



MTX CONTRACTS LIMITED

ROYAL BERKSHIRE HOSPITAL – UROLOGY OPC

ACOUSTIC DESIGN REPORT

03 February 2025

AEC REPORT: P5281/R01a/DMT

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1.0 INTRODUCTION

General

- 1.1 Acoustic & Engineering Consultants Limited (AEC) has been instructed by MTX to undertake an acoustic design review of the proposals for the new Urology OPC building at Royal Berkshire Hospital.
- 1.2 The proposals are to construct a new two storey building with clinical areas on the ground floor and a plant room on the 1st floor. The ground floor will include consultation rooms, treatment rooms, recovery bays, offices, seminar rooms, waiting rooms, staff room, and other ancillary areas. There are also external plant items on the roof.
- 1.3 A baseline noise survey was undertaken by Hepworth Acoustics (Hepworth) in January 2023 and the results are reported in their “*Plant Noise Assessment*” report, reference: P23-0290R02v1, dated June 2024. The noise levels presented in Hepworth’s report have been used to inform aspects of this assessment.
- 1.4 This acoustic design report provides: the design criteria; the measured baseline noise levels from the Hepworth report; an acoustic design assessment of the proposals; an assessment of emissions from building services plant, and compares the findings against the relevant assessment criteria.
- 1.5 Acoustic terminology used in this report is presented in Appendix A.

CDM Regulations

- 1.6 Although this report may reference specific products and/or manufacturers, these are included as a suitable example only and there will normally be numerous alternative products that could be used.
- 1.7 The final specifications for construction materials and methods would be prepared by others and any potential health and safety issues associated with the use of specific construction materials and/or methods must be confirmed based on all available information including that from the manufacturer and/or supplier.
- 1.8 Some of the risks associated with the use of materials commonly suggested for acoustic design purposes and certain construction methods could include:
 - manual handling of heavy blocks and boards;
 - handling of hazardous substances such as mineral wool, which can be an irritant and the appropriate protection should be worn during its use;
 - noise exposure of construction workers, which is the responsibility of the contractor(s) for assessing and providing PPE.
- 1.9 Based on the proposed building use, it is believed that that operational noise levels will not be potentially hazardous to staff or patients. However, the Client may need to be aware of potential hazardous noise exposure in the plant room.

2.0 BASIS OF ASSESSMENT

HTM 08-01

- 2.1 In terms of acoustics for healthcare buildings, appropriate design advice is included in the Department of Health's Special Services '*Health Technical Memorandum 08-01: Acoustics*' (HTM 08-01).
- 2.2 HTM 08-01 provides guidance for setting appropriate acoustic criteria for:
- indoor ambient noise levels due to building services plant, external noise sources and rainfall impacts;
 - sound insulation between noise sensitive rooms; and
 - reverberation times in noise sensitive spaces.
- 2.3 Additionally, building services plant noise needs to be controlled externally to an appropriate level at the nearest affected noise sensitive receptors.
- 2.4 Criteria relating to the above elements are discussed in detail below.

Internal Ambient Noise Limits

- 2.5 To comply with HTM 08-01 requirements, the internal noise limits detailed in Table 2.1, for noise breaking in from external sources and mechanical services plant, must not be exceeded.

Table 2.1 – Maximum Allowable Internal Noise Levels (sample of rooms)

Room type	External sources, dBL _{Aeq,1h}	Mechanical services noise (NR)
Consultation Rooms Treatment Rooms Small Office and Seminar Rooms (<35m ²)	40	35
Chemo and Lithotripter Room	40	35
Staff Rest, Multi-Person Office	40-45*	38*
Public Areas (<i>waiting</i>)	50	40
Public and staff toilet and shower	55	45
Circulation spaces	55	40
Clean & Dirty Utility	--	40

* AEC Suggested

Rain Noise

- 2.6 HTM 08-01 proposes that during "*heavy rain*" indoor ambient noise levels should not exceed the criteria detailed in Table 2.1, above, by more than 20dB or not greater than 65dB(A), whichever is the lowest.

- 2.7 It should be noted that 'heavy rainfall' has a return rate in the UK of about 50 years and 'Intense rainfall' (which generates noise levels some 20dB lower than levels due to 'heavy rainfall') has a return rate of about 2 years.

Internal Sound Insulation

Walls

- 2.8 The airborne sound insulation performance of the separating walls is determined by reference to Tables 3, 4 and 6 in HTM 08-01 which categorise the privacy requirements, noise generation, and noise sensitivity of various spaces. Using the HTM 08-01 guidance, the requirements of several key areas are provided in Table 2.2 below.

Table 2.2 – Minimum On-site Airborne Sound Insulation Requirements (sample of rooms)

Source Room	Receiver Room	Minimum sound insulation requirement (dBD _{nT,w})
Consultation / Examination Chemo Lithotripter Room	Consultation / Examination Circulation – no door Store	47
Sister's Office Staff Rest / Seminar (<35m ²)	Changing Rooms	42
One person offices (including virtual consultation office)	Other office spaces	
Waiting Room	Recovery	
Changing / WC	Changing / WC	37
Sub-Waiting Room	Changing	
Multi-Person Office	Multi-Person Office	

- 2.9 The above table is not an exhaustive list of all adjacencies. Reference should be made to Table 5 of HTM 08-01 for other specific adjacencies and **AEC's partition mark-up in Appendix D**. The mark-ups are also available in higher resolution PDF format and have been issued separately.
- 2.10 Corridor walls with a door to a noise sensitive room, will be limited by the acoustic performance of the door. In these instances, walls should be rated at least 40dBR_w as show on the mark-ups in Appendix D (including glazed elements).

Floors

- 2.11 The minimum airborne sound insulation performance between the ground floor and the 1st Floor Plant Room above should be 47dBD_{nT,w}. In practice, a performance of ≥50 dBD_{nT,w} would be desirable to fully control plant room noise. Impact noise between floors is not a major concern as there will not be regular footfall in the 1st floor plant areas.

Doorsets

- 2.12 HTM 08-01 recommends that solid-core doors (min. surface mass of 21kg/m²) should be used between corridors and noise sensitive rooms. Doorsets should be designed so air gaps between doors blanks and the frame can be closed. It is also important that any glazed vision panel does not downgrade the sound insulation performance of the door.

Pre-Completion Testing

- 2.13 It should be noted that the on-site measurements of sound insulation of the separating walls and floors will use a reference reverberation time of 0.5 seconds.

Reverberation Times

- 2.14 To provide appropriate acoustic conditions, the reverberation time (RT) in noise sensitive rooms needs to be controlled.
- 2.15 HTM 08-01 does not provide specific RTs for each room type but states that an area of acoustic absorption (rating of Class C or greater) equivalent to 80% of the floor area should be introduced to all noise sensitive spaces.
- 2.16 Generally, the provision of acoustically absorbent ceilings is the preferred approach to controlling reverberation times in sensitive areas, provided any such treatment meets clinical requirements.

External Building Services Plant

- 2.17 A noise impact assessment of external plant noise has been undertaken in general accordance with BS7445-1: 2003 '*Description and measurement of environmental noise. Guide to quantities and procedures*' and BS 4142- 2014+A1-2019 '*Methods for rating and assessing industrial and commercial sound*' (BS4142).
- 2.18 The following statement is provided in Hepworth's report in terms of setting appropriate noise limits for building services plant.

- 3.7 We note from previous similar assessments undertaken locally, that Reading Borough Council typically seek for the rating sound level of new plant to be 10dB below the pre-existing background sound level, $L_{A90,T}$ at a point 1 metre externally to nearby residences.
- 3.8 The foregoing demonstrates that this is a particularly onerous stipulation, following the provisions of BS 4142. Nonetheless, for the purposes of this assessment, based on this, and the findings of the baseline noise survey described here, the following noise rating limits are determined:
- 34dB $L_{A,r}$ at 1m from residences at Addington Road
 - 38dB $L_{A,r}$ at 1m from residences at Craven Road

- 2.19 Achieving the above limit would give a strong indication that the specific sound from the proposed external building services plant would have a 'low impact' at the residential properties and should satisfy the Local Authority. If there are minor exceedances of this limit in the daytime, then this should be acceptable as background noise will be higher.

3.0 EXTERNAL NOISE CLIMATE

- 3.1 The external noise climate has been surveyed by Hepworth on 31st January 2023. As the main aim of the Hepworth noise survey was to assess external plant noise, only night-time measurements were taken between 2343 to 0129h (as a worst case).
- 3.2 Measurements were taken at two locations representative of the nearby residential properties identified as Location 1 (Addington Road) and Location 2 (Craven Road) on Figure 1 below.
- 3.3 The noise climate was dominated by constant noise from existing hospital plant and occasional passing vehicles on the local roads. Measurements were at 1.5m above ground in acoustic free-field conditions.
- 3.4 In summary, the lowest background noise level measured at Location 1 and Location 2 was **44dBL_{A90,15mins}** and **48dBL_{A90,15mins}**, respectively.
- 3.5 The highest ambient noise level measured was 51dBL_{Aeq,15mins} at Location 1. Location 1 is much closer to Addington Road than the proposed Urology building. Therefore, as a worst-case estimate, the free-field noise levels affecting the proposed building facades could be up to **55BL_{Aeq,1hr}** during the daytime and **50BL_{Aeq,1hr}** during the night-time. In addition, based on AEC extensive experience of similar hospital sites, free-field night-time maximum noise levels would typically be no greater than 65dBL_{Amax,F} due to vehicle movements within the hospital site.
- 3.6 It is assumed that ambulances do not regularly use their sirens within the hospital site.

4.0 ASSESSMENT OF INDOOR AMBIENT NOISE LEVELS

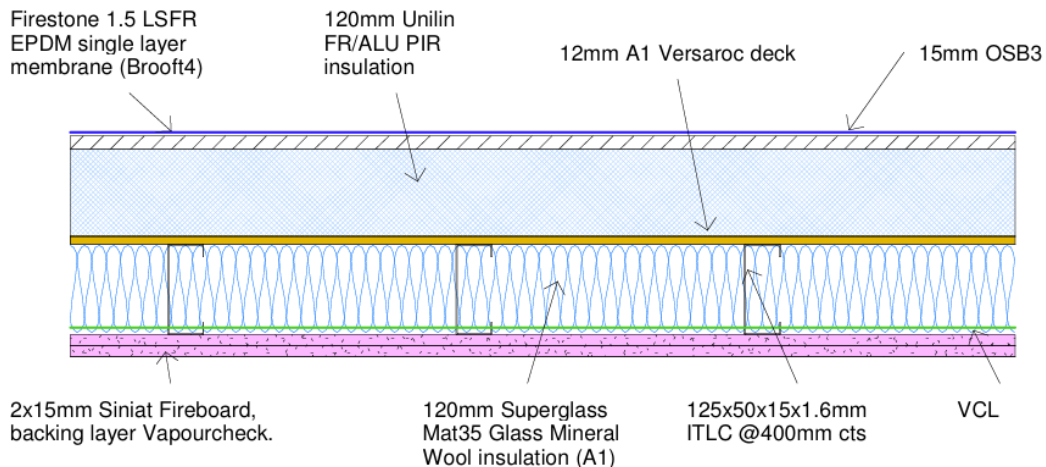
External Noise Ingress

- 4.1 It is understood that the proposals are to ventilate via mechanical means throughout the development. Therefore, although windows may be operable, the opening of windows will not be relied upon for ventilation.
- 4.2 The glazing is typically the weakest element in terms of noise ingress. The proposed glazing construction is 6mm toughened outer glass, 16mm argon filled thermal cavity, 6.8mm laminated inner glass. This should have laboratory tested performance of approximately 35dBR_w. This would reduce external noise by approximately 25 to 30dB.
- 4.3 Based on the external noise expected to impact the building, this glazing would comfortably control external noise ingress to meet the limits stated in Table 2.1 above.
- 4.4 The rest of the building envelope, walls and roof, would need to achieve a sound insulation of approximately 45dBR_w i.e. 10dB better than the windows. This will be achieved by the proposed external wall with rainscreen cladding.

Roof Construction

- 4.5 In terms of external airborne plant noise ingress, the roof structure should reduce plant noise to less than 35dBL_{Aeq,T} (NR30) inside the building. Based on typical external levels of around 75dBL_{Aeq,T} close to rooftop plant, the roof structure should achieve a sound insulation performance of at least around 45dBR_w.
- 4.6 The proposed roof structure is indicated in Image 4.1 below.

Image 4.1 – Roof Detail



- 4.7 Acoustic predictions indicate a sound insulation performance of approximately 54dBR_w. Therefore, the roof structure should reduce airborne noise to suitable internal levels, provided any external plant is not generating excessively high levels of low frequency noise.

Internal Plant Noise

- 4.8 Internal building services plant noise should be controlled to achieve the NR levels detailed in Table 2.1, above. The main points to be considered relating to building services plant are presented in Section 7, below.

Rain Noise

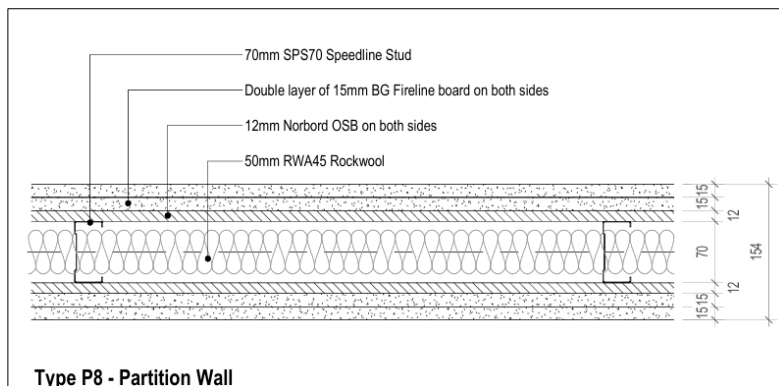
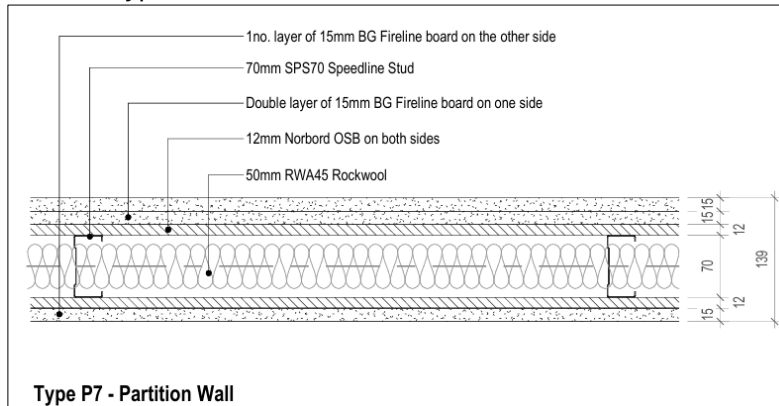
- 4.9 Rain noise test data is not likely to be available for the proposed roof construction; therefore, the actual on-site performance cannot be guaranteed by AEC. However, based on the single-ply roof construction in Image 4.1 above, the HTM 08-01 rain noise criteria is highly likely to be met. There are no lightweight roof lights into noise sensitive areas.

5.0 ASSESSMENT OF INTERNAL SOUND INSULATION

Walls

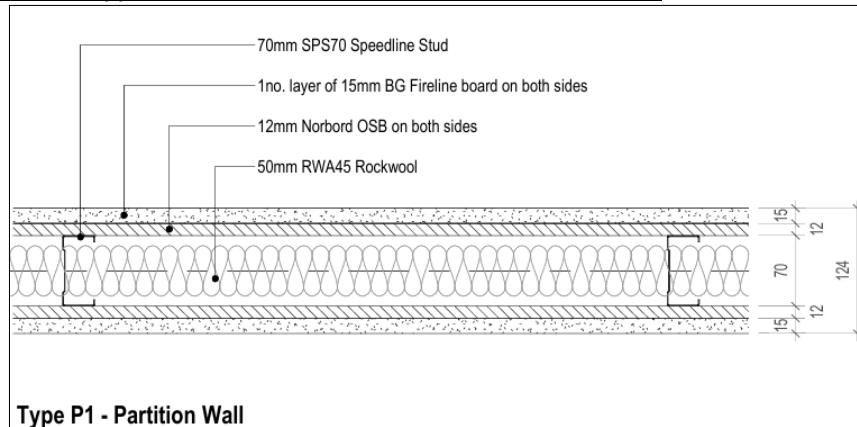
- 5.1 To achieve the on-site ($\text{dBD}_{\text{nT,w}}$) sound insulation values outlined in Table 2.2 above, and presented in Appendix D (acoustic mark-ups), a plasterboard partition with a minimum laboratory tested performance (dBR_w) of at least 5dB higher than that required on-site performance would need to be selected.
- 5.2 Therefore, to achieve a sound insulation performance of $42\text{dBD}_{\text{nT,w}}$ on-site, a partition with a laboratory tested performance of at least 47dBR_w would be required. Similarly, to achieve $47\text{dBD}_{\text{nT,w}}$ on-site, a partition with a laboratory tested performance of at least 52dBR_w would be required.
- 5.3 This difference between $\text{dBD}_{\text{nT,w}}$ and dBR_w may need to increase to +7dB or more where rooms are very narrow and/or there are concerns over multiple flanking paths.
- 5.4 No laboratory sound insulation test data has been provided for the proposed partition types. However, AEC has undertaken on-site tests of similar constructions on other MTX healthcare projects.
- 5.5 With reference to the partition type and junction detail drawings provided by MTX, an assessment of partition sound insulation is provided below.

Partition Type P7 & P8 – Suitable for $47\text{dBD}_{\text{nT,w}}$ On-site



- 5.6 Based on Insul© prediction software calculations and test data for similar constructions, it is likely that these two partitions would have a sound insulation performance of approximately 52-54dBR_w. Therefore, these partition would be suitable where an on-site requirement of 47dBD_{nT,w} (or lower) is required.
- 5.7 However, to achieve 47dBD_{nT,w} on-site with these partitions, it will be necessary to ensure good junction detailing and well-sealed service penetrations where they cannot be avoided. A high level of workmanship will be required, and unsealed doors can limit on-site sound insulation performance. Crosstalk (sound transfer via ductwork) will also need to be controlled.

Partition Type P1 – Suitable for 37 and 42dBD_{nT,w} On-site



- 5.8 Based on Insul© prediction software calculations and test data for similar constructions, it is likely that this partition would have a sound insulation performance of approximately 50dBR_w. This partition would be suitable where an on-site requirement of 42dBD_{nT,w} (or lower) is required. This would be marginal situation if used to achieve 47dBD_{nT,w} on-site.

Vision Panels

- 5.9 Where there is a vision panel (observation window) in a partition that also has a door, the typical arrangement between circulation areas to wards, the glazing should have a sound insulation performance of around 38dBR_w. This would ensure that the composite sound insulation of the partition and vision panel, would typically be at least 10dB better than the performance of the door.
- 5.10 The above glazing specification could be reduced slightly for small vision panels or vision panels to less noise sensitive areas. Further input can be provided on this element, if required.

Folding Partition

- 5.11 There is folding partition proposed between the staff rest area and seminar room. The on-site sound insulation performance of a folding partition is typically limited by the perimeter seals at the base and head of the partition. In AEC's experience the best on-site performance that can be achieved is around 40-43dBD_w. Therefore, it is recommended that a folding wall with a laboratory tested performance of around 53dBR_w is specified. There is limited benefit to specifying anything higher than this.

- 5.12 This should provide a basic/reasonable level of acoustic privacy, provided the noise levels in the adjacent rooms are not too quiet i.e. not below 35dBL_{Aeq,T}. If higher privacy is required then a solid permanent partition should be considered.

Lifts

- 5.13 The bed lift is separated from the noise sensitive areas and, therefore, this does not need to be considered further.

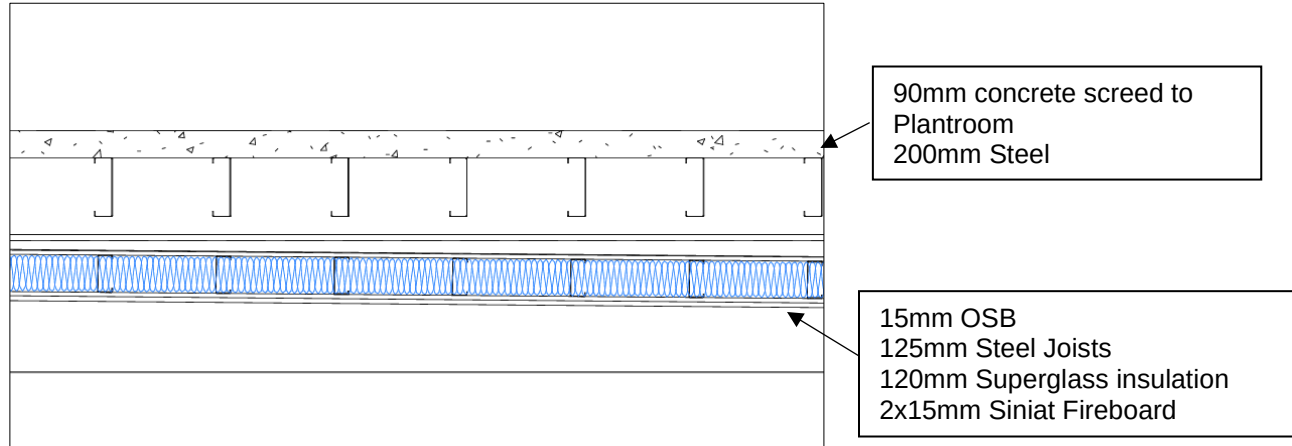
Doors

- 5.14 There are no acoustic requirements for doors to non-sensitive spaces such as WC's, storerooms, cleaning cupboards, clean & dirty utilities etc.
- 5.15 As stated above, for all other rooms which are deemed to be noise sensitive, HTM 08-01 states that solid core timber doors with a minimum surface weight of 21kg/m² should be used. These should be fitted with compression rubber seals fitted to the head, jams, threshold and meeting stiles (where relevant). This type of door with full seals should provide a sound insulation performance of around 30-35dBR_w.
- 5.16 HTM 08-01 recognises that there can be significant restrictions on the use of door seals. Hence, doors should be sealed as far as practically possible. The infection control team should be consulted as to where there is a conflict between the need for seals and infection control.
- 5.17 Examples of other conflicts to be considered are:
- doors that need to swing both ways (e.g. for anti-barricade properties);
 - where there are gaps around doors (or transfer grilles fitted) as part of the ventilation strategy, consideration should be given to a lined bulkhead with grilles or 'up and over' duct links above the ceiling;
 - wiper blade seals could be considered where rebated meeting stiles are not possible;
 - drop down threshold seals or wiper blade threshold seals should be considered, in which case appropriate hinges will be required to avoid the requirement for threshold plates.
- 5.18 Any vision panels should not downgrade the acoustic performance of the door.
- 5.19 It must be noted that even where seals are fitted to the entire perimeter, it may be possible to overhear conversations where a person is located outside the door where background noise levels outside the room are low and the room's occupants are talking in a raised voice.

Floors

- 5.20 The floor separates the first-floor plant room from the clinical spaces on the ground floor. There is a robust floor construction proposed which included a solid concrete slab for the 1st floor plantroom. This construction will achieve the minimum on-site requirement of $47\text{dB}_{\text{DnT,w}}$ and should also achieve the recommended enhanced performance of $50\text{dB}_{\text{DnT,w}}$. However, if there are any penetrations being made in the floor, for services etc, then this should be reviewed with AEC.

Proposed 1st Floor Construction – Suitable for $47\text{dB}_{\text{DnT,w}}$ On-site



- 5.21 In terms of the structural noise and vibration from the plant in the plantroom, there is some guidance provided in Section 7 below, relating to the mounting of plant items to reduce vibration and re-radiated noise in the building structure. This is based on a typical supporting concrete floor/roof e.g. 150mm concrete. A significantly lighter and less stiff supporting floor/roof can present unknowns in terms of vibrations transferred from building services plant into the building structure.

Flanking Paths and other Potentially Weak Elements

General

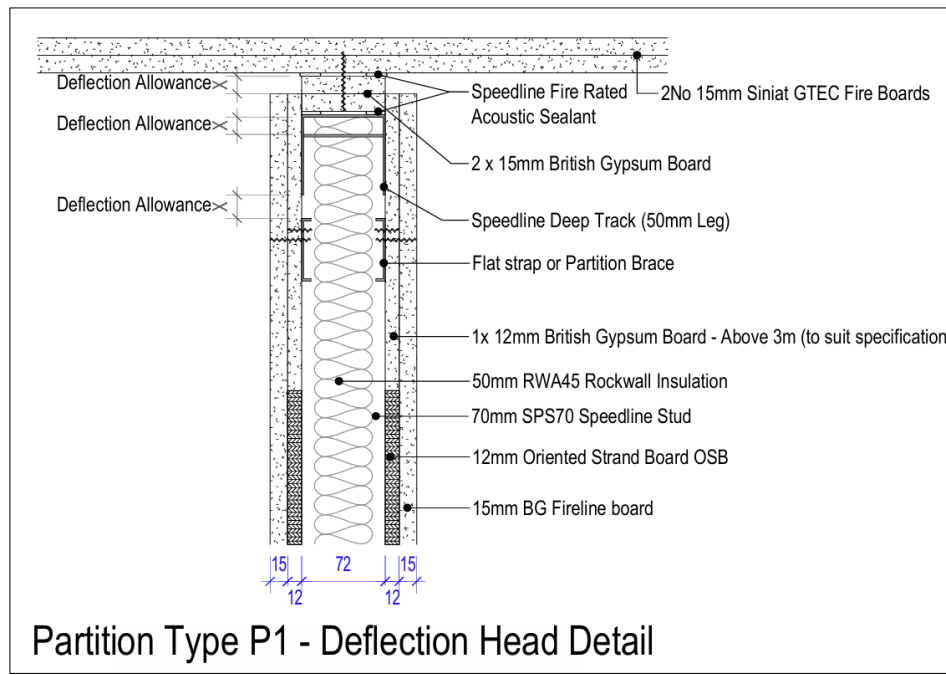
- 5.22 To maintain the sound insulation performance of partitions, flanking paths and other potentially weak elements must be considered.
- 5.23 It is important to note that the main reasons for on-site acoustic failures include (but are not limited to):
- Poorly constructed deflection head details not sealed with mastic and where the plasterboard lining forming the wall does not sufficiently overlap the core board;
 - Poor junction details between separating walls and perpendicular walls (normally external and corridor walls) i.e. continuous board flanking the separating walls;
 - Poor detailing of cavity barriers;
 - Service penetrations;

- Gaps behind continuous steelwork that are difficult to access and other linings;
- Gaps around profile fillers where a wall meets a trapezoidal floor or roof;
- Cross talk via ductwork; and
- Flanking via poorly sealed doors.

- 5.24 Although the separating partitions are generally considered suitable, the on-site performance can be undermined by flanking paths via floor, ceiling, corridor walls, external walls etc... as outlined above.
- 5.25 Typically, where an on-site acoustic performance of **greater than** $42\text{dB}_{\text{DnT,w}}$ is required (i.e. $47\text{dB}_{\text{DnT,w}}$), walls and soffits running perpendicular to separating walls must not run continuously. In addition, appropriate crosstalk attenuation must be allowed for.
- 5.26 Some proposed junction details have been provided by MTX and these have been reviewed below.

Flanking via ceiling / partition head ($47\text{dB}_{\text{DnT,w}}$)

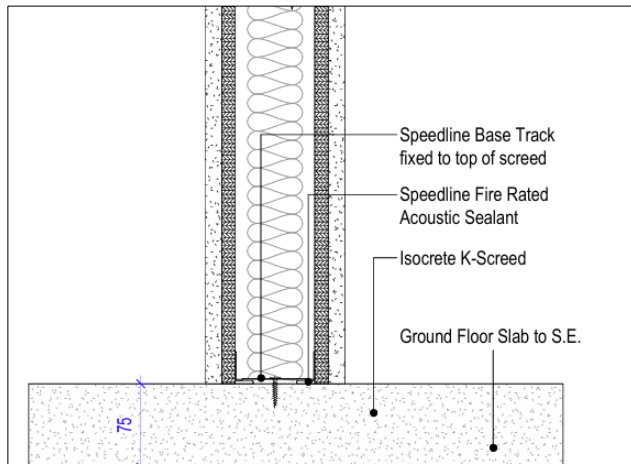
- 5.27 The proposed head detail is shown below.



- 5.28 It is assumed the ceiling (roof lining) would be continuous across the top of this partition. Provided the ceiling lining (roof lining) is at least 20kg/m^2 in total, with mineral wool behind, and assuming there is a suspended mineral fibre tile ceiling both sides of this partition head detail, then this detail is capable of achieving an on-site performance of around $47\text{dB}_{\text{DnT,w}}$.
- 5.29 This is based on test data obtained on other MTX projects with this same detail.

Flanking via floor / partition base (47dBD_{nT,w})

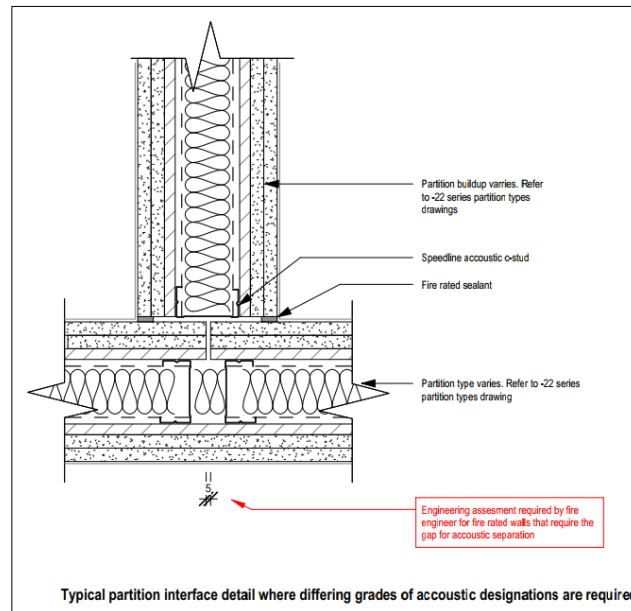
5.30 The based junction detail is provided below.



5.31 This detail will be suitable for all partitions provided it is suitably sealed at the junction before the floor coverings are applied.

Flanking via corridor partitions (47dBD_{nT,w})

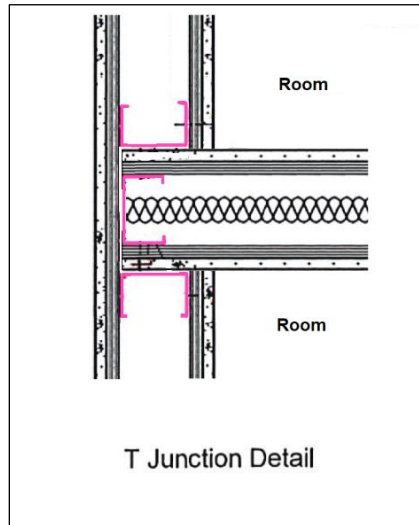
5.32 No corridor wall junction detail has been provided.



5.33 The above example junction detail, where the flanking wall lining has a break, is suitable where separating partitions are required to achieve $\geq 47\text{dBD}_{nT,w}$ on-site. Where $42\text{dBD}_{nT,w}$ or less is required on-site, then the flanking partition does not need to be broken, provided the lining of the flanking partition is 2 or 3 layers and there is mineral wool in the cavity.

Flanking via external wall

- 5.34 Ideally, where the separating partitions meet the external wall lining, the separating partition would break through and close the flanking cavity (see below). Or, a break would be provided, as per the corridor wall junction detail above. No specific external wall junction detail has been provided.



- 5.35 If the internal lining of the external wall cannot be broken then this would be a potential weak flanking path. It appears that the internal lining of the external wall is only 1 layer of 15mm Siniat LaDura board. This has a mass of 15kg/m². AEC would recommend at least 20kg/m² i.e. two layers of board. Proceeding with one layer of board would be a marginal situation in terms of achieving 47dBD_{nT,w} between the small consultation/examination rooms.

Mechanical Services Penetrations

- 5.36 Ideally, mechanical services would not penetrate partitions which need to achieve 47dBD_{nT,w}. However, this is often unavoidable and some ductwork penetrations are shown on the M&E layout drawings. Penetrations for services need to be kept to a minimum, packed with dense mineral wool and covered with a layer of dense plasterboard which overlaps the opening by at least 25mm, and is sealed with flexible acoustic mastic.
- 5.37 An indicative sketch is provided in Appendix D.

6.0 ASSESSMENT OF REVERBERATION TIMES

- 6.1 A mineral fibre tile ceiling system should be provided in noise sensitive areas and corridors. The construction specification documents states that the standard ceiling tiles are:
- Rockfon Medicare Standard, or
 - Armstrong Biogaurd.
- 6.2 The Rockfon Medicare Standard tile has a Class A¹ acoustic absorption which is suitable. However, it is a lightweight (2kg/m²) tile and therefore it does not offer much sound insulation from services noise or from flanking sound over the head or via service penetrations.
- 6.3 The Armstrong Biogaurd (now called “Biobloc”) tile must be the Biobloc “Acoustic” tile, not “Plain” or “Standard”, which does not have a suitable sound absorption performance. The Armstrong Biobloc Acoustic tile has a Class C acoustic absorption performance which is suitable. It is also a heavy tile (4.5kg/m²) and therefore has a higher sound insulation performance than the Rockfon tile, and offers more protection from services and flanking noise.
- 6.4 The above ceiling tiles would provide a suitable sound absorption throughout all noise sensitive and circulation areas. Therefore, the HTM 08-01 requirement would be complied with.

7.0 MECHANICAL AND ELECTRICAL SERVICES

Internal

- 7.1 As a general design guide, to achieve the plant noise levels presented in Table 2.1, the following maximum duct velocities for conventional low velocity systems presented in Table 7.1, should not be exceeded.

Table 7.1 – Maximum Ductwork Duct Velocities

Room Criteria NR	Duct Velocity, m/s		
	Main Duct	Branch Duct	Final Runout
30	6.5	5.5	3.25
35	7.5	6	4
40	9	7	5

- 7.2 To help control privacy between various areas, the noise levels should not be significantly lower than that stated in Table 2.1, as this could significantly reduce privacy between rooms.
- 7.3 As identified above, the design of the mechanical services system must allow for appropriate cross talk attenuation. AEC has reviewed the M&E ventilation layout and highlighted indicative locations where crosstalk attenuators should be considered. **These are indicated in Appendix E.**
- 7.4 For any new plant being located on the concrete roof/floor, it will be necessary to control structure-borne noise by effectively isolating the plant from the supporting structure. As an indicative guide the following points are recommended based on a solid concrete roof/floor:
- Air handling plant and chillers installed such that they are supported 150-200mm above the floor slab;
 - The support arrangement of air handling plant should include neoprene pads or similar achieving a minimum static deflection of approx. 2mm under applied load;
 - The fans and motor assemblies inside air handling unit plant should be supported off open spring isolation mounts achieving, nominally, 25mm minimum static deflection under applied load;
 - The supporting system of the chillers should include isolation mounts achieving nominally 25mm minimum static deflection under applied load, the system may need to be installed on an inertia base;
 - Connecting ductwork should be effectively isolated from air handling units using flexible connections with a minimum operating length of 150mm;
 - Extract fans condensers would need to be supported via neoprene pads or similar;
 - The supporting systems of large pump sets, where applicable, should include open spring isolation mounts achieving at least 25mm minimum static deflection under applied load. The system would need to be installed on an inertia base;

- Connecting pipe work to any large pump sets should be isolated from the supporting structure by vibration isolators achieving at least 10mm static deflection under applied load.
- 7.5 Where the support structure for the plant is not fixed on a solid thick concrete roof/floor, the above guidance may not be suitable or sufficient, and there is increased potential for plant vibration and re-radiated noise to affect sensitive parts of the building. This would apply to the AHUs to be located on the lightweight roof section. It is not possible to accurately predict structure-borne noise via this modular lightweight structure and there is no manufacturer test data available, therefore, AEC cannot guarantee this.
- 7.6 To minimise the potential for vibration from plant to be transferred to the structure and cause re-radiated noise in sensitive areas, the following could be considered:
- Resiliently mounting the plant on protruding elements off the main structure and not having plant in direct contact with the roof.
 - Adding more mass and stiffness to the roof, or sections of the roof, where plant is located.
 - Having vibration isolation that can be tuned/adjusted after installation if there are issues.

External Building Services Noise

- 7.7 It is understood that the plant could be operational 24 hours a day, seven days a week.
- 7.8 As stated in Hepworth's report the noise rating limits at the nearest residential properties are:

- 34dB $L_{A,r}$ at 1m from residences at Addington Road
- 38dB $L_{A,r}$ at 1m from residences at Craven Road

- 7.9 These limits are based on night-time operation and slightly higher noise levels should be acceptable in the daytime, when background noise levels are higher.
- 7.10 Based on a clear line of sight and a distance of 55m, from the nearest residential properties, all plant would need to be limited to approx. **60dB $L_{Aeq,T}$ at 3 meters.**
- 7.11 This limit is indicative and should not be applied to individual plant items. Slightly lower or higher limits could be applied to individual noise sources depending on the specific distance and amount screening relative to the receptors.
- 7.12 The noise from the proposed plant will be similar in character to the building services plant associated with other existing hospital buildings and, therefore, does not require an acoustic rating correction, particularly as it is likely to be practicably inaudible.

- 7.13 AEC has been provided with the technical specifications for the proposed external plant items and the AHUs. The noise data is summarised below in Table 7.2.

Table 7.2 – Source Noise Level Data

Item	Model	Sound Pressure (dBA) @10m
VRF Outdoor unit	PURY-P200YNW-A2	39
DX Outdoor unit	PUZ-ZM35VKA2	36
DX Outdoor unit		38
AHU DX Outdoor unit	PUZ-SM250YKA2	42
AHU DX Outdoor unit		42
AHU DX Outdoor unit		42
AHU DX Outdoor unit		42
AHU DX Outdoor unit		42
AHU 01 – Supply Inlet	HSF / 05 / S	48*
AHU 01 – Extract Exhaust		46*
AHU 02 – Supply Inlet		48*
AHU 02 – Extract Exhaust		47*

*Including attenuators

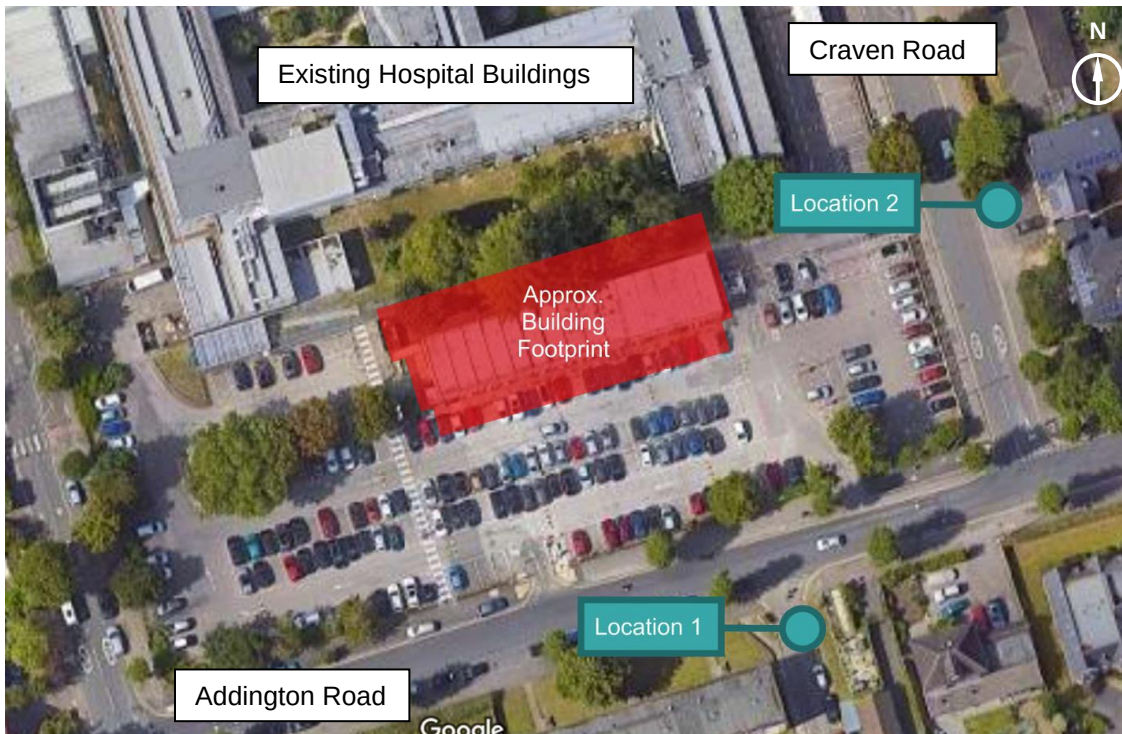
- 7.14 Based on the above data, screening provided by the plantroom and 1.4m roof parapet (minimum -10dB), the atmosphere side attenuators on the AHUs, and distance attenuation to the nearest receptors, the resulting noise levels at the receptors have been calculated. The results are presented in Table 7.3 below. The receptors are both approximately 55m away from the plant items.

Table 7.3 – Noise levels at receptors

Receptor	Total Plant Noise Level dBA	Existing Background dBL _{A90} (night-time)	Criteria dBL _{Ar,T} (-10dB below background)	Assessment Criteria Achieved (Y/N)
Addington Road (55m to the south)	34	44	34	Yes
Craven Road (55m to the east)	33	48	38	Yes

- 7.15 The above assessment demonstrates that the planning noise level criteria would be achieved based on the proposed plant selections, screening from the roof parapet, and the atmosphere side attenuators on the AHU supply intake and extract exhaust.
- 7.16 It should be noted that the above assessment is a worst-case which assumes all plant is running at full duty at night. In practice this is unlikely to be the case, and in the daytime the background noise levels due to other sources would be higher, hence the noise impact in the day would be even lower.
- 7.17 In addition, plant noise levels at the existing hospital buildings would be approximately 50dBA. This is generally suitable and would not cause significant adverse impacts on the existing building.

FIGURE 1 – Existing Site Showing Monitoring Locations



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APPENDIX A – Acoustic Terminology in Brief

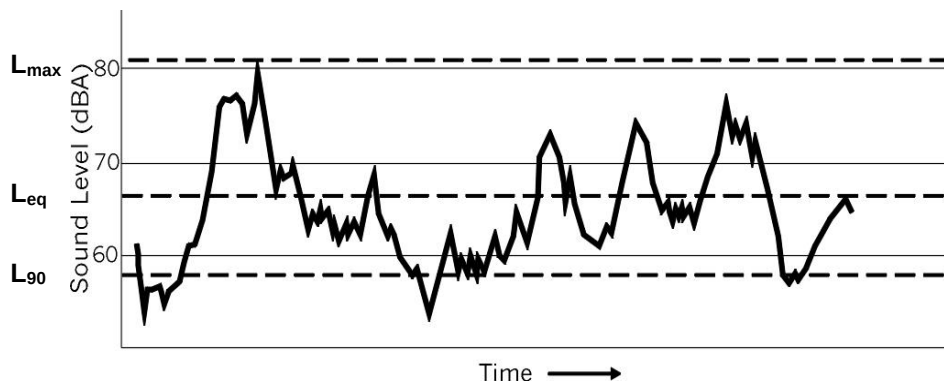
Sound is produced by mechanical vibration of a surface, which sets up rapid pressure fluctuations in the surrounding air. The rate at which the pressure fluctuations occur determines the pitch or *frequency* of the sound. The frequency is expressed in Hertz (*Hz*), that is, cycles per second. The human ear is sensitive to sounds from about 20 Hertz to 20,000 Hertz. Although sound can be of one discrete frequency - a 'pure tone' - most sound is made up of many different frequencies.

The human ear is more sensitive to some frequencies than others, and modern instruments can measure sound in the same subjective way. This is the basis of the A-weighted sound pressure level *dBA*, normally used to assess the effect of noise on people. The *dBA* weighting emphasizes or reduces the importance of certain frequencies within the audible range.

Sound Units

In order to assess environmental noise, measurements are carried out by sampling over specific periods of time, such as fifteen minutes or one hour, the statistically determined results being used to quantify various aspects of the sound.

The figure below shows an example of sound level varying with time. Because of this time variation the same period of sound can be described by several different levels. The most common of these are described below. It should be noted that in many instances in the main body of text, the unit will be preceded by a *dB* descriptor in the report e.g. $L_{Aeq,T}$ could be written $dB_{L_{Aeq,T}}$.



Example of Sound Level Varying With Time

- $L_{Aeq,T}$** The equivalent continuous (A-weighted) sound level. It may be thought of as the “average” sound level over a given time, *T*. It is used for assessing noise from various sources: industrial and commercial premises, construction sites, railways and other intermittent noises and can be considered as the “ambient” noise level.
- L_{A1}** The (A-weighted) sound level exceeded for 1% of a measurement period. It is the value generally used to indicate a ‘typical’ maximum noise level.
- L_{A90}** The (A-weighted) sound level exceeded for 90% of a measurement period. It is the value often used to describe background noise.

L_{Amax} The maximum (A-weighted) sound level measured during a given time. 'Fast' or 'Slow' meter response should be cited.

Free-field Level This refers to the sound level measured outside, away from reflecting surfaces.

Other Acoustics Units

NRC Noise reduction coefficient – a single figure number sometimes used to describe the performance of sound absorbing materials based on a combination of its absorption coefficient at various frequencies.

NR Noise rating – a graphical method for assigning a single number rating to a noise spectrum and is often use to specify noise level limits for mechanical services.

R_w Sound reduction index - single number rating used to describe the laboratory airborne sound insulation properties of a material or building element over a range of frequencies, typically 100-3150Hz.

R'_w Apparent sound reduction index - Single number rating used to describe the sound reduction index of an on-site construction over a range of frequencies, typically 100-3150Hz.

D_w Single number rating used to describe the on-site airborne sound insulation properties of a material or building element over a range of frequencies, typically 100-3150Hz.

$D_{nT,w}$ Single number rating used to describe the on-site airborne sound insulation performance properties of a material or building element over a range of frequencies, typically 100-3150Hz, which is calculated in terms of a standardized reverberation time of 0.5 seconds.

$L'_{nT,w}$ Single number rating used to describe the on-site impact sound insulation performance properties of a floor over a range of frequencies, typically 100-3150Hz, which is calculated in terms of a standardized reverberation time of 0.5 seconds.

RT The RT (Reverberation Time) of a space is defined as the time it takes for the sound pressure level to reduce by 60dB. It is not always possible to measure the full 60dB decay, so the first 20dB decay (T_{20}) or 30dB decay (T_{30}) is used to approximate the reverberation time (T_{60})

APPENDIX B – Excerpt of Noise Survey Details

2.0 NOISE SURVEY

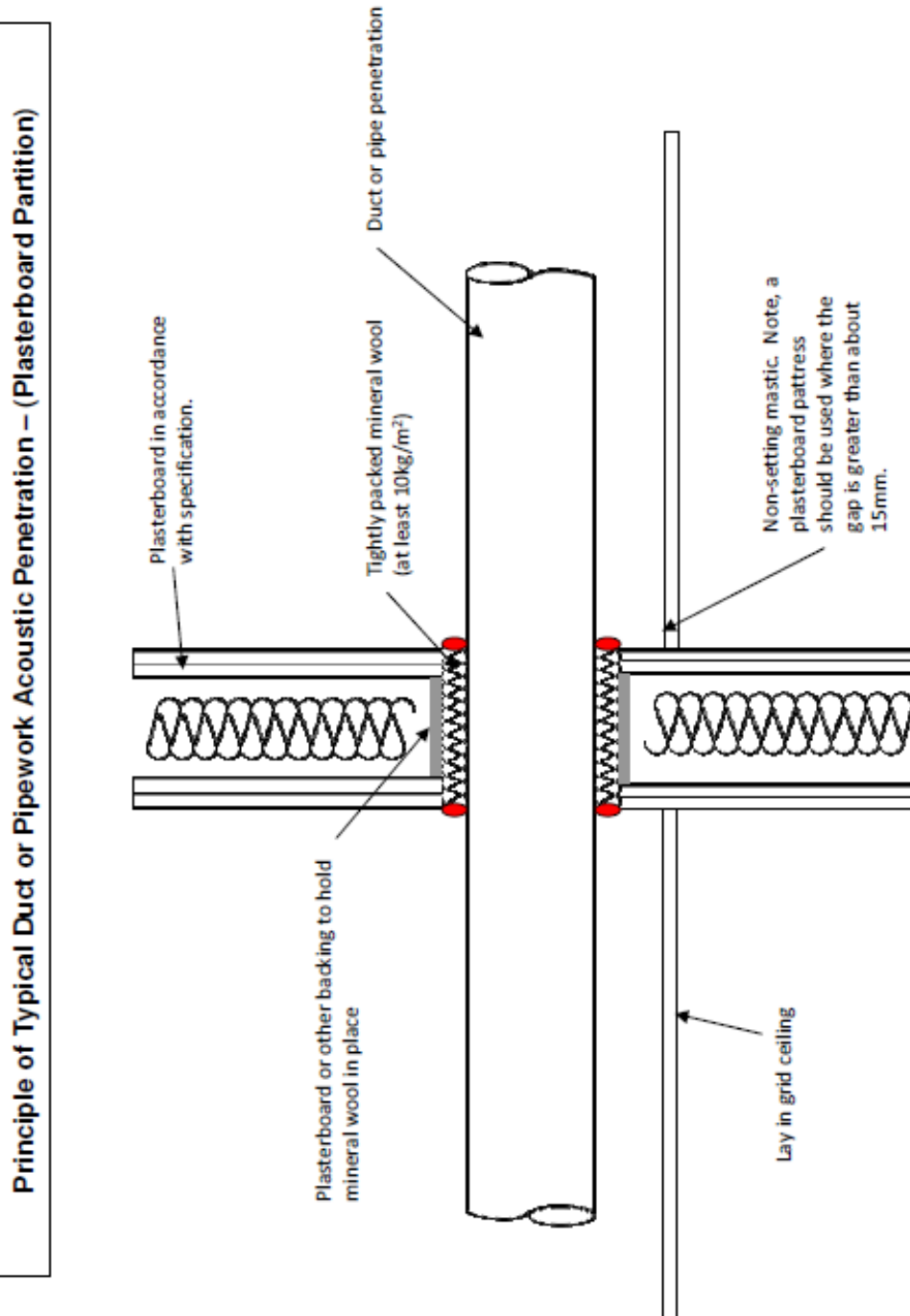
- 2.1 A baseline noise survey was undertaken at the site in the early night-time period from 2343hrs on Tuesday 31st January 2023 until 0129hrs of the following morning to determine prevailing ambient/background noise levels at the nearest noise sensitive properties to the proposed plant.
- 2.2 Noise measurements were undertaken in 15-minute samples in alternation between two on-street locations at Addington Road and Craven Road respectively, as identified in Figure 2.
- 2.3 The measured noise levels are set out in Table 1.

Table 1 : Measured Noise Levels

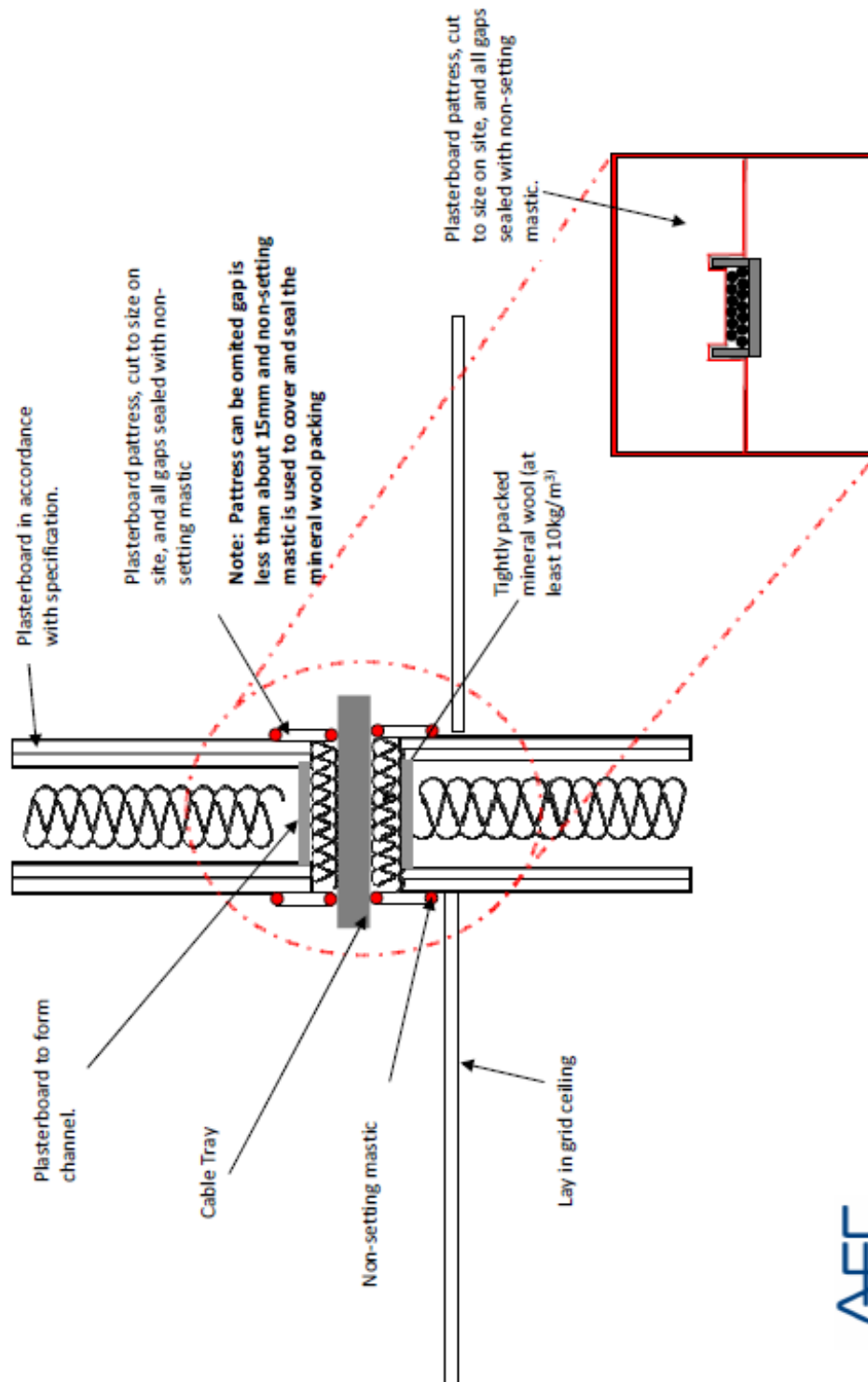
Time	Noise Level (dB)			
	<i>L</i> _{Aeq,15min}		<i>L</i> _{A90,15min}	
	Location 1	Location 2	Location 1	Location 2
2347 hrs	51	-	45	-
0005 hrs	-	53	-	48
0022 hrs	49	-	44	-
0039 hrs	-	50	-	48
0057 hrs	47	-	44	-
0114 hrs	-	49	-	48

- 2.4 The measured background noise levels were generally due to existing hospital building services plant noise emissions and also occasional passing vehicles.
- 2.5 The noise measurements were undertaken using a Norsonic 140 Type 1 Integrating Sound Level Meter (serial no. 31617). Field calibration checks were carried out using a Norsonic 1251 class 1 acoustical calibrator (serial no. 20804) before and after the survey and no variation in the calibration level was observed.
- 2.6 The measurement microphone was fitted with a windshield and mounted at 1.5m above local ground in free-field conditions.
- 2.7 The weather during the survey was dry and calm, with windspeeds typically below 3m/s.

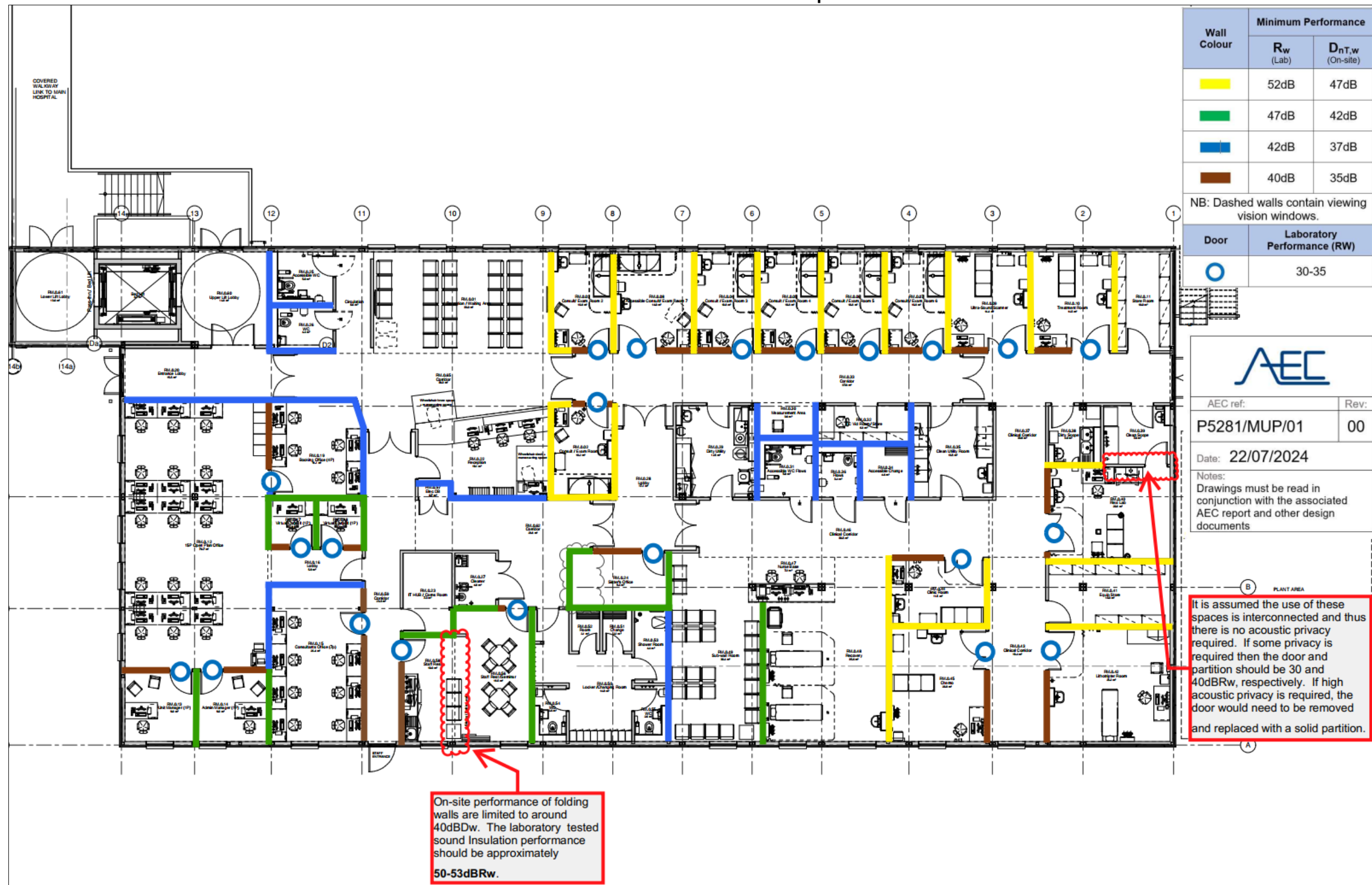
APPENDIX C – Indicative Service Penetration Details



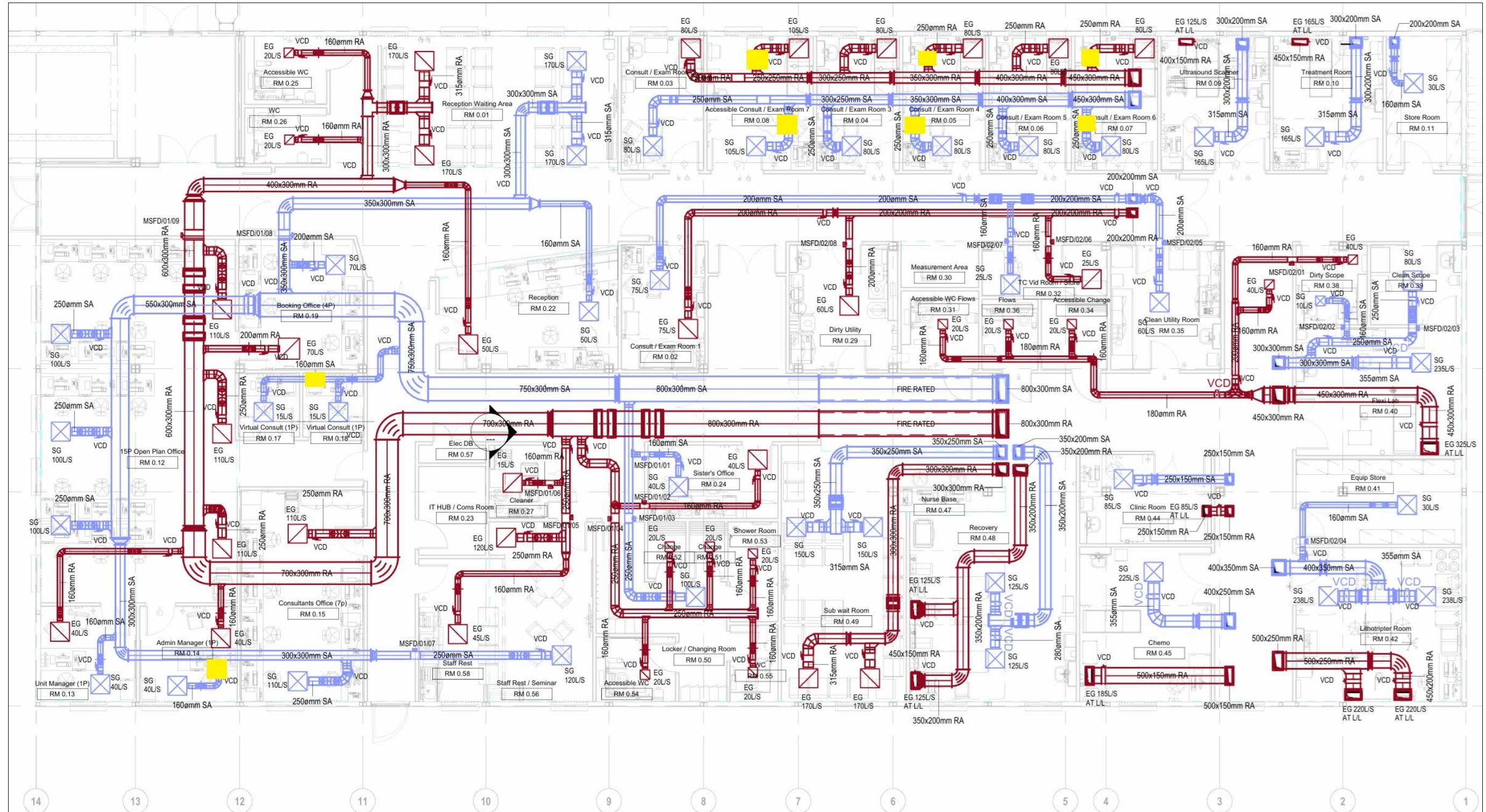
Principle of Typical Cable Tray Penetration – (Plasterboard Partition)



APPENDIX D – Partition Mark-Up



APPENDIX E – Indicative Assessment of Crosstalk Attenuators



N.B. Eight Areas have been identified above (with a yellow box) where crosstalk attenuators (300mm) would be beneficial, if practicable to include