HOARE LEA

Field House.
Dewsbury.
Mood Developments Ltd.

ACOUSTICS
STAGE 3 DESIGN REVIEW

REVISION 00 – 09 SEPTEMBER 2021

STAGE 3

Audit sheet.

Rev.	Date	Description of change / purpose of issue	Prepared	Reviewed	Authorised
00	09/09/2021	Initial issue	LR	MW	PM

Project number: 10-13359
Document reference: REP-1013359-5A-LR-20210909-Acoustic Stage 3 design review-Rev00

Contents.

Audit sheet. 2

Executive summary 4

1. Introduction. 5

2. Acoustic design reference. 5
2.1 Design standards & guidance. 5
2.2 Lab-to-site tolerances. 5

3. Site appraisal. 5
3.1 Site description and location. 5
3.2 Environmental noise survey. 5

4. Building envelope. 6
4.1 Ventilation strategy. 6
4.2 Internal noise level criteria. 6
4.3 Façade sound insulation performance. 7
4.4 Roof. 7
4.5 Proposed rooflights. 7

5. Internal sound insulation. 8
5.1 Criteria. 8
5.2 Floors. 8
5.3 Partitions. 9
5.4 A3 commercial unit wall linings. 9
5.5 Doors. 9

6. Detailing guidance. 10
6.1 General detailing guidance. 10
6.2 Party wall detailing. 10
6.3 Retained structural columns. 10

7. Finishes – Reverberation. 10
7.1 Criteria. 10
7.2 Review of proposed finishes to common areas. 10

8. Control of noise transfer from commercial unit to apartments. 11
8.1 Kirklees Council requirements. 11
8.2 Recommended landlord operational noise limits within A3 commercial unit. 11

9. Building services noise considerations. 11
9.1 Internal building services criteria. 11
9.2 General internal building services considerations. 11
9.3 MVHR units. 12
9.4 Services within apartments – design considerations. 12
9.5 Noise emissions to surroundings. 12

10. Building services noise assessment. 13
10.1 Proposed landlord building services scheme. 13
10.2 Future tenant – Current allowances. 13
10.3 Basis of initial plant assessment. 13
10.4 Initial plant noise assessment. 13
10.5 Review of proposed tenant plant allowances. 14

Appendix A: Glossary of terms. 15

Appendix B: Example penetration details. 16

Executive summary

This report sets the key acoustic considerations associated with the development, sets out the proposed acoustic design standards and presents a review of the acoustically relevant elements of the design to date.

Design basis.

The scheme is required to comply with Approved Document E of the Building Regulations (ADE), as well as Kirklees City Council Planning Conditions 13, 14, 15, 16, and 17.

Best-practice guidance with regards to internal noise level/noise emissions criteria in accordance with BS8233:2014, BS4142:2014+A1:2019 and BS6472:2008 is referenced within the acoustic design.

Building envelope.

Full-house mechanical ventilation is currently proposed within each apartment dwelling, with purge ventilation to be provided via openable windows.

Provision is made for comfort cooling to control overheating to the duplex apartment units, with increased air change ventilation proposed for the proposed apartments units on the lower floors.

Minimum sound insulation performances are provided for the retained and new-build elements of the building envelope.

Internal sound insulation.

Minimum airborne and impact sound insulation requirements for separating walls and floors are provided for residential and non-residential spaces respectively.

The proposed drywall selections have been reviewed with commentary provided where enhancements are required.

The proposed floor constructions have been reviewed with commentary provided where enhancements are required.

Example constructions and general guidance on detailing are provided to assist the developing design.

Reverberation and sound absorbent finishes.

Sound absorbent finishes will be required in the common corridors from which apartments are accessed in line with the requirements of the Building Regulations.

The proposed finishes strategy incorporates allowance for sound absorbent finishes. Comments on the current finishes strategy are provided where enhancements are recommended.

Building services.

Noise and vibration from building services plant and systems will need to be controlled by suitable attenuation and isolation measures both internally and externally for the development.

Internal and external criteria for building services plant have been provided. Recommended strategic principles to be adopted are set out.

A plant noise assessment is presented based on the current preliminary plant selections, with mitigation measures recommended where applicable.

1. Introduction.

Hoare Lea have been appointed to provide acoustic advice for the proposed residential refurbishment at Field House in Dewsbury.

The scheme comprises the conversion of the existing building into 23no apartment units, including 7no duplex apartments on the top floor with a new-build roof extension proposed.

Partial retained commercial A3 use on the ground floor and basement is also proposed as part of the refurbishment scope of works.

This report has been prepared to clarify for the Client and project team the key acoustic design considerations to be accounted for in further developing the design.

Key items that will need to be addressed can be broadly broken down into the following main areas:

- External envelope design
- Internal sound insulation
- Sound absorbent finishes - Reverberation
- Building services noise emissions (internal and external)

A glossary of acoustics terms used in this report is provided in Appendix A.

2. Acoustic design reference.

2.1 Design standards & guidance.

The scheme is required to comply with the acoustic design requirements set out by the following:

- Approved Document E to the Building Regulations.
- Kirklees Council planning consent document ref: 2019/92962

Guidance on acoustic design standards also relevant to the scheme are available from a variety of references including, but not limited to, the following:

- BS 8233: 2014 'Guidance on sound insulation and noise reduction for buildings'
- BS 4142: 2014+A1:2019 'Method for Rating Industrial and Commercial Sound'
- BS 6472-1: 2008 *'Guide to evaluation of human exposure to vibration in buildings'*

2.2 Lab-to-site tolerances.

The following minimum tolerances are advised when selecting elements based on the Weighted Sound Reduction Index (R_w) measured under laboratory conditions:

- Drywall partitions and timber party floors between dwellings - $R_{w+}C_{tr} \geq D_{nTw}+C_{tr} + 9$ dB
- Masonry partitions and floors – $R_w \geq D_{nT,w} + 2$ dB.

3. Site appraisal.

3.1 Site description and location.

The proposed site comprises an existing 4 storey office building which is proposed to be converted into 5 storeys of residential apartments, including a one-storey partial extension to create a total of 23no. apartment units, including 6no. duplex apartments, on the upper floors.

The existing ground floor is proposed to comprise of 2no. apartment units, residential entrance and circulation spaces, and a separate A3 class commercial unit. The commercial unit is to be delivered up to Shell and Core as part of the proposed works to maximise future tenant fit-out flexibility. The site in relation to its surroundings is shown in Figure 1, with the nearest identified noise sensitive receivers shown in blue.

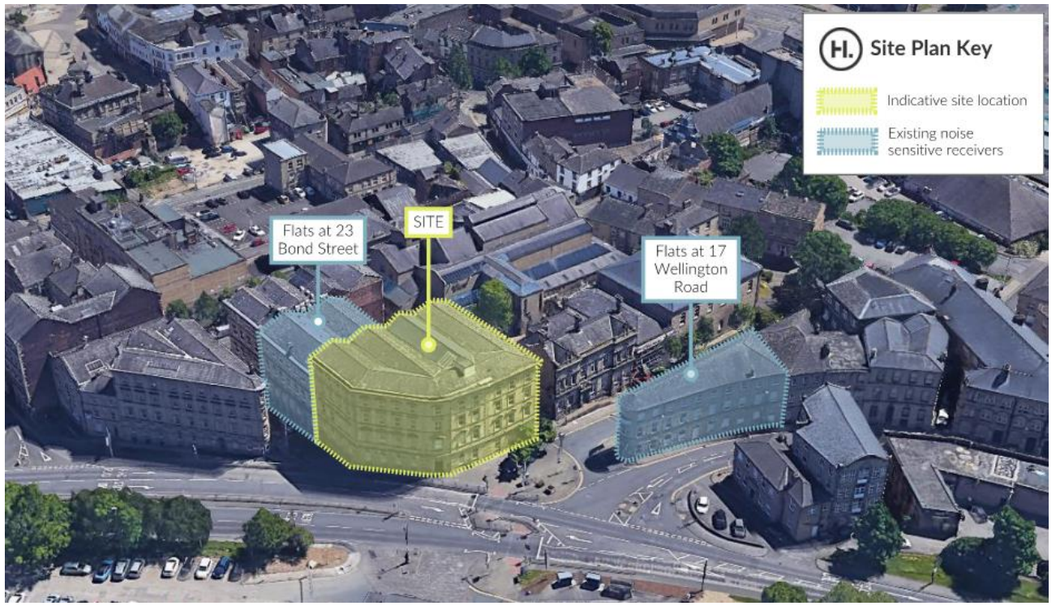


Figure 1 Annotated 3D render indicating site and nearest noise sensitive premises location (courtesy of Google)

The site is located within a mixed commercial and residential area of Dewsbury. It is bounded by Dewsbury Ring Road to the north west, Bond Street to the north and Wellington Street to the south west. Relatively steady road traffic noise along Dewsbury Ring Road was determined to drive ambient and background noise levels locally.

The nearest noise sensitive receivers have been identified as residential flats at 23 Bond Street, which directly bound the site to the east, and 17 Wellington Road approximately 15m to the south west. These are indicated by the areas shaded in blue in Figure 1.

3.2 Environmental noise survey.

The environmental noise survey was carried out on site over a period of 5 days between 1 May 2019 and 13 May 2019, the full details of which are presented in HLA planning report *REP-1011282-RJ-20190515-Acoustic planning report-Rev01-F*, dated 15/05/2019.

The survey measurement positions and prevalent noise levels around the site are summarised in the annotated 3D rendered image presented in Figure 2. Positions A1 and A2 indicate the attended survey positions and position U1 indicates the unattended measurement position.

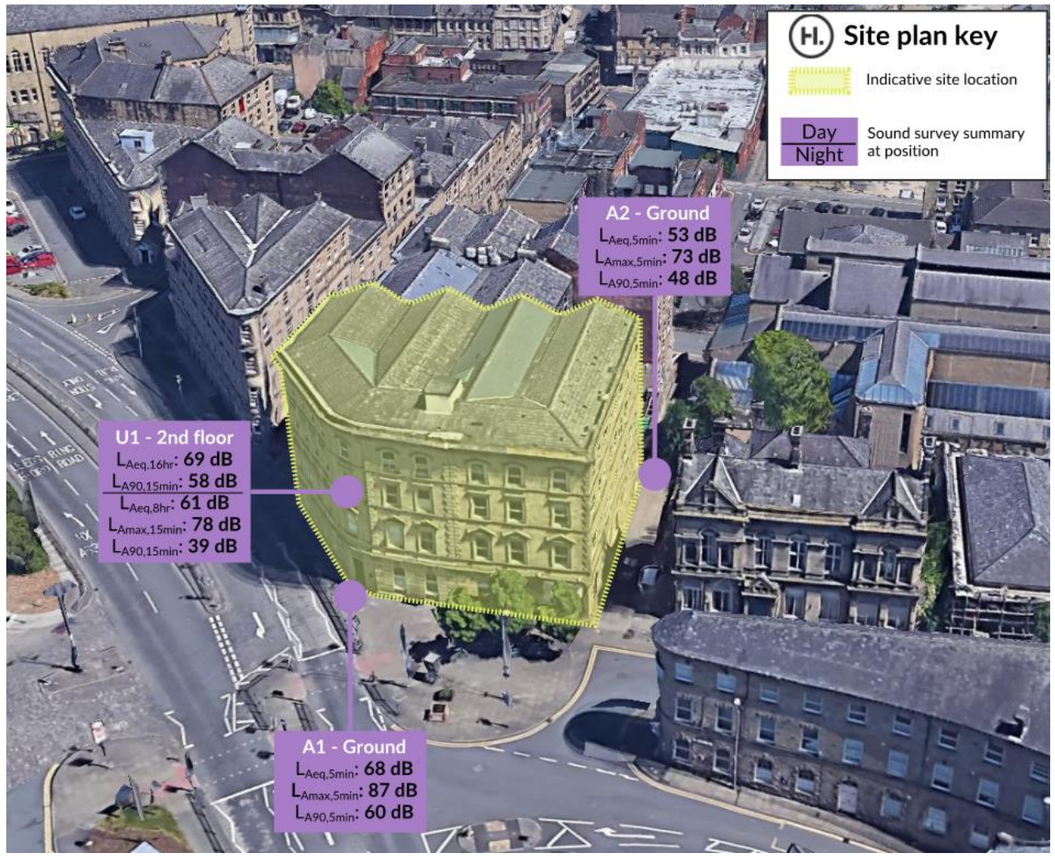


Figure 2 Annotated 3D rendered image indicating measurement positions and prevalent sound levels (courtesy of Google Earth)

3.2.1 Ambient noise levels.

The average ambient sound levels measured during the unattended logging survey were:

- Daytime (07:00 - 23:00) - $L_{Aeq,16hr}$ 69 dB;
- Night-time (23:00 - 07:00) - $L_{Aeq,8hr}$ 61 dB.

3.2.2 Background noise levels.

The representative background noise levels measured during the survey, based on the 20th percentile of measured background noise levels, were as follows:

- Daytime (07:00 - 23:00) - $L_{A90,15min}$ 58 dB;
- Night-time (23:00 - 07:00) - $L_{A90,15min}$ 39 dB.

3.2.3 Maxima noise levels.

The typical maxima noise levels not normally exceeded during the night (23:00 to 07:00) was $L_{Amax,15mins}$ 78 dB.

4. Building envelope.

4.1 Ventilation strategy.

The proposed ventilation strategy for the development comprises the following discrete approaches at present:

- Apartments on Ground, First and Second floor: Full-house mechanical ventilation through a dedicated MVHR unit to each apartment, with enhanced ventilation rate mode to control overheating. Purge ventilation proposed to be achieved via openable windows. Windows openable at resident discretion but not relied upon for the ventilation design excepting purge ventilation.
- Duplex apartments: Full-house mechanical ventilation through a dedicated MVHR unit to each apartment, with comfort cooling provision to control overheating. Purge ventilation proposed to be achieved via openable windows. Windows openable at resident discretion but not relied upon for the ventilation design excepting purge ventilation.
- A3 commercial unit: No ventilation proposed to be installed as part of current scope of works, however future allowance for external condenser units and 1no. kitchen extract fan has been made in the present design.

The internal noise levels set out in Section 4.2 are to apply during background ventilation in line with BS8233:2014 guidance. As these levels are intended to comprise the cumulative contributions from external noise break-in and building services noise, proposed maximum internal noise contributions from the mechanical services scheme providing background ventilation are set in Section 9.1.

No internal noise criteria are applicable while windows are open for purge ventilation in line with BS 8233:2014.

4.2 Internal noise level criteria.

4.2.1 Kirklees Council requirements.

General noise break-in control.
Kirklees Council planning condition 13 states that:

> *'Prior to first occupation of any apartment within the residential use hereby approved, and subject to details to be approved pursuant to condition 3, the sound attenuation works as specified in Table 5 ("Recommended performance of façade elements") of the Acoustics Planning Report (Hoare Lea, Rev 01, 15/05/2019) shall be completed for that apartment and shall be retained thereafter.'*

Overheating ventilation.
Kirklees Council planning condition 14 states that:

> *'Prior to first occupation of the residential use hereby approved, a ventilation scheme for apartments that would need to keep windows closed to prevent adverse amenity impacts due to noise shall be submitted to and approved in writing by the Local Planning Authority.*
>
> *The ventilation scheme shall show how habitable rooms of these apartments shall be provided with sufficient ventilation to help control thermal comfort and avoid overheating during hot weather without the need to open windows. All works forming part of the approved ventilation scheme shall be completed prior to occupation of that apartment and shall be retained thereafter.'*

4.2.2 Residential areas.

BS 8233:2014 '*Guidance on sound insulation and noise reduction for buildings'* is the current British Standard providing guidance for acoustic requirements within buildings, including residential dwellings. The BS 8233 internal design criteria for dwellings are set out in Table 1.

Table 1 Indoor ambient noise levels for dwellings

Activity	Location	Time Period	
		Day (07:00 to 23:00)	Night (23:00 to 07:00)
Resting	Living rooms	35 dB $L_{Aeq,16hour}$	N/A
Dining	Dining Room / Area	40 dB $L_{Aeq,16hour}$	N/A
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$

BS 8233 also refers to the requirement to control noise intrusion from individual events during the night to reduce the risk of sleep disturbance. In line with the World Health Organisation Guidelines for Community Noise, it is proposed that the internal noise level from individual events should not be exceeded more than 10-15 times per night.

4.2.3 A3 commercial unit.

Maximum recommended internal noise contributions from external noise break-in within non-residential spaces should not exceed L_{Aeq} 55 dB within the commercial unit in line with BS 8233 guidance.

4.3 Façade sound insulation performance.

4.3.1 Incident noise levels upon proposed elevations.

The prevalent ambient and maximum noise levels at the proposed elevations of the development site that formed the basis of the design are presented in Table 2.

In order to present a conservative worst-case assessment of incident noise levels at residential elevations, a minimal correction of -5dB has been applied between the maxima noise events measured at the front elevation and those measured at the rear elevations, based on synchronised attended noise measurements within the rear alleyway and the unattended measurement position overlooking the ring road.

Table 2 Incident noise levels used in façade noise assessment

Elevation	Daytime period (07:00 to 23:00)	Night period (23:00 to 07:00)
Front elevation	$L_{Aeq,16hour}$ 69 dB	$L_{Aeq,8hour}$ 61 dB $L_{Amax,15min}$ 78 dB
Rear elevation	$L_{Aeq,16hour}$ 53 dB	$L_{Aeq,8hour}$ 45 dB $L_{Amax,15min}$ 73 dB

4.3.2 Existing retained external walls.

It is understood that the existing external walls comprise internal drylined masonry constructions with a minimal thickness of 300 mm. While the exact build-up of the external walls is not currently known, this type of construction is considered capable of achieving a minimum sound insulation performance of R_w 58 dB / R_w+C_{tr} 51 dB, and the assessment of noise break-in is based upon this.

Once strip-out works are carried out, these elements should be inspected and made good with any gaps or holes through them appropriately sealed prior to the installation of new drylining systems.

4.3.3 Proposed new windows.

The existing windows on site are to be removed as part of the strip-out works, with new double glazed configurations proposed as part of the refurbishment works. The minimum recommended sound insulation performance requirements for the building envelope elements are presented in Table 3 below.

Table 3 Recommended performance of facade elements

Apartment facade	Room	Glazing (including framing system)
Facade unscreened from Dewsbury Ring Road	Bedrooms and living rooms	R_w+C_{tr} 34 dB
Facade screened from Dewsbury Ring Road		R_w+C_{tr} 27 dB

Standard thermal double glazing systems with the appropriate sound reduction ratings would be anticipated to meet the requirements along the rear elevations, with higher performance double glazing solutions required along the main elevations overlooking Dewsbury Ring Road.

The recommended ratings should be achieved by the glazing system, including the frames and associated window furniture. If sash windows are proposed as a like-for-like replacement due to heritage constraints, suppliers will need to demonstrate whole-system compliance with the above requirements.

4.3.4 Proposed extension external wall construction.

The proposed external wall build-up for the fourth floor duplex extension understood to comprise a lightweight zinc-faced thermal insulation cladding panel with 12mm OSB backing board to the rear and 2 layers of 15mm plasterboard internally with approximately 70mm mineral fibre insulation in the cavity.

The above build-up is expected to provide a minimum sound insulation performance in the region of R_w 43 dB, on the basis of dense plasterboard linings such as SoundBloc or equivalent being specified. This performance is considered suitable to control external noise break-in at this level.

4.4 Roof.

The current roof build-up proposals comprise a new-build lightweight roof construction understood to comprise a lightweight cladding construction with 12mm OSB backing board and 2 layers of 15mm plasterboard (assumed to be dense plasterboard such as SoundBloc or equivalent) internally with approximately 70mm mineral fibre insulation in the cavity. In addition to this, the proposed suspended ceiling to the duplex living rooms under draws this as shown in drawing 2018-051_0231_RevA, dated 03/09/2021. The ceiling is understood to comprise 2x15mm layers of plasterboard with no mineral fibre in the cavity.

The above build-up is considered capable of controlling external noise break-in and rain noise drumming through the roof and ceiling structure into the habitable spaces below.

4.5 Proposed rooflights.

To control rain noise drumming through to the living room spaces of the duplex apartments, it is recommended that as a minimum standard thermal double glazed units be specified for these elements to achieve a sound insulation performance no lower than R_w+C_{tr} 34 dB.

5. Internal sound insulation.

5.1 Criteria.

5.1.1 Residential spaces.

Residential developments must comply with the acoustic requirements set out in Approved Document E (2003 Edition including 2004 and 2010 amendments) to the Building Regulations 2010 (ADE). The requirements for the scheme relating to internal sound insulation between dwellings are set out in Table 4.

Table 4 Internal sound insulation requirements in line with ADE

Separating element	Airborne Sound Insulation	Impact sound insulation
Walls between apartments	$D_{nT,w}$ +C_{tr} ≥43 dB	N/A
Floors between apartments	$D_{nT,w}$ +C_{tr} ≥45 dB	$L'_{nT,w}$ ≤62 dB
Internal walls within apartments	R_w 40 dB	N/A
Internal floors within duplex apartments	R_w 40 dB	N/A

5.1.2 A3 commercial unit to apartments above.

In addition to the above, a minimum on-site sound insulation performance of $D_{nT,w}$+C_{tr} 50 dB is recommended across the vertical adjacency between the ground floor commercial unit and the first floor residences above as part of the conversion works.

This level of sound insulation would be anticipated to permit background music within the retail spaces as part of the landlord works.

As it is currently understood this unit is to be left as a Shell and Core fit-out for future tenants, confirmation is requested from the Client and Design Team as to whether higher levels of operational noise should be contemplated as part of the landlord works.

5.2 Floors.

5.2.1 Note on existing floors.

Investigative sound insulation tests of the existing floors across Field House were carried out on 08/05/2019 during the survey works undertaking to assist with the planning application for the scheme.

The existing floors were noted to generally be in a poor state of repair, with moisture damage visible to the timber elements above exposed ceiling tiles, and the sound insulation performances measured on site ranged from D_w+C_{tr} 37 to 40 dB.

The measured performances fell significantly short of the requirements of ADE, and were limited by flanking along the building envelope as well as direct transfer through the floors.

5.2.2 Proposed floors.

The proposed floor build-ups are presented in Figure 3 and Figure 4, both extracted from proposed floor build-up drawing 2018-051_0311, dated 18/08/2021.

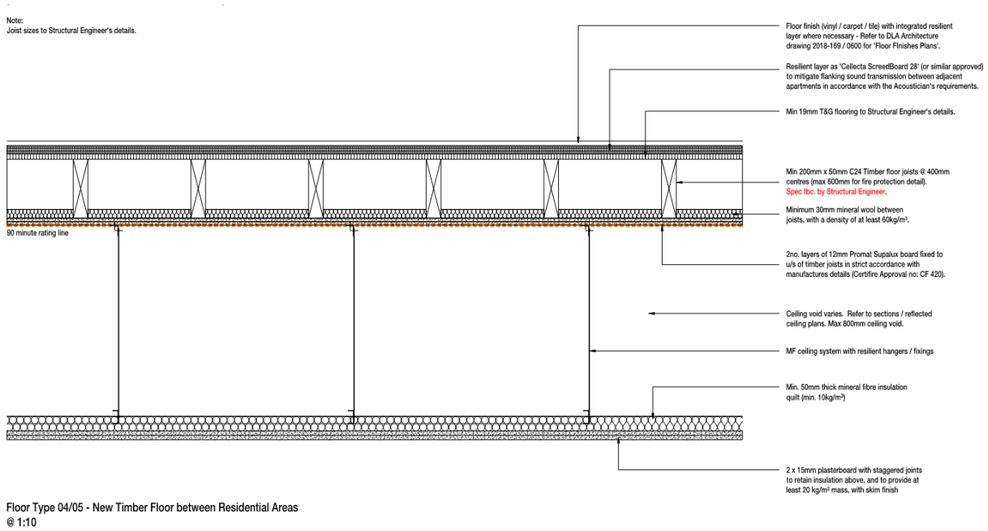


Figure 3 Proposed new-build timber floor build-up between apartment units

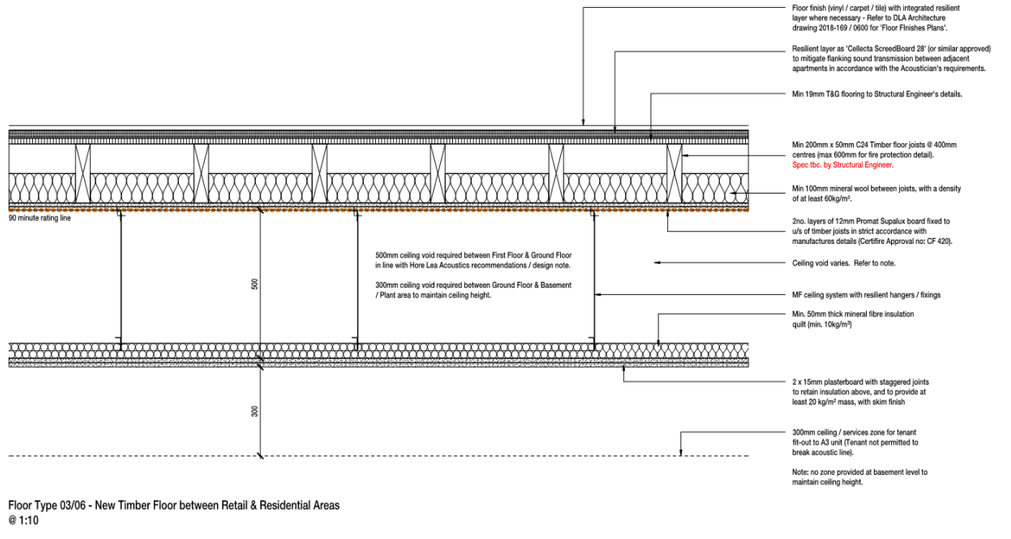


Figure 4 Proposed new-build timber floor build-up between apartment units and A3 commercial unit below

The proposed build-ups presented above are anticipated to be capable of achieving the requirements of ADE for both airborne and impact noise transmission across party floors.

Coordination of the interface details between separating constructions shall be carried out to ensure the acoustic performance across separating elements is not compromised. Initial guidance on this is provided in Section 6.

5.3 Partitions.

5.3.1 Review of proposed wall constructions

The acoustically relevant proposed wall constructions and acoustic strategy plan 2018-051_0281_RevA, dated 27/08/2021 have been assessed against the requirements of ADE and the enhanced sound insulation proposals where these apply. The results of the review are provided in Table 5.

Table 5 Review of proposed wall constructions

Wall type	Build-up	Expected sound insulation performance	Comment
01	2x12.5mm SoundBloc to both sides of 92mm AcouStud with 50mm mineral fibre insulation in cavity (British Gypsum ref: A206A291S)	R_w+C_{tr} 53 dB	Compliant with ADE See Section 5.3.2
02	1x15mm SoundBloc to both sides of 70mm 'C' stud, no mineral fibre insulation in cavity (British Gypsum ref: A206165)	R_w 42 dB	Compliant with ADE
03	2x15mm SoundBloc to one side of 70mm 'I' stud independently mounted, forming 80mm cavity partially filled with 50mm mineral fibre insulation (British Gypsum ref: IWL B216006(D))	Not applicable	Suitable independent wall lining construction See Section 5.3.3
04	2x12.5mm SoundBloc to both sides of twin 48mm 'C' studs, forming 150mm cavity partially filled with 50mm mineral fibre insulation (British Gypsum ref: A216009)	R_w+C_{tr} 56 dB	Compliant with ADE
10	215 mm thick blockwork wall [1] + timber backing to 2x15mm FireLine forming 115mm cavity partially infilled with mineral fibre insulation	R_w+C_{tr} 59 dB	Compliant with enhanced requirements
11	215 mm thick blockwork wall [1] + Wall Type 3	R_w+C_{tr} 62 dB	Compliant with enhanced requirements
NOTES			
[1] Based on medium density blockwork (>1400 kg/m^3).			

5.3.2 Note on acoustic stud drywall construction.

While the proposed party wall build-up would be expected to provide a sufficient laboratory to site performance reduction tolerance to allow for flanking and workmanship quality, this type of construction trades a wider thickness for enhanced structural bridging control.

As such, it is essential that no direct bridging connections be introduced into the system, such as long screws through the plasterboard layers piercing the acoustic stud middle section, otherwise any gains in acoustic performance are likely to be lost. This type of construction requires careful on-site installation monitoring in order to ensure the acoustic performance of the wall is not compromised.

5.3.3 Independent wall linings.

Independent wall linings, Wall Type 03, are currently specified directly between apartment adjacencies and the retained lift shaft, which works well acoustically.

While it has not been possible to test the current sound insulation performance of the existing demise walls between Field House and adjacent properties and the performance of these elements could not be determined, these are understood to comprise a type of cavity masonry construction from discussions with the Architect.

In order to provide some control of noise transfer through these demise walls, it is recommended that an independent drywall lining be provided on the residential side of the walls, such as Wall Type 03.

The above enhancement should provide a reasonable improvement to the existing sound insulation performance of the wall and protect the proposed residential dwellings from noise transfer from the existing office premises, as well as further assist with vertical flanking noise control between apartments.

5.4 A3 commercial unit wall linings.

While fit-out of the proposed A3 commercial unit is to be carried out by others, it is recommended that a zonal allowance for the provision of Wall Type 3 independent wall linings be made internally at this stage to account for any future enhancements required to control vertical noise flanking through the retained existing masonry walls and external walls. Further comment on this is provided in Section 8.

5.5 Doors.

5.5.1 Apartment entrance doors.

To comply with Approved Document E, entrance doors to apartments shall comply with one of the following:

- Install doors which have been tested in a laboratory and shown to achieve an acoustic rating of at least R_w 29 dB; or
- Install doors which meet the following parameters:
  - Door leaf to have a minimum mass per unit area of 25 kg/m2
  - Door to have good perimeter seals, including a threshold seal where practicable.

From a review of the Architectural Acoustic Strategy Plan 2018-051_0281_RevA, dated 27/08/2021, this is currently allowed for in the design.

5.5.2 Riser doors.

It is recommended that riser doors provide a minimum sound insulation performance of R_w 35 dB.

6. Detailing guidance.

6.1 General detailing guidance.

Careful detailing is necessary to ensure the sound insulation performance across separating elements on site is not compromised. This section addresses the key flanking strategies to address within the design and on site.

It is also essential that the detailing of electrical boxes (eg, sockets and switches) does not undermined the sound insulation performance of the partitions. Typically, the most straight forward way to avoid this is to surface mount services or to include backing boxes to staggered sockets/ switches located within partitions.

Suitable interface details will need to be developed to ensure that the internal sound insulation requirements are not compromised.

6.2 Party wall detailing.

Party walls should be built from structural floor to structural floor (i.e. existing timber floor), with ceilings and floor finishes being installed independently within each residence (ie no contiguous floors or ceilings between residences under/above walls).

All partitions should be built full height from slab to slab, with resiliently backed floor finishes installed individually within each apartment space. So as not to compromise impact sound insulation performance, the resilient layer barrier should wrap around the top floor layers to isolate these from the party walls as shown in the sketch provided.

Once stripping out works have been concluded, the edges of the structural floors and recessed timber beam joints with the existing external / demise masonry walls should be inspected and any gaps between the joists and the wall tightly packed with mineral fibre to limit potential flanking via these weaknesses in the base-build structure.

Where partitions interface with the external wall, the internal lining of the façade shall be broken by the partition as shown indicatively in Figure 5.

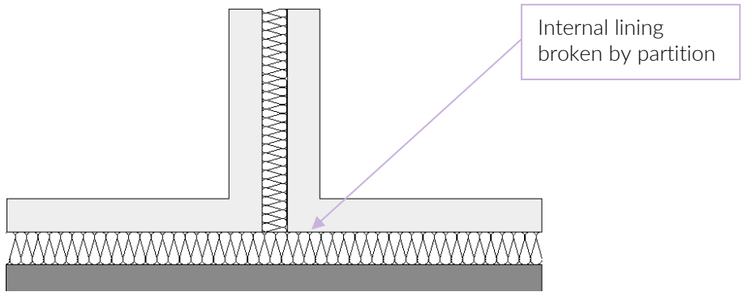


Figure 5 Detailing at junction between partition and building envelope

6.3 Retained structural columns.

It is understood from design coordination discussions that a number of existing structural columns are to be retained as part of the proposed refurbishment works.

6.3.1 Columns within proposed party walls.

Where existing columns are located within new-build acoustically rated walls, these shall be boxed-in with 2x12.5mm layers of dense plasterboard such as BG Soundbloc or equivalent, with the cavity packed with mineral fibre. Where the party wall abuts these elements, the party wall shall break the drywall encasement of the column to control flanking noise transfer through this element. An indicative sketch is provided in FIGURE XX for added clarity of the detailing strategy to be developed.

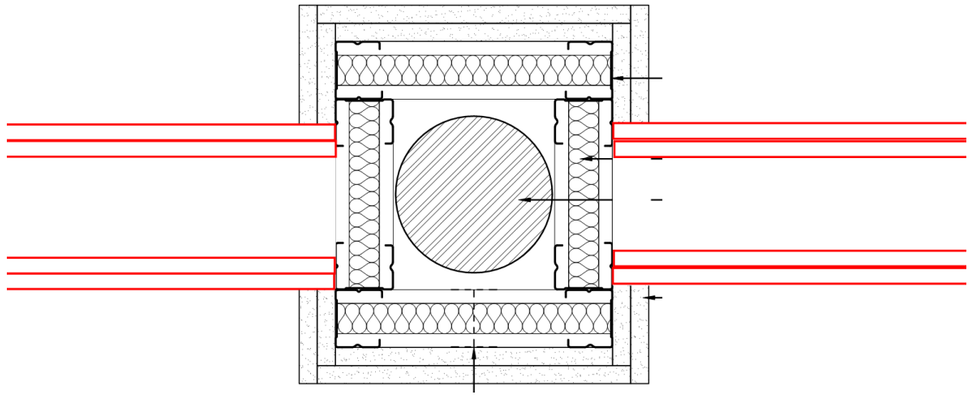


Figure 6 Detailing sketch of junction between party wall partition and encased retained columns

6.3.2 Exposed cast iron columns.

It is understood that existing circular cast iron columns on site are proposed to be retained and exposed within the refurbished apartment buildings.

Further to correspondence with the Architect on 07/09/2021, it is understood that these elements are not continuous across proposed party floor lines, with an unspecified timber beam stopping detail between columns vertically, located within the existing and proposed floor build-up zone. This was confirmed by the Structural Engineer on 08/09/2021.

As these elements introduce a high risk of structure borne transmission vertically between apartments if not adequately isolated, an appropriate detail incorporating a resilient element to isolate the columns across vertical adjacencies will need to be developed to ensure the transmission paths are broken as the design develops.

7. Finishes – Reverberation.

7.1 Criteria.

Reverberation in common areas (i.e. common corridors) that lead to residential dwellings via a door must be controlled such that it is compliant with Requirement E3 of Building Regulations Approved Document E (ADE).

7.2 Review of proposed finishes to common areas.

From a review of the floor and ceiling finishes plans, dated 11/06/2021, the following finishes are currently specified within the proposed design:

- Corridors / Lobbies: Carpeted floor finishes with 100% ceiling coverage of Class C ($\alpha_w \geq 0.6$) sound absorbent finishes.
- Stairwells: Carpeted floor finishes with 50% ceiling coverage of Class C ($\alpha_w \geq 0.6$) sound absorbent finishes.
- Building Entrance: 50% hard floor finishes, 50% carpeted floor finishes, with 100% ceiling coverage of Class C ($\alpha_w \geq 0.6$) sound absorbent finishes.

The above acoustic finishes specification would be expected to comply with the requirements of ADE.

8. Control of noise transfer from commercial unit to apartments.

8.1 Kirklees Council requirements.

Kirklees Council planning condition 15 states the following:

> *"Prior to internal works commencing (other than demolition and soft strip-out works) a noise assessment report shall be submitted to and approved in writing by the Local Planning Authority. The report shall include:-*
>
> *a) an assessment of all of the likely noise emissions from the A3 use hereby approved; and*
>
> *b) a written scheme detailing how occupants of the noise-sensitive residential use hereby approved would be protected from noise from the A3 use hereby approved including details of all necessary noise attenuation measures.*
>
> *The A3 use hereby approved shall not commence until all works included within the measures specified in the approved report have been*
>
> *carried out in full and such works shall be thereafter retained..*

Note on Planning Condition 15: While the refurbishment design presented herein applies best-practice methods to comply with the intent of planning condition 15, given the Shell and Core only fit-out of the unit as part of the proposed works, this is not considered dischargeable until an assessment against prospective tenant requirements can be carried out.

8.2 Recommended landlord operational noise limits within A3 commercial unit.

With the presently recommended floor build-ups, the tenants would be allowed to generate sound levels of up to L_{Aeq} 80 dB within the ground floor commercial unit. This initial limit is currently based on standard drylining being provided to full height internally by future tenant fit-out works to the existing retained walls and external walls within the A3 commercial unit. In the interests of future proofing the design, a zoning allowance should be made in the design to enable independent wall linings to be provided by future tenant teams.

Should higher operational sound levels be required, it shall be incumbent upon future tenant fit-out teams to provide enhancement works to the landlord constructions so as to ensure noise from the operation of the commercial unit (inclusive of front of house and back of house areas such as kitchens etc) does not adversely impact residential amenity above. It is advised that this requirement be included in the retail tenant's lease.

9. Building services noise considerations.

9.1 Internal building services criteria.

9.1.1 Internal noise limits.

It is recommended that noise from building services be designed to meet the noise levels given in.

Table 6 Maximum recommended building services noise limits

Space	Maximum internal building services noise
Bedrooms	NR 25 (23:00 - 07:00) NR 30 (07:00 - 23:00)
Living rooms	NR 30
Kitchens, dining rooms, halls	NR 35
Bathrooms	NR 40
Plant rooms (applicable at basement level only)	NR 65

Noise from the building services plant should not contain tonal elements or contain acoustic features such as distinct impulses or bangs.

9.1.2 Vibration from building services plant.

Adequate vibration isolation will be provided to all systems such that there is no perceptible vibration from building services plant throughout the development.

When all building services are operating at normal duty they shall not:

- Cause the maximum vibration dose value 0.1 $m.s^{-1.75}$ as given in to BS 6472-1: 2008 *Guide to Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)* in dwellings to be exceeded during the night (23:00-07:00).
- Cause the maximum vibration dose value 0.2 $m.s^{-1.75}$ as given in to BS 6472-1: 2008 *Guide to Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)* in dwellings to be exceeded during the daytime (07:00-23:00)
- Be of a magnitude which causes the internal noise criteria to be exceeded.

9.2 General internal building services considerations.

9.2.1 Routing.

Where possible services shall be routed to ensure that ducts, pipes and cable trays do not penetrate through separating walls and should where possible enter rooms above the doors in room fronts. Service penetrations through separating walls between apartments should be avoided.

9.2.2 Services penetrations.

Service penetrations (ducts, pipes and electrical services) through walls, floors and ceilings shall be sealed in such a way that the acoustic integrity of the structure is maintained and vibration transfer is eliminated. Example penetration details are provided in Appendix C.

9.2.3 Plumbing.
Rainwater pipes and other drainage routes should be routed in circulation spaces away from noise sensitive rooms. Where this is not possible the pipes shall be lagged with mineral fibre insulation and boxed with a minimum 2 layers of dense plasterboard as a minimum, with the encasement studwork separate from the drainage pipe support system.

9.2.4 Note on laundry spaces.
All washing machines within the proposed apartments should be mounted on a massed inertia base supported on low frequency anti-vibration mounts.

9.2.5 Lifts.
Lifts should be specified to be quiet in operation, inclusive of any reproduced sounds associated with the operation of doors and the lift cabin, having regard to the proximity of apartment entrances. Machinery and associated equipment should be anti-vibration isolated.

9.2.6 Anti-vibration measures.
All fans, pumps, fan coil units, standby generators and other rotating and reciprocating plant should be fitted with efficient anti-vibration mountings (AVMs). AVM selection will be determined by plant type and characteristics together with the performance criteria of adjoining spaces.

Plant mounted on AVMs should be isolated by flexible connections from ducts, pipes and conduits.

All pump sets should be installed on suitable concrete inertia bases.

Ductwork and pipework in the plant rooms and ductwork and pipework in contact with structures bounding noise sensitive areas should be supported on anti-vibration hangers.

9.3 MVHR units.

Proprietary attenuators will need to be provided to the ductwork routing to ensure that the internal building services noise levels in the apartments comply with the criteria set out in Section 9.1.

To control noise intrusion to the apartments via the atmospheric terminations, it is recommended that allowance be made for attenuators to be provided as close to the external grilles as possible.

To control structure borne noise from the building services units, they should be fitted on suitable anti-vibration mounts. To minimise the risk of disturbance to the occupants, it is recommended that the units are not fitted on walls to bedrooms wherever possible.

Product selections/attenuation packages will need to be carefully selected to ensure that noise break-out from the utility cupboards is controlled.

9.4 Services within apartments – design considerations.

The following highlights the key considerations in further developing the design of services within the apartments.

- If due to space limitations, MVHR systems are proposed to be installed directly above or in a cupboard directly off the room, specialist noise reduction measures will be required for the enclosure.

  Where utility cupboards open directly onto a living room, it would be necessary either for the MVHR to be contained within an enclosure within the utility room and standard access doors or specialist acoustic doors including seals would be required. Should it be necessary to draw air through the door to extract air and heat from the utility room, it would be necessary for the penetration to be acoustically treated.
- If the units are proposed above ceilings, provisions need to be made as a minimum for a double layer of dense plasterboard and insulation to minimise risk of case radiated noise breakout directly to space below.
- MVHR units should not be mounted on lightweight partitions. Provision should be made for FCU systems to be hung from the slab. This could take the form of a uni-strut frame suspended from the soffit with suitable anti-vibration mounts between the unit and frame. Alternatively, an independent frame could be considered within the main utility cupboard.
- Sound attenuation to MVHR systems ductwork should be allowed for in the scheme design.
- Flexible ducting which allows noise breakout should be avoided between units and attenuators.
- Ductwork should be appropriately sized to avoid high resistance. Ducts should contain minimal bends and allow for low air velocities.
- Care will need to be taken in developing coordinated designs where the risk of cross talk through the ducted ventilation system is addressed.
- Adequate vibration isolation will need to be provided to all systems such that there is no perceptible vibration or associated re-radiated airborne noise in any occupied parts of the scheme.

9.5 Noise emissions to surroundings.

9.5.1 Kirklees Council requirements.

Cumulative plant noise egress control.
Kirklees Council planning condition 16 states that:

> *'The combined noise from any fixed mechanical services and external plant and equipment shall be effectively controlled so that the combined rating level of noise from all such equipment does not exceed the background sound level at any time.'*

A3 unit kitchen extract ventilation control.
Kirklees Council planning condition 17 states that (HL emphasis):

> *'The A3 use hereby approved shall not commence until a detailed kitchen extract ventilation system scheme has been submitted to and approved in writing by the Local Planning Authority. The scheme shall include:*
>
> *a) an odour risk assessment for the A3 use taking into consideration the likely odour and grease loading and the proximity of odour sensitive receptors;*
>
> *a) details, including plans showing the proposed location of the main components of the ventilation system, in particular the fans, any silencers, any odour control equipment, the extract flue and the terminal cowl;*
>
> *b) details of any methods of treatments of emissions and filters that would be necessary to remove the odours that are likely to be generated; and*
>
> ***c) details of the noise that would be generated by the ventilation system and any necessary noise mitigation measures that are required to ensure the noise does not have an adverse impact on any noise sensitive premises***
>
> *The works specified in the approved scheme shall be implemented before the A3 use hereby approved commences. These works shall there-after be retained, operated at all times when the kitchen of the A3 use is in use, and maintained in accordance with the manufacturer's instructions.'*

9.5.2 Plant noise limits.

Based on the wording of Planning Condition 16 and the results of the noise survey carried out on site, summarised in Section 3.2, suitable plant noise limits have been derived, applicable at the nearest identified noise sensitive receptors.

It should be noted that due to the reduction in road traffic during the night period, the background noise levels incident at the unattended measurement position U1 are deemed to be representative of those experienced at the rear elevations of the site and adjacent noise sensitive premises.

Plant items shall therefore be selected such that the overall maximum sound pressure levels for fixed plant, equipment and machinery associated with the development shall not exceed the levels presented in Table 7 at 1 m from the nearest noise sensitive premises.

Table 7 Maximum plant sound pressure level at 1 m from the nearest noise sensitive premises

Noise sensitive receiver	Time of day	Maximum plant noise level at 1m from the nearest noise sensitive receptor window ($L_{Ar,T}$, dB) *
Residential elevations facing Dewsbury Ring Road	Daytime (07:00 to 23:00 hrs)	58
	Night (23:00 to 07:00 hrs)	39
Residential elevations screened from Dewsbury Ring Road	Daytime (07:00 to 23:00 hrs)	48
	Night (23:00 to 07:00 hrs)	34

*If plant noise contains any tonal characteristics further corrections shall be applied.

10. Building services noise assessment.

10.1 Proposed landlord building services scheme.

The currently proposed building services scheme comprises the items of plant presented in Table 8 along with available manufacturer noise data.

Table 8 Proposed externally terminating / externally located building services plant items

Plant item	Model	No of units	Operational hours	Sound power level, L_w (per unit, dBA)
Residential MVHRs (internally located with façade and rooftop terminations)	Vent Axia Low Carbon Sentinel Kinetic BH	23	Day and night	70 [1]
Residential condensers (externally located on roof)	Daikin 3MXM68N9	7	Day and night	61
Residential Bin Store Fan (internally located with façade termination)	Nuaire DAVE seize DE4H	1	Day and night	80 [1]

[1] – Worst-case sound power level for unit at 100% speed

10.2 Future tenant – Current allowances.

In addition to the landlord services plant to be installed as part of the refurbishment works, allowance is currently made within the proposed design for the following tenant plant areas:

- Future tenant condenser units (12no. units)
- Future ground floor A3 commercial unit extract and supply fans (1no each)

10.3 Basis of initial plant assessment.

A conservative desktop assessment of the proposed plant noise egress for the building services scheme as set out above has been carried out for the worst affected identified residential receivers at 23 Bond Street. For the purposes of the assessment, only conservative worst-case estimates of screening corrections have been used, and minimal internal losses have been accounted.

Where mitigation measures are required, localised limits at 1m from the atmospheric terminations are provided to guide final equipment and attenuation selections in the next design stage.

10.4 Initial plant noise assessment.

10.4.1 Residential condenser units.

The assessment of the proposed condenser units indicates that the current landlord condensers on the roof of the proposed new-build extension are capable of complying with the plant noise limits set without any further mitigation measures.

10.4.2 Residential bin store extract fan.

The assessment of the proposed condenser units indicates that the current bin store extract fan terminating at ground level on Bond Street is capable of complying with the plant noise limits set on the basis of a 1500mm long attenuator being provided on the atmospheric connection to achieve a localised sound pressure level of L_{Aeq} 50 dB at 1m ground level termination louvre on Bond Street.

10.4.3 Residential MVHR units.

The assessment of the proposed MVHR units would be compliant with the plant noise limits set at the front of 23 Bond Street on the basis of 1500mm long attenuators being provided on the atmospheric connections.

Additional mitigation measures will be required to sufficiently reduce noise egress from the proposed MVHR terminations at the rear of the site along the eastern elevation (Flats 1.06 and 2.06). This is due to a combination of the relatively high noise levels from the proposed MVHR selection, the very short distance to the nearest residential windows, and the lower plant noise limits applicable at this location.

A localised sound pressure level of L_{Aeq} 25 dB at 1m from the MVHR louvre terminations for the flats in question in order to achieve the plant noise limit for the night time period at this location. Possible mitigation options to address these could comprise a combination of the following, to be further developed:

- Selection of quieter units
- Re-routing MVHR atmospheric terminations onto the south elevation of the building (note: this would result in relaxed localised sound pressure levels per louvre)
- Provision of acoustically lined atmospheric plenums to the rear of the external louvres
- Provision of acoustically rated louvres.

10.5 Review of proposed tenant plant allowances.

To ensure the proposed operational scheme complies with the requirements of Planning Conditions 15, 16 and 17 in so far as practicable, maximum localised plant noise limits are provided below for the currently identified future tenant plant scheme.

- Tenant condenser units: L_{Aeq} 50 dB at 1m from unit, per unit;
- Tenant Supply and Extract fan units: L_{Aeq} 50 dB at 1 m from unit, per unit.

The above limits have been derived to ensure cumulative landlord and tenant building services plant egress during building operation does not exceed the contributions calculated above for landlord-only services egress.

Note: As tenant plant specification and installation cannot be assessed as part of the landlord works, it shall be incumbent upon future tenants to demonstrate compliance with the limits set above.

Appendix A: Glossary of terms.

Recognizing that the report is necessarily technical in content, requiring the use of quite specific acoustic terminology which may be unfamiliar, the following offers a brief overview of the key parameters used.

Sound is physically a regular and ordered oscillation of air molecules that travels away from a source of vibration and creates fluctuating positive and negative acoustic pressure. When acoustic pressure acts on any solid object it causes microscopic deflections in the surface so it can manifest in both air and structure.

Noise is subjectively sound that evokes a feeling of displeasure in the environment in which it is heard, and is therefore unwelcomed by the receiver.

Sound pressure level is stated on many of the results charts herein. It is the amplitude of the acoustic pressure fluctuations in a sound wave, fundamentally measured in Pascals (Pa) typically from 20 micro-Pascals to 100 Pascals but commonly simplified into the decibel scale.

Decibel is the unit normally employed to measure the magnitude of sound, a logarithmic scale where an increase of 10 dB in sound pressure level is equivalent to an increase by a factor of 10 in the sound pressure level; abbreviated as dB or dB(A) for the decibel level of a sound that has been A-weighted

A-weighting is a filter that down-weights low frequency and high frequency sound to better represent the frequency response of the human ear when assessing the likely effects of noise on humans

Frequency is a term that will be regularly used. It is the number of acoustic pressure fluctuations per second (also known as the 'pitch' of a sound). Hertz is the unit normally employed to measure the frequency of a sound, equal to cycles per second of acoustic pressure fluctuations. The frequency limits of audibility of a healthy human ear are generally accepted as being from 20 Hz to 20,000 Hz.

Equivalent continuous sound pressure level is commonly used throughout the report and is the steady sound level which has the same energy as a time varying sound signal when averaged over the same time interval, T, denoted by L_{eq} of $L_{Aeq,T}$.

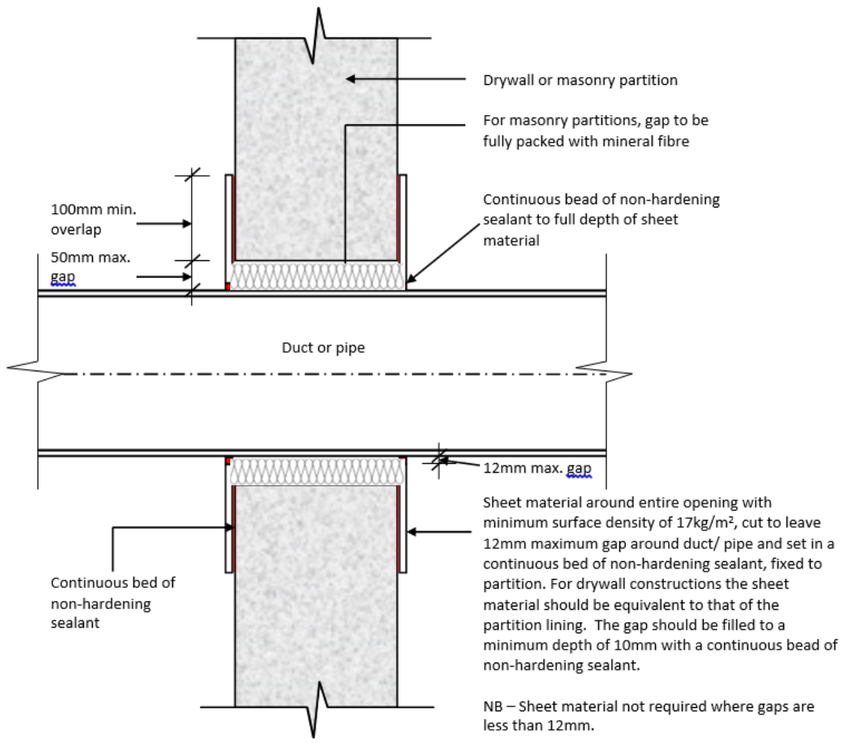
Reverberation Time is defined as the time taken for a noise level in an enclosed space to decay by 60 dB from a steady level, once the noise source has stopped. It is measured in seconds. Often a 60 dB decay cannot be measured so the reverberation time is measured over a lesser range and corrected back to the time for a 60 dB drop assuming a constant decay rate. Common parameters are T20 (time taken for a 20 dB decay multiplied by three) and T30 (time taken for a 30 dB decay multiplied by two).

Airborne Single Number Quantity Weighting. This is a weighting procedure defined in BS EN ISO 717, Part 1 for converting third octave band R, R', D and DnT values to a single number quantity denoted as R_w, R'_w, D_w or $D_{nT,w}$. It is a decibel value.

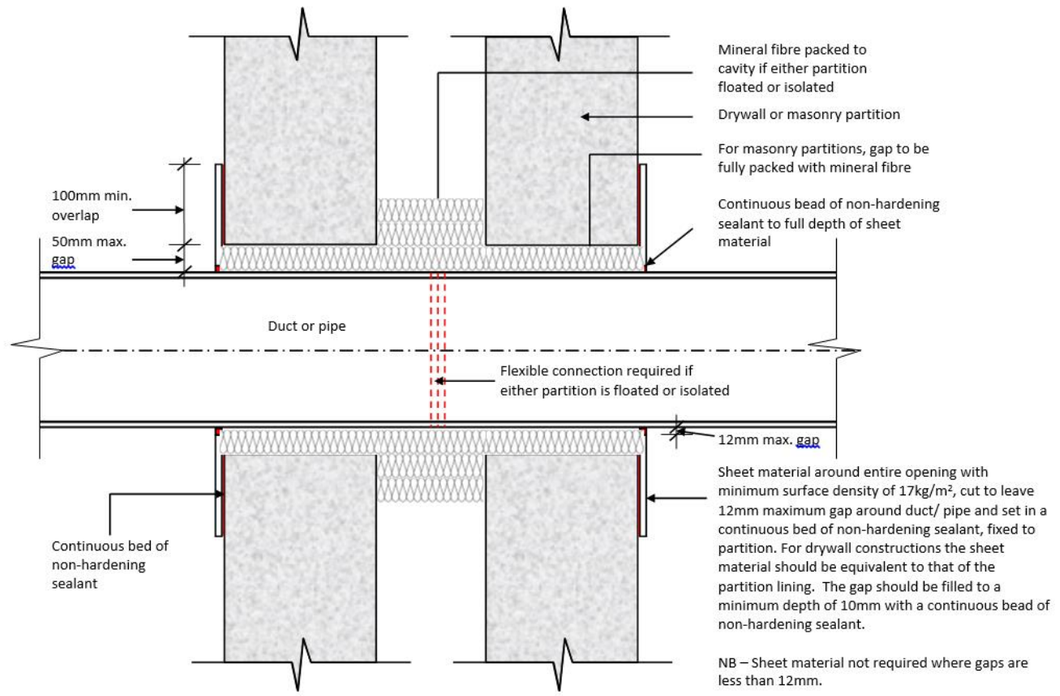
Impact Single Number Quantity Weighting. This is a weighting procedure defined in BS EN ISO 717, Part 2 for converting third octave band L'_{nT} values to a single number quantity denoted in $L'_{nT,w}$. It is a decibel value.

Appendix B: Example penetration details.

Duct or pipe penetration detail – Single partition



Duct or pipe penetration detail – Double partition



HOARE LEA

LUIS RUIVO
PRINCIPAL ACOUSTICS ENGINEER

+44 161 672 7217
luisruivo@hoarelea.com

HOARELEA.COM

Royal Exchange
Manchester
M2 7FL
England