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ACOUSTIC CONSULTANTS

HORWICH HEALTHCARE HUB

DETAILED DESIGN REPORT

REPORT REFERENCE NO. J004610/7405/02

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	Name	Position
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This document has been prepared for the client only and solely for the purposes expressly defined herein. We owe no duty of care to any third parties in respect of its content. Therefore, unless expressly agreed by us in signed writing, we hereby exclude all liability to third parties, including liability for negligence, save only for liabilities that cannot be so excluded by operation of applicable law.

This report has been prepared based upon a scope of works and associated resources agreed between the client and Philip Dunbavin Acoustics Ltd (PDA). This report has been prepared with all reasonable skill, care and diligence and has been based upon the interpretation of data collected. This has been accepted in good faith as being accurate and valid at the time of the collection. This report has been based solely on the specific design assumptions and criteria stated herein.

CONTENTS

1.0 SUMMARY

This detailed design report has been prepared by Philip Dunbavin Acoustics Ltd (PDA) on behalf of PRP Architects to inform the design team of the applicable acoustic requirements for the proposed healthcare development scheme at Horwich.

This assessment has been undertaken in accordance with the requirements of BREEAM New Construction 2018 Hea-05: Acoustics. A further report will be compiled dealing with the Pol-05: Reduction of Noise Pollution credit for BREEAM.

The report has incorporated a review of the current design drawings and specifications for the project as referenced in Appendix C.

The findings of the report are summarized as follows:

- Section 5.0 reviews the internal sound insulation provisions based on HTM 0801/ BREEAM Hea05 requirements.
- Section 6.0 gives recommendations for the façade structures in terms of sound insulation.
- Section 7.0 gives recommendations for mechanical services design based on supplied drawings projects. **Please note the requirement to relocate a limited number of fan units as set out in this section.**
- Section 7.0 goes on to give further general recommendations for suppression of mechanical services noise and vibration.
- Section 8.0 deals with room acoustics and reverberation.
- Section 9.0 details external limits for mechanical services noise. This will be further addressed in a separate report when additional information becomes available.
- Section 10.0 outlines potential CDM requirements.

The report finds that the current drawings are generally in line with the acoustic requirements for the projects.

- **Notwithstanding the above, a limited number of queries are bulleted in bold type and should be addressed by the architects and or mechanical services engineers.**

A glossary of the acoustic terminology used in this report is presented in Appendix A, along with notes for quality control in Appendix B. Appendix C gives a list of drawings as currently received. The marked up drawings provided by the architect in terms of sound insulation specification are included in Appendix D.

2.0 ASSUMPTIONS

The assessment in this report is based on PRP Architects drawings as set out in Appendix C.

3.0 ASSESSMENT CRITERIA

3.1 BREEAM New Construction (United Kingdom) 2018

The acoustic credits available under the BREEAM New Construction 2018 scheme are being targeted for the development. The credits sought for the current project are as follows:

3.1.1 New Build

There are up to three credits available under Hea 05 which requires the following to demonstrate compliance;

"The building meets the appropriate acoustic performance standards and testing requirements defined in the checklists and tables section which defines criteria for the acoustic principles of:

a) Sound insulation;
b) Indoor ambient noise level; and
c) Reverberation times.

Or

A suitably qualified acoustician (SQA) is appointed to define a bespoke set of performance requirements for all function areas in the building. The bespoke performance requirements use the three acoustic principles defined in criterion Hea 05 Acoustic performance: Criterion 1 setting out the performance requirements for each and the testing regime required."

It is understood that the client *wishes to target all three credits for this development scheme.* The performance standard and testing requirement to achieve these credits are detailed below;

First Credit- Sound Insulation

"Achieve the airborne sound insulation performance standards set out in Section 2 of HTM 08-01: Acoustic design requirements, 2013 determined according to the privacy requirements using both Table 3 and Table 4 from HTM 08-01. The weighted standardised impact sound pressure level ($L_{nT,w}$) must not exceed 65 dB for floors over noise-sensitive rooms, following the guidance in HTM 08-01."

Second Credit - Indoor Ambient Noise Levels

"The indoor ambient noise requirements for noise intrusion from external sources in Table 1 of HTM 08-01 are not exceeded. The values for internal noise from mechanical and electrical services in Table 2 of HTM 08-01 are not exceeded.
A programme of pre-completion acoustic testing is carried out by a compliant test body in accordance with the Section 7 of HTM 08-01: Acoustics."

Third Credit- Room Acoustics

"Acoustic environment (Control of reverberation and sound absorption): Achieve the requirements relating to sound absorption set out in Section 2 of HTM 08-01."

3.1.2 Pol 05; Reduction of Noise Pollution

This is to be assessed in a separate report to follow.

3.2 BREEAM New Construction (United Kingdom) 2018

3.2.1 Sound Insulation

Target performance standards provided within HTM 08-01 (Table 4 of Section 2) of the standard design manuals presents a matrix. This matrix is used to select the standard of sound insulation required based on these parameters in terms of the weighted standardised level difference ($D_{nT,w}$). This is determined upon the sensitivity of the receiver room and the scale *(Very High to Low)* of the noise generation of the source room.

With regards to Impact noise transmission, HTM 08-01 indicates that a standardised impact sound pressure ($L'_{nT,w}$) of 65dB is considered a reasonable maximum value for floors over noise-sensitive areas for the development scheme.

3.2.2 Indoor Ambient noise level

All aspects of the building facades are required to provide enough insulation to safeguard suitable internal noise levels within each space. Table 1 sets out the criteria from HTM 08-01 for noise intrusion to be met inside the spaces from external sources:

Table 1. Criteria for noise intrusion from external sources from HTM 08-01

Room type	Example	Criteria for noise intrusion to be met inside the spaces from external sources (dB)
Ward – single person	Single-bed ward, single-bed recovery areas and on-call room, relatives' overnight stay	40 $L_{Aeq,1hr}$ daytime, 35 $L_{Aeq,1hr}$ night, 45 L_{Afmax}, night
Small office-type spaces	Private offices, small treatment rooms, interview rooms, consulting rooms	40 $L_{Aeq,1hr}$
Operating Theatre	**Operating Theatre**	**40 $L_{Aeq,1hr}$ 50 $L_{Amax,f}$**
Circulation spaces	Corridors, hospital street, atria	55 $L_{Aeq,1hr}$
Public areas	Dining areas, waiting areas, playrooms	50 $L_{Aeq,1hr}$
Personal hygiene (en-suite)	Toilets, showers	45 $L_{Aeq,1hr}$
Personal hygiene (public and staff)	Toilets, showers	55 $L_{Aeq,1hr}$
Small food-preparation areas	Ward kitchens	50 $L_{Aeq,1hr}$
Large food-preparation areas	Main kitchens	55 $L_{Aeq,1hr}$
Large meeting rooms (>35 m^2 floor area)	Lecture theatres, meeting rooms, board rooms, seminar rooms, classrooms	35 $L_{Aeq,1hr}$
Small meeting rooms (≤35 m^2 floor area)	Meeting rooms, seminar rooms, classrooms, board rooms	40 $L_{Aeq,1hr}$
Laboratories	Laboratories	45 $L_{Aeq,1hr}$

Rain Noise

Indoor ambient-noise levels during *" heavy"*[1] rainfall should not exceed the intrusive noise criteria in the Table above by more than 20 dB(A) or should not be more than 65 dB(A), whichever is lower.

Sporadic Noise

Hospitals are often affected by noise from sporadic events such as vehicle sirens, helicopters and aircraft etc. Each source must be considered separately, and an appropriate strategy devised. A policy of no sirens on site *(unless essential)* is recommended.

Mechanical and Electrical Services Noise

In order to safeguard against excessive internal noise from mechanical and electrical services, HTM 08-01 notes that internal noise levels set out in Table 2 must not be exceeded.

Table 2. Criteria from HTM 08-01 for Internal Noise from Mechanical and Electrical Services

Room type	Example	Criteria for Mechanical and Electrical Services sources (NR)
Ward – single person	Single-bed ward, single-bed recovery areas and on-call room, relatives' overnight stay	30
Small office-type spaces	Private offices, small treatment rooms, interview rooms, consulting rooms	35
Operating Theatre	**Operating Theatre**	40
Circulation spaces	Corridors, hospital street, atria	40
Public areas	Dining areas, waiting areas, playrooms	40
Personal hygiene (en-suite)	Toilets, showers	40
Personal hygiene (public and staff)	Toilets, showers	45
Small food-preparation areas	Ward kitchens	40
Large food-preparation areas	Main kitchens	NR 50 (NR 55 below extract hoods)
Large meeting rooms (>35 m² floor area)	Lecture theatres, meeting rooms, board rooms, seminar rooms, classrooms	30
Small meeting rooms (≤35 m² floor area)	Meeting rooms, seminar rooms, classrooms, board rooms	35
Laboratories	Laboratories	NR 40 when laboratory has no fume cupboards NR 60 at 1 m from fume cupboards with open sash

[1] *" Moderate"* and *" heavy"* rainfall is as described in BS EN ISO 140-18; Acoustics -- Measurement of sound insulation in buildings and of building elements -- Part 18: Laboratory measurement of sound generated by rainfall on building elements

3.2.3 Reverberation Times

Requirements for the control of reverberation in healthcare buildings are specified in HTM: 08-01. In accordance with the document, sound-absorbent treatment should be provided in all areas (including all corridors), except acoustically unimportant rooms (for example storerooms etc.), where cleaning, infection-control, patient-safety, clinical and maintenance requirements allow, with washable, acoustically-absorbent materials being required in some areas within the infection-control regime.

Application of Method A or Method B (as defined in HTM: 08-01 section 10) should sufficiently satisfy the requirements of HTM: 08-01. Compliance via Method A involves including a set amount of acoustic absorption and a Class C absorbent ceiling will generally meet the requirements. Compliance via Method B involves calculating the amount of additional absorption required based on the proposed finishes.

3.3 BS 4142:2014: Methods for rating and assessing industrial and commercial sound

This is to be assessed in a separate report to follow.

4.0 EXTERNAL NOISE SURVEY DETAILS

Full details of the survey procedures and monitoring results can be found in the standalone planning report reference Ref. J003861-5647-LK-02; *'Environmental Noise Assessment, Health Hub, Horwich",* dated 18 July 2022.

5.0 INTERNAL SOUND INSULATION

5.1 Wall Construction

PRP Architects wall type drawings in **Appendix D** sets out internal sound insulation criteria between each space depending on privacy requirements, typical noise generation levels and sensitivity. PDA Ltd have checked these drawings and architects internal wall type plans as shown in Appendix D and these are considered to be in line with the required criteria.

- **Notwithstanding the above, I note that the wall type drawings currently show First Floor Consulting and Treatment Rooms F03 to F08 as having no corridor walls and this is of course understood to be an oversight but needs redressing.**

It is assumed that the construction is to be of composite steel and concrete construction with a masonry type cladding system. It is understood that the internal walls will be of lightweight construction. PRP architects internal wall types drawing 6001 (see drawing register in Appendix C) gives the following wall types which are adequate (with correct detailing as discussed later) to meet the sound insulation requirements for the project. The wall types and typical system references to achieve requirements are as follows:

63 dB R_w (to achieve 47 dB $D_{nT,w}$ on site)

Wall Type IN-01

e.g. BG System Reference A216011

Studs:	Twin 48mm 'I' Studs at 600mm centres
Linings:	Two layers of 15mm SoundBloc plasterboard each side with skim finish
Cavity insulation:	75mm Isover Acoustic Slab

58 dB R_w (to achieve 47 dB $D_{nT,w}$ on site)

Wall type IN-06

BG System Reference A206A198S

Studs:	70mm Gypframe 70 AS 50 AcouStuds at 600mm centres
Linings:	Two layers of 12.5mm SoundBloc plasterboard each side with 2.5mm plaster skim finish
Cavity insulation:	25mm Isover Acoustic Partition Roll (APR 1200)

I note that the system you have described on drawing 06001-P01 is actually A206A198S with 2.5mm plaster skim finish whereas you have labelled it as A206A198. However, both systems are acceptable.

<u>48 dB R_w (to achieve 42 dB $D_{nT,w}$ / 37 dB $D_{nT,w}$ on site)</u>

Wall Type IN-05

BG System Reference Q606063S

Studs:	70mm Studs at 600mm centres
Linings:	1 layer of 15mm BG Gyproc Duraline each side with skim finish
Cavity insulation:	75mm Isover Acoustic Slab

I note that the system you have described on drawing 06001-P01 is actually Q606063S with 2.5mm plaster skim finish whereas you have labelled it as Q606063. However, both systems are acceptable.

<u>40 dB R_w</u>

IN-04

BG System Reference Q606062

Studs:	70mm Studs at 600mm centres
Linings:	1 layer of 15mm BG Gyproc Duraline each side with skim finish
Cavity insulation:	None

<u>Acoustic Rating to be Confirmed</u>

IN-03

Masonry:	140mm blockwork (min 1300 kg/m^3)
Linings:	12.5mm BG Wallboard on dabs with 2.5mm plaster skim finish (one side only).
Cavity insulation:	None

This wall is to be used between the G.18 plant and G.16 group room, and between the G19 Pharmacy to adjacent non-noise sensitive spaces. Whilst we would normally recommend a minimum 58 dB R_w wall to achieve minimum 47 dB $D_{nt,w}$ on site, we note that the said plant room is only to have fairly quiet electrical plant and pumps, boilers or the like. As such, and assuming this room would not normally be accessed, then it seems that this lower performance wall would be adequate as there would be no privacy requirement. However, this should be checked with the client.

Please note that this assessment is assuming that there is good build quality and construction detailing onsite. The following points will need to be considered to ensure the acoustic performance is maintained.

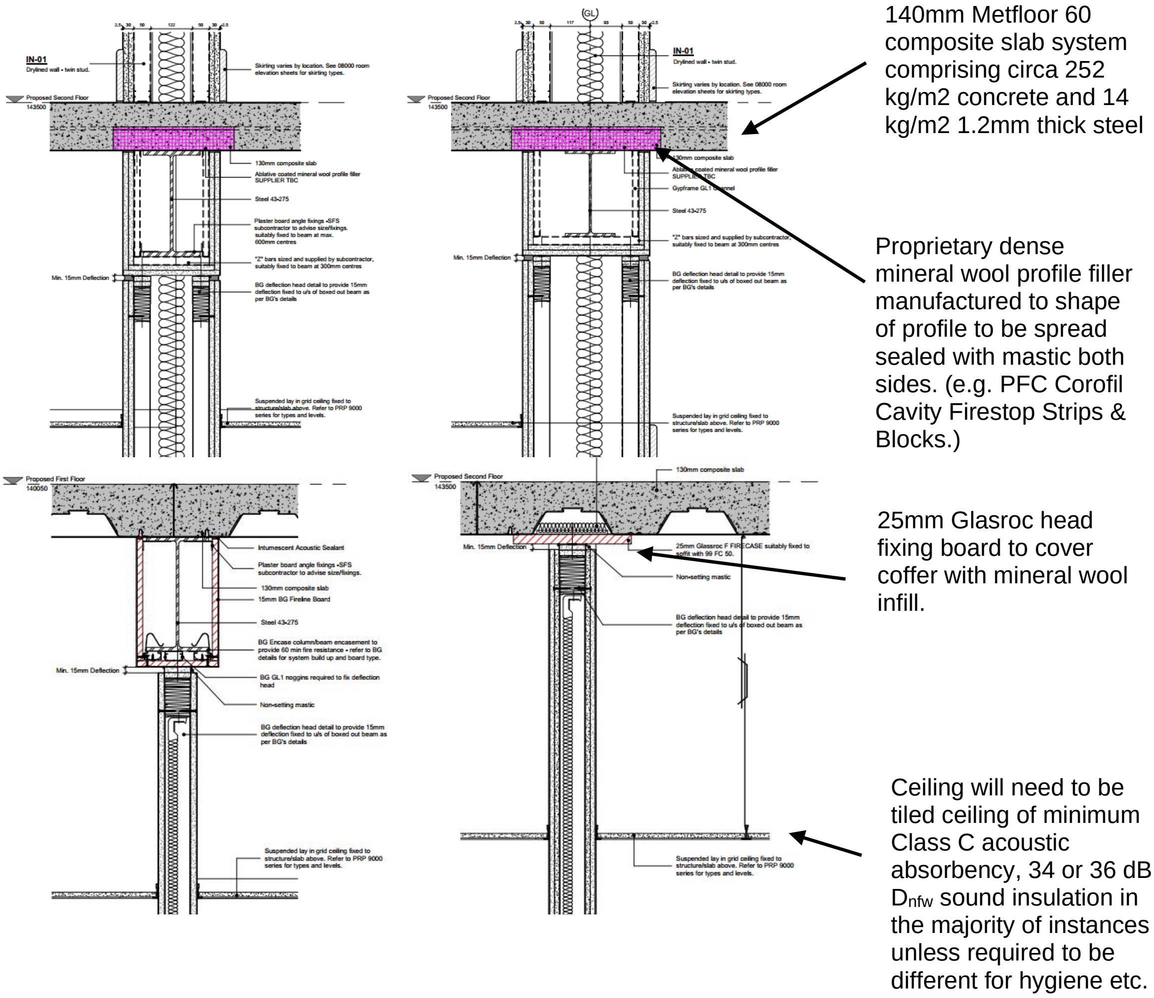
- Seal all joints with tape or caulk with sealant.
- Ensure quilt covers the entire wall area.
- Ensure all perimeter joints are well sealed with tape or caulk with sealant.
- Ensure plasterboard layers are staggered to ensure that all airborne sound paths are sealed.
- With regard to AcouStuds special care must be taken to ensure fixing to manufacturers details as incorrect installation including but not exclusive to use of overlong screws can reduce sound insulation performance significantly.

5.2 Floor Construction

5.2.1 General Floors

It is understood, based on the sections provided that the floor construction will be as follows:

Drawing 1. Proposed Floor Construction



The following construction will be required to have an absorbent ceiling of minimum Class C absorption and 34 (Noise sensitive non-clinical areas) and 36 dB D_{nfw} (Noise sensitive clinical areas) ceiling sound attenuation except as required for hygiene etc. and this is shown in the drawings. In addition the floor will need to be finished in carpet or vinyl with minimum impact sound insulation of 10dB ΔL_w. As such the revised floor/ceiling build up would be:

- Where rooms overly noise sensitive rooms a carpet or vinyl surface finish minimum impact insulation 10 dB ΔL_w will be required. I note that the current drawings correctly reflect this on the upper floors with the 17dB ΔL_w Forbo Surestep Decibel Slip Resistant Safety Vinyl specified apart from as follows:
  - **First Floor F.16 Reception currently shows standard vinyl but will need to be upgraded to the Forbo Surestep Decibel Slip Resistant Safety Vinyl as there is a clinical area below.**

- 140mm Metfloor 60 (or equivalent) re-entrant profile Composite Deck (or equivalent mass deck with trapezoidal profiles).
- Minimum 500mm void.
- 34 dB D_{nfw} (Noise sensitive non-clinical areas) or 36 dB D_{nfw} (Noise sensitive clinical areas) Class C acoustic ceiling e.g Zentia Bioguard Acoustic.

Calculations indicate that the airborne acoustic performance of this system would be in excess of the site requirement of 47 dB $D_{nT,w}$, this being the minimum performance requirement. The above is as shown in the detailed drawings.

With regards to Impact noise transmission, a standardised impact sound pressure ($L'_{nT.w}$) of 65dB is considered a reasonable maximum value for floors over noise-sensitive areas for the development scheme. The above floor system is predicted to achieve this requirement.

- **I note that the Internal Detail Sections Sheets 1 to 6 show 130mm thick concrete composite slab but it is understood that this should actually be 140mm thick.**

The following ceiling systems are required and are correctly shown in the current drawings:

Clinical Areas

The selection as per the PRP reflected ceiling drawings of Zentia Bioguard Acoustic which has absorption coefficient of Class C and sound insulation performance D_{nfw} of 36 dB is commensurate with requirements.

Group / Meeting Rooms, Offices, Reception, Circulation, Waiting Area, Stair, Brew, Meeting Areas, Library / Quiet Areas

The selection as per the PRP reflected ceiling drawings of Zentia Dune Evo which has absorption coefficient of Class C and sound insulation performance D_{nfw} of 34 dB is acceptable for these spaces.

Other Non-Sensitive Spaces

The selection as per the drawings of Zentia Bioguard Non-Acoustic is acceptable for these spaces.

5.2.2 Ground Floor Plant Room Ceiling

It would be assumed that the plant room would contain relatively low noise items.

In light of the above, the proposed ceiling can be substituted with 6mm Calcium Silicate board on 166mm dense mineral wool batt (minimum density 100kg/m^3) e.g. Firetherm or equivalent.

The above is correctly shown in the drawings.

5.3 Flanking Noise

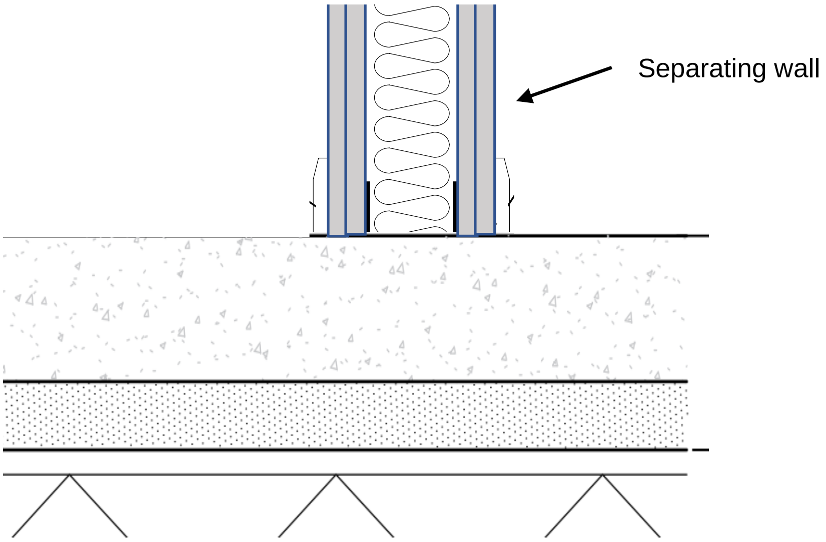
It will need to be ensured that flanking noise does not reduce the acoustic performance of the separating element between spaces when measured in-situ. Our assessment is as follows:

5.3.1 Junction of Internal Partitions with Floors

Drawings indicate that the ground floor is a 150mm concrete slab with a 100mm thermal insulation layer below it.

Please refer to Drawing 3 below which provides our recommended detail which appears to be correctly shown in the GA section drawings.

Drawing 2: Junction of internal partition with ground floor (acoustic principles only)



It is noted that if any floating floors are proposed then these should be broken either side of the partition base.

Upper Floors

Junctions of the base of internal partitions with upper floor 140mm thick concrete slabs must also meet the suspended concrete base slab in a similar way to the ground floor slab junction shown in Drawing 2 above.

However, with regard to flanking transmission via the floor (estimated 264 kg / m^2) between horizontal adjoined rooms then based on Bastian® sound insulation prediction software and previous tests of similar systems where separating walls incorporate risers between rooms a performances of circa 46-48 dB D_{nTw} would be predicted with floor profiles running perpendicular to separating walls.

I note that the separating wall between F.08 and F.07 does not incorporate a riser but we would still expect this to achieve 45 dB D_{nTw} with the 140mm flanking floor system as described.

Zentia Bioguard Ceiling tiles with sound insulation rating 36 dB $D_{n'fw}$ and Class C acoustic performance are required in all consulting rooms and treatment rooms, with Zentia Evo Ceiling tiles with sound insulation rating 36 dB $D_{n'fw}$ and Class C acoustic performance in all other noise sensitive rooms. This is correctly shown in the current reflected ceiling plans.

Again, if any floating floors are proposed then these should be broken either side of the partition base.

5.3.2 Junction of Internal Partitions with the Floor Soffit

It will need to be ensured that all partitions (including corridor walls) are continuous to the underside of the roof soffit and are well sealed with acoustic sealant.

Where a separating partition meets the underside of the soffit/roof, care must be taken to ensure a good junction to maintain acoustic performance, particularly where a deflection head is employed.

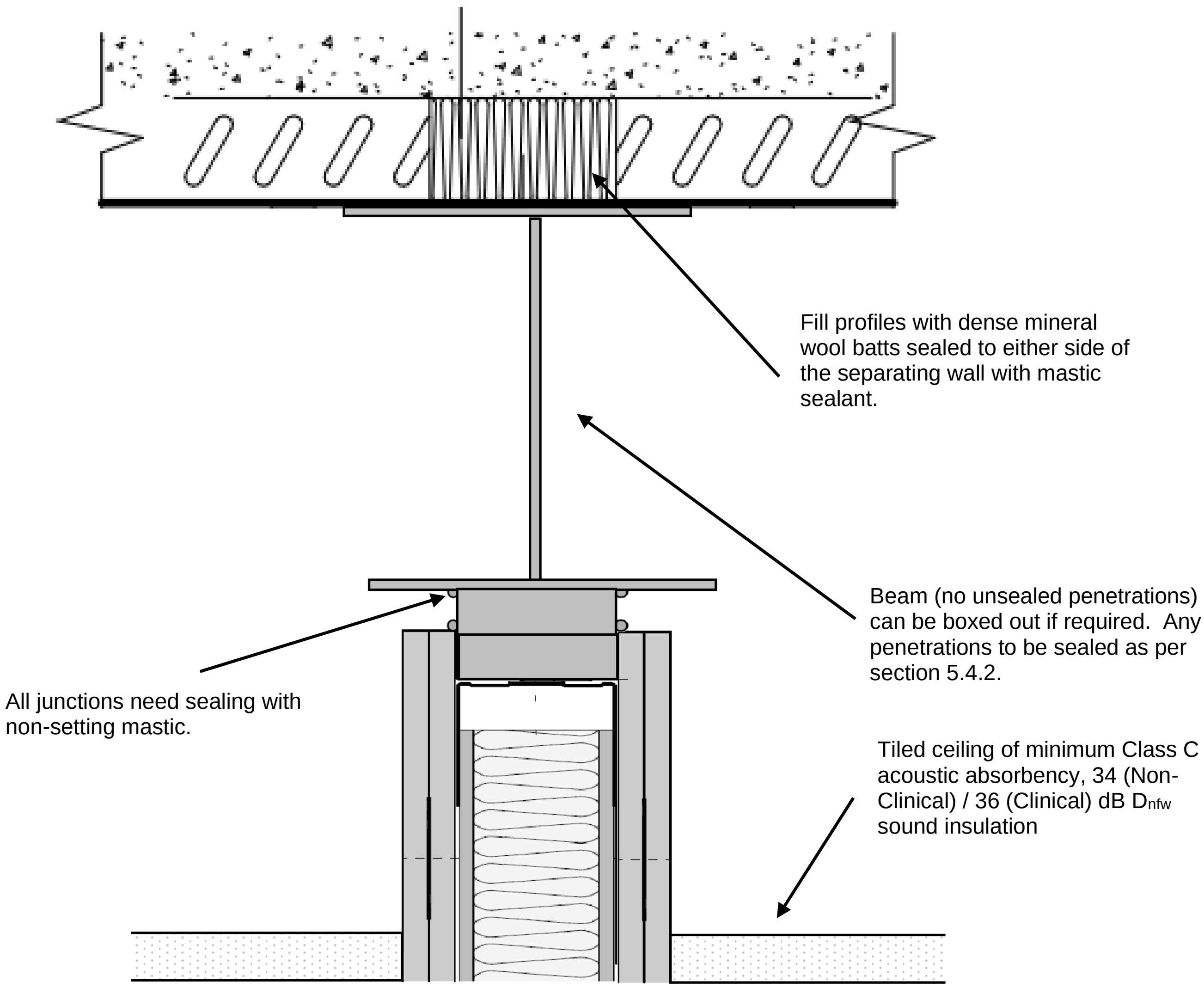
Where the partition runs along the line of a profiled deck, a board at the head may be used to give a good surface to fix into. Any gaps formed by the deck profiles, either in line with or perpendicular to the separating wall, should be filled to the full width of the separating partition with dense mineral wool batts and sealed on both sides of the separating wall with flexible mastic sealant. Pre-cut profiled dense mineral wool batts are commercially available, e.g. PFC Corofil Cavity Firestop Strips & Blocks. This is correctly shown in the current drawings.

The head plate may be timber blocking or layers of core plasterboard and should extend down far enough to create a reasonable overlap with the board linings. All gaps between the plasterboard linings and deck should be sealed with a continuous ribbon of flexible mastic sealant; deflection heads should be in accordance with manufacturer instructions. This is correctly shown in the current drawings.

Drawing 1 above show acceptable head details.

Drawing 3 below shows typical requirement where a partition meets the underside of a steel beam:

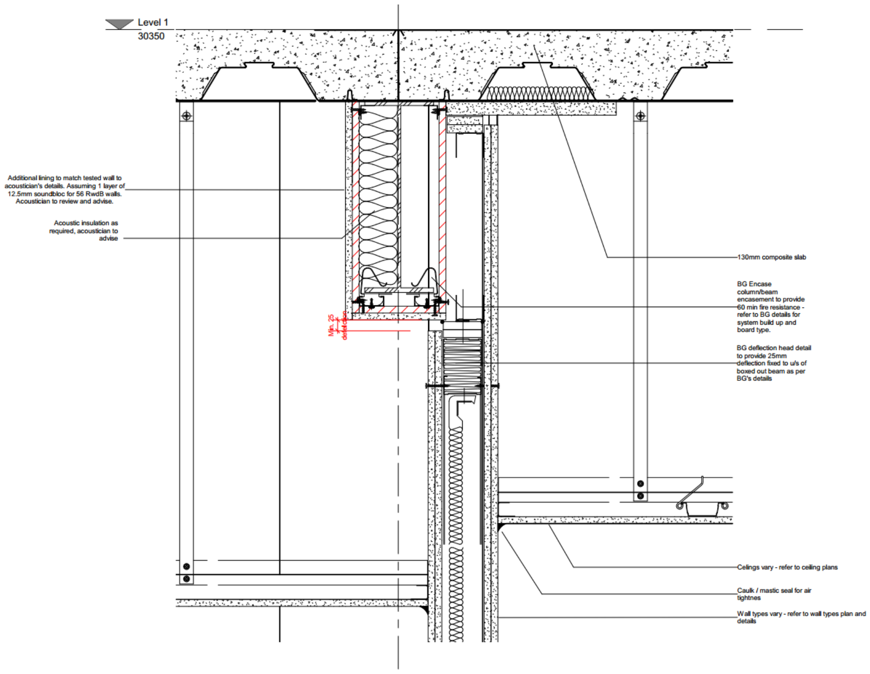
Drawing 3. Partition head to Steel Beam - vertical section (acoustic principles only)



It is of course acceptable to box out the beams if required for fire etc., and the current drawings are acceptable in that respect.

I note that where partitions are offset from beams but still within the footprint of the beam then it makes sense to box out the beam as per previous projects as shown in Drawing 4 below:

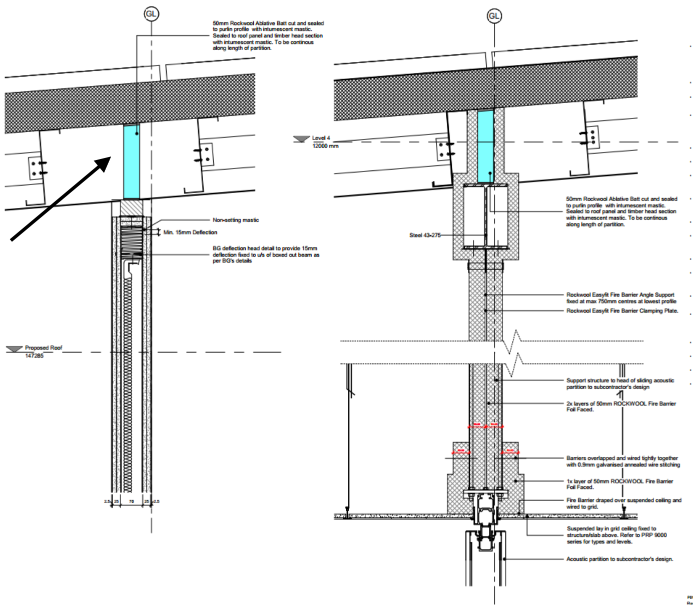
Drawing 4. Potential Beam offset to Wall Details (acoustic principles only)



Acceptable roof head details as detailed below are shown in the current PRP drawings:

Drawing 5. Roof Junction Details (acoustic principles only)

Mastic sealed ablative board head seal.

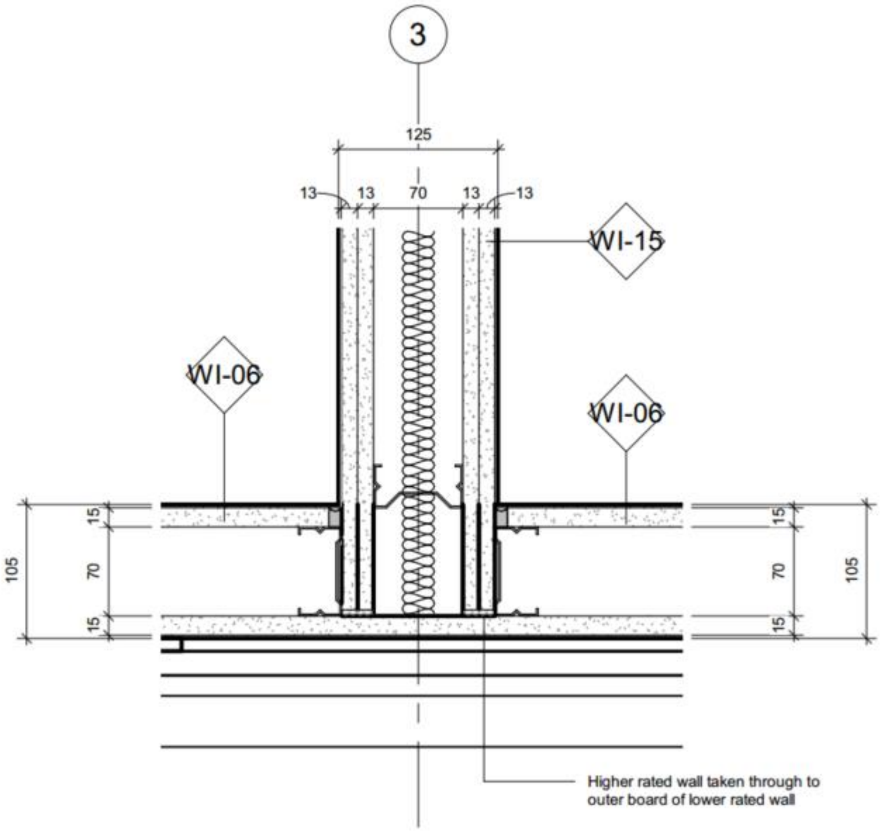


Moveable wall head detail (Brew to Staff Room)

5.3.3 Junction of Internal Wall to Corridor Wall

Due to the use of single layers of plasterboard on corridor walls then where a separating partition meets a corridor wall, the separating partition should dominate the junction. The inner leaf of the corridor wall should be discontinuous across the separating partition and break the cavity of the corridor wall, as shown below:

Drawing 6. T-junction plan details (acoustic principles only – adapt as necessary for single board partitions)

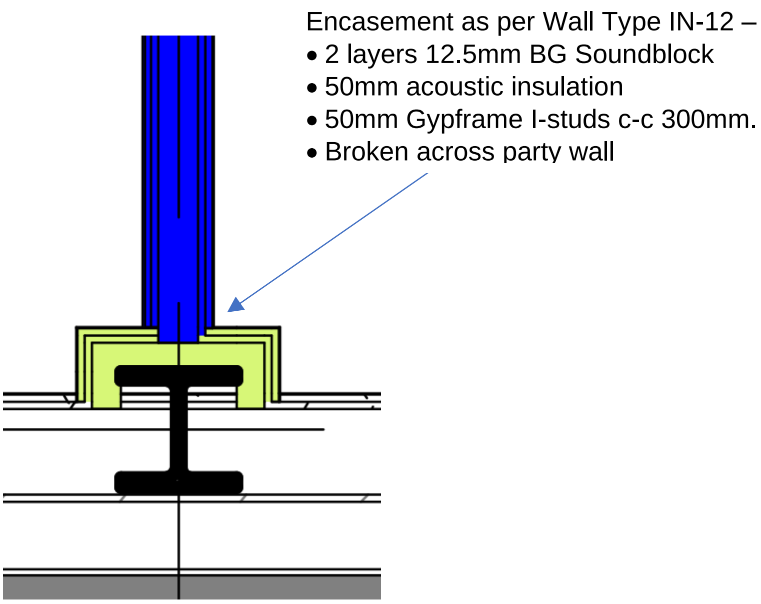


Similar details as set out in the PRP drawings are acceptable.

The perimeter joints of all plasterboard linings should be sealed airtight with a continuous ribbon of flexible acoustic sealant.

Where partition walls meet a column then the wall system must effectively encase the column in equivalent plasterboard linings to the wall system.

Drawing 7. T-junction plan details (acoustic principles only– insulation omitted for clarity)



The above detail is correctly shown in the wall type drawings.

5.3.4 Junction of Separating Wall with External Wall

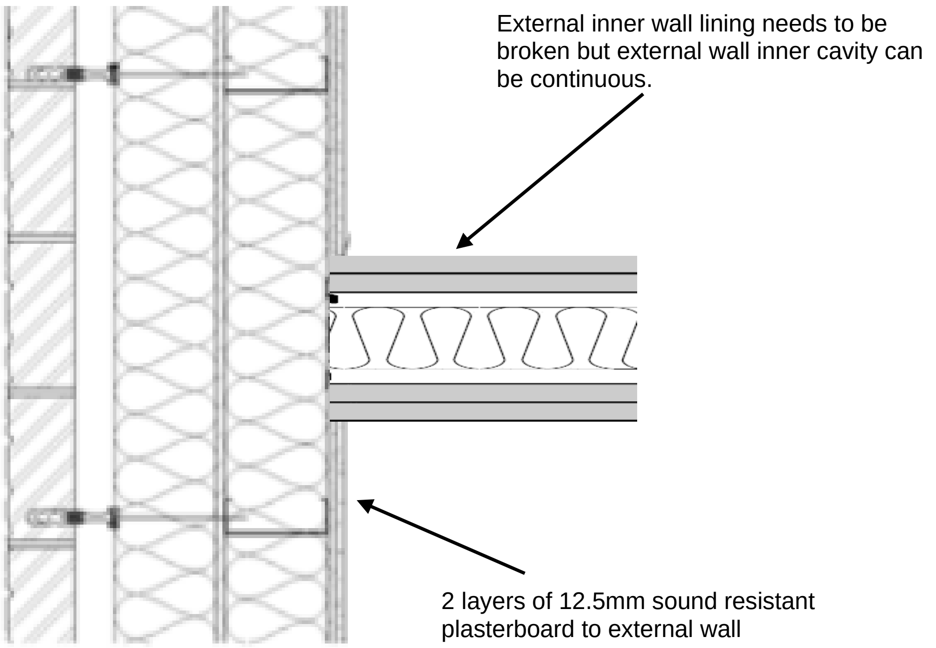
The drawings indicate that the external wall is of Metsec construction.

Due to the use of double layers of plasterboard on inner linings of external walls then where a separating partition meets a corridor wall, the separating partition should dominate the junction but does not need to fully close the junction. The inner leaf of the corridor wall should be discontinuous across the separating partition and break the cavity of the corridor wall, as shown below:

Please refer to the drawing below for typical flanking details.

Drawing 8. Junction of partition with external wall - plan

Walls of 45 dB R_w or more – plan section (acoustic principles only)



Please note that walls of less than 45 dB R_w can but against the external wall lining without breaking it.

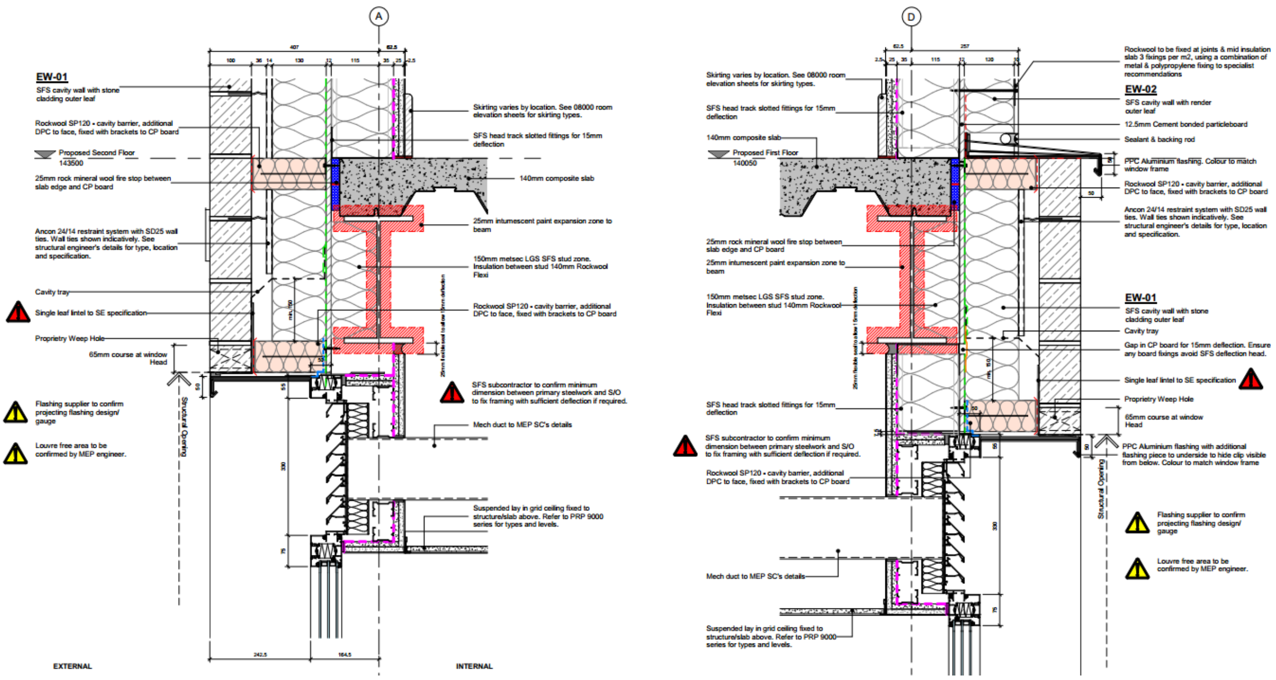
The above is correctly shown in PRP Architects drawings.

5.3.5 Junction of Suspended Floor Concrete Slab and External Wall

The structural floor slab should be built into the inner leaf of the external wall to ensure no continuous inner leaf between floor levels. A cavity stop should be used to fill the cavity in external walls along the line of the separating floor where appropriate.

The current drawings show acceptable details as reproduced in

Drawing 9. External wall and separating floor junction detail – vertical section (acoustic principles only)



It is noted that in the second drawing there is a louvre backed with an insulated (PIR) metal sandwich panel. It is understood that this instance would only occur above ceiling height and below window sill height in noise sensitive rooms and is therefore acceptable due to the attenuation of the ceiling.

5.3.6 Curtain Walling

Continuous curtain walling only appears to be incorporated running between floors in the staircase between gridlines 2 and 3 and gridlines A and B. As such there does not currently appear to be curtain walling running either vertically or horizontally between noise sensitive spaces.

5.4 General Recommendations

5.4.1 Electrical services and sockets

For plasterboard partitions it would be recommended that sockets be mounted in dado trunking thus not penetrating critical plasterboard partitions.

However should they be required to be mounted flush then they should be staggered a minimum of 150mm distance edge to edge and a board of similar thickness as used in the partitions should be installed behind the socket box, sealed around with mineral wool and a minimum 10mm depth with non-setting mastic. Alternatively an intumescent mouldable putty pad such as the Hilti CP617 putty pad to protect electrical sockets could also be employed.

5.4.2 Enclosure of Services and Penetrations

Penetrations through partitions within the ceiling void should be slightly oversized (approximately 5-10mm gap formed around penetrating element) to suppress structure-borne noise transmission across partitions. The remaining gap should then be well sealed on both sides of the partition wall with mineral wool and sealed with acoustic non-setting mastic. Larger gaps would need to be made good with a plasterboard collar cut to shape, again leaving approximately 5-10mm gap formed around the pipe, etc, and finished and sealed with acoustic non-setting mastic, with mineral wool or foam packed in the cavity, to seal all gaps.

Where ducts pass through adjacent noise sensitive rooms then this must occur above ceiling height and adequate cross-talk attenuators must be fitted where adjacent occupancies are on the same ventilation run. The ventilation layout drawings (see Appendix C) show adequately placed cross-talk attenuators.

Penetration holes should be slightly oversized (5-10mm) and gaps sealed to full wall depth with mineral wool and sealed both sides with copious amounts of flexible mastic sealant. The mechanical services submission document for previous projects *210602-en-actionair-installation-method-eis-standard-circular* shows adequate acoustic sealing details using overlapping plasterboard over mastic sealed perimeter gaps.

It is understood that penetrations of ducts and other services between walls will be below steel beam. This makes for a more acceptable sealings detail as the width of the wall enhances the sound insulation between the sealing mechanisms on each side.

If any pipes internal to noise sensitive rooms, e.g. soil, water or rainwater pipes etc, are to be run in risers or horizontal service ducts these need to be boxed out with board material of at least 15kg/m^2, e.g. two layers of 12.5mm plasterboard. The pipes either need to be wrapped in 25mm unfaced mineral wool or the enclosure should be lined with 25mm unfaced mineral wool.

Where possible open cable trays should not pass through separating walls. Where this is unavoidable the penetration should only occur above ceiling height. Gaps should be minimal and stuffed to full wall depth with mineral wool and spread sealed both sides with flexible mastic sealant.

Any pipes or ductwork in the risers or partitions should not be rigidly fixed to any wall that is common to a noise sensitive space.

5.4.3 Steelwork

Where a separating partition incorporates structural steel columns below ceiling height, or where a steel beam protrudes into a noise sensitive room, the steel should be boxed out for its entire length with plasterboard; the build-up should be equivalent to the linings for that partition and the cavity packed with mineral wool. It should be ensured that the plasterboard is not in direct contact with the steel using a clip system such as British Gypsum Gyplyner Encase. This is evidenced in PRP wall type drawings.

Should any steel beams pass perpendicularly through a separating or corridor wall, an enclosure is not required providing the steelwork is above the false ceiling as detailed elsewhere in this report (not in direct contact with the ceiling), and the wall linings are cut around the steelwork with all gaps fully sealed. Steelwork penetrations should be dealt with as detailed above.

5.4.4 Internal Glazed Partitions

There do not appear to be any internal fully glazed partitions between cellular spaces. However, if this is to change then details should be passed on to PDA Ltd for approval.

However, the corridor wall to the second floor meeting room / group room S.01 comprises a glazed screen as do parts of corridor walls in other locations . In this case we would recommend installation of R_w 40 dB glazing to a bulkhead above, again with walls running full height floor to soffit.

- **We note that we cannot currently see any sound insulation specification for these screens in the drawings and this needs to be addressed.**

5.4.5 Movable Partitions

It is understood that there is a proposal for a movable acoustic partition between S.11 Brew and S.06 Staff Room.

With regard to movable walls HTM 08-01 states:

> *Movable/folding partitions may be beneficial for operational reasons, but the acoustic performance of these partitions is limited. They are not recommended where speech privacy is required and/or where it will not be acceptable to have any noise disturbance from one room to another.*

- **We would note that the moveable wall will limit the sound insulation between these spaces when the wall is closed. In our experience the sound insulation between these spaces is unlikely to exceed 40-45 dB $D_{nT,w}$ even for the higher specification walls. We would recommend a 58 dBR_w selection if a "mid-range" sound insulation performance of in the region of 42 dB D_{nTw} is sought. It may be possible to install a lower performance if privacy is not critical between the rooms but any such proposals should be forwarded to ourselves for approval.**

- **Flanking elements should be treated strictly in accordance with the moveable wall manufacturer's instructions with general further points to note as follows:**

  - Example suppliers we have worked with before are Accordial, Huffcor and Style amongst others.
  - For the movable wall shown between Brew Space and Staff Room then the current details above wall head with two layers of foil faced mineral wool sealed at all perimeter, joins and penetrations with non-setting mastic would be acceptable (see drawing 5 above).
  - All perimeter and supporting structures must be built other within the tightest tolerances such that the head and jambs can butt up completely flush with the perimeter to create a full seal.
  - The wall and bulkhead over must run full height floor to soffit breaking any ceilings of floating floors.
  - There should be no pass doors in the operable wall as these can significantly reduce performance.
  - The housing of the adjustable jamb must be sealed effectively to the perimeter structure with non-setting mastic.

The above appears to be shown correctly in the current drawings.

- **However, I note that the product and specification of the partition is still to be agreed. The selected product should be provided to PDA Ltd for approval.**

It is imperative that the sealing of the wall and the moveable panels are checked on the day of installation to avoid operatives having to re-visit site on commissioning. It should be noted that the smallest visible gap in the sealing will cause significant reductions in sound insulation. Such gaps should be checked for **directly after fitting whilst fitters are still on site** by closing the wall up and moving a torch around the perimeter joints and joints between panels on one side and checking for light leakage from the other side.

5.4.6 Internal Door-sets and Risers

Solid core doors should be used for access from corridors to noise sensitive rooms, and the combined door and door-set should be capable of achieving an acoustic performance of R_w 30dB or above (noise sensitive rooms only) to achieve HTM 08-01 requirements. Such performance requires seals to be installed around all door perimeter, however, conflicts like opening force, infection control, patient safety and ventilation regimes need to be considered. It should be noted that a door-set incorporated into a partition will significantly downgrade the composite performance of the partition. There is therefore no benefit in specifying a partition performance with a R_w that is more than 10dB greater than the R_w of the door-set within it.

I note that all internal doors appear to be correctly specified in the drawings. Further comments I would make are as follows:

- **Please ensure that the seals are all neoprene seals and are present around the full perimeter and at meeting stiles, including drop seals at the threshold.**

On recent projects I have seen the seals stopping at these locations which gives a discontinuous seal and will significantly reduce the acoustic performance of the door.

- **Please ensure that seals are *continuous* around the full perimeter and at meeting stiles with the seals being continuous around door latches and keeps / mortices to maintain a full seal.**

With regards to riser doors, a performance of 38dB R_w is likely to be acceptable except for where a significant amount of noise is generated (>75dB), which is considered unlikely. In such an instance, it is nearly always best to adopt several different noise control techniques to achieve the desired result, e.g. consideration to also acoustically lagging riser ducts, purchasing double skinned fan units etc., as appropriate. A further review of riser doors shall be undertaken as the scheme develops.

I note that currently the riser doors show no acoustic performance and this needs to be addressed. However, the risers do not face into critically noise sensitive areas with the most sensitive adjacency being waiting rooms. On this basis, and if the services are not considered to be noise generated within the risers, then a non-acoustic door is likely acceptable for sound insulation purposes.

5.4.7 Interconnecting doors

The drawings indicate that there are no inter-connecting doors between noise sensitive spaces in the building.

5.4.8 General

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

5.5 Quality Control

Please note that achieving performance standards requires strict adherence to best practice construction methodology on site. A checklist of acoustic requirements for quality control is attached at the rear of this report.

6.0 NOISE BREAK-IN

6.1 Glazed Facade Requirement

The standalone planning report (doc. Ref. J003861-5647-LK-02; *'Environmental Noise Assessment, Health Hub, Horwich",* dated 18 July 2022) indicate that the following glazing will be required to meet or exceed the HTM 08-01 requirements (with windows closed):

Table 3. Required Minimum Sound insulation of Combined Glazing and Framing

Typical Product	Minimum Sound Reduction Index R (dB) at Octave Band Centre Frequency (Hz)								R_w dB
	63	125	250	500	1k	2k	4k	8k	
4/12/4	22	21	17	25	37	42	37	37	**29**

Figures stated in the table above are based on Saint-Gobain manufacturer quoted data. Acoustic ratings should be checked with the manufacturer and supported by laboratory test reports where necessary. The sound insulation performance of the window is for the glazing system (including framing, seals, opening lights in the closed position etc) as opposed to the glass panels alone. Any areas of aluminium panelling (if proposed) adjacent to the window glass should meet the same minimum specification as the glass to which they are adjacent.

We have not seen the window specifications but as the specified windows are base line non-acoustic systems then we would expect any chosen specification to meet the requirements.

6.2 External Wall Requirements

Based on previous report J003861-5647-LK-02 it has been assumed that the external wall construction will be a cavity masonry construction. Within our calculations it has been determined that the sound insulation performance of the façade should be no less than 49dB $R_{w.}$ The typical construction would consist of 100mm brick with a 75mm cavity and a plasterboard inner frame.

Please note that the external façade should have no unsealed penetrations, and any openings for ventilation should meet the specifications for ventilators below.

I note that we would expect the external walls as detailed in the PRP drawings to meet the above requirements.

6.3 Ventilation Requirement

Based on previous report J003861-5647-LK-02, Table 4 presents the required acoustic performance that would need to be achieved by selected vents in octave frequency bands, together with examples of trickle vents that can achieve the required sound insulation performance.

Table 4. Required ventilator performance

Typical Product	Minimum Sound Reduction Index $D_{n,e}$ (dB) at Octave Band Centre Frequency (Hz)								$D_{n,e,w}$ dB
	63	125	250	500	1k	2k	4k	8k	
Passivent Aircool 330mm (Internal Cowl)	23*	23	19	22	28	34	38	38*	**28**

*Assumed $D_{n,e}$ in the absence of manufactures data

The acoustic specification relates to the combined performance of all ventilation elements. Where two or more ventilators are required to meet the ventilation requirement, the acoustic performance for a single ventilator must be selected so that the combined performance is as stated in the table below, e.g. for 2 no. ventilators, the acoustic performance of each will need to be $D_{n,e,w}$ 41 dB to meet a combined specification of $D_{n,e,w}$ 38 dB. Requirements should be checked with the manufacturer.

Notwithstanding the above, the drawings indicate that the noise sensitive rooms will be fully mechanically ventilated, with windows being openable for purge ventilation (e.g. dispersion of temporary odours etc.). Each intake and exhaust from and to the atmosphere is shown as having an attenuator allowed for and as such the criteria from Table 4 will be comfortably complied with.

6.4 Roof Construction

HTM-0801 indicates that indoor ambient-noise levels during *" heavy"*[2] rainfall should not exceed the intrusive noise criteria in Table 1 by more than 20 dB(A) or should not be more than 65 dB(A), whichever is lower.

It is understood that a standing seam thermally insulated roof is proposed being '*JI Roof PIR*' construction consisting of insulated panels with a PIR core. It is stated within the manufacturers literature that the sound reduction performance of the particular panel is 26 dB Rw for a 145mm overall thickness (e.g. similar to other rain noise tested roofs such as Kingspan KS 1000 RW/80).

Whilst there are no clinical areas currently proposed for the upper floor there are meeting rooms, quiet room / library and cellular offices. For these areas HTM-0801 would recommend an upper limit for rain noise (heavy) of 60 dB(A) L_{eq}. Based on a standing seam type metal roof with a circa 34 dB D_{nfw} ceiling as we recommend then we would predict 66-67 dB(A) L_{eq} rain noise level which is higher than HTM-0801 would recommend.

However, with the proposed 80% coverage of solar panels on the roof (assumed similar to other rain noise tested roofs such as Kingspan KS 1000 RW/80) then we would expect the roof under heavy rain excitation to achieve in the region of 60 dB(A) L_{eq} provided that minimum 34 dB D_{nfw} ceiling tiles are used in all the said noise sensitive areas (and throughout the building on all floors).

Zentia Dune Evo as detailed in the reflected ceiling plans which has absorption coefficient of Class C and sound insulation performance D_{nfw} of 34 dB is acceptable for upper floor spaces, none of which are clinical spaces.

- **Solar panels must be evenly spaced to allow at least 80% coverage over all noise sensitive rooms.**

7.0 MECHANICAL SERVICES

7.1 Calculations of Noise Levels and Recommendations

I have sighted tender drawings from Integrated Mechanical Ltd as detailed in Appendix C.

I note that there are also drainage and domestic services layout drawings. However general advice on enclosure of soil and vent pipes and mounting of water services has been given in previous sections.

Looking at the drawings, the ventilation units consist of Lossnay LGH 50, 65, 80, 100 Heat Recovery Units (HRUs 0-01 – 2-07). I note that noise data available for these units is not of high quality but I have used other data from different manufacturers to normalise the available data to allow estimation of noise levels in the rooms served.

We would note that there is no specification provided on the extraction units which serve various toilet, utility and changing spaces, thus we have assumed the units will be Vent-Axia extract fans ACM 100T, 150T, 200T similar to previous projects.

Within HTM08-01 it is considered that, apart from store rooms, all of these spaces are noise sensitive. Calculations have been carried out considering a standard mineral fibre ceiling and to meet the respective NR criteria as stated within Section 3.22 Table 2.

Recommendations and assumptions are as follows:

- **All HRUs to have Vent-Axia or similar 600mm long silencer/. Insertion loss performance requirement of the silencer is assumed as follows:**

[2] *" Moderate"* and *" heavy"* rainfall is as described in BS EN ISO 140-18; Acoustics -- Measurement of sound insulation in buildings and of building elements -- Part 18: Laboratory measurement of sound generated by rainfall on building elements

Table 8. HRU Silencer required Insertion Loss (Supply and Extract)

Typical Product	Insertion Loss IL (dB) Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Vent Axia Airtrak 600mm long 250mm diameter or equivalent performance	3	6	10	19	24	29	19	8

- **Gilberts GDS-C 595 x 595 swirl supply and return grilles.**
- **Gilberts GX/GE 150 – 300 ø extract grilles.**
- **Ventilation layouts are assumed to be as shown in drawings.**
- **Ducting runs are not lined (where they may be then the predicted noise levels will be further reduced)**
- **Final flexible ducting run-out of circa 0.25m length of more should be in acoustic flexible ducting (e.g. Tecsonic 400s of correct diameter or equivalent).**

Based on the above, all rooms apart from Consultation F03, Consultation F13 and Group Room G05, are predicted to meet the noise level limits given in Section 3.2.2, Table 2.

- **We would highlight that the extraction systems located within Consultation F03 (EF1-01), Consultation F18 (EF1-02) and Group Room G05 (EF0-01) are causing the criteria exceedance due to casing noise break-out from the fan unit. Therefore we would suggest that the fan units themselves are moved into corridor areas which are less noise sensitive.**

Internal ambient noise levels within the relevant spaces have been calculated based on the Heat Recovery Units (HRU's) operating at flow speeds SP2 – SP3 as indicated within the drawings provided by Integrated Mechanical Ltd. We would note that where HRUs are operating at SP4 then the NR criteria may be exceeded in some spaces. However, we are of the understanding that this purge ventilation would not be a typical operational speed of the units and likely only for a short period of time.

7.2 Cross-talk Silencers

As previously mentioned, I note that the mechanical drawings currently show correctly positioned cross-talk silencers. Typical required performance required would be as follows:

Table 6. Cross-Talk Silencer required Minimum Insertion Loss

Typical Product	Insertion Loss IL (dB) Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Vent Axia Airtrak 300mm long 150mm diameter or equivalent performance	3	3	6	14	20	23	21	11

7.3 General Recommendations

General best practice plant installation recommendations for reducing airborne noise are as follows:

- All duct bends must be of smooth radius type.
- Metal ducts from HRUs and fans must be carefully lined up with diffuser / grille boxes to avoid contorting of flexible ducts to achieve a connection.
- Flexible ducts should be fully extended to make a smooth run to the diffuser / grille.

- Any bends in flexible ducts should be gradual and smooth such that there is no ovalling or contorting of the circular cross section, as any roughness or contortion will increase airflow turbulence and subsequent regenerated airflow noise at the diffusers.
- Diffusers and dampers should be carefully selected to ensure that they will not generate high levels of turbulent noise at the required air flow velocities. Opposed blade or Iris dampers should be used instead of single blade dampers to reduce airflow noise wherever possible.
- Duct discontinuities such as bends, dampers, grilles and diffusers should not be positioned in close proximity and should be located a minimum of 3 (and preferably 5 to 10) duct diameters away from room grilles if possible.
- Careful installation taking account of the above guidelines is critical.

General best practice plant installation recommendations for reducing structure-borne noise and vibration are as follows:

- All HRUs and other plant should be mounted on suitable anti-vibration mounts being cognizant of the span, mass and rigidity of the mounting structure as per CIBSE, manufacturer's or equivalent guidelines.
- Flexible connections should be employed between plant and non-isolated and structural components. These connections should allow unrestricted movement of the plant item.

8.0 ROOM ACOUSTICS (REVERBERATION)

Acoustically-absorbent materials should have a minimum absorption equivalent to a Class C absorber (as defined in BS EN ISO 11654:19975) and should cover at least 80% of the area of the- floor in all areas including all corridors (except acoustically unimportant rooms e.g. store rooms)- in addition to the absorption that may be provided by the building materials normally used.

If a Class A or B absorbent material is used, less surface area is needed. Typical performance of Class A - D absorption are shown in Table 7.

Table 7. Performance of Acoustic Absorbers

Absorption Class	Octave Band Centre Frequency (Hz)				
	250	500	1k	2k	4k
Class A	0.70	0.90	0.90	0.90	0.80
Class B	0.65	0.80	0.80	0.80	0.75
Class C	0.40	0.60	0.60	0.60	0.50
Class D	0.40	0.60	0.60	0.60	0.50

Careful detailing and product selection are vital to ensuring favourable room acoustics are achieved. Acoustic calculations and design advice will continue to be provided during design evolution in helping finalise the specification, location and coverage of acoustically absorbent material in the different room spaces to control the build-up of reverberant noise to within target criteria, taking account of the existing absorption provided by all room surfaces.

The current ceiling specifications in the drawings meet the requirements as set out above and as such would be deemed to comply with HTM-0801 / BREEAM requirements.

9.0 EXTERNAL BUILDING SERVICES NOISE

9.1 Nearest receiver consideration

In-order to achieve a BREEAM credit for mitigating noise pollution, Pol 05 requires first-and-foremost an evaluation of the nearby noise-sensitive receivers to the proposed building.

Measurements were undertaken at two positions at the site. Noise from the local road network were deemed the biggest contributing factors to the continuous ambient noise levels surrounding the site, therefore noise was monitored in line with the proposed façade positions facing Church Street and Victoria Road . The two measurement locations can be seen below in Figure 1 below.

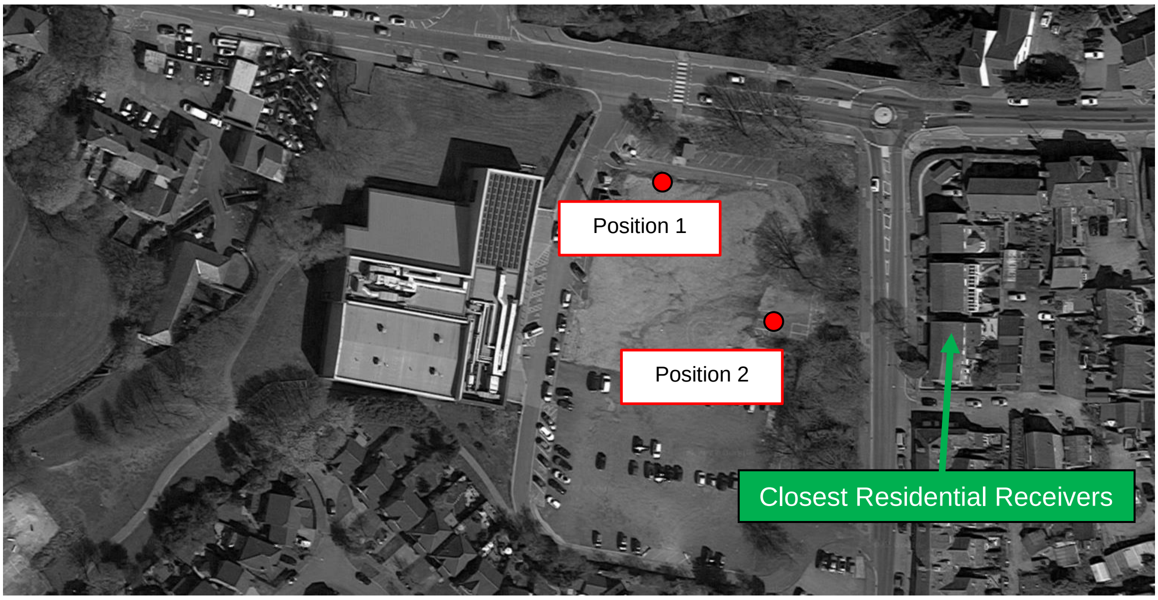


Figure 1. Noise measurement positions and nearest noise-sensitive receivers

As the nearest receiver is separated from the site by 45m (<800m), a noise impact assessment compliant with BS4142:2014 is commissioned, in line with BREEAM Pol 05.

The background noise measurement procedure is detailed in previous PDA Report J003861-5647-LK-02 as referenced previously. The results of the noise survey are displayed in Figure 3 within Section 5 of our previous report. The derived background sound level at measurement position 1 is deemed to be representative of the typical level experienced at the closest residential receivers due to the distance between and similar noise character at both locations.

9.2 Preliminary BREEAM Pol. 05 comment

PDA have been made aware by the client that there will be no external plant operating outside of opening hours of the proposed Health Hub, understood to be 08:00 – 18:00 hours.
As there is no scheme put in place detailing any noise egress from the site thus yet, the only measures that can be presently taken in terms of a plant-noise assessment is to set a limit on what the daytime noise levels can be at the nearest noise-sensitive receiver in-line with a BS4142 assessment. Note that BREEAM Pol 05 requires any contribution to the background noise level at the nearest receiver due to the development to be 5dB below the background level. The table below gives guidance as to what those levels should be in relation to the results presented in Section 5, as taken from report Ref. J003861-5647-LK-02; *'Environmental Noise Assessment, Health Hub, Horwich",* dated 18 July 2022.

Table 8 – Limit on noise due to any plant at the nearest noise-sensitive receiver

Time period - T	Representative background level at nearest noise sensitive receiver location - L_{A90} (dBA)	Criteria for level which should not be exceeded at receiver due to plant noise egress from site for BREEAM Pol. 05 accreditation – $L_{Aeq,T}$ (dBA)
Day 0700 – 2300	47	42

A further report is to be compiled dealing with the Pol-05 credit for BREEAM.

10.0 CDM

Under the Construction Design and Management regulations 2015 (CDM) PDA Ltd has certain responsibilities with respect to health and safety matters involved with the design and construction aspects of the project. In this capacity PDA Ltd assists the *'Principal Designer"* by undertaking the role of *'Designer'*. The Designer's role is to identify and minimise health and safety related risks associated with consulting recommendations and advice it has provided.

The following list, albeit not intended to be exhaustive, identifies potential foreseeable risks associated with acoustic related aspects of the design, along with options for minimising / reducing said risks:

Table 9: Potential Foreseeable Health and Safety Risks - Acoustic Design Aspects

Element	Health and Safety Aspect	Mitigation to Minimise / Reduce Risk
Blocks and Boards	Weight	Follow manual handling guidelines for lifting, moving and installation
Glazed Units	Weight	Follow manual handling guidelines for lifting, moving and installation
Acoustic Baffles / Rafts	Working at Height	Arrange suitable access for installers trained in working at height.
General Construction Activities	Noise Exposure	Provision of requisite training and provision of hearing protection enforcement of use where appropriate under the 2005 Control of Noise at Work Regulations.

While examples of specific manufacturers' products may be provided in the report, there will generally be alternatives that can be used. It is noted that finalised selections of specific construction materials and/or methods must have potential health and safety risks confirmed based on information available including that from the supplier or manufacturer.

11.0 GENERAL

All recommendations in this report relate to acoustic principles only. All recommendations and details should be checked for compliance in other areas e.g. fire, structure etc.

The current report is a preliminary design report. More developed details should be forwarded to ourselves for approval as the project develops and such that this report can be updated to reflect the detailed design.

APPENDIX A – DEFINITION OF ACOUSTIC TERMS

The decibel

This is the basic unit of noise, denoted dB.

A Weighting

This is a weighting process which simulates the human ear's different sensitivity at different frequencies. A weighting can be shown two typical ways, 50 dB(A) L_{eq} or 50 dB L_{Aeq}. Both mean the same thing. (See below for a definition of L_{eq}). The dB(A) level can be regarded as the overall level perceived by human beings.

L_{eq} and $L_{eq(s)}$

This is the equivalent continuous noise level which contains the same acoustic energy as the actual time-varying sound. In other words it is a kind of average noise level. It is denoted dB L_{eq} or, for A-weighted figures dB(A) L_{eq} or dB L_{Aeq}. It can also be expressed in terms of frequency analysis (see later). $L_{eq(s)}$ is the sample L_{eq} level.

L_n

This is the level exceeded for n% of the time. It is denoted dB L_n or, for A-weighted figures dB(A) L_n or dB L_{An}. It can be expressed in terms of frequency analysis (see later). L_{90} is the level exceeded for 90% of the time and is a measure of the lowest level typically reached. L_{10} is the level exceeded for 10% of the time and is the highest level typically reached. L_{50} is the level exceeded for 50% of the time and, mathematically, it is the median.

L_{max}

This is the maximum level reached during a measurement period. The "time constant", or the ability of the equipment to respond to impulses is usually expressed along with it, e.g. "Fast", "Slow", etc. It is denoted dB L_{max} or, for A-weighted figures dB(A) L_{max}, dB L_{Amax}, etc. It can also be expressed in terms of frequency analysis.

Frequency Analysis

Whereas dB(A) gives a very useful overall figure, it has its limitations in that it cannot be used to model or predict the effect of noise control and mitigation as this nearly always has radically different performance at different frequencies.

Frequency analysis expresses an overall noise level at each frequency or band of frequencies in the audible range. Octave band analysis divides the audible range into 10 bands from 31.5 Hz to 16 kHz and the noise level in each band can be expressed in any form e.g. L_{eq}, L_{90}, L_{max} etc. One third octave band analysis uses 30 bands.

Narrow band analysis takes the process to resolutions of less than 1 Hz. This is useful for identifying the existence of tones (whines, hums, etc.) and in pin-pointing the sources.

APPENDIX B – NOTES FOR QUALITY CONTROL

1. Blockwork

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

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

2. Plasterboard

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

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

3. Mineral Fibre

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

4. Windows

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

5. Electrical Sockets

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

6. Water Pipes

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

7. Penetrations

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

8. Approved Samples and Inspections

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

APPENDIX C – DRAWING REGISTER

PLANS, SECTIONS, ELEVATIONS AND WALL TYPES

- HWH-PRP-ZZ-ZZ-DR-A-06002-P01-Internal Wall Types Schedule 2_2
- HWH-PRP-01-00-DR-A-09001-P02-Reflected Ceiling Plan - Ground Floor Zone 1
- HWH-PRP-01-01-DR-A-09004-P02-Reflected Ceiling Plan - First Floor Zone 1
- HWH-PRP-01-02-DR-A-09007-P02-Reflected Ceiling Plan - Second Floor Zone 1
- HWH-PRP-01-XX-DR-A-08010-P03-Stair 01 (Plans, Sections, Details)
- HWH-PRP-02-00-DR-A-09002-P02-Reflected Ceiling Plan - Ground Floor Zone 2
- HWH-PRP-02-01-DR-A-09005-P02-Reflected Ceiling Plan - First Floor Zone 2
- HWH-PRP-02-02-DR-A-09008-P02-Reflected Ceiling Plan - Second Floor Zone 2
- HWH-PRP-Z1-00-DR-A-05051-P02-Internal Wall Types Plan - GF Zone 1
- HWH-PRP-Z1-02-DR-A-05054-P02-Internal Wall Types Plan - FF Zone 1
- HWH-PRP-Z1-02-DR-A-05057-P02-Internal Wall Types Plan - SF Zone 1
- HWH-PRP-Z2-00-DR-A-05052-P02-Internal Wall Types Plan - GF Zone 2
- HWH-PRP-Z2-02-DR-A-05055-P02-Internal Wall Types Plan - FF Zone 2
- HWH-PRP-Z2-02-DR-A-05058-P02-Internal Wall Types Plan - SF Zone 2
- HWH-PRP-ZZ-00-DR-A-05050-P02-Internal Wall Types Plan - Ground Floor
- HWH-PRP-ZZ-00-DR-A-08026-P02-Level 0 - Door Types Plan
- HWH-PRP-ZZ-00-DR-A-09000-P02-Reflected Ceiling Plan - Ground Floor
- HWH-PRP-ZZ-01-DR-A-04003-P03-GA Plan - First Floor
- HWH-PRP-ZZ-01-DR-A-05053-P02-Internal Wall Types Plan - First Floor
- HWH-PRP-ZZ-01-DR-A-08027-P02-Level 1 - Door Types Plan
- HWH-PRP-ZZ-01-DR-A-08101-C01
- HWH-PRP-ZZ-01-DR-A-09003-P02-Reflected Ceiling Plan - First Floor
- HWH-PRP-ZZ-02-DR-A-04006-P03-GA Plan - Second Floor
- HWH-PRP-ZZ-02-DR-A-05056-P02-Internal Wall Types Plan - Second Floor
- HWH-PRP-ZZ-02-DR-A-05106-P02-Setting Out Plan - Second Floor
- HWH-PRP-ZZ-02-DR-A-08028-P02-Level 2 - Door Types Plan
- HWH-PRP-ZZ-02-DR-A-09006-P02-Reflected Ceiling Plan - Second Floor
- HWH-PRP-ZZ-XX-DR-A-04100-P02-GA Elevations - North and South
- HWH-PRP-ZZ-XX-DR-A-04101-P03-GA Elevations - East and West
- HWH-PRP-ZZ-XX-DR-A-04200-P02-GA Sections
- HWH-PRP-ZZ-XX-DR-A-04201-P02-GA Sections
- HWH-PRP-ZZ-ZZ-DR-A-04300-P02-Strip Sections - 1 to 3
- HWH-PRP-ZZ-ZZ-DR-A-04301-P02-Strip Sections - 4 to 6
- HWH-PRP-ZZ-ZZ-DR-A-05059-P01-External Wall Types Elevations
- HWH-PRP-ZZ-ZZ-DR-A-06002-P02-Internal Wall Types Schedule 2_2
- HWH-PRP-ZZ-ZZ-DR-A-06003-P03-External Fabric Types Schedule
- HWH-PRP-ZZ-ZZ-DR-A-06010-C01-External Details - DPC (Sheet 1)
- HWH-PRP-ZZ-ZZ-DR-A-06011-C01-External Details - DPC (Sheet 2)
- HWH-PRP-ZZ-ZZ-DR-A-06020-P01-External Details - Walls - Plan - Sheet 1
- HWH-PRP-ZZ-ZZ-DR-A-06021-P01-External Details - Walls - Plan - Sheet 2
- HWH-PRP-ZZ-ZZ-DR-A-06022-P01-External Details - Walls - Plan - Sheet 3
- HWH-PRP-ZZ-ZZ-DR-A-06030-P01-External Details - Walls - Section - Sheet 1
- HWH-PRP-ZZ-ZZ-DR-A-06031-P01-External Details - Walls - Section - Sheet 2
- HWH-PRP-ZZ-ZZ-DR-A-06032-P01-External Details - Walls - Section - Sheet 3
- HWH-PRP-ZZ-ZZ-DR-A-06033-P01-External Details - Walls - Section - Sheet 4
- HWH-PRP-ZZ-ZZ-DR-A-06034-P01-External Details - Walls - Section - Sheet 5

- HWH-PRP-ZZ-ZZ-DR-A-06040-P01-External Details - Roof - Sheet 1
- HWH-PRP-ZZ-ZZ-DR-A-06041-P01-External Details - Roof - Sheet 2
- HWH-PRP-ZZ-ZZ-DR-A-06100-P01-Internal Details - Plan - Sheet 1
- HWH-PRP-ZZ-ZZ-DR-A-06101-P01-Internal Details - Plan - Sheet 2
- HWH-PRP-ZZ-ZZ-DR-A-06102-P01-Internal Details - Plan - Sheet 3
- HWH-PRP-ZZ-ZZ-DR-A-06110-P01-Internal Details - Section - Sheet 1
- HWH-PRP-ZZ-ZZ-DR-A-06111-P01-Internal Details - Section - Sheet 2
- HWH-PRP-ZZ-ZZ-DR-A-06112-P01-Internal Details - Section - Sheet 3
- HWH-PRP-ZZ-ZZ-DR-A-06113-P01-Internal Details - Section - Sheet 4
- HWH-PRP-ZZ-ZZ-DR-A-06114-P01-Internal Details - Section - Sheet 5
- HWH-PRP-ZZ-ZZ-DR-A-06115-P01-Internal Details - Section - Sheet 6
- HWH-PRP-ZZ-ZZ-DR-A-07010-P02-Curtain Walling Schedules
- HWH-PRP-ZZ-ZZ-DR-A-08021-P02-Internal Door Types (Sheet 2 of 3)
- HWH-PRP-ZZ-ZZ-DR-A-08023-P02-Internal Screen Types
- HWH-PRP-ZZ-ZZ-DR-A-08024-P02-Internal Door Schedule
- HWH-PRP-Z2-02-DR-A-05055-P02-Internal Wall Types Plan - FF Zone 2_1
- HWH-PRP-ZZ-00-DR-A-09030-P02-Floor_Wall Finishes Plan - Ground Floor
- HWH-PRP-ZZ-01-DR-A-09031-P02-Floor_Wall Finishes Plan - First Floor
- HWH-PRP-ZZ-02-DR-A-09032-P02-Floor_Wall Finishes Plan - Second Floor

MECHANICAL SERVICES

- M1680.100_Ground Floor Ventilation Services_S3-Suitable for Review & Comment_P01
- M1680.101_First Floor Ventilation Services_S3-Suitable for Review & Comment_P01
- M1680.102_Second Floor Ventilation Services_S3-Suitable for Review & Comment_P01
- M1680.110_Ground Floor Ventilation Schedules_S3-Suitable for Review & Comment_P01
- M1680.111_First Floor Ventilation Schedules_S3-Suitable for Review & Comment_P01
- M1680.112_Second Floor Ventilation Schedules_S3-Suitable for Review & Comment_P01

APPENDIX D – SOUND INSULATION MARK-UP DRAWINGS