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Bank of New York, 4 Angel Square, Manchester

Stage 4 acoustic design report

SANDY BROWN
ACOUSTICS

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Summary

Sandy Brown has been appointed by Overbury Plc to provide acoustic advice to the design of new office accommodation for Bank of New York at 4 Angel Square, Manchester.

This report sets out the key acoustic performance requirements associated with the fit-out for the occupied spaces and summarises the design measures required to achieve these.

This report is commensurate with RIBA Stage 4 Technical Design. This report is an interim issue and will be updated with the Stage 4 architectural and MEP packages when available.

Key outstanding items for development and review include:

- The proposed Stage 4 door schedule will need to be provided for review
- The resilient layer setting out plans will need to be provided for review
- The proposed raised access floor break detail will need to be provided for review
- The proposed moveable wall base detail needs to be updated to incorporate a break in the raised access floor. The updated detail will need to be provided for review
- The proposed moveable wall stopping post detail will need to be provided for review
- Details of the finishes strategies to the assembly space, gym and medical facilities will need to be provided for review
- Where the LEED internal noise level criteria are lower than the NR values, attenuation is expected to be required to ensure compliance with the relevant criterion. The internal plant attenuation strategy will need to be reviewed
- Crosstalk attenuator layouts and insertion losses will need to be reviewed
- The provision of a sound masking system to the first floor office areas above the gym should be discussed with the client team. Provision of a sound masking system would likely allow an extra 5 dB from amplified music/activity noise.

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1 Introduction

Sandy Brown has been appointed by Overbury Plc to provide acoustic advice to the design of the new office accommodation for the Bank of New York at 4 Angel Square in Manchester.

This report sets out the key acoustic performance requirements associated with the fit-out for the occupied spaces and summarises the design measures required to achieve these.

This report is commensurate with RIBA Stage 4 Technical Design. This report is an interim issue and will be updated with the Stage 4 architectural and MEP packages when available.

2 Approach

The technical design has been developed during Stage 4 based on the Stage 3 design. This report provides acoustic performance requirements for all relevant architectural elements as well as building services noise & vibration criteria. This report also considers the requirements of the LEED and WELL sustainability standards, as well as the BNY design standards.

On completion of the fit out, acoustic tests will be undertaken in a representative sample of spaces to demonstrate compliance with the specified performance requirements. Any significant weaknesses or failures will be identified with recommendations for improvements, where appropriate

3 Basis of design advice

3.1 Standards/design guidelines

The following standards/design guidelines have been considered in preparation of this report:

- BS 8233:2014 Guidance on sound insulation and noise reduction for buildings
- British Council for Offices (BCO) Guide to specification 2019
- British Council for Offices (BCO) Guide to fit-out 2025
- FIS A Guide to Office Acoustics (2015)
- LEED v4.1 Interior Design + Construction Guide
- WELL v2, Q1-Q2 2024
- The Chartered Institute of Building Services Engineers (CIBSE) Guide A 2015 Environmental criteria for design
- BS 6472 Part 1: 2008 Guide to evaluation of human exposure to vibration in buildings: Part 1 Vibration sources other than blasting
- The Control of Noise at Work Regulations 2005
- The Disability Discrimination Act 2004
- The Construction (Design and Management) Regulations 2015
- Building Safety Act 2022.

3.2 Design information:

The following design information has been reviewed in preparation of this report:

- TP Bennett Stage 3 general arrangements dated rev T2
- TP Bennett wall finishes drawing package received via email on 15 August 2025
- TP Bennett Stage 4 partition construction and interface detail package received via email on 5 September 2025
- TP Bennett reflected ceiling plan package received via email on 9 September 2025
- TP Bennett finishes schedule received via email on 22 September 2025
- TP Bennett Stage 4 partition setting out package received via email on 25 September 2025
- TP Bennett gym drawing package received via email on 25 September 2025
- CWC WIP ventilation layouts received via email on 6 October 2025
- VE design change schedule received via email on 14 January 2026
- Caice attenuator schedule *135027/Q00012* received via email on 6 February 2026
- Sandy Brown report 025132-R02-A Stage 3 acoustic design report dated 23 May 2025
- Outcomes of design team meetings during Stage 4.

3.3 Project requirements

The proposed acoustic performances have been based on the standards and design guidelines set out in Section 3.1. Client requirements for acoustic finishes have been received as detailed within *BNY Design_Standards_CBRE_11.6.24_Version 1*.

3.4 Sustainability

The scheme is targeting LEED, WELL and NABERS 5 stars sustainability accreditations.

The accreditation scheme requirements for available credits/points are provided in Appendix G. A design assessment is included in Section 9.

Markups of noise zones for the WELL pre-requisite are set out in Appendix B.

3.5 Sound insulation

3.5.1 Calculation of rating values

Laboratory and site sound insulation performance parameters referred to in this report shall be calculated in accordance with BS EN ISO 717-1:2020 *Acoustics – rating of sound insulation in buildings and of building elements – Part 1: Airborne sound insulation*.

3.5.2 Laboratory sound insulation

Measurements of the laboratory sound insulation of building elements shall be carried out in accordance with BS EN ISO 10140 2: 2021 *Acoustics – laboratory measurement of sound insulation of building elements, Part 2: Measurement of airborne sound insulation*.

3.5.3 Site sound insulation

In-situ sound insulation performances shall be measured in according to BS EN ISO 140-4: 1998 *Acoustics – Measurements of sound insulation in buildings and of building elements or BS EN ISO 16283-1: 2021 Acoustics – Field measurements of sound insulation in buildings and of building elements*.

3.5.4 Sound absorption

Sound absorbent finishes shall be rated in accordance with BS EN ISO 11654: 1997 *Acoustics – Sound absorbers for use in buildings – Rating of sound absorption*.

4 Sound insulation strategy

4.1.1 Partitions and doorsets sound insulation requirements

Mark-ups of the specified sound insulation strategy are provided in Appendix C.

4.2 Site tolerances

The laboratory sound insulation performance (Weighted Sound Reduction Index, R_w) is the sound insulation provided by a given construction when tested in a laboratory. It is used to select the drywall construction from relevant manufacturer's technical literature such as the British Gypsum White Book.

The site sound insulation performance (Weighted Level Difference, D_w) is the sound insulation provided by a given construction when installed on site. Ultimately it is this performance that is of greater importance. It is accepted that there will be a reduction in the sound insulation performance of a drywall between laboratory and site.

The specified laboratory-to-site tolerances are set out in Table 1.

Table 1 Site tolerances for sound insulating elements

Element	Sound insulation site tolerance
Drywalls	Full height partitions with ceilings to both sides: $R_w \geq D_w + 7$ dB All other full height partitions (slab-to-slab): $R_w \geq D_w + 10$ dB Partial height partitions (eg, raised access floor to soffit (with acoustic floor void barrier): $R_w \geq D_w + 10$ dB (limited to D_w 40 dB in-situ)
Glazing	$R_w \geq D_w + 3$ dB
Doors	$R_w \geq D_w + 3$ dB

Sound Transmission Class (STC) is approximately equivalent to R_w.

Noise Isolation Class (NIC) is approximately equivalent to D_w.

4.3 WELL S03 Sound barriers

In line with the WELL feature S03, between loud zones and regularly occupied spaces there is a requirement to provide a wall to meet R_w 60 dB or STC 60. This applies to the following areas:

- Gym
- SCR rooms
- MCR room
- UPS room
- Cafeteria
- Kitchens and enclosed tea point/catering spaces
- Catering prep room.

4.4 Partition constructions

4.4.1 Drywall partitions

The proposed Stage 4 partition constructions are summarised in Table 2. All partitions are to be constructed full height, from structural floor to structural soffit. The proposed constructions achieve their stated sound insulation performance.

Table 2 Proposed Stage 4 partition constructions

Wall type	Stated sound insulation performance	Proposed construction build-up and BG reference
Type P01	R_w 45 dB	Nominal thickness 122 mm 2 x 12.5 mm of Gyproc Wallboard to both sides of Gypframe 70S 50 'C' stud BG reference A206015(A) (EN)
Type P02	R_w 50 dB	Nominal thickness 132 mm 2 x 15 mm of Gyproc Wallboard to both sides of Gypframe 70S 50 'C' stud BG reference A206048(A) (EN)

Wall type	Stated sound insulation performance	Proposed construction build-up and BG reference
Type P03	R_w 55 dB	Nominal thickness 136 mm 2 x 15 mm of Gyproc SoundBloc to both sides of Gypframe 70S 50 'C' stud and 25 mm APR 1200 in the cavity with 2 mm Thistle MultiFinish on both sides BG reference A206199S (EN)
Type P04	R_w 61 dB	Nominal thickness 132 mm 2 x 15 mm of Gyproc SoundBloc to both sides of staggered 60 I 70 'I' studs with 50 mm APR 1200 in the cavity BG reference A233023 (EN)
Type P05	R_w 45 dB	Nominal thickness 122 mm 2 x 12.5 mm of Gyproc WallBoard each side of Gypframe 70 S 50 'C' Studs BG reference A206015(B)(EN)
Type P06	R_w 53 dB	Nominal thickness 122 mm 2 x 12.5 mm of Gyproc SoundBloc each side of Gypframe 70 AS 50 AcouStuds BG reference A206A166 (B)(EN)
Type P07	R_w 57 dB	Nominal thickness 144 mm 2 x 12.5 mm of Gyproc SoundBloc each side of Gypframe 92 AS 50 AcouStuds with 25 mm APR1200 in the cavity BG reference A206A290 (B)(EN)
Type P08	R_w 61 dB	Nominal thickness 198 mm 2 x 12.5 mm of Gyproc SoundBloc to both sides of staggered 92 I 90 'I' studs with Gypframe SC2 Spacer Clips and 50 mm APR 1200 in the cavity BG reference A233007 (B)(EN)
Type P09	R_w 54 dB	Nominal thickness 212 mm 2 x 15 mm of Gyproc FireLine to both sides of Gypframe 146 AS 50 AcouStuds with 2 mm Thistle MultiFinish on both sides BG reference A206A180S (B)(EN)
Type P10	R_w 50 dB	Nominal thickness 198 mm 2 x 12.5 mm of Gyproc Wallboard to both sides of Gypframe 146 S 50 'C' stud BG reference A206027 (B)(EN
Type P11	R_w 55 dB	Nominal thickness 141 mm 2 x 12.5 mm Baseline and 1 x 16 mm Duraline to both sides of Gypframe 62 mm 'C' stud with 50 mm APR1200 in the cavity BG reference N/A
Type P13	R_w 42 dB	Nominal thickness 102 mm 1 x 15 mm of Gyproc SoundBloc MR each side of Gypframe 70 S 50 'C' stud BG reference A206165 MR2 (EN)
Type P14	R_w 54 dB	Nominal thickness 144 mm 2 x 12.5 mm of Gyproc SoundBloc each side of Gypframe 92 AS 50 AcouStuds BG reference A206A289 (EN)
Type P15	R_w 55 dB	Nominal thickness 198 mm 2 x 12.5 mm of Gyproc SoundBloc each side of Gypframe 146 S 50 'C' stud and 25 mm APR 1200 in the cavity BG reference A206A289 (EN)
Type IWL01	-	2 x 12.5 mm of Gyproc WallBoard to one side of independent Gypframe 92 I 90 independent studs with 50 mm APR1200 in the cavity

Wall type	Stated sound insulation performance	Proposed construction build-up and BG reference
Type IWL02	-	2 x 15 mm of Gyproc SoundBloc to one side of independent Gypframe 146 I 80 independent studs with 50 mm APR1200 in the cavity
Type MWS01	R_w 57 dB	Specialist moveable partition system, Variflexs 100 system or equivalent

4.4.2 Staggered / twin stud partitions

Staggered / twin stud partitions not only provide a high degree of airborne sound insulation but also reduce impact and structure-borne sound transmission between rooms from sources such as:

- Electrical socket switches
- Objects dropping onto work surfaces/credenzas
- Lockers
- Wall mounted loudspeakers/AV screens with audio capabilities
- Plumbing and plant items fixed or adjacent to partitions.

The specified locations of staggered/twin stud partitions are shown in the mark-ups in Appendix C.

4.4.3 AcouStuds

AcouStuds are prone to workmanship issues, primarily resulting from incorrect screw lengths resulting in the studwork becoming bridges, which compromises the sound insulation performance of the partition. These issues are often difficult to identify and rectify once partitions are boarded to both sides. As such, particular care shall be taken when constructing partitions utilising AcouStuds.

4.4.4 Independent wall linings within catering prep room

A sound insulation performance of R_w 60 dB is specified between the ground floor catering prep room and the adjacent treatment room and assembly space. Due to the floor to ceiling height of this space, partition type P09 is required, which falls 6 dB short of the R_w 60 dB requirement. To achieve the sound insulation performance requirement, independent linings (IWL02) are to be provided within the catering prep room. These linings are shown in Figure 1 highlighted in red. This approach is acceptable from an acoustic perspective.

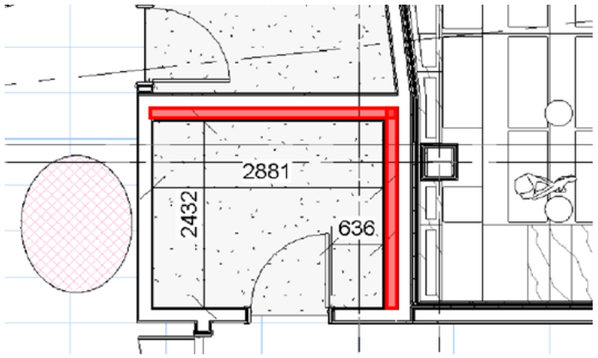


Figure 1 Independent linings IWL02 within catering prep room

4.4.5 Partition type P09 shortfalls

There are instances at ground floor where partition type P09, which achieves a sound insulation performance of R_w 54 dB, is proposed to adjacencies with a R_w 55 dB sound insulation performance requirement. The partitions in question are shown in Figure 2 circled in red. Partition type P09 falls 1 dB short of the R_w 55 dB requirement. A 1 dB shortfall is considered negligible, and this approach has been agreed with the client team.

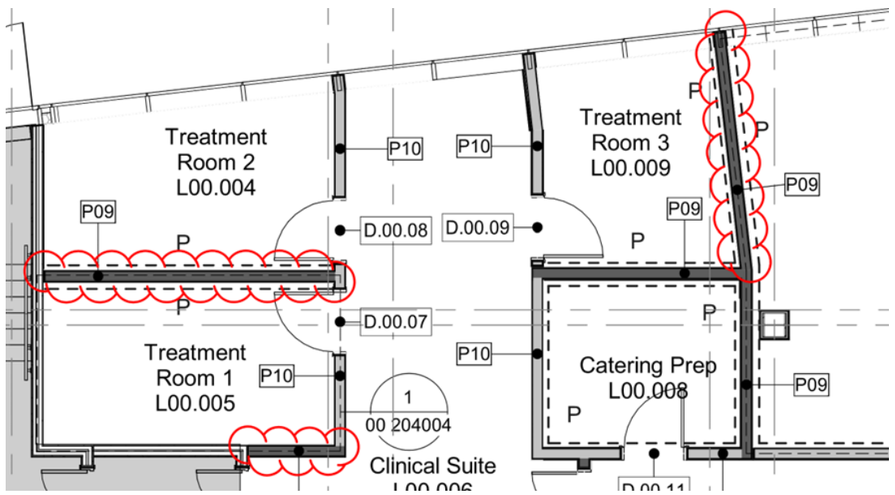


Figure 2 Partition type P09 shortfalls

4.4.6 Glazed partitions

The proposed glazed partition constructions are summarised in Table 3. The proposed constructions achieve their stated sound insulation performance providing the glazing configurations are appropriately specified as per the comments in Table 3.

Table 3 Proposed glazing constructions

Glazing type	Indicated sound insulation	Indicated glazing	Comments
Type PG01	R_w 40 dB	Single glazed Optima 117 Plus Shoreditch	In line with manufacturer's specification, to achieve the indicated sound insulation performance 16.8 mm acoustic laminate glass will be required
Type PG02	R_w 43 dB	Double glazed partition Optima Revolution 54 Plus Shoreditch	In line with manufacturer's specification, to achieve the indicated sound insulation performance 12.8 mm acoustic laminate glass+ 12.8 mm acoustic laminate glass in a multi-module screen will be required
Type PG03	R_w 43 dB	Double glazed partition Optima Revolution 54 Plus Shoreditch	In line with manufacturer's specification, to achieve the indicated sound insulation performance 12.8 mm acoustic laminate glass+ 12.8 mm acoustic laminate glass in a multi-module screen will be required

4.4.7 Partition setting out

The proposed partition setting out has been reviewed and achieves the sound insulation performance requirements set out in the mark-ups in Appendix C, with the exceptions discussed in Section 4.4.5.

4.5 Flexible void barriers

Where flexible void barriers are proposed, they shall comprise minimum 100 mm thick mineral fibre with a minimum density of 100 kg/m^3, foil or intumescent-faced on each side, providing a minimum sound insulation performance of R_w 30 dB.

Ablative coated fire batts shall be a minimum of 50 mm thick and have a minimum density of 140 kg/m^3 with intumescent facing on both sides.

4.6 Doorsets

Doorsets shall be specified to achieve the minimum sound insulation performances set out in the mark-ups in Appendix C. The proposed Stage 4 door schedule will need to be reviewed when available.

4.7 Risers

There are risers indicated with doors opening to horizontally and vertically adjacent meeting rooms as shown in Figure 3.

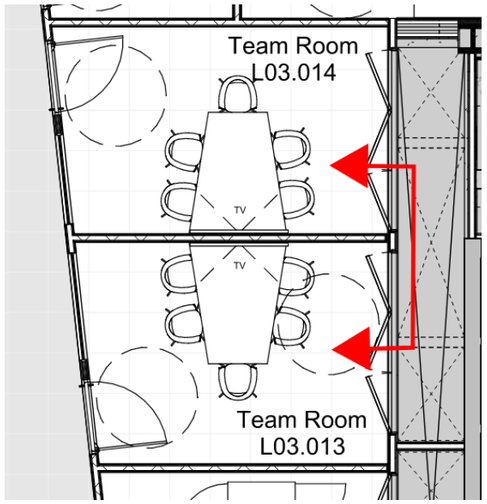


Figure 3 Example of horizontal noise transfer via risers to meeting rooms

These risers are specified to achieve a sound insulation performance of R_w 41 dB. On this basis, flanking sound transmission is expected to be suitably controlled without the need for further enhancements.

4.8 Proprietary pods

The proprietary pods are furniture items, and so the specific system will be selected by the client team as part of the furniture package. The following specification has been provided to aid in specifying the pod system, as requested by the client team.

Free-standing pods shall be specified to achieve a minimum sound insulation performance of $D_{nT,w}$ 35 dB (applicable to both crosswalls and room fronts).

The requirements for pod finishes are set out in Section 6.10, and building services noise within pods in Section 7.3.

4.9 Assembly space

An assembly space proposed to the ground floor as shown in Figure 4. Independent lining type IWL02 is proposed to the separating partition to control structure-borne noise transfer from the coffee bar. This approach is acceptable from an acoustic perspective.

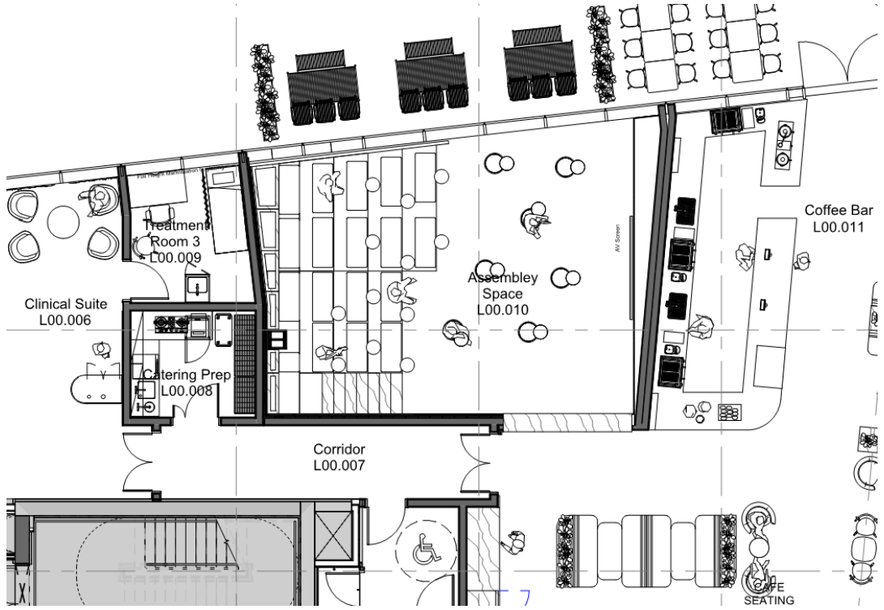


Figure 4 Proposed assembly space on L00

4.10Floors

4.10.1 General

The principal acoustic design requirements for internal floors are:

- Airborne sound insulation – to control airborne sound transfer from one space to another on an adjacent floor (above or below)
- Impact sound insulation – to control of impact sound transfer from one floor to another below.

4.10.2 Airborne sound insulation

The base build floor constructions are expected to provide an airborne sound insulation in the region of $D_{nT,w}$ 50 dB. Airborne sound insulation would be further supplemented by suspended ceilings, where proposed.

4.10.3 WELL - S07 Impact

Part 1 Specify impact noise reducing flooring

The maximum impact sound insulation performances to demonstrate compliance with criterion S07 are summarised in Appendix D. These are required for the project.

Table 4 WELL S07 Floor impact sound insulation requirements

Space type	Maximum impact sound insulation performance ($L_{nT,w}$)
Above quiet zones (except areas for concentration)	50
Below areas for Fitness (if space is within the project boundary)	55
Above enclosed Areas for Concentration and Conferencing	55
Above open areas for concentration	60
Below areas for retail and dining (if space is within the project boundary)	60

Part 2 Meet thresholds for impact noise rating

The same criteria as Part 1 above are applicable for Part 2. Part 2 requires performances to be measured on site (therefore it is assumed that the $L'_{nT,w}$ parameter is applicable). These are required for the project.

4.10.4 Impact sound insulation

To control impact sound transfer to adjacent spaces on the same floor, and below, eg, from footfall, either:

- A carpeted floor shall be provided, or
- A resilient layer shall be included underneath any hard floor finishes.

A maximum of 3 points are available from WELL Feature S07 (impact noise management). This criterion deals with impact sound insulation to control structure-borne noise transfer associate with footfall, gym equipment, etc. The WELL requirements are set out in Appendix D.

Resilient layers and floor finishes shall be selected to ensure that the WELL impact sound insulation standards are met.

These would typically be installed between the floor finish and the raised access floor, and shall be selected to provide a minimum of:

- ΔL_w 17 dB in all open-plan spaces.
- ΔL_w 23 dB to spaces located above cellular / quiet spaces based on WELL markups in Appendix B.

It has been confirmed by TP Bennett that the above will be included within the construction pack resilient layer setting out drawings, which will be reviewed when available.

Any hard floor finishes and the raised access floor below shall be discontinuous where these lead into sensitive cellular spaces with a soft joint at the line of partitions, including the entrance door. All partitions are to be constructed full height, from structural floor to structural soffit. The detail for entrance doors is further discussed in Section 5.8.

4.10.5 Cafeteria, kitchen specialist acoustic flooring

The cafeteria and kitchen have the potential to generate high levels of structure borne noise and vibration.

An Instafloor cradle and batten system (or equivalent) achieving a minimum ΔL_w 30 dB is proposed within these spaces. A resilient perimeter strip around the edge of the floor shall be provided to avoid any rigid connection to the walls.

Within the servery a resilient layer is included within the floor build-up achieving a minimum ΔL_w 23 dB.

4.10.6 Gym floors

Four different floor build-ups are proposed within the gym. The locations of these floor build-ups are shown in Figure 5.



Figure 5 Gym flooring zones

The group exercise studio gym floated floor build-up (FF06) is shown in Figure 6. The extent of this floor build-up is shown in Figure 5 highlighted in blue. This build-up is acceptable from an acoustic perspective providing that no dropping of weights or equipment onto the floor is proposed.

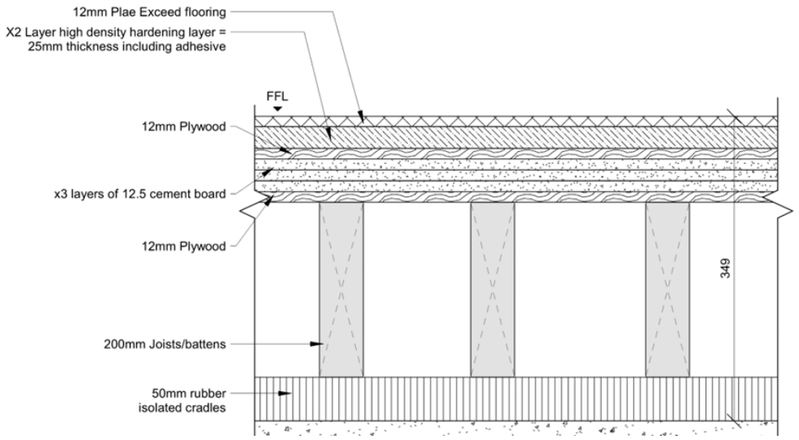


Figure 6 Proposed FF06 exercise studio floor build-up

The gym reception floor build-up (FF07) is shown in Figure 7. The extent of this floor build-up is shown in Figure 5 highlighted in yellow. This build-up is acceptable from an acoustic perspective providing no gym activities take place on top of it.

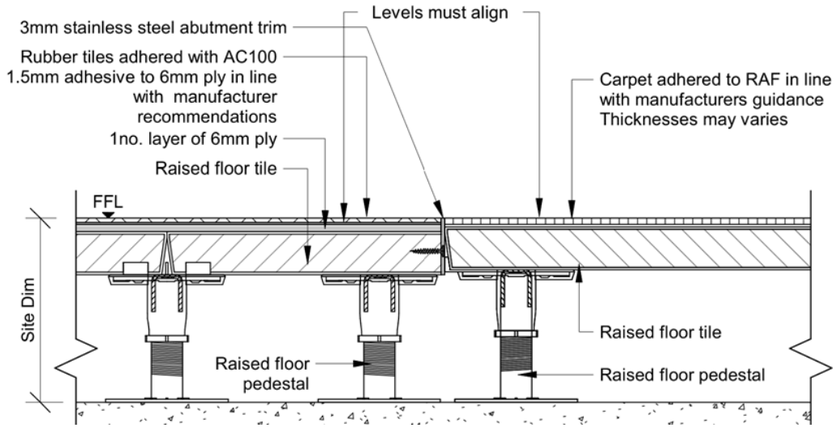


Figure 7 Proposed FF07 gym reception floor build-up

The gym turf floated floor build-up (FF08) is shown in Figure 8. The extent of this floor build-up is shown in Figure 5 highlighted in green. This build-up is acceptable from an acoustic perspective providing that no dropping of weights or equipment onto the floor is proposed.

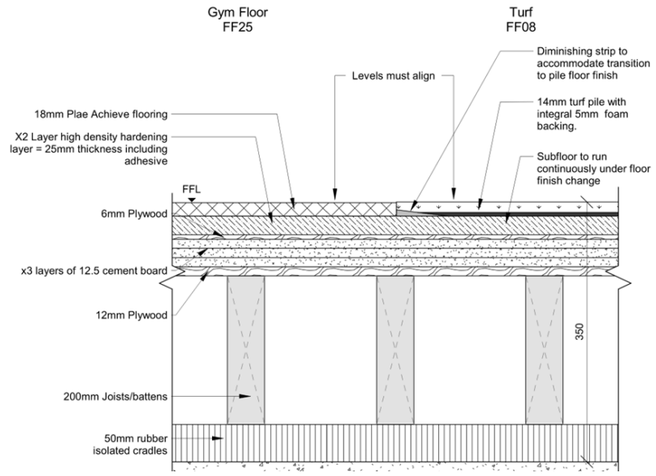


Figure 8 Proposed FF08 gym turf floor build-up

The main gym floated floor build-up (FF25) is shown in Figure 9. The extent of this floor build-up is shown in Figure 5 highlighted in red. This build-up is considered acceptable from an acoustic perspective.

This floated floor system is required to achieve a natural frequency of <20 Hz. The TVS system proposed achieves a natural frequency ≤ 6 Hz under live load, which complies with this requirement.

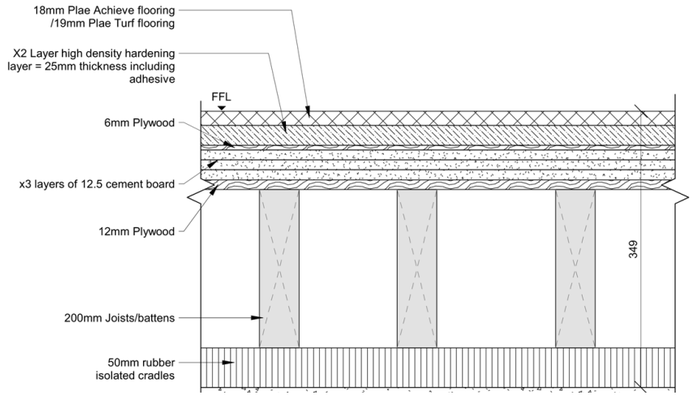


Figure 9 Proposed FF25 main gym floor build-up

Resilient perimeter strips shall be provided around the edge of the gym floors to avoid any rigid connection to the walls.

4.10.7 Gym flooring rationalisation

It is understood that the gym flooring types may be rationalised. It will need to be ensured that a floor type with a higher acoustic performance is not rationalised to one with a lower acoustic performance, such that the floor performance is not reduced.

4.10.8 Gym flooring verification testing

Early in-situ testing of the proposed gym floated sub-floors shall be undertaken to verify their performance in combination with the building structure.

4.11 Sound insulating ceiling to gym

4.11.1 Main gym areas

Within main gym areas, the sound insulating ceiling has been omitted from the design proposals. Without this ceiling, sound insulation between the ground and first floor is expected to be in the range of $D_{nT,w}$ 45 to 50 dB.

Sound levels from amplified music in the main gym will consequently need to be limited to approximately L_{Aeq} 75 – 80 dB to avoid disturbance to level 1 occupants.

This would be suitable for background music but not for loud amplified music, such as commonly used in group exercise classes (eg, Zumba, dance, spin classes).

The final operational noise levels will need to be set following acoustic testing.

In terms of activity noise, it is expected that the highest noise levels will be thumps from dropping of weights, for example from dumbbells, barbells and weight machines.

Provided the space is managed so that gym users are aware to not drop weights from height, it is anticipated that this could be infrequent.

4.11.2 Group exercise studio

A sound insulating ceiling is proposed within the group exercise studio consisting of 2 x 15 mm SoundBloc or equivalent suspended on resilient hangers with a natural frequency of <20 Hz and minimum 150 mm ceiling void containing 25 mm mineral fibre insulation. With this ceiling, sound insulation to level 1 is expected to be in the range of $D_{nT,w}$ 55-60 dB.

Sound levels from amplified music up to approximately L_{Aeq} 85 – 90 dB are expected to be able to be accommodated without resulting in disturbance to level 1 occupants.

The final operational noise levels will however need to be set following acoustic testing.

The sound insulating ceiling shall be imperforate with no recessed fixtures, fittings or MEP, and shall close off the slab edge to minimise flanking via this route. Perimeter isolation strips shall be installed to prevent bridging.

Sound absorbent treatment shall then be provided below this ceiling as set out in Section 6.14.

4.11.3 Flanking via the structure

All perimeter columns within the gym are encased with a lightweight boarding as shown in Figure 10. The exercise studio sound insulating ceiling shall seal tightly against this, with no gaps above.

Buffer/guard rails or panels shall be added at low level on the column encasements to minimise banging and impact noise transfer into the building structure.



Figure 10 Photograph of gym column encasements

5 Interface details

5.1 General

There are several base-building elements which have the potential to affect the acoustic standards achievable. These include sound transmission:

- Around partitions where they abut the perimeter facade/cladding
- Around partitions where they abut the structural slab soffit
- Via internal columns and beams
- Via common services, in particular, supply and return air pathways.

All of the above need to be taken into account in order to provide good acoustic integrity to cellular spaces.

All acoustically rated interfaces shall be sealed airtight with a flexible non-setting acoustic sealant. Specific interface details are provided in the following sections.

5.2 Base build wall linings

The proposed interface detail where drywall partitions abut base build wall linings is provided in Figure 11. This detail is acceptable from an acoustic perspective.

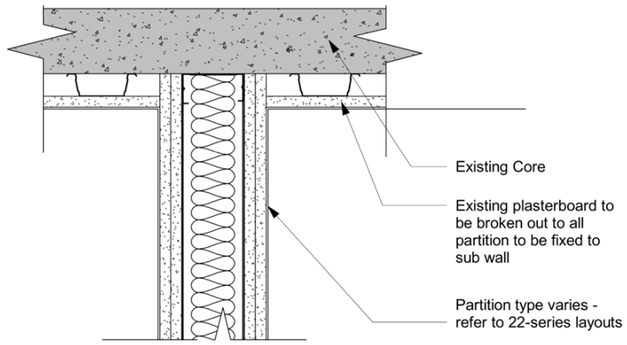


Figure 11 Proposed interface between drywall partitions and base build wall linings

5.3 Head details – Profiled deck

Partitions will interface with the underside of the profiled deck. Partition head details shall be carefully considered to ensure flanking transmission does not undermine the sound insulation performance of acoustically rated partitions.

The proposed partition head details are provided in Figure 12 and Figure 13 for where partitions run perpendicular and parallel to the trapezoidal deck profiles. These details are acceptable from an acoustic perspective.

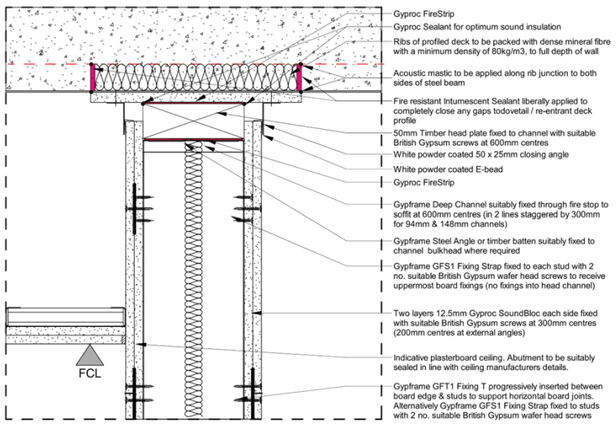


Figure 12 Proposed detail where drywall partitions with acoustic ratings run perpendicular to the profiled deck

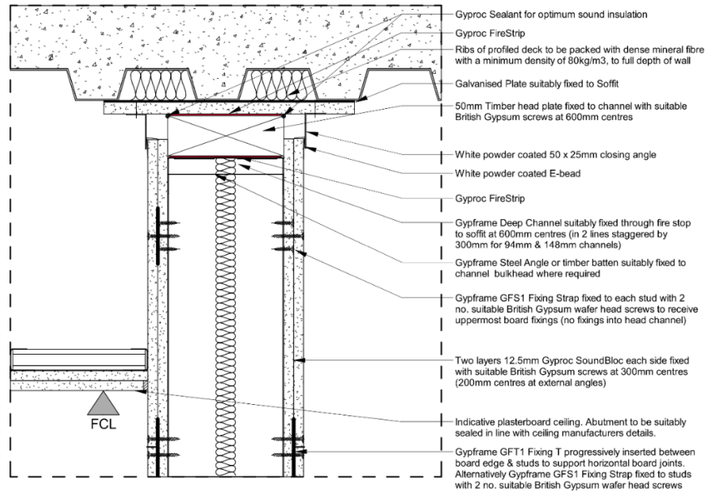


Figure 13 Proposed detail where drywall partitions with acoustic ratings run parallel to the profiled deck

5.4 Partitions interfacing with beams

The proposed detail for instances where partitions interface with beams is provided in Figure 14. This detail is acceptable from an acoustic perspective.

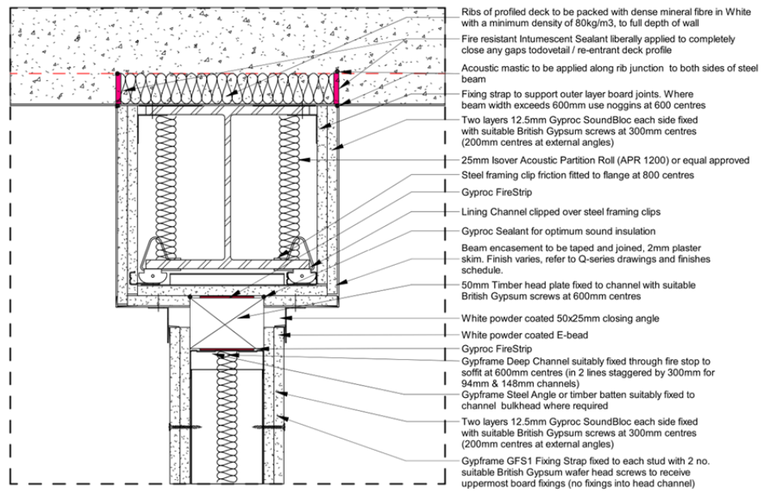


Figure 14 Proposed detail where drywall partitions interface with beams

5.5 Columns

5.5.1 Encased columns

The proposed detail for instances where partitions interface with enclosed columns is provided in Figure 15. This detail is acceptable from an acoustic perspective.

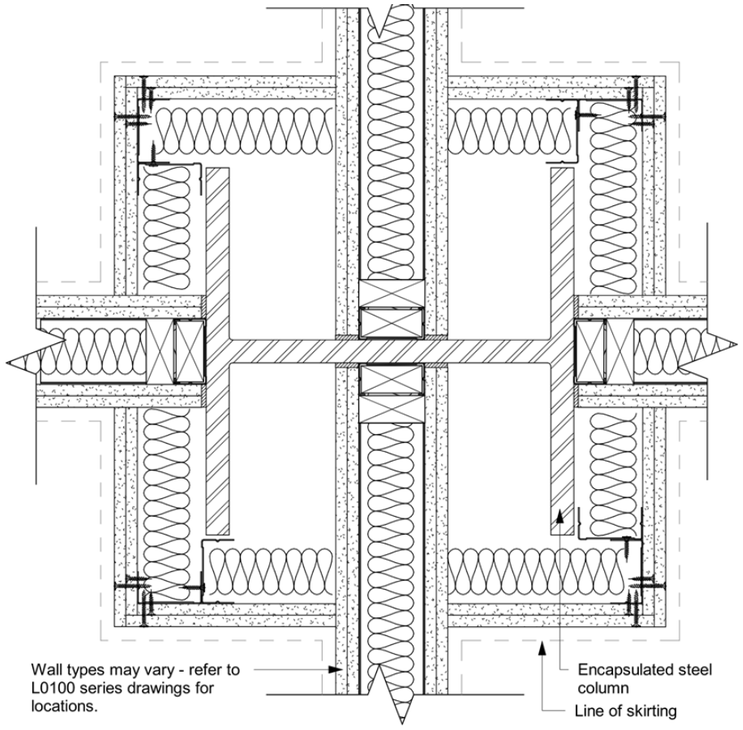


Figure 15 Proposed detail where drywall partitions interface with encased columns

5.5.2 Exposed columns

The proposed detail for instances where partitions interface with exposed columns is provided in Figure 16. This detail is acceptable from an acoustic perspective.

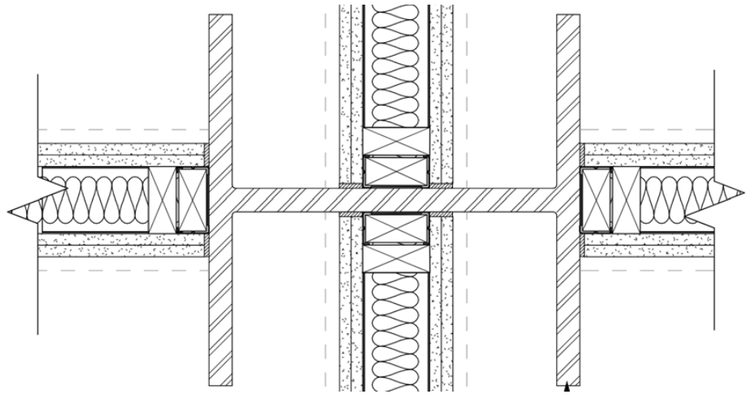


Figure 16 Proposed detail where drywall partitions interface with exposed columns

5.6 Partitions interfacing with mullions

The proposed detail for instances where drywall partitions interface with mullions is provided in Figure 17. This detail is acceptable from an acoustic perspective.

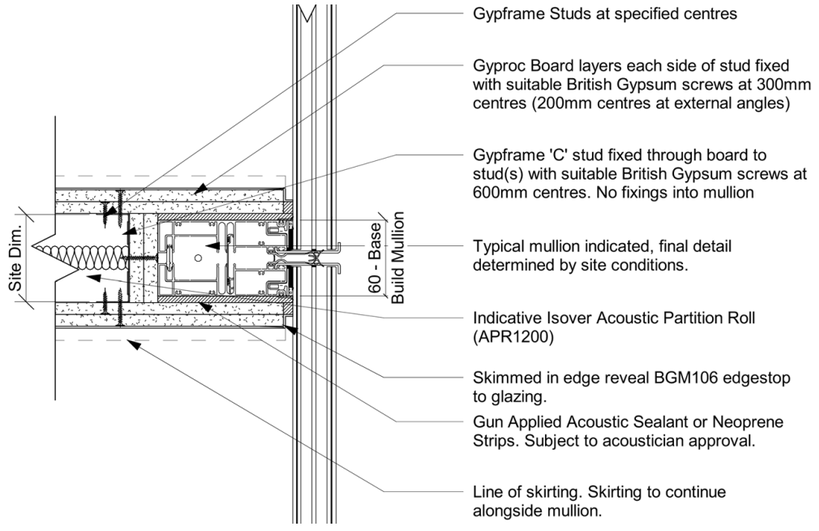


Figure 17 Proposed detail where drywall partitions interface with mullions

5.6.1 Junction details

The proposed detail for instances where single a stud drywall partition abuts another single stud drywall partition is provided in Figure 18. This detail is acceptable from an acoustic perspective. There are some junction details which do not show a break in the inner partition leaf at the junction line. This junction detail shall only be provided to non-acoustically rated partition junctions.

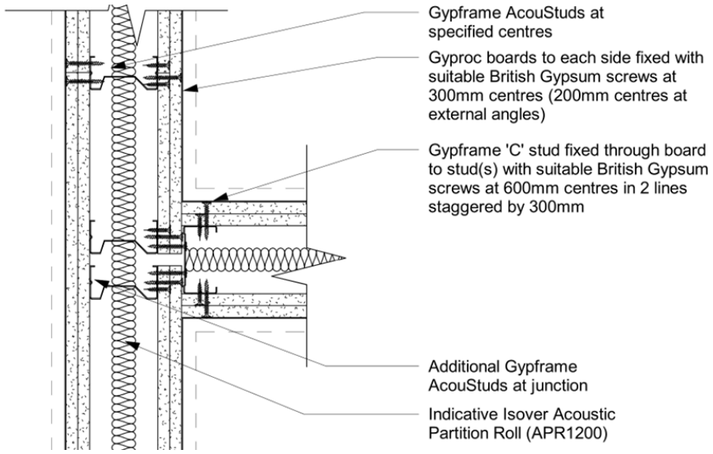


Figure 18 Proposed detail – Single stud drywall partition T-junction

5.7 Internal glazing

Internal glazing shall be built from a drywall upstand to the underside of a drywall bulkhead. The drywall bulkheads shall achieve the following minimum sound insulation performances:

- R_w 50 dB drywall bulkhead for R_w 44 dB glazing
- R_w 45 dB drywall bulkhead for R_w 40 dB glazing
- R_w 45 dB drywall bulkhead for R_w 38 dB glazing.

The proposed bulkhead detail is provided in Figure 19. The proposed drywall upstand detail is provided in Figure 20. Both details are acceptable from an acoustic perspective.

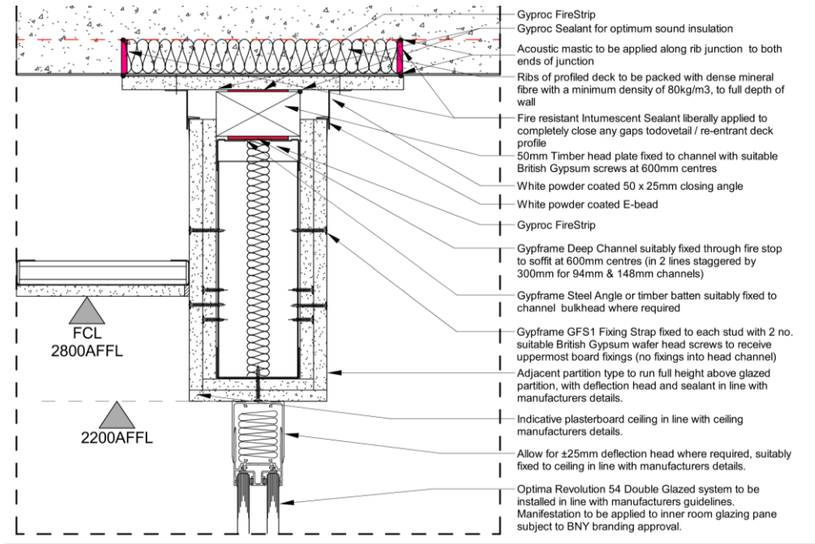


Figure 19 Proposed detail – Internal glazing drywall bulkhead

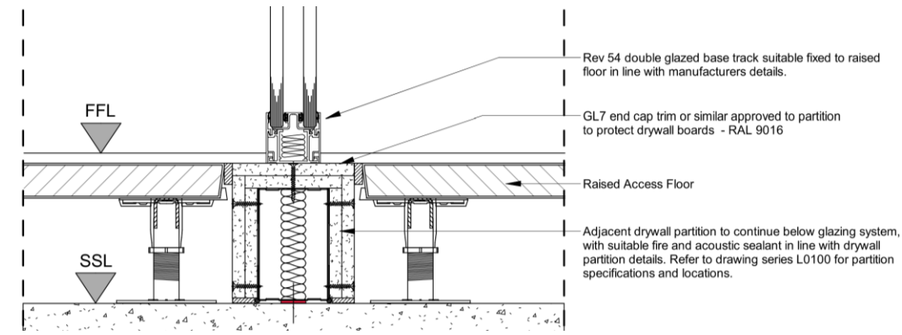


Figure 20 Proposed detail – Internal glazing drywall upstand

5.8 Raised access floor break

All partitions are to be constructed full height, from structural floor to structural soffit and so the raised floor is to be discontinuous at the partition lines.

For acoustically rated entrance doors, as discussed in Section 4.10.4, any hard floor finishes and the raised access floor below shall be discontinuous where these lead into sensitive cellular spaces with a soft joint at the line of partitions. An example sketch detail of this is provided in Figure 21.

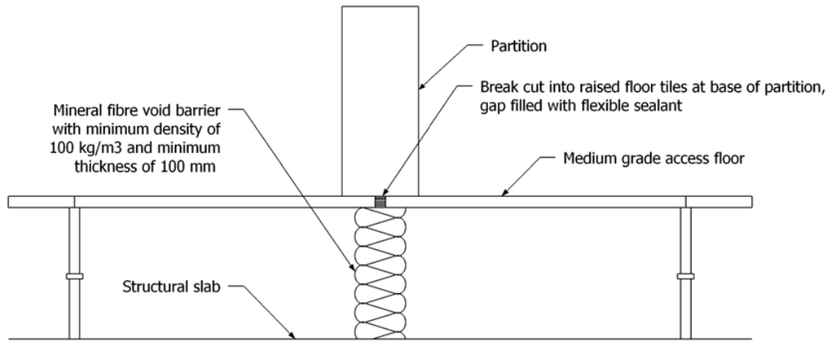


Figure 21 Example sketch detail –Raised access floor (broken)

5.9 Moveable walls

The proposed moveable wall bulkhead detail is provided in Figure 22. This detail is acceptable from an acoustic perspective.

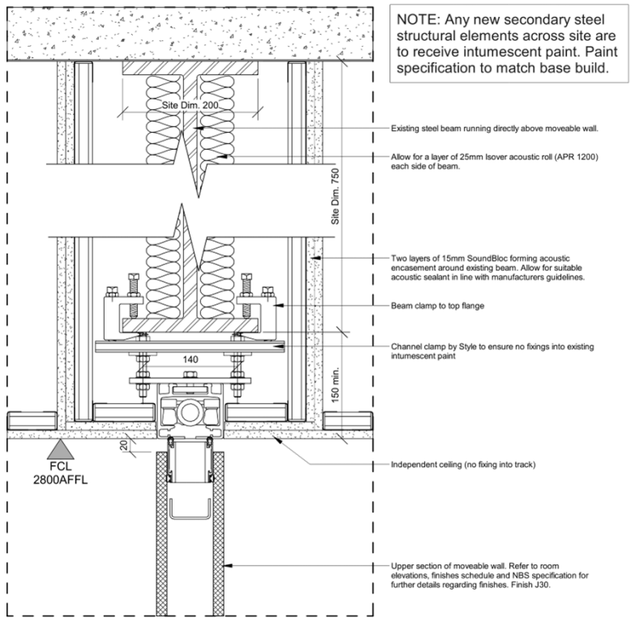


Figure 22 Proposed detail – Moveable wall bulkhead

The proposed moveable wall base detail is provided in Figure 23. This detail shall be updated to include a break in the raised access floor at the moveable wall line. This break is shown in Figure 23 in red.

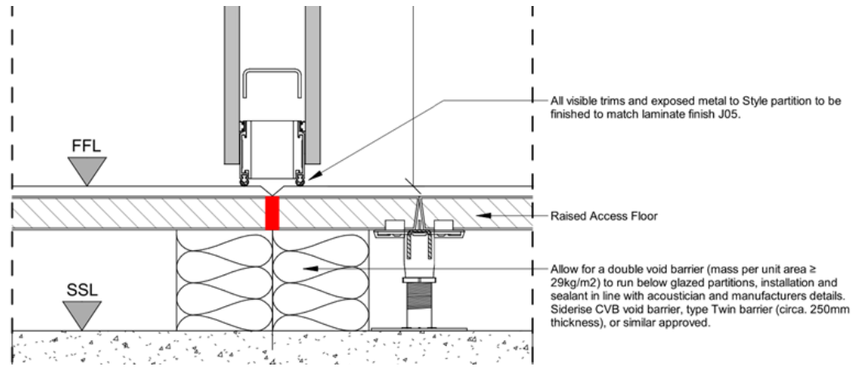


Figure 23 Proposed detail – Moveable wall base

The stopping posts for the moveable wall shall be recessed into a drywall construction (either the internal lining to the column, or an internal drywall partition) which extends either side of the moveable wall and the cavity stop shall be filled with dense mineral fibre (≥ 80 kg/m^3). This is shown in Figure 24.

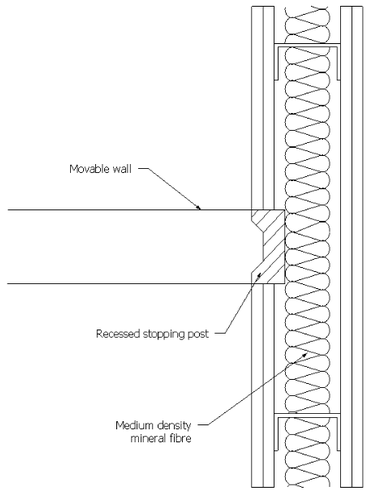


Figure 24 Example sketch detail – Moveable wall junction with drywall construction

6 Room acoustics

6.1 General

The two main acoustic design requirements for finishes are as follows:

- Sound absorption – Sound absorbing finishes assist in controlling reverberation, reflected sound and noise build-up where necessary.
- Impact sound insulation – Resilient floor finishes assist in mitigating impact sound transmission through floors from sources such as footsteps, furniture moving, etc to adjacent spaces both horizontally and vertically (refer to Section 4.10.4).

Rubber or linoleum floor finishes can provide a degree of resilience and therefore assist in improving impact sound insulation of floors. However, they provide very little sound absorption. Carpet provides both impact sound insulation improvement and sound absorption in spaces.

For guidance, a sound absorbent ceiling/wall finish would be one that has a Weighted Sound Absorption Coefficient (as defined in BS EN ISO 11654:1997) of at least α_w 0.65.

6.2 Reverberation time criteria

Reverberation time criteria for cellular spaces are provided in Table 5. These are based on industry good practice and include LEED and WELL requirements (most onerous criterion presented where relevant).

Table 5 Reverberation time criteria for cellular spaces

Space	Maximum mid-frequency reverberation time, T_{mf} (s)
Town Hall	≤ 0.6[1]
Meeting booths, focus rooms, phone booths	≤ 0.6[1]
Team rooms	≤ 0.6[1]
VC rooms	≤ 0.6[1]
Conference rooms	≤ 0.6[1]
Open collaboration, touchdown, breakout, open workplace	< 0.8[1]
Gym	≤ 0.8 [2]
GP room, physio room, physiology	≤ 0.8
Unwind room, nursing aid, multi-faith	≤ 0.8
Tea point, café, cafeteria, breakout	≤ 1.0[2]
Library	≤ 1.0
Reception	≤ 1.0

[1] Reverberation time criteria based on LEED – these will also need to provide the same values in the 500, 1000 and 200 Hz octave bands

[2] Reverberation time criteria based on WELL

6.2.1 Bank of New York criteria

With reference to *BNY Design_Standards_CBRE_11.6.24_Version 1*, Table 6 sets out the requirements for acoustic finishes.

Table 6 Sound absorptive finishes requirements (Bank of New York)

Room type	Floor finish	Wall finishes	Ceiling finish
Team rooms	Carpet	Potentially acoustic wall treatments on AV wall	2′ x 2′ acoustic ceiling tiles
Small conference room	Carpet	Acoustic wall covering on AV walls	2′ x 2′ acoustic ceiling tiles
Medium conference room	Carpet	Acoustic wall covering on monitor walls	2′ x 2′ acoustic ceiling tiles
Large conference room and boardroom	Carpet	Acoustic wall covering on monitor walls (to be coordinated with technology team)	2′ x 2′ acoustic ceiling tiles
Lounge and alternative work points	Carpet	Should have acoustic properties where possible	Should have noise reducing properties
Cafe	Carpet	Should have acoustic properties where possible	-

Room type	Floor finish	Wall finishes	Ceiling finish
Print room	LVT	Walls constructed to structural deck with sound insulation	Acoustic ceiling tiles
IDF room	SDT (Static dissipative tile)	-	Can have open ceilings
Single occupant restroom	-	-	Acoustic ceiling tiles
Nursing mother room	LVT	Walls constructed to structural deck with sound insulation	Acoustic ceiling tiles
Multi-faith room	Hard flooring in entrance vestibule and wet area Carpet in the other two rooms	Walls constructed to structural deck with sound insulation	Acoustic ceiling tiles
Unwind room	Carpet or hard flooring with a rug	Walls constructed to structural deck with sound insulation	Acoustic ceiling tiles

6.3 Sustainability accreditation scheme requirements

6.3.1 LEED - Reverberation

The LEED documentation states that the reverberation times listed in Table 7 shall be met.

Table 7 Reverberation time requirements (LEED)

Location	T60(s), at 500 Hz, 1000 Hz and 2000 Hz
Executive or private office	< 0.6
Conference rooms	< 0.6
Teleconference rooms	< 0.6
Open-plan offices	< 0.8

6.3.2 WELL - S04 reverberation time

2 points are available from Well Feature S04 (reverberation time). To achieve these 2 points, the reverberation time criteria set out in Table 8 shall be met. This can either be verified by a technical document or acoustic testing.

Table 8 WELL S04 Reverberation time requirements

Space	Criteria T_{60} (s)[1]
Areas for conferencing (volume < 10,000 ft^3)	$T_{60} \leq 0.6$
Dining spaces	$T_{60} \leq 1.0$
Areas for fitness (volume < 10,000 ft^3)	$T_{60} \leq 0.8$

[3] The relevant documentation does not clarify whether this constitutes the average reverberation time in key frequencies (known as mid-frequency reverberation time T_{mf}) which is a common parameter in the UK. For the purposes of these assessments, T_{mf} is adopted, and this approach be agreed with the relevant assessor.

Compliance with BREEAM Hea 05 can be used as an alternative method to meet S03 Part 4.

6.3.3 WELL - S05 sound reducing surfaces

A maximum of 2 points are available from WELL Feature S05 (sound reducing surfaces). To achieve these 2 points, sound absorbent wall and ceiling finishes shall be provided as per Table 9.

WELL provides the following definition of 'available ceiling area':

"any ceiling area that is directly viewable to occupants and excludes areas where beams, skylights, ducts or other ceiling components that prohibit the application of direct mounted or hung acoustical treatment".

Table 9 WELL S05 absorbent finishes requirements

Spaces	1 point (tier 1)	2 points (tier 2)
Open workspaces	α_w 0.75 for at least 75% of available ceiling area	α_w 0.90 for all available ceiling area Partial height barriers with a minimum height of 1.2 m above finish floor and a minimum value of α_w 0.7 between all opposing workstations

Spaces	1 point (tier 1)	2 points (tier 2)
Areas for conferencing	α_w 0.75 for at least 50% of available ceiling area	α_w 0.90 for all available ceiling area
	α_w 0.75 for at least 25% of at least two walls	α_w 0.80 for at least 25% of two perpendicular walls
Dining	α_w 0.75 for at least 50% of available ceiling area	α_w 0.90 for all available ceiling area

6.4 Open plan workspaces

6.4.1 WELL and LEED requirements

Specific design criteria for open plan office spaces have not been set by the client with respect to the control of reverberation, however the project is targeting WELL and LEED.

WELL S05 sets out minimum requirements for sound absorbing finishes which are:

- Sound absorbing treatment with $\alpha_w \geq 0.75$ to at least 75% of available ceiling area for 1 point (Tier 1)
  OR
- Sound absorbing treatment with $\alpha_w \geq 0.90$ to at least 100% of available ceiling area for 2 points (Tier 2)

BCO states the following in relation to reverberation time in open plan office.

'The reverberation time [RT] has traditionally been used to define acoustic quality in open-plan space, and a reverberation time in the range 0.5-0.8 seconds, depending on the volume of the room, is recommended.'

BCO also refers to LEED in relation to reverberation time.

LEED v4.1 Interior Design + construction Guide states reverberation time targets as set out in Table 10.

Table 10 LEED reverberation time requirements

Location	T_{60} (s) at 500 Hz, 1kHz and 2kHz
Open plan offices	< 0.8

6.4.2 Open plan finishes strategy

A screengrab of the reflected ceiling plan is shown in Figure 25.

The indicated area of suspended sound absorptive rafts above the desk (shown in grey) is approximately 33% of the total soffit area. The sound absorptive rafts proposed are Autex Cube which are specified to achieve Class A (α_W 0.90) sound absorption.

The indicated area of ceiling type C03, which is a Class A sound absorbent SAS mesh suspended ceiling tiles with acoustic backing above circulation space (shown in pink) and is approximately 21 % of the total soffit area. This ceiling type has been omitted as part of a value engineering exercise. The implications of this are discussed in Section 6.4.4.

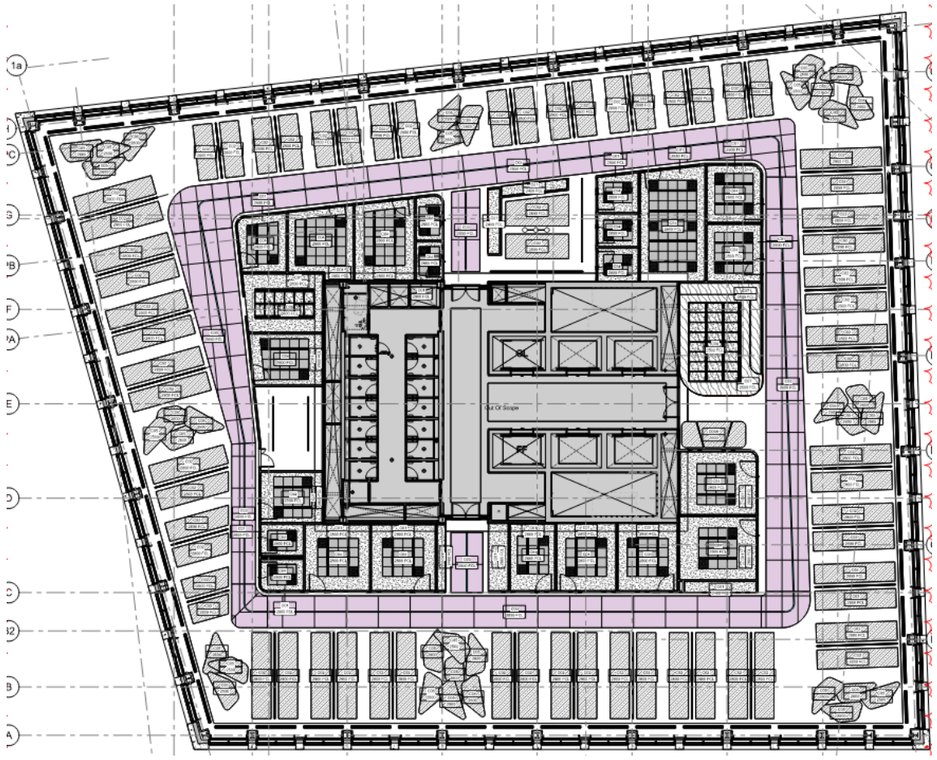


Figure 25 Screenshot of proposed RCP

6.4.3 Proposed finishes

The proposed finishes within open plan workspaces are summarised in Table 11.

Table 11 Proposed finishes within open plan workspaces

Location	Finish
Floor	Carpet tiles
Ceiling and soffit	Class A (α_W 0.90) rafts above work desks and break out spaces at maximum height of 2.8 m above the floor level
	Exposed trapezoidal decking
Seating and tables	Slightly upholstered chairs
	Wooden tables
Walls and columns	Plasterboard
Facade	Glazed at perimeter of floor plate

6.4.4 Assessment

Ceiling type C03 is a SAS suspended metal ceiling tile system with an acoustic backing which is specified to achieve a sound absorption performance of Class A. This ceiling type was proposed above circulation routes, though has been omitted as part of a value engineering exercise.

When considering the omission of ceiling and the remaining finishes as per Table 11, the predicted reverberation times T_{60} (s) at 500 Hz, 1kHz and 2kHz range between 0.6-0.8 seconds.

With ceiling type C03 omitted, there will be greater levels of reverberation and reverberant noise build-up in circulation routes, particularly where they are enclosed and have an acoustically reflective floor finish.

The resulting reverberation times in open plan areas are expected to be borderline with the LEED reverberation time criterion. Achieving this credit should therefore not be relied upon, as compliance may not be feasible. This is further discussed in Section 9.

6.5 Town hall

6.5.1 Reverberation criteria

There is no specific reverberation time criterion in LEED/WELL for town hall spaces. Following discussions with the sustainability consultant, the 'conference room < 10,000 ft^3' criterion has been adopted. On this basis, a maximum reverberation time criterion of T_{60} 0.6 s at 500-2 kHz is required based on LEED and WELL requirements.

6.5.2 Proposed finishes

The proposed finishes within the town hall are presented in Table 12.

Table 12 Summary of finishes within town hall

Location	Finish
Floor	Carpet floor tiles
Doors	Timber
Columns at facade	Plasterboard
East / West wall	Kvadrat fabric panels (100 mm cavity behind panels) to full extent
North wall	24 mm thick Autex cube installed with air gap. Installed from floor to plasterboard bulkhead (2400 mm) to an area approximately equivalent to 18 m^2
	Plasterboard where acoustic finishes are not installed
South wall	Glazed facade construction
Ceiling (no treatment)	Plasterboard ceiling
	Kvadat fabric panels (100 mm cavity behind panels) to an area equivalent to 60 m^2 or approximately 40 % of the floor area.

The sound absorption data for the proposed finishes are summarised in Table 13.

Table 13 Proposed sound absorbent finishes absorption data

Proposed acoustic finish	Sound absorption coefficient, α_w Octave-band centre frequency, (Hz)					
	125	250	500	1000	2000	4000
Kvadrat fabric wrapped panels (100 mm cavity behind panels)	0.05	0.35	0.70	0.70	0.65	0.65
Autex cube (24 mm + air gap)	0.15	0.40	0.85	0.95	0.95	0.95

The sound absorption data for the Kvadrat fabric wrapped panels is on the basis there is a 100 mm cavity behind the panels. If this approach were to change to reduce the overall depth of the treatment, the treatment should be specified to achieve a sound absorption performance of at least Class C (α_w 0.65).

6.5.3 Assessment

A 3D acoustic model of the level 10 town hall space has been created using Odeon, a specialist room acoustic software. A screenshot of the 3D room acoustic model is given in Figure 26.

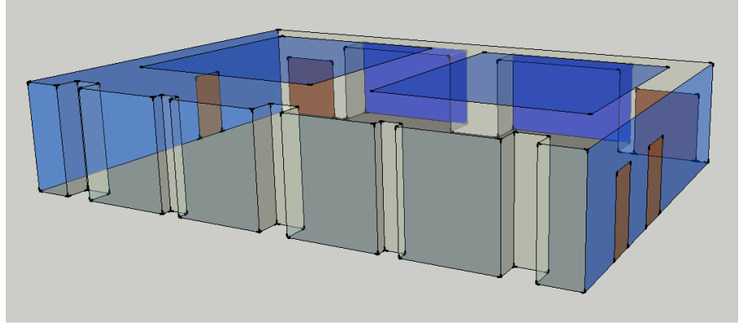


Figure 26 Screenshot of town hall 3D acoustic model

The predicted reverberation time within the town hall based is predicted to be in the region of T_{60} 0.4-0.5 seconds at 500-2kHz. This is compliant with the T_{60} 0.6 at 500-2 kHz reverberation time criterion.

The modelling has been undertaken without considering furnishings within the town hall. When furnished, it is expected that reverberation would be lower than predicted.

6.6 Interconnecting staircase

There are stairs which connect the tea point / collaboration area on level 5 and the open plan workstations on level 7 to a cafeteria on level 6. There is a risk of excessive noise transfer from the cafeteria the office spaces via the stair.

To reduce this risk, closing off the stairs/enclosing the stairs as far as practically possible along with provision of sound absorbent treatment to the soffit above and around the stairs is proposed.

Based on the Stage 3 acoustic design report, the requirement is for at least 84 m^2 of Class C (α_w 0.65) sound absorbent treatment to be provided to the soffit around the perimeter of the staircase per floor.

6.6.1 Proposed finishes

The proposed ceiling finishes around the perimeter of the staircase per floor are summarised in Table 14.

Table 14 Proposed finishes around interconnecting staircase

Floor	Proposed finishes around staircase
Level 5	Plasterboard MF ceiling
Level 6	Class C (α_w 0.65) Autex cube baffles to entire surrounding ceiling area
Level 7	Class A (α_w 0.90) SAS mesh suspended ceiling tile system with back acoustic backing to entire surrounding ceiling area

6.6.2 Assessment

3D acoustic modelling has been carried out to evaluate the proposed acoustic treatment proposed. A screenshot of the 3D room acoustic model is provided in Figure 27.

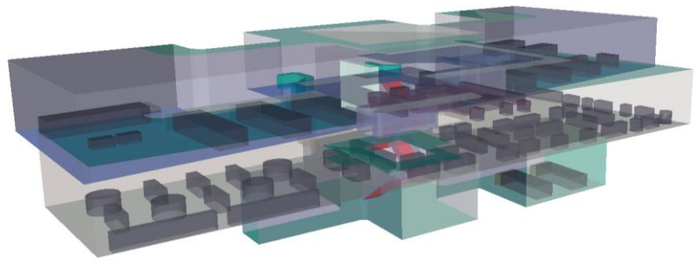


Figure 27 Screenshot of interconnecting stairs 3D acoustic model

Noise transfer has been assessed by considering hubbub generated by the occupants within the level 6 cafeteria and servery. This is based on a mix of people standing and sitting, with approximately one person speaking with a raised voice for every other table. Additional sources speaking with a raised voice have been placed around the servery, to recreate the additional hubbub generated. This aligns with the assessment approach undertaken by the client team during Stage 3.

A summary of the predicted levels of noise transfer to level 5 and level 7 is provided in Table 15, along with a comparison to the predicted Stage 3 noise transfer levels.

Table 15 Summary of predicted noise transfer from level 6

Floor	Predicted noise transfer based on Stage 3 finishes strategies	Predicted noise transfer based on Stage 4 finishes strategies
Level 5	L_{Aeq} 57 dB	L_{Aeq} 60 dB
Level 7	L_{Aeq} 57 dB	L_{Aeq} 57 dB

The predicted level of noise transfer to level 5 aligns with that predicted during Stage 3, and so the level 6 and level 7 finishes approaches are considered compliant.

The predicted level of noise transfer to level 5 is approximately 3 dB greater than that predicted based on the Stage 3 sound absorbent finishes strategy. This is due to the ceiling at level 5 being plasterboard, rather than sound absorbent. This will increase the risk of disturbance to the occupants of the tea point and collaboration area. There will also be increased levels of noise ingress to conference rooms which have room fronts facing the staircase. This approach will need to be agreed with the client team.

6.7 Boardroom, conference rooms and team rooms

A maximum mid-frequency reverberation time of less than T_{mf} 0.6 seconds shall be achieved within the boardroom / conference rooms / team rooms. It is also important to ensure that there are no strong reflections between parallel reflective surfaces.

The following finishes strategy is proposed for these rooms:

- Carpeted floor finish
- Class A (α_w 0.90) SAS suspended ceiling tile system to approximately 60 % of the soffit area
- Class C (α_W 0.65) 24 mm thick Autex / Kvadrat sound absorbent wall treatments to at least two non-parallel walls (including AV/monitor walls as per BNY criterion).

This approach is expected to comply with the reverberation time criterion and provide adequate control of reflections between parallel reflective surfaces.

It is proposed that to sound absorbent wall treatments to core walls, the Autex Groove panelling is to be reduced in thickness from 24 mm thickness to 12 mm. This is expected to reduce the sound absorption performance of the treatment to Class D.

This change will impact compliance with the WELL - S04 reverberation time, WELL- S05 sound reducing surfaces and LEED – Reverberation time requirements. This is further discussed in Section 9.

6.8 Focus rooms, meeting booths and phone booths

A maximum mid-frequency reverberation time of less than T_{mf} 0.6 seconds shall be achieved within focus rooms, meeting rooms and phone booths.

The following finishes strategy is proposed for these rooms:

- Carpeted floor finish
- Class A (α_w 0.90) SAS suspended ceiling tile system to at least 50 % of the soffit area
- Class C (α_W 0.65) 24 mm thick Autex sound absorbent wall treatment to one wall.

This approach is expected to comply with the reverberation time criterion.

6.9 Wellness rooms and multi-faith

A maximum mid-frequency reverberation time of less than T_{mf} 0.8 seconds shall be achieved within wellness rooms including nursing aid, multi-faith and unwind rooms.

The following finishes strategy shall be provided for these rooms:

- Carpeted floor finish
- Class A (α_w 0.90) SAS suspended ceiling tile system to at least 50 % of the soffit area.

This approach is expected to comply with the reverberation time criterion

6.10 Proprietary pods

Pods shall be selected to include sound absorbent finishes on most of the surfaces.

As a minimum, a Class C (α_W 0.65) sound absorbent finish shall be applied to at least 2 adjacent surfaces, and the underside of the lid.

6.11 Cafe

The sound absorbent ceiling within the cafe has been omitted as part of the value engineering exercise.

This will prevent both the WELL S04 reverberation time and WELL S05 sound reducing surfaces credits for dining spaces being achieved. This is further discussed in Section 9.

It should be noted that this change will result in increased levels of reverberant noise build-up within the cafe and potentially unpleasant acoustic conditions.

6.12 Assembly space

To control reverberant sound build-up within the assembly space, the following sound absorbent wall and ceiling treatment shall be provided:

- Class D (α_W 0.30) ceiling/soffit treatment to an area equivalent to at least 80% of the floor area as a minimum
- Class C (α_W 0.65) wall treatment to at least 50% of two non-parallel walls.

Fabric curtains/blinds shall be provided to the glazed facade.

Details of the finishes strategy to the assembly space will need to be reviewed when available.

6.13 Kitchen areas/tea points

Class C (α_W 0.65) sound absorbent timber ceilings are proposed above the kitchen areas / tea points. This approach is expected to provide a suitable level of control of reverberant noise build-up.

6.14 Gym

To comply with the requirements of WELL, a maximum mid-frequency reverberation time of less than T_{mf} 0.8 seconds shall be achieved within the gym.

To control reverberation within the gym, Class C (α_W 0.65) Autex surface mounted panels are proposed to the soffit. The reflected ceiling plan for the gym will need to be reviewed when available.

The ceiling treatment alone however is not expected to control reverberation to be in line with the requirements of WELL. Additional Class A wall panels would be required to all available wall surfaces to achieve the WELL criterion. This is onerous given the size of the space and is understood to not be feasible. This non-compliance with the WELL requirements is further discussed in Section 9.

6.15 Medical facilities

A maximum mid-frequency reverberation time of less than T_{mf} 0.8 seconds shall be achieved within medical facilities rooms including the GP room, physio room and physiology room.

The following finishes strategy shall be provided for these rooms:

- Predominantly Class A sound absorbent ceiling finish (assumed to be > 50 % coverage).

Details of the finishes strategy to the medical facilities will need to be reviewed when available.

7 Building services noise and vibration

The acoustic design requirements associated with building services relate to:

- The control of noise & vibration from plant and equipment to acceptable levels within the building
- The control of noise egress to outside for any new fit-out plant
- The acoustic sealing of penetrations through sound insulating constructions
- The control of crosstalk between rooms in supply and return air systems.

7.1 Sustainability accreditation scheme requirements

The scheme is targeting LEED and WELL sustainability accreditations.

7.1.1 LEED

Internal indoor ambient noise levels

The LEED documentation states that the design shall achieve maximum background noise levels from heating, ventilating, and air conditioning (HVAC) systems per 2011 ASHRAE Handbook, HVAC Applications, Chapter 48, Table 1; AHRI Standard 885-2008, Table 15; or a local equivalent.

Table 16 displays the services noise levels displayed in 2011 ASHRAE Handbook and the AHRI Standard 885-2008.

Table 16 Services noise levels required by LEED

Location	2011 ASHRAE Handbook		AHRI Standard 885-2008
	NC/RC	SPL (dBA)	RC(N)
Executive or private office	30	35	25 - 35
Conference rooms	30	35	25 - 35
Teleconference rooms[1]	25	30	≤ 25
Open-plan offices	40	45	≤ 40
- with sound masking	-	-	≤ 35
Corridors and lobbies	40	45	40 - 45

[1] Understood to apply to Cisco type telepresence room rather than meeting rooms/offices that include video conferencing.

7.1.2 WELL v2

S02 maximum noise levels

A maximum of 3 points are available from WELL Feature S02 (maximum noise levels). To achieve 3 points, internal spaces shall achieve the following maximum internal noise levels:

- Areas for conferencing, learning or speaking: L_{Aeq} 35 dB, L_{Afmax} 45 dB
- Enclosed areas for concentration: L_{Aeq} 40 dB, L_{Afmax} 50 dB
- Open areas for concentration, areas with regularly used PA systems, areas for dining (excluding office kitchenettes): L_{Aeq} 45 dB, L_{Afmax} 55 dB
- Areas with machinery and appliances used by occupants: L_{Aeq} 50 dB, L_{Afmax} 60 dB.

Post-completion measurements will be carried out to demonstrate that the above maximum internal noise levels are achieved.

Compliance with BREEAM Hea 05 can also be used as an alternative method to meet WELL S02 Tier 1 (1 point).

7.2 NOMA Plot P MEPC Base Build Design Brief Rev 3

The base build building services design criteria set out in the NOMA Plot P design brief are summarised in Table 17.

Table 17 NOMA Plot P MEPC Base Build building services criteria

Ref	Space	Design Standard
B.1.2.1	Entrance Lobby and Circulation Spaces	NR 40
B.1.2.2	Toilets	NR 45
B.1.2.3A	Office Areas (Open Plan)	NR 38
B.1.2.3B	Office Ares (Cellular)	n/a
B.1.2.4	Underground Car Parks	NR 55
B.1.2.5	Plant Room	< $L_{Aeq,T}$ 50 dB
B.1.2.6	Loading Bays	n/a

7.3 Internal noise criteria

It is important to ensure that noise from building services systems strikes the right balance between being too noisy such that it gives rise to disturbance and too quiet such that privacy is significantly reduced. Based on the above, the specified background noise criteria are summarised in Table 18.

Table 18 Internal services noise criteria

Space	Internal noise level limits	
	NC required by LEED	NR
Control room	N/A	NR 30
Townhall	N/A	NR 30
11P-13P VC room	NC 30	NR 35
3P-11P Meeting room	NC 30	NR 35
Large conference	NC 30	NR 35
Project room	NC 30	NR 35
Strategy room	NC 30	NR 35
Proprietary pods	NC 30	NR 35
Focus room	N/A	NR 35

Space	Internal noise level limits	
	NC required by LEED	NR
Medical rooms (level 1), Nursing Aid	N/A	NR 35
Resting room/ Wellbeing/Unwind	N/A	NR 35
Multi-faith male/female	N/A	NR 35
Settlement	N/A	NR 35
Market Ops	N/A	NR 35
Tech express	N/A	NR 35
Bridgewater	N/A	NR 35[1]
IT Build	N/A	NR 35
Open plan office	NC 40	NR 38
Space X	NC 40	NR 38
Reception	NC 40	NR 40
Print	N/A	NR 40
Teapoint	N/A	NR 40
Circulation	NC 40	NR 40
Strong room	N/A	NR 40
Welcome/wait	NC 40	NR 40
Client reception	NC 40	NR 40
Library	N/A	NR 40
Mail room	N/A	NR 40
Mail concierge	N/A	NR 40
Cafeteria	N/A	NR 40
Assembly	N/A	NR 40
Servery	N/A	NR 40
Coffee bar	N/A	NR 40
Gym	N/A	NR 40
WC	N/A	NR 45
Store room	N/A	NR 45
BoH Kitchen	N/A	NR 45
Pantry	N/A	NR 45
MCR, SPR/SCR	N/A	NR 55
Plant room (back-up generator)	N/A	NR 55
Car park	N/A	NR 55

As LEED internal noise level criteria are adopted, where these are lower than the NR values, attenuation may be required to ensure compliance with the relevant criterion. This would be limited to the following spaces :

- 11P-13P VC room
- 3P-11P Meeting room
- Large conference
- Project room
- Strategy room.

7.3.1 Minimum background noise level and sound masking

The underlying minimum level of background noise generated by the building services (primarily ventilation systems) is essential to achieve speech privacy.

Historically, building services systems have operated constantly in office buildings and have been relied upon to provide a relatively consistent level of background noise both in cellular and open plan areas. However, modern systems have been designed with energy efficiency in mind and typically have variable duty operation, resulting in reduced noise levels for most of the time.

Whilst systems can be adjusted to generate more noise, this typically results in increased energy usage and can also affect thermal comfort, etc. With such systems therefore, an electronic sound masking system is now more commonly considered as a means of providing a guaranteed minimum level of background noise and privacy.

While understood to not be adopted at this stage, consideration could be given to providing a sound masking system as a Day 2 item in the circulation space outside sensitive rooms, open plan offices and sensitive cellular spaces.

Consideration should also be given to the installation of a sound masking system to the first floor office areas above the gym. Whilst this alone wouldn't be expected to compensate completely for omission of the sound insulating ceiling within the main gym, it would likely allow an extra 5 dB from amplified music/activity noise. This would need to be discussed with the client team. There are also sustainability credentials available for sound masking systems in both LEED and WELL.

7.4 Noise characteristics

Noise from building services plant and systems shall be designed such that it does not contain any distinguishable attention catching characteristics (eg, whine, hiss, screech, hum, bangs, clicks, clatters or thumps) and is not irregular enough to attract attention. Where this is not possible, noise limits for new plant will be at least 5 dB lower than those identified in Table 18 or as part of the landlord/planning requirements.

7.5 Vibration

All mechanical plant and equipment shall be appropriately isolated.

Vibration will need to be controlled such that it does not:

a) exceed a Vibration Dose Value (VDV) of 0.4 m/s$^{1.75}$ as given in BS 6472-1: 2008 '*Guide to evaluation of human exposure to vibration in buildings : Part 1 Vibration sources other than blasting*' in any occupiable space, or

b) be of a magnitude which causes the maximum noise criteria specified be exceeded.

These are expected to be achievable by conventional measures such as anti-vibration mounts, resilient hangers and flexible connections.

7.6 External noise

It will be important to ensure that noise from any new external fit-out plant does not give rise to nuisance to the occupants of neighbouring buildings and the occupants of the proposed roof terrace.

Such plant will be subject to limits established by the landlord taking into account any planning/environmental restrictions and the contribution of noise from landlord plant.

The external plant noise limits at 1 m from building facade and at external amenity spaces (level 10) are set out in NOMA Plot P MEPC Base Build Design Brief Rev 3 and set out below:

- Day operation: L_{Aeq} ≤ 51 dB
- Night operation: L_{Aeq} ≤ 41 dB
- External amenity spaces (level 10) L_{Aeq} ≤ 50 dB.

It is assumed that these limits are applicable at 1 m from the facades of occupiable spaces.

7.7 Normally operating plant noise egress assessment

7.7.1 Proposed items of plant

The following items of normally operating plant are proposed to the rooftop:

- 2 no. AHUs
- 1 no. Q-Ton ESA30 series condenser unit
- 3 no. Mitsubishi PUHY-P300YNW-A2 condenser units
- 1 no. Mitsubishi PUHY-P350YNW-A2 condenser unit
- 1 no. Mitsubishi Ecodan CAHV-P500YA-HPB ASHP
- 2 no. Condenser units (no information available)
- 2 no. Kitchen extract fan.

The sound power data for the proposed items of normally operating plant is summarised in Table 19.

Table 19 Normally operating plant sound power data

Plant item	Sound power level, L_W (dB) Octave-band centre frequency, (Hz)							
	63	125	250	500	1000	2000	4000	8000
Town hall AHU								
Intake	67	75	76	72	68	67	63	61
Exhaust	74	83	80	78	77	76	73	68
Kitchen extract fan	90	91	99	92	90	87	84	81
Q-Ton ESA30 series condenser unit	86	76	73	69	72	64	63	57
Kitchen AHU								
Intake	80	79	82	80	73	72	69	70
Exhaust	82	86	88	86	84	85	81	77
Teapoint extract fan	79	82	80	80	78	75	69	60

The sound pressure data for the proposed items of normally operating plant is summarised in Table 20.

Table 20 Normally operating plant sound pressure data

Plant item	Sound pressure level, L_{eq} (dB) at 1 m Octave-band centre frequency, (Hz)							
	63	125	250	500	1000	2000	4000	8000
Mitsubishi PUHY-P300YNW-A2 condenser units [1]	76	66	63	59	62	54	53	47

Plant item	Sound pressure level, L_{eq} (dB) at 1 m Octave-band centre frequency, (Hz)							
	63	125	250	500	1000	2000	4000	8000
Mitsubishi PUHY-P350YNW-A2 condenser unit [1]	75	65	62	58	61	53	52	46
Mitsubishi Ecodan CAHV-P500YA-HPB ASHP	55	62	59	57	50	48	51	41
Kitchen condenser unit 1 RCS HTF 75-5 [1, 2]	37	44	41	39	32	30	33	23
Kitchen condenser unit 1 RCS LTF 150-9 [1, 2]	38	45	42	40	33	31	34	24

[1] Octave band sound pressure spectrum has been assumed based on similar size condenser units due to single figure noise data only being available

[2] Sound pressure level measured at 10 m distance

Mitigation is proposed in the form of in-duct attenuation to the atmospheric terminations of the AHUs. The proposed attenuator insertion losses are provided in Table 21.

Table 21 Proposed in-duct attenuation insertion losses

Plant item	Attenuator insertion losses, L_i Octave-band centre frequency, (Hz)							
	63	125	250	500	1000	2000	4000	8000
600 mm induct atmosphere attenuator	4	8	13	21	32	28	24	16

7.7.2 Operational hours

It has been confirmed by Buro Happold that the kitchen condenser units are to operate up to 24 hours a day. All other plant is to operate while the building is occupied (07:00 – 23:00).

7.7.3 Predicted noise egress levels

An assessment of normally operating plant noise egress has been undertaken. The calculations include losses due to geometry as well as distance attenuation and screening.

Based on the information outlined above, the predicted plant noise egress levels for normally operating plant are summarised in Table 22.

Table 22 Predicted external plant noise egress levels

Location	External plant noise limits, L_{Aeq} (dB)	Predicted plant noise egress level, L_{Aeq} (dB)
1 m from worst affected facade of occupiable space during daytime (07:00-23:00)	51	75
1 m from facade of occupiable space during night-time (23:00-07:00)	41	29
Level 10 external amenity spaces (day and night)	50	56

The normally operating plant noise egress criteria are predicted to be exceeded during the day (07:00-23:00). The exceedances predicted are due to the noise emissions of the kitchen extract fan and teapoint extract fan.

To comply with plant noise egress criteria, induct attenuation is required to kitchen extract fan and teapoint extract fan. The required octave band insertion losses are set out in Table 23.

Table 23 Minimum in-duct attenuation insertion losses

Item	Minimum attenuator insertion losses, L_i Octave-band centre frequency, (Hz)							
	63	125	250	500	1000	2000	4000	8000
Kitchen extract fan and teapoint extract fan exhausts	6	12	18	34	41	41	34	21

The above losses can typically be achieved with a 1200 mm long in-duct attenuator.

Regenerated noise via the attenuators will need to be suitably controlled such that the plant noise egress criteria are not exceeded.

7.8 Emergency plant noise egress and transfer

7.8.1 Emergency plant noise egress criteria

The SRL external plant noise assessment report *81408-SRL-RP-YA-001-S2-P1* dated 19 May 2023 and Planning Condition 16B both relate to plant noise egress from the base building normally operating plant and state the following:

> *Prior to the first use of the development hereby approved, details of any externally mounted ancillary plant, equipment and servicing shall be submitted for approval. For the avoidance of doubt, externally mounted plant, equipment and servicing shall be selected and/or acoustically treated in accordance with a scheme designed so as to achieve a rating level of 5 dB (L_{Aeq}) below the typical background (L_{A90}) level at the nearest noise sensitive location.'*

For emergency operating plant, MCC typically allow a relaxation of noise egress criteria to be 10 dB above typical background. On this basis, the following noise egress limits would be applicable to emergency items of plant:

- Day (07:00-23:00) operation: $L_{Aeq} \leq 66$ dB
- Night (23:00-07:00) operation: $L_{Aeq} \leq 56$ dB.

7.8.2 Generator internal noise and transfer criteria

The internal noise and transfer criteria which apply to the emergency generators are summarised in Table 24.

Table 24 Generator internal noise and transfer criteria

Location	Criteria
Within generator room	Within the generator room, noise levels from normally operating plant should not exceed NR 55. Specific criteria for emergency plant have not been specified by the Client team.
Transfer to car park	Noise levels from normally operating plant should not exceed NR 55 in the car park. Ideally, noise transfer from the generators should not exceed NR 65 within the car park based on a 10 NR relaxation. However, when considering the base building generator room construction and spatial constraints, this is not achievable. It is understood that higher noise levels are deemed acceptable to the Client team providing measures to reduce them as much as feasible are taken.
N/A	The Control of Noise at Work Regulations 2005 The level at which employers must provide hearing protection and hearing protection zones is 85 dBA (daily or weekly average exposure) and the level at which employers must assess the risk to workers' health and provide them with information and training is 80 dBA. There is also an exposure limit value of 87 dBA, taking account of any reduction in exposure provided by hearing protection, above which workers must not be exposed.

7.8.3 Proposed emergency generator arrangement

Within the basement, 3 no. YorPower life safety generators are proposed. The location of these units is shown in Figure 28.

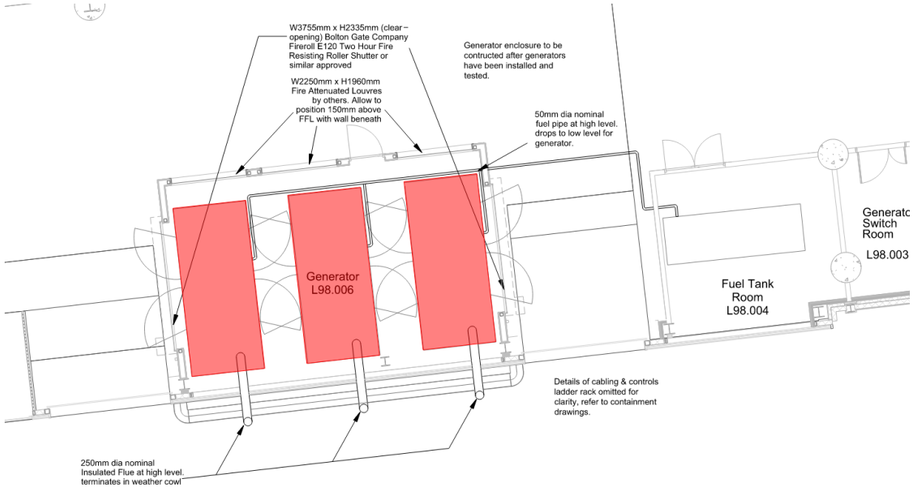


Figure 28 Location of emergency generator units

The generator room is separated from the car park via non-acoustic louvres and roller shutters. These will provide little acoustic separation between the generator room and the car park.

Each generator unit has a flue which terminates externally at roof level.

7.8.4 Generator noise data

With an acoustic package and exhaust attenuation, each generator produces a noise level of L_{Aeq} 78 dB at 1 m. This relates to maximum design duty.

Noise level data for the generator has only been provided as a broadband sound pressure level and so is not sufficiently detailed for an accurate assessment. For this assessment, a typical generator spectrum has therefore been used and adjusted to equate to the same broadband level. This typical spectrum is provided in Table 25.

The requirement to use this spectrum introduces some uncertainty in the calculated results so they have to be considered a best estimate.

Table 25 Emergency generator sound pressure level spectrum

	Sound pressure level, L_{eq} (dB) at 1 m Octave-band centre frequency, (Hz)								
	63	125	250	500	1000	2000	4000	8000	L_{Aeq}
Generator (single unit)	90	89	83	73	50	29	30	32	78

7.8.5 Nearby noise sensitive premises

On the basis that 4 Angel Square is excluded from the assessment of noise egress, the nearest and worst-affected noise sensitive receptor is the Parkers Hotel Apartments located within 109 – 113 Corporation Street, approximately 40 m to the north west. This receptor is shown in Figure 29 highlighted in red. The location of the generator room is indicated by a green icon.

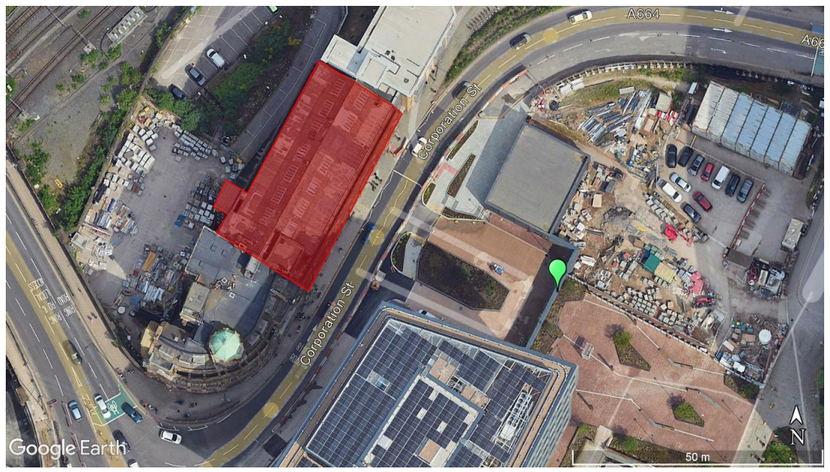


Figure 29 Aerial view of site (courtesy of Google Earth Pro)

7.8.6 Predicted level of noise egress

Calculations have been undertaken to estimate the resultant level of the two emergency generators operating. These calculations account for noise build-up within the generator room as well as distance attenuation.

A noise level of L_{Aeq} 56 dB is estimated at 109 – 113 Corporation Street. This complies with both the proposed day and night emergency plant noise egress criteria as per Section 7.8.1.

At the nearest facade of 4 Angel Square, a level of L_{Aeq} 62 dB is predicted. This is expected to be acceptable to the Landlord and Client team as the resultant internal noise levels are not likely to impact the audibility of emergency alarm sounders.

7.8.7 Predicted noise transfer from generator room to car park

Noise transfer from the generator room to the car park is estimated to be:

- L_{Aeq} 94 dB / NR 96 at 2 m from the generator room intake louvres
- L_{Aeq} 94 dB / NR 95 at 5 m from the generator room intake louvres, which is approximately the distance to the nearest parking space.

The predicted noise levels have the potential to impact the audibility of emergency alarm sounders. There is also a health and safety risk to the occupants of the car park, as the predicted level exceeds the Control of Noise at Work Regulations 87 dBA threshold. This will need to be reviewed by the Client team, as well as the emergency alarm designer. Visual alarm devices are expected to be required.

7.8.8 Periodic generator testing

Periodic testing of the generators will need to be undertaken. This should be done at a time such that the potential for disturbance to occupants of 4 Angel Square as well as surrounding noise sensitive receptors is minimised. If possible, the testing should be done with the generators operating at a reduced duty such that their noise emissions are reduced.

7.8.9 Generator flue termination sound power limit

On the basis that the generator flues terminate externally above the generator room, the noise emissions from the generator flues should each be controlled to not exceed L_{wA} 85 dB at the termination based on the assumed generator spectrum in Table 25.

7.9 Design strategy

The following section provides acoustic design requirements for the building services systems.

7.9.1 General

Services shall be run within corridors or open-plan areas where possible thereby avoiding penetrations through crosswalls which typically have a much higher sound insulation performance than room fronts.

Enclosed cellular spaces shall be served by their own terminal units(s). Spaces that share terminal units or are without a terminal unit are likely to be very quiet which will reduce speech privacy across enclosing partitions.

7.9.2 FCUs

The base build FCUs have been selected to provide internal ambient noise levels of NR38, on this basis FCUs are expected to require modification, attenuation or replacement for spaces with internal noise level criteria lower than NR38.

7.9.3 New basement plant in car park

There are new stand-by generators and air source heat pumps proposed within the basement car park. These will need to be carefully selected and appropriately attenuated to ensure that the NR55 criterion for the car park is met, as well as noise egress criteria.

7.9.4 Kitchen plant items

New kitchen extract fans and condensers are proposed to serve the kitchen. The exact location will need to be reviewed as the Stage 4 design progresses.

7.9.5 Ventilation strategy and crosstalk

Where common ductwork/ventilation openings are formed in sound insulating partitions or very short duct runs separate acoustically sensitive spaces, crosstalk attenuators shall be provided in supply and return air feeds to ensure that the speech privacy and sound insulation between spaces is not adversely affected.

An indicative sketch of the acoustic services strategy for cellular spaces is shown in Figure 30.

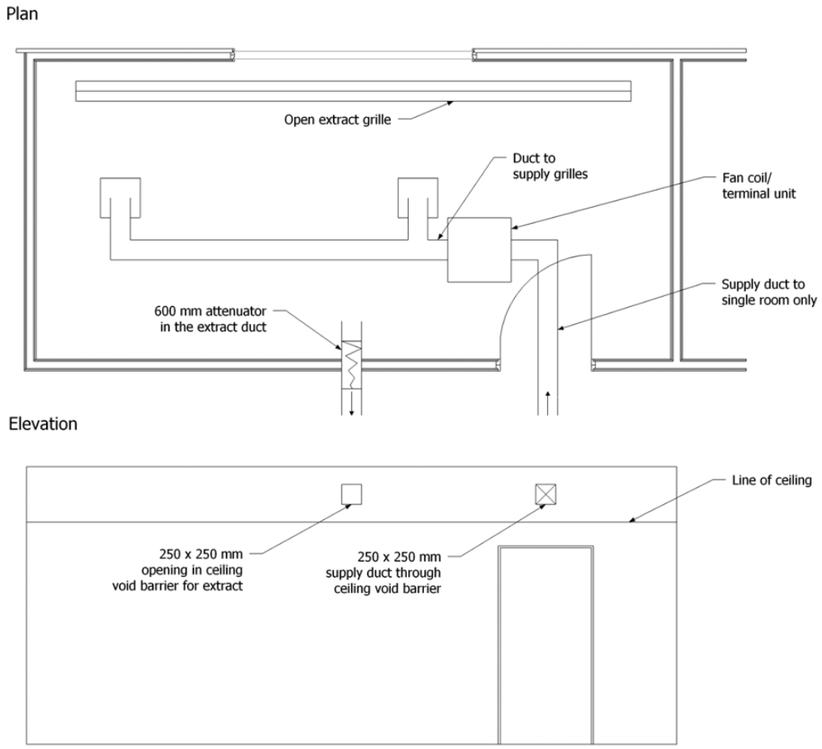


Figure 30 Example sketch detail showing the services strategy for cellular spaces

7.9.6 Existing and proposed main branch ductwork

Main branch ductwork is proposed to run above acoustically sensitive cellular spaces with a building services noise criterion of ≤ NR 35, such as the conference room shown in Figure 31.

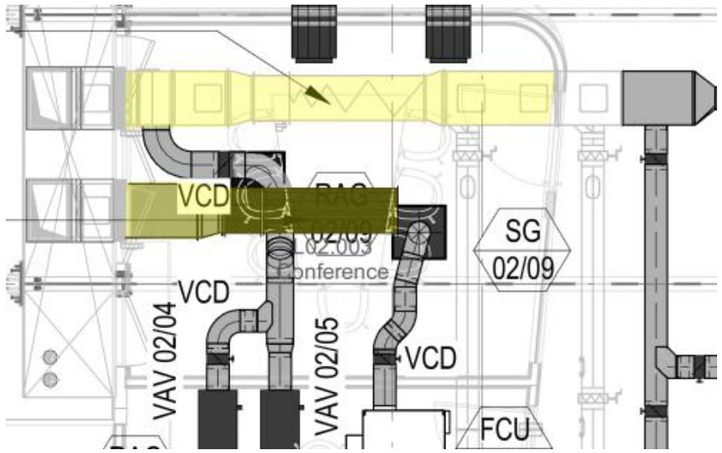


Figure 31 Existing and proposed ductwork east of core

Where this occurs, this ductwork will need to be acoustically lagged to control ductwork noise breakout. This lagging shall comprise minimum 5 kg/m² flexible mass layer on 25 mm mineral fibre.

7.9.7 Ductwork proposed to penetrate crosswall partitions

Return air attenuators are proposed within crosswall partitions of noise sensitive spaces such as those highlighted in red in Figure 32.

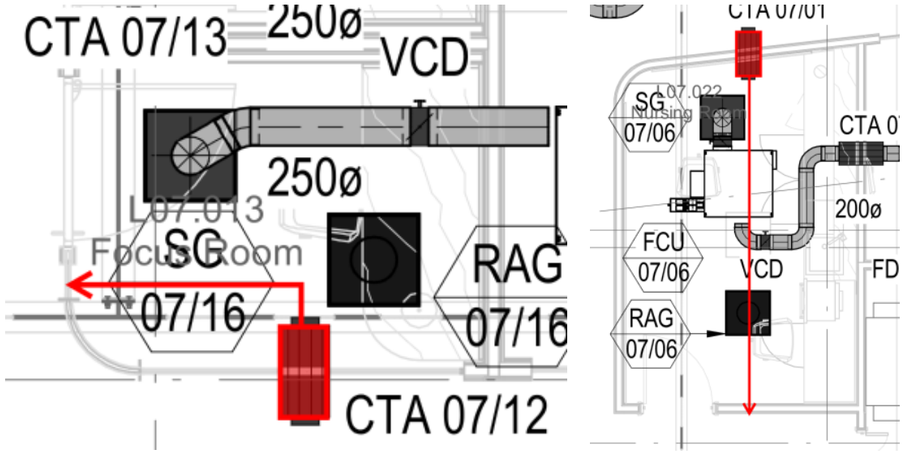


Figure 32 Return attenuators proposed to crosswalls

Where possible, return air attenuators shall be relocated to be within room fronts, otherwise the attenuation requirements are expected to be onerous.

7.9.8 Potential crosstalk routes via supply ductwork between shared FCUs

There are locations throughout the project where shared supply ductwork is indicated between noise sensitive cellular spaces with no crosstalk attenuation proposed. An example location where this occurs is shown in Figure 33, with the potential crosstalk route highlighted in yellow.

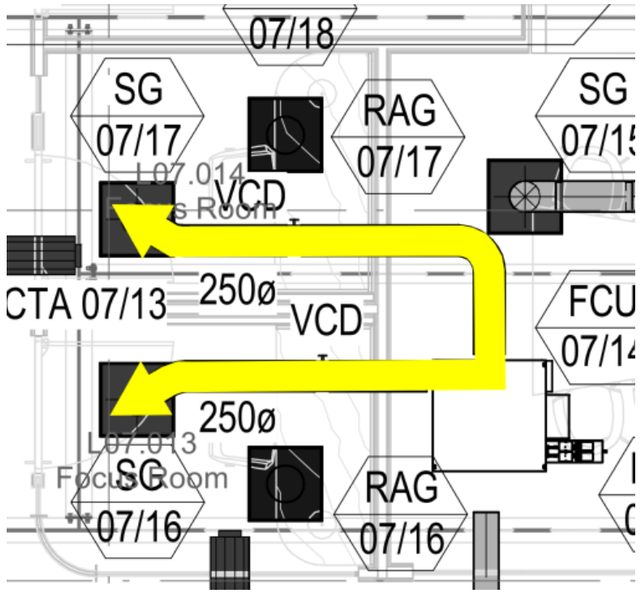


Figure 33 Potential crosstalk route via supply ductwork between shared FCU

This will need to be avoided wherever possible. Where this is unavoidable, an allowance will need to be made for crosstalk attenuators within the common ductwork to ensure that the sound insulation performance of the separating partition is not degraded.

Where this occurs, the attenuation requirements are expected to be onerous. In some instances, the ductwork routing may need to be adjusted to accommodate the attenuators spatially.

7.9.9 Ductwork proposed to clinical suite / treatment rooms

There is a high density of supply and extract ductwork proposed between treatment rooms and the catering room on the ground floor, with no crosstalk attenuators. Crosstalk attenuators will need to be allowed for in the locations highlighted in yellow in Figure 34.

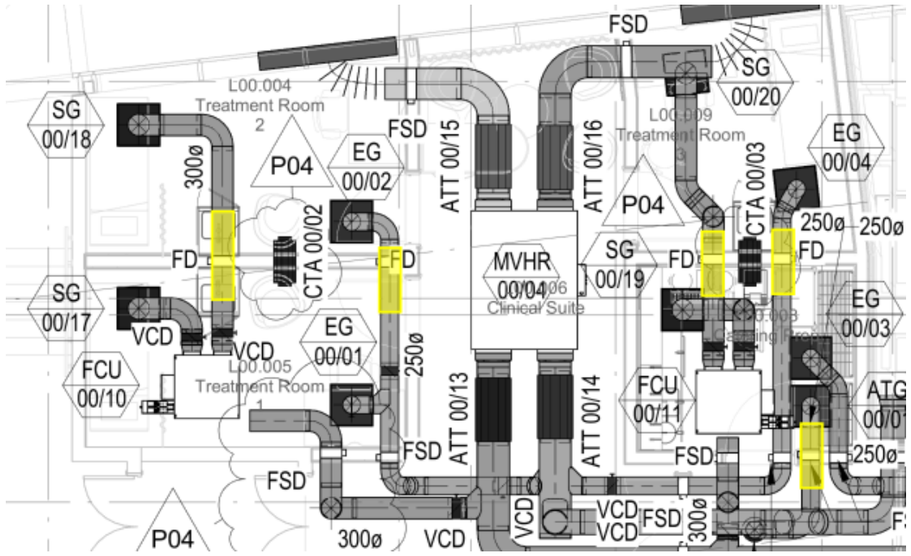


Figure 34 Recommended crosstalk attenuator locations

7.9.10 Crosstalk attenuator schedule and setting out layouts

When available, the revised crosstalk attenuator schedule and setting out layouts will need to be provided so an updated review can be undertaken.

7.9.11 Noise sensitive cellular spaces with no terminal unit

There are multiple cellular spaces such as focus rooms and team rooms that do not have a terminal unit within them. In these spaces, it is expected that the building services noise levels will be low, which in turn will result in low background noise levels, particularly where they are located within the floor plate (not along a facade). This has the potential to reduce speech privacy to these spaces. This will need to be highlighted to the client team. Introducing sound masking system to these spaces should be considered to maintain a minimum background noise level.

7.9.12 Pipework

Any potentially noisy pipework which passes through the ceiling void above sensitive spaces (defined as having a limiting services noise level of NR40 or less) shall be either:

- Acoustically lagged (minimum 4.5kg/m^2 flexible mass layer on 25 mm mineral fibre); or
- Boxed in with 2 x 12.5 mm Wallboard, independent of the pipework and 25 mm Isowool APR 1200 or equivalent insulation in the void.

7.9.13 BS/BC boxes

BC/BS boxes shall be located above the ceiling in back-of-house (non-noise-sensitive) spaces, rather than above front-of house spaces.

7.9.14 Electrical sockets

Where practicable, electrical sockets shall be installed with furniture (eg, credenzas/tables) or the raised floor rather than in enclosing partitions, particularly crosswalls.

Should this be unavoidable, the plasterboard wall linings shall be returned around the rear of the sockets to maintain sound insulation and sockets offset (ideally by at least 600 mm) on either side of partitions. An alternative would be to use widely available intumescent acoustic putty pads as shown in Figure 35.



Figure 35 Intumescent acoustic putty pad (source: Hilti)

7.9.15 High level services co-ordination with partitions/void barriers

No services shall run along partition lines where full height walls or void barriers are proposed.

7.9.16 Core bell mouth extract ducts

Core bell mouth extract ducts shall be located above open plan office or circulation space. Where core bell mouth extract ducts are located in the ceiling void above enclosed occupiable spaces, they will shall be ducted out to minimize their impact on the integrity of partitions.

7.9.17Comms rooms

Any large CRAC cooling units shall positioned away from the door, adjacent to a non-sensitive space and located a minimum of 100 mm from the wall to minimise potential 'drumming'. Cooling units are to be positioned away from the door and fixed to a wall adjacent to a non-acoustically sensitive space.

All such equipment will need to be appropriately vibration isolated.

If an inert gas-based fire suppression system is proposed, the barometric pressure relief damper to allow the air to escape during deployment is required to be positioned in a wall facing away from occupied desks.

Should the damper be facing occupied desks, a 900 mm crosstalk attenuator shall be included positioned to the rear to minimise noise breakout from the comms room.

7.9.18 Grilles and diffusers

Diffusers and grilles shall be selected on the basis of manufacturer's regenerated noise data to at least 5 NR points below the relevant room criteria.

Where dampers are located on stub extracts then secondary attenuation is to be considered to offset potential for high levels of regenerated noise.

7.9.19 Acoustic lagging

In some locations, acoustic lagging to supply or extract air ducts may be required to control crosstalk between spaces. This will need to be reviewed once the Stage 4 ventilation layouts are available for review.

7.9.20 Services penetrations

All services passing through acoustically rated walls shall be acoustically sealed. Penetrations shall be avoided to crosswalls wherever possible.

An indicative detail for ductwork/pipework is shown in Figure 36. The same principles shall be adopted for cable trunking/trays which shall be packed to full wall depth with mineral fibre before over-boarding, as shown in Figure 37.

Where there is a suspended ceiling on both sides, it would be acceptable to seal services with 2x50 mm ablative coated fire batt (minimum density 140 kg/m^3), with each layer positioned in line with the outer face of the wall and leaving as large a cavity as possible between the two layers. The size of the fire batt shall be no more than 50 mm larger than the service penetration in all directions.

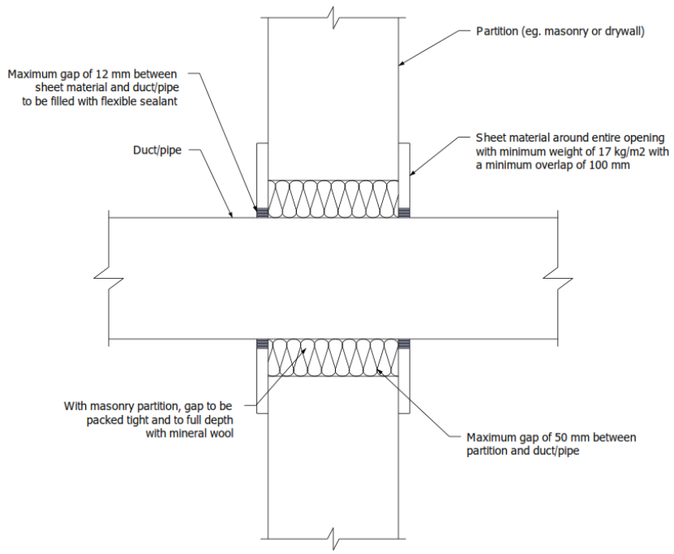


Figure 36 Example duct/pipe penetration detail through a single partition (indicative only, not for construction)

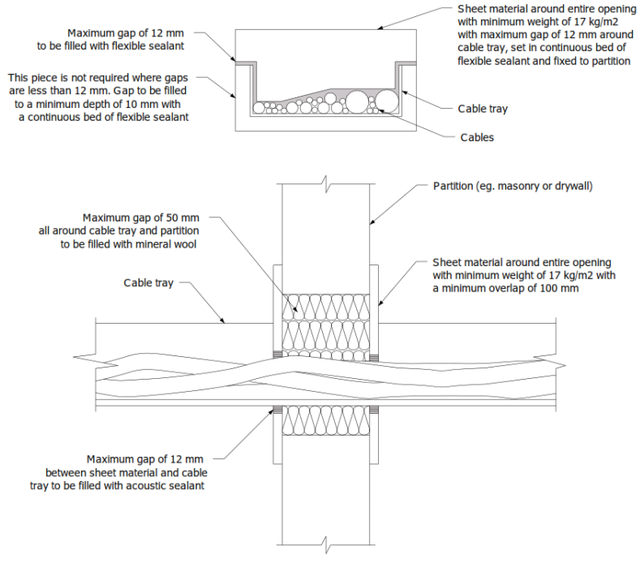


Figure 37 Example cable tray penetration through a single partition (indicative only, not for construction)

8 Audio visual

Screens shall be surface mounted or within separate joinery walls rather than recessed into sound insulating walls to maintain acoustic integrity.

Loudspeakers shall be ceiling mounted and distributed throughout the meeting rooms to ensure even coverage and minimize sound volumes. This approach will also serve to minimize sound transmission through partitions which can result with wall mounted speakers.

Where loudspeakers are wall mounted (including screens with integral speakers) and back onto an occupied space, staggered/twin stud partitions shall be utilized to mitigate structure-borne sound transmission.

Back-to-back screens shall be avoided unless appropriate design measures are taken, such as sacrificial linings to minimize the requirement for openings in partitions. Where AV screens are located back-to-back, the partitions may need to be wider to accommodate recesses and containment, allowing the plasterboard to be returned around the rear. As a minimum, containment serving back-to-back screens is to be located in separate stud bays to avoid continuous holes through walls.

9 Sustainability

Requirements of the LEED and WELL accreditation schemes are included in Appendix D. Instances of non-compliance are summarised in Table 26.

Table 26 Summary of instances of non-compliances with sustainability credits

Credit	Non-compliance
LEED – Reverberation, *WELL* – S05 sound reducing surfaces	Ceiling type C03 (SAS Class A sound absorbent suspended metal ceiling tile system) has been omitted. This ceiling type was proposed above circulation routes. With this ceiling type omitted, there will be greater levels of reverberation and reverberant noise build-up in circulation routes, particularly where they are enclosed and have an acoustically reflective floor finish. The resulting reverberation times in open plan spaces are expected to be borderline with the LEED reverberation time requirement. Achieving this credit should therefore not be relied upon, as compliance may not be feasible.
	The WELL S05 tier 1 requirement for sound reducing surfaces within open plan workspaces is α_w 0.75 for at least 75% of available ceiling area. With ceiling type C03 omitted, the above requirement would not be achieved. The WELL S05 credit would therefore not be achieved.
WELL – S04 reverberation times, WELL – S05 sound reducing surfaces, LEED – Reverberation	It is proposed that to sound absorbent wall treatments to core walls, the Autex Groove panelling is to be reduced in thickness from 24 mm thickness to 12 mm. This is expected to reduce the sound absorption performance of the treatment to Class D. The levels of reverberation in conference rooms and team rooms would increase due to the reduction in sound absorption. The resulting reverberation times are expected to be borderline with the WELL S04 reverberation time requirement, ≤ T_{mf} 0.6 seconds. Achieving this credit should therefore not be relied upon, as compliance may not be feasible. The WELL S05 sound reducing surfaces requirement of α_w 0.80 to at least 25% of two perpendicular walls for conferencing areas will not be achieved.
WELL – S04 reverberation times, WELL – S05 sound reducing surfaces,	The ground floor cafe sound absorbent ceiling is to be omitted. This will result in significantly increased levels of reverberation and will prevent both the WELL S04 reverberation time and WELL S05 sound reducing surfaces credits for dining spaces being achieved.
WELL Feature S06 (minimum background noise)	A sound masking system is not proposed
LEED masking systems	A sound masking system is not proposed

10 Safety in Buildings

An acoustic design risk register for the project, relating to safety in the building, is given in Appendix E.

The risk register aims to identify all significant foreseeable risks associated with the acoustic design, put forward in our role as Designers as outlined in the CDM Regulations 2015 and Building Safety Act 2022 (the 'Regulations'). It is to be revised as the design progresses and whenever there are significant design changes. These risks shall be monitored and mitigated during the design, pre-construction and construction stages of the project.

Under the Regulations, the client is responsible for appointing a Principal Designer.

All duty holders under the Regulations must critically review the design at relevant stages to ensure that all necessary safety considerations are addressed. Risks shall be mitigated as much as reasonably practicable or reduced to more acceptable levels. The Principal Designer must be an integral part of these discussions and decisions.

Any remaining hazards post-construction shall be recorded in the residual risk register and included in the project Health & Safety File. This file shall be handed over to the Client upon project completion to ensure they, or the end user, have the necessary information to safely manage the identified risks.

Appendix A

Glossary of acoustic terms

General terms

Absorptive material	Material that absorbs sound energy. Soft or porous finishes such as mineral fibre are effective sound absorbers.
Acoustic absorption	The conversion of sound energy, often by the use of a porous material. It is a term used to describe the amount of sound absorbed by a finish or object within a room.
Airborne sound	Sound propagating through the air.
Airborne sound insulation	The ability of building elements or structures to reduce airborne sound transmission.
Density	Mass per unit volume, expressed in kilograms per cubic metre (kg/m^3).
Direct sound transmission	The process in which sound that is incident on one side of a building element is radiated by the other side.
Flanking element	Any building element that contributes to the sound transmission between rooms in a building that is not the separating element in question. It is typically an element which continues past the separating element
Flanking sound transmission	Sound transmitted between rooms via flanking elements instead of directly through separating elements, or along any path other than the direct path.
Floating/isolated floor	A floating or isolated floor consists of a floating layer that is decoupled from the main structure by a resilient layer or other resilient element (see also 'Resilient layer' and 'Floating/isolated layer'). The type of resilient element depends on the level of isolation required.
Floating/isolated layer	A surface that rests on a resilient layer or other resilient element and is therefore isolated from the main structure (see also 'Floating/isolated floor' and 'Resilient layer').
Frequency	The number of cycles per second. The unit of frequency is the Hertz (Hz). Frequency gives a sound its distinctive tone.
Frequency band	A continuous range of frequencies between stated upper and lower limits (see also 'Octave band' and 'One-third octave band').
Impact sound	Sound resulting from direct impact (such as footsteps) on a building element.
Impact sound insulation	The ability of building elements or structures to reduce impact sound transmission.
Independent ceiling or lining	A ceiling or lining which is mounted independently of (ie with no direct physical connections to) a separating floor or wall.
Isolation	The absence of rigid connections between two or more building elements.
Mass per unit area	The mass per unit area, expressed in terms of kilograms per square metre (kg/m^2). Also known as 'surface density'.
Resilient layer/element	A layer or other resilient element that isolates a floating layer from a base floor and the surrounding walls.
Resiliently mounted ceiling or lining	A ceiling or lining which is mounted resiliently from (ie connected only via specialist resilient hangers or ties) a separating floor or wall.
Reverberation	The persistence of sound in a space after a sound source has stopped.
Reverberation time	The time, in seconds, taken for the sound in a room to decay by 60 dB after a sound source has been stopped.
Room acoustics	The study of how sound propagates and behaves within enclosed or semi-enclosed rooms
Separating element	An element (such as a wall, floor, door, window) which separates buildings or parts of buildings.
Sound pressure level	A logarithmic measure of the effective sound pressure of a sound relative to a reference value, measured in decibels, dB. Sound pressure levels are dependent on the conditions under which they are measured.
Sound power level	A logarithmic measure of the sound power in comparison to specified reference level, measured in decibels, dB. Unlike sound pressure, sound power is not room or distance dependent.
Spectrum	The composition of a particular sound in terms of separate frequency bands.
Surface density	The surface density, expressed in terms of kilograms per square metre (kg/m^2). Also known as 'mass per unit area'.
Structure-borne sound	Sound which is transferred by vibration via the structure of a building.

Acoustic parameters

'A' weighting	Frequency weighting based on the frequency response of the human ear which has been found to correlate well with the subjective response to sound.
Decibel (dB)	A logarithmic unit used for many acoustic values to indicate the level with respect to a reference level
Hz	Hertz (Hz) is the unit of frequency (see also 'Frequency')
$L_{A90,T}$	The A-weighted sound pressure level exceeded 90% of the measurement period (T) over which a noise is measured (ie, the quietest 10% of the period). When not weighted it is denoted $L_{90,T}$. This parameter is generally considered to be representative of a constant noise source, or background noise level.

$L_{Aeq,T}$	Equivalent A-weighted sound pressure level of a steady noise that has the same acoustic energy as a fluctuating noise over the measurement period (T). When not weighted it is denoted $L_{eq,T}$.
$L_{A10,T}$	The A-weighted sound pressure level exceeded for 10 % of the measurement period (T) over which a noise is measured. When not weighted it is denoted $L_{10,T}$.
$L_{Amax,T}$	The highest A-weighted sound pressure level measured in the period (T) with either fast (L_{AFmax}) or slow (L_{ASmax}) time weightings. When not weighted it is denoted L_{Fmax} or L_{Smax}.
$L_{A90,T}$	The A-weighted sound pressure level exceeded 90% of the measurement period (T) over which a noise is measured (ie, the quietest 10% of the period). When not weighted it is denoted $L_{90,T}$. This parameter is generally considered to be representative of a constant noise source, or background noise level.
Octave band	A frequency band in which the upper limit of the band is twice the frequency of the lower limit.
One-third octave band	A frequency band in which the upper limit of the band is the cube root of two times the lower limit of the band or more simply one third of an octave band.

International organization of standardization (ISO)

C_{tr}	The correction to a sound insulation quantity (such as R_w or $D_{nT,w}$) to take account of a specific sound spectrum with low frequency sound energy.
D	The difference in sound level between a pair of rooms, in a stated frequency band. A higher numerical quantity represents a better performance.
D_w	A single number weighted quantity which characterizes the airborne sound insulation between rooms. It is not corrected for reverberation or element size and is therefore representative of the sound insulation heard on site. A higher numerical quantity represents a better performance.
$D_{n,f}$, $D_{n,c}$	The difference in sound level between a pair of rooms via a specified flanking sound transmission path in a stated frequency band. $D_{n,c}$ relates specifically to ceilings but has been superseded by $D_{n,f}$ which can relate to any specified path. A higher numerical quantity represents a better performance.
$D_{n,f,w}$, $D_{n,c,w}$	A single number weighted quantity which characterizes the airborne sound insulation between rooms via a specified flanking path. $D_{n,c,w}$ relates specifically to ceilings but has been superseded by $D_{n,f,w}$ which can relate to any specified path. A higher numerical quantity represents a better performance.
$D_{n,e}$	The difference in sound level via a specified small element in a stated frequency band. A higher numerical quantity represents a better performance.
$D_{n,e,w}$	A single number weighted quantity which characterizes the airborne sound insulation via a specified small element. A higher numerical quantity represents a better performance.
D_{nT}	The difference in sound level between a pair of rooms, in a stated frequency band, normalized for the reverberation time. A higher numerical quantity represents a better performance.
$D_{nT,w}$	A single number weighted quantity which characterizes the airborne sound insulation between rooms, corrected for reverberation time. A higher numerical quantity represents a better performance.
$L_{n,f}$	The impact sound pressure level in a stated frequency band, flanking via a floor connecting adjacent rooms. A lower numerical quantity represents a better performance.
$L_{n,f,w}$	A single number weighted quantity used to characterize the flanking impact sound pressure level via a floor connecting adjacent rooms. A lower numerical quantity represents a better performance.
L'_{nT}	The impact sound pressure level in a stated frequency band, corrected for the reverberation time. A lower numerical quantity represents a better performance.
$L'_{nT,w}$	A single number weighted quantity used to characterise the impact sound insulation of floors. A lower numerical quantity represents a better performance. The ASTM parameter, IIC, rates the performance of the floor, meaning a higher numerical quantity represents a better performance).
NR (Noise Rating)	Noise Rating. Single figure term used to reflect the spectral content of noise. This is generally applied within rooms in relation to building services noise. Broadly equivalent to the ANSI term, NC (Noise Criterion) for typical spectra.
R	Sound reduction index. A quantity, measured in a laboratory, which characterises the airborne sound insulation of a material or building element in a stated frequency band. A higher numerical quantity represents a better performance. Broadly equivalent to the ASTM term, TL.
R_w	Weighted sound reduction index. A single number quantity which characterises the airborne sound insulation of a material or building element in the laboratory. A higher numerical quantity represents a better performance. Broadly equivalent to the ASTM term, STC.

R'	Apparent sound reduction index. The on-site equivalent of the sound reduction index, R which is measured in presence of flanking paths. A higher numerical quantity represents a better performance. Broadly equivalent to the ASTM term, ATL
R'_w	Apparent weighted sound reduction index. The on-site equivalent of the weighted sound reduction index, R_w. A higher numerical quantity represents a better performance. Broadly equivalent to the ASTM term, ASTC.
T_{mf}	The arithmetic average of the reverberation time in the 500 Hz, 1 kHz and 2 kHz octave bands (see also 'Reverberation time').
α_w	Weighted absorption coefficient. A quantity characterising the effectiveness of a sound absorbing surface. The proportion of sound energy absorbed is given as a number between zero (for a fully reflective surface) and one (for a fully absorptive surface). Broadly equivalent to the ASTM term NRC and SAA.
ΔL_w	The measured improvement of weighted impact sound insulation resulting from the installation of a floor covering or floating floor on a test floor in a laboratory. A higher numerical quantity represents a better performance.

Appendix B

WELL Sound mapping markups



Title	WELL Noise Plan mark-ups
Project	Bank of New York, 4 Angel Square
Project no.	026008
Version	B
Marked-up by	Rhys Craven
Reviewed by	Kane Mitchell
Date	11 February 2026

Mark-up key

- Loud zones
- Mixed / circulation zones
- Quiet zones

SANDY BROWN ACOUSTICS

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All areas have been measured from current drawings.They may vary because of (EG) survey, design development, construction tolerances, statutory requirements or re-definition of the areas to be measured.

Rev.	Date	Comment	Drawn	Checked
P02	25-09-2025	Furniture model linked in halftone with relevant coordination notes where required	SOF	PPR
P01	01-08-2025	First issue	SOF	AMN

Issue Purpose: Preliminary

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Project
Bank of New York
4 Angel Square M4 4FW
Manchester

Drawing Title
Level 00
General Arrangement Plan

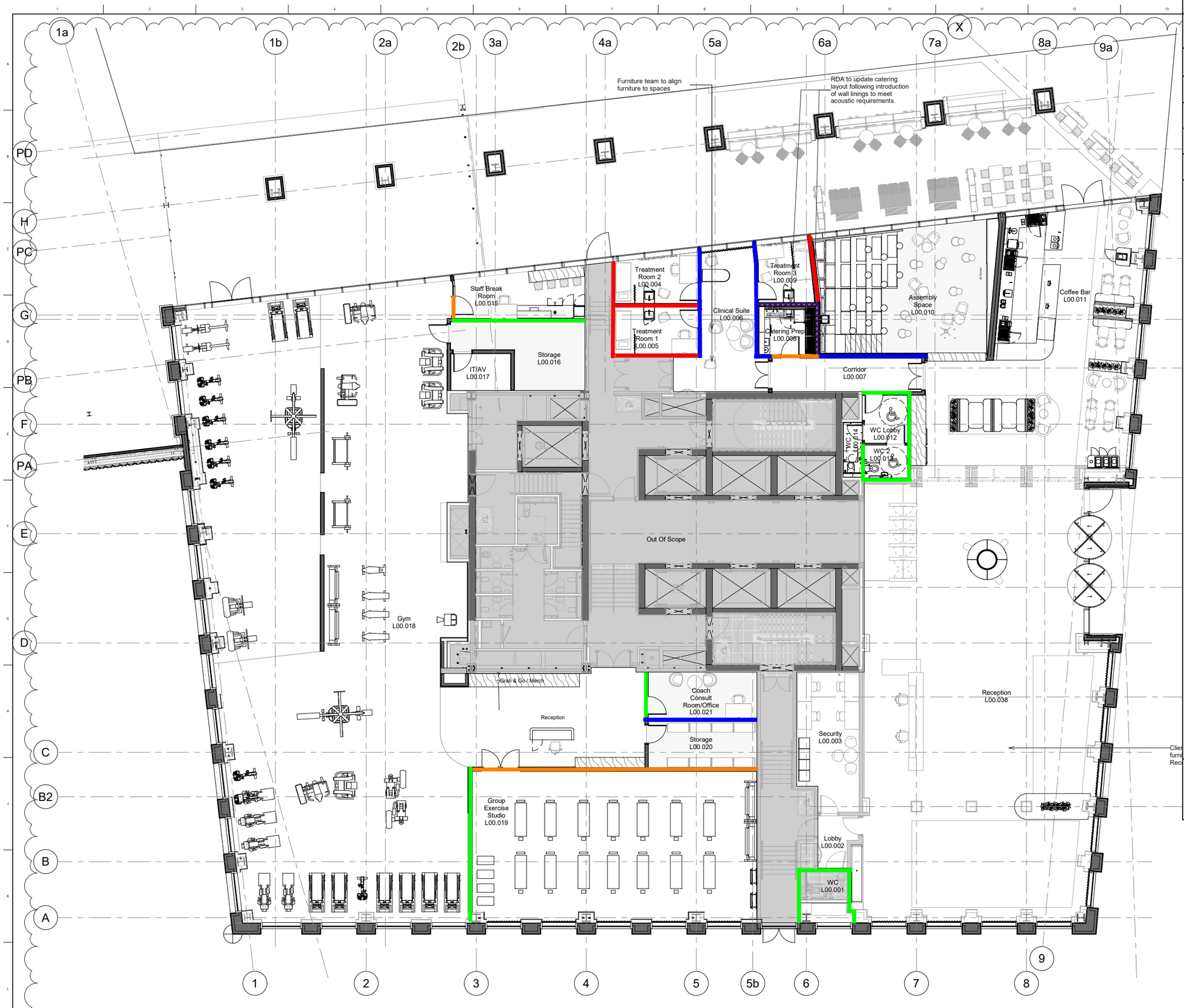
Drawn	Date	Scale @ A1	Alt. Ref.
KBH	17/02/2025	1:100	U8912

Project	Originator	Volume	Level	Type	Role	Number	Suitability	Revision
BNYM	TPB	ZZ	00	DR	ID	201001	S3	P02

Model Ref.: BNYM-TPB-ZZ-ZZ-M3-ID-SH0001

Appendix C

Sound insulation strategy mark-ups



Title	Partition and door sound insulation mark-up
Project	BNY, 4 Angel Square, Manchester
Project no.	026008
Version	B
Marked-up by	Name
Reviewed by	Kane Mitchell
Date	11 February 2026

Mark-up key laboratory ratings

- R_w 60 dB staggered stud drywall partition
- R_w 55 dB staggered stud drywall partition
- R_w 55 dB slab to slab drywall partition
- R_w 50 dB raised floor to slab staggered stud drywall partition with flexible floor void barrier
- R_w 50 dB raised floor to slab drywall partition with flexible floor void barrier
- R_w 45 dB raised floor to ceiling drywall partition with flexible floor and ceiling void barriers
- R_w 40 dB raised floor to ceiling drywall partition with flexible floor and ceiling void barriers
- R_w 52 dB raised floor to ceiling movable partition with flexible floor void barrier and plasterboard bulkhead
- Independent lining
- R_w 43 dB glazed screen with R_w 50 dB drywall bulkhead and drywall floor barrier
- R_w 40 dB glazed screen with drywall bulkhead and drywall floor barrier
- R_w 38 dB glazed screen with drywall bulkhead and drywall floor barrier
- R_w 40 dB doorset
- R_w 38 dB doorset
- R_w 35 dB doorset
- R_w 30 dB doorset

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Preliminary

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Project
Bank of New York
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Manchester

Drawing Title
Level 00
General Arrangement Plan

Drawn	Date	Scale @ A1	Alt. Ref.
KBH	17/02/2025	1:100	U8912

Project	Originator	Volume	Level	Type	Role	Number	Suitability	Revision
BNYM	TPB	ZZ	00	DR	ID	201001	S3	P02

Model Ref.: BNYM-TPB-ZZ-ZZ-M3-ID-SH0001

Appendix D

Sustainability accreditation scheme requirements

LEED

Sound insulation

The LEED documentation states that the composite sound transmission class (STC_C) ratings listed in Table 27 shall be met. For the purposes of this review, STC can be considered approximately equivalent to R_w.

Table 27 Minimum composite sound transmission class ratings for adjacent spaces (LEED)

Adjacency combination		STC/R_w
Source	Sound insulation	
Standard office	Standard office	45
Executive office	Executive office	50
Conference room	Conference room	50
Office, Conference room	Hallway, stairway	50[1]
Mechanical equipment room	Occupied area	60 [1]

[3] Assumed to relate to crosswalls between spaces as such performances would not typically be achievable in room fronts owing to the limited performance of doors.

Internal indoor ambient noise levels

The LEED documentation states that the design shall achieve maximum background noise levels from heating, ventilating, and air conditioning (HVAC) systems per 2011 ASHRAE Handbook, HVAC Applications, Chapter 48, Table 1; AHRI Standard 885-2008, Table 15; or a local equivalent.

Table 28 displays the services noise levels displayed in 2011 ASHRAE Handbook and the AHRI Standard 885-2008. NC and RC are approximately equivalent to NR.

Table 28 Services noise levels required by LEED

Location	2011 ASHRAE Handbook		AHRI Standard 885-2008
	NC/RC	SPL (dBA)	RC(N)
Executive or private office	30	35	25 - 35
Conference rooms	30	35	25 – 35
Teleconference rooms	25	30	≤ 25
Open-plan offices	40	45	≤40
- with sound masking	-	-	≤35
Corridors and lobbies	40	45	40 - 45

Reverberation

The LEED documentation states that the reverberation times listed in Table 29 shall be met.

Table 29 Reverberation time requirements (LEED)

Location	T60(s), at 500 Hz, 100 Hz and 2000 Hz
Executive or private office	< 0.6
Conference rooms	< 0.6
Teleconference rooms	< 0.6
Open-plan offices without sound masking	< 0.8
Open-plan offices with sound masking	< 0.8

Sound reinforcement

The LEED criteria states that, for all large conference rooms and auditoria seating more than 50 persons, the designer will evaluate whether sound reinforcement and AV playback capabilities are needed.

If needed, the sound reinforcement systems must meet the following criteria:

- Achieve a speech transmission index (STI) of at least 0.60 or common intelligibility scale (CIS) rating of at least 0.77 at representative points within the area of coverage to provide acceptable intelligibility.
- Have a minimum sound level of 70 dBA.
- Maintain sound-level coverage within +/–3 dB at the 2000 Hz octave band throughout the space.

There is no sound reinforcement within the acoustic scope of work and it is recommended that the project AV consultant advise on this aspect.

Masking Systems

LEED states that, for projects that use masking systems, the design levels must not exceed 48 dBA. It also states that the designers shall ensure that loudspeaker coverage provides uniformity of +/–2 dBA and that speech spectra are effectively masked.

WELL v2

S01 sound mapping

Well Feature S01 (sound mapping) is a pre-condition. This requires a mark-up of noise levels in different zones across the office floor (loud, quiet, mixed and circulation zones), to be made available to occupants.

Where loud zones directly border quiet zones, a plan for mitigating noise transmission between these spaces is required.

Well Feature S01 also requires either:

- A plan developed by the project team and/or project owner that outlines acoustical solutions and a timeline for implementation with a focus on managing acoustical comfort, background noise, speech privacy, reverberation time and/or impact noise within the project boundary

OR

- A detailed report from a professional in acoustics that describes existing conditions, recommended solutions and measurement results with a focus on managing background noise, speech privacy, reverberation time and/or impact noise within the project boundary.

S02 maximum noise levels

A maximum of 3 points are available from WELL Feature S02 (maximum noise levels). To achieve 3 points, internal spaces shall achieve the following maximum internal noise levels:

- Areas for conferencing, shall or speaking: L_{Aeq} 35 dB, L_{Afmax} 45 dB
- Enclosed areas for concentration: L_{Aeq} 40 dB, L_{Afmax} 50 dB
- Open areas for concentration, areas with regularly used PA systems, areas for dining (excluding office kitchenettes): L_{Aeq} 45 dB, L_{Afmax} 55 dB
- Areas with machinery and appliances used by occupants: L_{Aeq} 50 dB, L_{Afmax} 60 dB.

Post-completion measurements shall be carried out to demonstrate that the above maximum internal noise levels are achieved.

Compliance with BREEAM Hea 05 can be used as an alternative method to meet WELL S02 Tier 1 (1 point).

S03 sound barriers

A maximum of 3 points are available from WELL Feature S03 (sound barriers).

1 point can be achieved where partitions meet the minimum laboratory sound insulation performances set out in Table 30.

Table 30 WELL S03 Minimum sound insulation performance for internal adjacencies

Adjacency	Minimum sound insulation performance
Between loud zones and other occupiable spaces	R_w 60 dB
Between areas for conferencing, learning or sleeping and other regularly occupied spaces	R_w 55 dB
Between adjacent quiet zones	R_w 50 dB
Between rooms for concentration and other regularly occupied spaces	R_w 45 dB
Between Circulation zones and regularly occupied spaces	R_w 40 dB

Doors that connect two occupiable rooms and doors to mechanical equipment rooms shall have a minimum sound insulation performance of R_w 30 dB, comprising a non-hollow core with seals at the head, jamb and base.

2 additional points can be achieved where either of the following options are met:

- On-site sound insulation performances (D_w) are achieved based on the laboratory sound insulation performances (R_w) given in Table 30, taking into account a 5 dB lab-to-site tolerance

OR

- The sum of on-site sound insulation performances (D_w) and receiver room internal noise levels (L_{Aeq}) meet the minimum values given in Table 31.

Post completion sound insulation testing shall be carried out to demonstrate that either of the above options are achieved.

Table 31 WELL S03 Speech privacy targets

Source room	Receiver room	Minimum D_w+NR
Enclosed loud zones	Any open areas for concentration or circulation zones	80
Enclosed loud zones	All other occupiable areas	85
Enclosed areas for conferencing, learning or sleep	Any open areas for concentration or circulation zones	75

Source room	Receiver room	Minimum D_w+NR
Enclosed areas for conferencing, learning or sleep	Enclosed quiet zones	80
Enclosed areas for conferencing, learning or sleep	Enclosed areas for conferencing, learning or sleep	85
Enclosed quiet zones	Any open areas for concentration or circulation zones	70
Enclosed quiet zones	Enclosed quiet zones (except offices)	75
Enclosed quiet zones	Enclosed offices or areas for conferencing, learning or sleep	80
Any other occupiable space	Enclosed quiet zones	75

S04 reverberation time

2 points are available from Well Feature S04 (reverberation time). To achieve these 2 points, the reverberation time criteria set out in Table 32 shall be met. This can either be verified by a technical document or acoustic testing.

Table 32 WELL S04 Reverberation time requirements

Space	Criteria T_{60} (s)[1]
Areas for conferencing (v < 10,000 ft^3)	$T_{60} \leq 0.6$
Dining spaces	$T_{60} \leq 1.0$
Areas for fitness (v < 10,000 ft^3)	$0.7 \leq T_{60} \leq 1.0$

[1] The relevant documentation does not clarify whether this constitutes the average reverberation time in key frequencies (known as mid-frequency reverberation time T_{mf}) which is a common parameter in the UK. For the purposes of these assessments, T_{mf} is adopted, and this approach be agreed with the relevant assessor.

S05 sound reducing surfaces

A maximum of 2 points are available from WELL Feature S05 (sound reducing surfaces). To achieve these 2 points, sound absorbent wall and ceiling finishes shall be provided as per Table 33.

WELL provides the following definition of 'available ceiling area':

"any ceiling area that is directly viewable to occupants and excludes areas where beams, skylights, ducts or other ceiling components that prohibit the application of direct mounted or hung acoustical treatment".

Table 33 WELL S05 absorbent finishes requirements

Spaces	1 point (tier 1)	2 points (tier 2)
Open workspaces	α_w 0.75 for at least 75% of available ceiling area	α_w 0.90 for all available ceiling area Partial height barriers with a minimum height of 1.2 m above finish floor and a minimum value of α_w 0.7 between all opposing workstations
Areas for conferencing	α_w 0.75 for at least 50% of available ceiling area	α_w 0.90 for all available ceiling area
	α_w 0.75 for at least 25% of at least two walls	α_w 0.80 for at least 25% of two perpendicular walls
Dining	α_w 0.75 for at least 50% of available ceiling area	α_w 0.90 for all available ceiling area

S06 minimum background noise

A maximum of 2 points are available from WELL Feature S06 (minimum background sound).

1 point can be achieved where:

- A sound masking system is installed in open areas with quiet zones, circulation zones and enclosed rooms labelled as quiet zones and produces a 1/3 octave band adjustable output signal and frequency spectrum of 100 Hz to 5 kHz
- The sound masking system is commissioned such that the following sound pressure levels are not exceeded:

- Open areas with quiet zones and/or circulation zones: 48 dBA

- Enclosed rooms labelled as Quiet zones: 42 dBA

- The sound masking system is verified by a professional sound masking system installer in accordance with ASTM 1573-18 or equivalent standard.

1 additional point can be achieved where the above conditions are met (Feature S06 part 1), as well as either the on-site sound insulation performances or speech privacy targets as per Feature S03 Part 2 or the sound absorbent wall and ceiling finishes as per Feature S05.

S07 impact noise management

A maximum of 3 points are available from WELL Feature S07 (impact noise management). This criterion deals with impact sound insulation to control structure-borne noise transfer associate with footfall, gym equipment, etc.

Part 1 Specify impact noise reducing flooring

The maximum impact sound insulation performances to demonstrate compliance with criterion S07 are summarised in Table 34.

Table 34 WELL S07 Floor impact sound insulation requirements

Space type	Maximum impact sound insulation performance ($L_{nT,w}$)
Above quiet zones (except areas for concentration)	50
Below areas for Fitness (if space is within the project boundary)	55
Above enclosed Areas for Concentration and Conferencing	55
Above open areas for concentration	60
Below areas for retail and dining (if space is within the project boundary)	60

Part 2 Meet thresholds for impact noise rating

The same criteria as Part 1 above are applicable for Part 2. Part 2 requires performances to be measured on site (therefore it is assumed that the $L'_{nT,w}$ parameter is applicable).

WELL testing

Any acoustic testing to demonstrate compliance with WELL would need to be carried out by a WELL Performance Testing Agent.

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