7	10	11	9	8	7	
ATT-S.08	FCU-S.04 Inlet	2F Master Bedroom 2	900	35	4	8	14	21	27	27	21	16	
ATT-S.09	FCU-S.05 Outlet	2F Walk-in Closet 2	600	50	1	2	7	10	11	9	8	7	
ATT-S.10	FCU-S.05 Inlet	2F Walk-in Closet 2	600	50	1	2	7	10	11	9	8	7	
ATT-R.03	HRU-01 Extract	Roof	900	50	2	4	9	15	17	14	10	8	
ATT-R.04	HRU-01 Supply	Roof	1200	35	5	11	19	29	36	37	29	18	

Notes: