

DOH Health Facility Guidelines 2019

Part G – Acoustics



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Structure of the Guidelines

These Health Facility Guidelines are divided into 8 volumes in order to present information in a comprehensive and logical sequence and avoid unnecessary duplication of information between sections:

Part A	Administrative Provisions • Approval process for Health Facility Licensing • Prequalification of Health Facility Design Consultants • Standards and Guidelines applicable to planning and engineering
Part B	Health Facility Briefing and Planning (this part) • Planning guidelines • Role delineation level • Functional Planning Unit incorporating Description of each Unit • Functional Relationships with diagrams • Schedule of Accommodation for typical units • Standard Components Room Layout Sheets and Room Data Sheets
Part C	Access, Mobility and OH&S • Space standards • Human Engineering • Ergonomic considerations • Accessibility requirements • Signage guidance • Safety and mobility considerations for floors, grab rails, doors, windows
Part D	Infection Prevention and Control • General principles applicable to health facilities • Hand hygiene • Sources of Infection • Isolation Rooms • Surfaces and Finishes • Construction and Renovation
Part E	Engineering – Building Services • Electrical / ELV & ICT • Mechanical (HVAC) • Water Systems

	• Drainage Systems • Medical Gas Systems • Fuel Systems • Pneumatic Tube Systems • Fire Protection Systems (Special Areas Only) • Applicable Standards
Part F	Feasibility Planning and Costing A framework related to Part A licensing and methodology covering • Needs analysis • Risk Analysis • Funding strategies • Procurement strategies
Part G	Acoustics • Architectural Elements • Mechanical Services – Noise and Vibration • Public Health Services – Noise and Vibration • Electrical Services • Lift Specification
Part H	Costing

All parts must be taken into consideration in the design of health facilities.

1. Application of Guidelines

The Acoustic requirements outlined in this part of the Guidelines are based on best practice and they are provided as a guide. These requirements should not override other more stringent requirements as mandated by the local Authorities.

Acoustic requirements within this Acoustic Guideline are in addition to any other non-acoustic requirements such as structural integrity, fire rating, material compatibility, etc.

2. Architectural Elements

2.1 Walls

2.1.1 Minimum STC/Rw Requirements

The recommended Rw ratings for the various space's types are shown in the table below.

Details of corresponding wall types are presented in Part G - Appendix 1.

Space Type	Proposed Rating
Store Rooms, Utilities	35
Toilet, Change Rooms, Ensuite	40
General Office, Lounge	40 (35 for wall to corridor)
Interview, Consult/Exam, Treatment, Inpatient bed rooms	45 (40 for wall to corridor)
AV room, Dirty Utility or Lounge adjacent to Inpatient bed rooms	50 (40 for wall to corridor)
Plant room walls adjacent to Offices/ Inpatient Bedrooms or Suites	55

Table 1 – Required Wall Rating

*Note – These ratings are laboratory/design ratings. After construction, a field measured rating will commonly be less than the laboratory recommended rating. This can occur as a result of field-testing uncertainties (ie – test is not conducted under laboratory conditions). When verification testing, any field test rating must be within at least 5 Rw points of the design rating. When verification testing, and field measured acoustic performance (R'w) must be within 5 points of the specified design Rw rating.

Carry out the installation of all walls/partitions in a manner that will not reduce the performance of the walls below the tabled Rw requirements. This includes but not limited to the proper filling of joints between blocks/panels, back filling with mortar any chasing of walls and sealing of wall junctions.

Unless stated otherwise all acoustically rated walls shall be installed slab-to-slab and sealed at the head.

2.1.2 Penetrations

Acoustically treat all penetrations through walls to maintain the nominated acoustic rating as listed in above.

No penetrations are to be made into the wall constructions unless specified or shown in the drawings.

2.1.3 Wall Junctions and Mullions

Unless otherwise detailed in this acoustic specification, with the exception of set plasterboard-to-plasterboard sheet joints acoustically seal all vertical and horizontal wall junctions using a flexible 100% polyurethane flexible sealant (10-15mm high joint with minimum 10mm sealant bead depth, plus foam backing rod).

Acoustically seal all vertical and horizontal junctions between wall panels and plasterboard wall sheeting required to have an acoustic rating.

2.1.4 Brick/Blockwork

Lay brick/blockwork with full beds and perpend in walls required to have an acoustic rating.

Seal vertical and horizontal wall junctions/joints using a fire rated flexible sealant (10-15mm high joint with minimum 10mm sealant bead depth, plus foam backing rod). Seal intersecting brick/blockwork walls either by keyed together or by leaving a gap and using a fire rated flexible sealant (10-15mm wide joint with minimum 10mm sealant bead depth, plus foam backing rod).

2.1.5 Sealants

Carry out sealing of joints in acoustic walls using a fire rated flexible sealant equal to low modulus, non-slumping PSA composite acoustic sealant.

2.1.6 Manufacturer's Recommendations

Install all systems in accordance with the manufacturer's requirements and recommendations.

2.1.7 Contact with services

Prevent contact between any part of the walls or the ceiling supports with water, waste, stormwater or air conditioning piping. Maintain a minimum 15mm gap between the pipes and ceiling or ceiling supports.

2.1.8 Medical Service Panels

If Medical Service Panels are recessed into an acoustic partition, provide 1mm thick sheet metal box in wall cavity behind the panel with any penetration of the box and they must be sealed air tight.

2.1.9 Services Walls

Where toilets are located on a wall adjacent to a noise sensitive space (inpatient bedroom, office, consult, treatment, lounge, a secondary/dummy wall is required.

Refer to Figure 6 in Part G - Appendix I for detail of constructing this secondary wall.

2.2 Glass Partitions and Viewing Panels

2.2.1 Glass partitions in corridor walls with doors

- Glass panels to meeting rooms, head of department, teleconference and interview rooms are to consist of 10.38mm laminated glass.
- Remaining glass panels to consist of 6.38mm laminated glass.

2.2.2 Glass partitions in wall with no doors

In this scenario, the wall rating is not reduced as a result of a door. Any glass partition will therefore significantly decrease the potential acoustic rating of a wall. This will require a double-glazed system consisting of 10mm glass/70mm airgap/10mm glass.

2.3 Partition Infills at Façade Junctions

At the junction of partition to façade, if the partition stops short of the junction and an infill piece is used (either for light ingress or for servicing of jockey sashes), the acoustic performance of the wall should not be reduced as a result the infill piece.

2.4 Operable Partitions

Operable walls or partitions when used, it is recommended to have no less than Rw 45.

2.5 Doors

The acoustic performance between adjacent spaces is generally determined by the rating of the wall. However, other elements such as doors will often have a lower acoustic performance than the wall and will limit the potential performance of the wall.

Recommended door constructions are outlined below.

Door	ALC Recommended Minimum Constructions
Plant Rooms	45mm thick solid core doors with full perimeter seals. To be determined based on final plant selections.
Corridor to: Meeting, Consult, Interview, Theatres, Head of Department Office, Treatment	Minimum 38-40mm thick solid core doors with full perimeter seals.
Remaining Doors (including ward and typical office)	Min 35mm solid core doors with gaps minimised (undercut no more than 10mm).
Inter-connecting door between offices/consult rooms (if proposed)	Rw 45 proprietary acoustic door.

Table 2 – Minimum Requirements for Door Construction

When the use of door seals is required for functionality/servicing reasons, they are considered to override acoustic requirements.

Carry out the installation of all doors and seals in a manner that will not reduce the performance of the doors including:

- Doors to occupied rooms are not to have grilles.

- Ensure doors are installed without warps and hung with even gaps.
- Installing door with minimum gap at door bottom complying with manufacturer's requirement. Threshold under door seal is to be level and flat. Install aluminum threshold plate under door seals where door seals close onto carpet.
- Installing seals where nominated.
- Adjusting seals so that they are acoustically effective around the full perimeter without excessive effort required to close the doors.
- Ensure that the door hardware does not foul the seals and the seals form a continuous seal around the door perimeter.

2.5.1 Manufacturer's recommendations

Install all systems in accordance with the manufacturer's requirements and recommendations.

2.6 Floors

2.6.1 Minimum STC/R_w Requirements

The following should be considered as the minimum requirement:

Floor Type	Nominated R _w /STC Values*
Between Floor Areas - Generally	50
Between Floors - Plant Rooms	60

Table 3 – Recommended Minimum Airborne Noise Floor Performance Criteria

*Field tested performance (R_w/FSTC) must be within 5 rating point of the design acoustic performance listed in this table.

Carry out the installation of floors in a manner that will not reduce the performance below the tabled acoustic requirements. This includes but not limited to the proper filling of joints, back filling with non-shrink grout any chasing, and installation of ceilings where required to comply with the overall floor/ceiling rating.

2.6.2 Impact Noise Isolation

Any timber floor finish to be located over an inpatient bedroom, office, meeting room, interview room, consult, medical suites is to have 5mm thick acoustic undelay installed below it (equal to Vibralag from Acoustic Supplies).

2.6.3 Penetrations

Acoustically treat all penetrations through floors to maintain the nominated acoustic rating as listed in the table of minimum requirement. No penetrations are to be made into the floor constructions unless specified or shown in the drawings.

2.6.4 Floor joints

Unless otherwise detailed in this acoustic specification, seal construction joints using a fire rated flexible sealant (10-15mm high joint with minimum 10mm sealant bead depth, plus foam backing rod).

2.6.5 Sealants

Carry out sealing of joints in floors using a fire rated flexible sealant equal to low modulus, non-slumping PSA composite acoustic sealant.

2.6.6 Manufacturer's recommendations

Install all systems in accordance with the manufacturer's requirements and recommendations.

2.7 Ceiling/Roof and Room Finishes and Reverberant Noise Controls

The recommended reverberation times represent appropriate room acoustic conditions for different building areas can be found below.

Space/Activity Type	Recommended Internal Reverberation Times
Wards	0.4s – 0.7s
Waiting rooms, reception areas, lobbies	0.4s – 0.7s
Consulting rooms, interview/quiet rooms.	0.4s – 0.6s
Private Offices	0.6s – 0.8s
General office areas (open plan offices)	0.4s – 0.6s
Common areas	Minimised as far as practicable
Operating Theatres	Minimised as far as practicable

Table 4 – Recommended Reverberation Times

In addition, light fittings are not to have slot diffusers or similar openings into the ceiling space which would create a noise transmission path from room to room via the ceiling cavity.

In the event that a slotted, perforated or other penetrated ceiling is installed:

- Mechanical services are not recommended to be installed in this ceiling space.
- All bounding walls of the room are to be constructed slab to slab.
- All stormwater and wastewater pipework is to be wrapped with two layers of foam backed loaded vinyl.

2.7.1 Ceiling Tiles

Any mineral ceiling tile required to achieve the CAC and NRC ratings are shown in the construction diagrams in Appendix I. Ceiling tiles are to have a minimum NRC of 0.6 as recommended reverberation times.

Required CAC rating is dependent on the acoustic rating of the adjacent wall. Refer to details in appendix 1 for required CAC rating. CAC 40 tiles will be required for all office, consult, interview, quiet, toilets, lounge, staff rooms and inpatient unit.

2.7.2 Penetrations

Acoustically treat all penetrations through ceilings to maintain the nominated acoustic rating as listed in the table of minimum requirement.

No penetrations are to be made into the ceiling constructions unless specified or shown in the drawings.

2.7.3 Sealants

Carry out sealing of joints in acoustic walls using a fire rated flexible sealant equal to low modulus, non-slumping PSA composite acoustic sealant.

2.7.4 Manufacturer's Recommendations

Install all systems in accordance with the manufacturer's requirements and recommendations.

2.7.5 Contact with Services

Prevent contact between any part of the ceilings or the ceiling supports with water, waste, stormwater or air conditioning piping. Maintain a minimum 15mm gap between the pipes and ceiling or ceiling supports.

2.7.6 Resiliently Suspended Ceilings

Where resiliently suspended ceilings are nominated (if any), use resilient ceiling hangers equal to CSR where the ceiling cavity is 40mm or less and Embelton RHC elsewhere. Submit alternatives for approval by the Acoustic Consultant.

Install ceilings so that there is no direct contact between the ceiling and the slab above, except via the resilient hanger. Acoustically seal all penetrations through the ceilings using a resilient sealing method that prevents the transfer of vibration from the ceiling to the item penetrating the ceiling.

2.8 Ducted skirtings, sills and sub-sills

2.8.1 Rw 45 walls

- Where a ducted skirting or a sill/subsill is continuous through a Rw 45 wall – pack the skirting/sill with 32kg/m³ mineral wool insulation for 300mm on each side of the wall.

2.8.2 Rw 50 walls

- Ducted skirting - where a ducted skirting is continuous through a Rw 45 wall – pack the skirting/sill with 32kg/m³ mineral wool insulation for 300mm on each side of the wall.
- Sill/sub-sill – it is not recommended that there be a sill/subsill continuous through an Rw 50 wall. Partition wall sheeting to run through the sill, to prevent continuous cavity.

2.9 Access Panels

Install acoustically certified access panels to equal the acoustic performance of the element in which they are installed.

Install access panels in ceilings over bathrooms, laundries and kitchens, and on risers containing waste pipes in bathrooms, laundries and kitchens with a minimum rating of Rw 30.

Access panels for waste piping shall not be located on the sides of risers containing waste pipes facing habitable rooms.

Access panels below fan coil units (if any) to have same surface density as ceiling in which they are installed.

2.10 Risers

Risers in plant rooms do not require acoustic treatment.

Risers located in wet areas should follow the construction as shown in Figure 1 below.

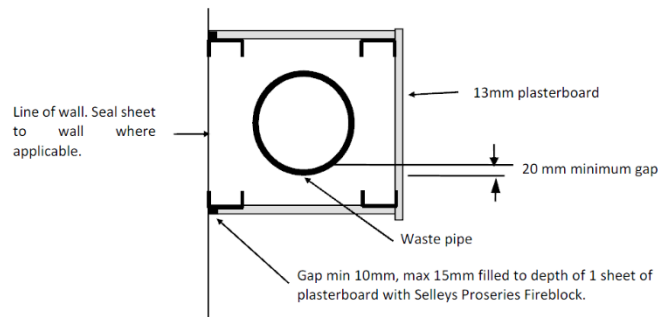


Figure 1 - Recommended constructions for riser in wet area

Risers located outside of wet areas should follow the construction as shown in either Figure 2 or Figure 3 below. It is recommended a single type of construction system will be applied through the building.

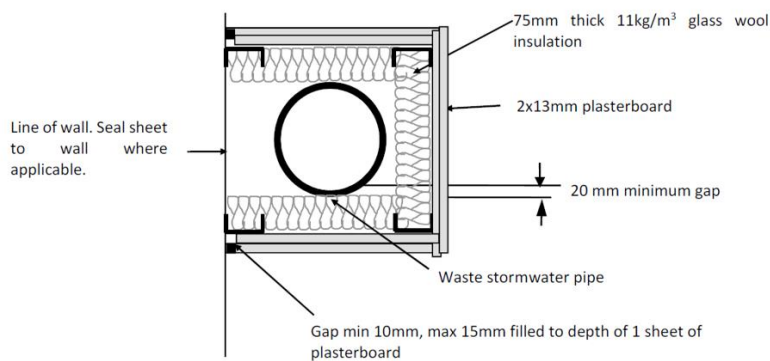


Figure 2 - Recommended construction for riser outside of wet area

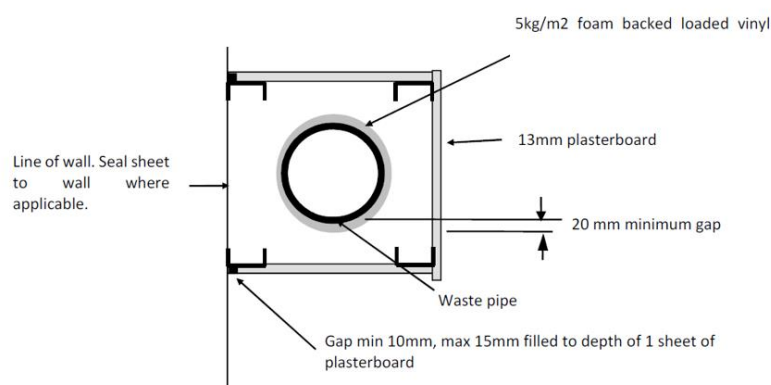


Figure 3 - Recommended construction for riser outside of wet area

2.11 Acoustic Details

Refer to Part G - Appendix I.



3. Mechanical Services – Noise and Vibration

Refer also to acoustic details provided in Part G – Appendix I.

3.1 Noise Criteria

3.1.1 Internal Noise levels

Noise from mechanical plant inside the development shall not exceed the levels given below. Unless stated otherwise, the noise level criteria shall not be exceeded with the plant operating under normal operating conditions, and at start-up for intermittently operating plant items.

Allow for any additional treatment to fully comply with the internal and external noise level requirements, including noise from diffusers, grilles and louvres, ductwork and risers notwithstanding the equipment noise ratings indicated in the mechanical services brief or the acoustic treatments indicated in the mechanical services specification or drawings.

Allowable noise levels are listed in the table below.

Space/Activity Type	Recommended Internal Reverberation Times
Wards	35
Consult Rooms, Meeting, Procedure, Private Office, Interview	40
Operating Theatre, Open plan office, Staff Room, Recovery	45
Lobby / Reception	45
Toilets / Store Rooms	50

Table 5 – Recommended Design Internal Noise Level Criteria for different areas

Noise within rooms shall be free of tones or other undesirable characteristics.

Noise during a Fire Emergency

Noise from all plant during a fire emergency shall comply with the requirements of AS 1668. AS 1668 requires that noise levels during a fire emergency not exceed 80 dB(A) within fire isolated passageways or 65 dB(A) within occupied spaces. Noise levels inside the fire control room shall not exceed 65dB(A) during a fire emergency.

External Noise Levels

Noise levels emitted by the mechanical plant at all property boundaries and nearby buildings on adjacent properties shall meet the requirements of local Authorities. If specific requirements are not available, the following can be considered as the minimum standard.

INP – Intrusiveness Assessment

Intrusiveness criteria permit noise generation to be no more than 5dB(A) above existing background noise levels.

Location	Time of Day	Background noise Level – dB(A)L90	Intrusiveness Noise Objective dB(A)Leq(15min) (Background + 5dB)

Nearby residences	Day Time (7am - 6pm)	38	43
	Evening (6pm - 10pm)	38	43
	Night (10pm - 7am)	31	36

Table 6 – Intrusiveness Assessment

INP – Amenity Assessment

The Amenity criteria set additional criteria based on the land use of the noise sensitive receivers. Amenity criteria are as follows:

Receiver Location	Landy Type	Time of Day	Amenity Noise Objective dB(A) Leq(Period)
All Potentially Affected Residential Properties	Suburban	Day Time (7am - 6pm)	55
		Evening (6pm - 10pm)	45
		Night (10pm - 7am)	40
Commercial	All	When in use	65

Table 7 – Amenity Criteria

3.1.2 Outdoor Areas on the Development Site

Noise emissions to external areas on the site are to comply with the specified levels below:

- Public Spaces (areas where people may sit): <55dB(A)Leq
- Public Spaces (thoroughfares): <60dB(A)Leq

3.2 Noise Generated by Air Distribution Systems

Noise from the air distribution system shall be minimised by:

- Selecting grilles, diffusers, dampers and accessories to meet the specified noise levels.
- Balancing the system using dampers on duct branches, with dampers at grilles being used for minor adjustment of air volumes. Where excessive noise levels are due to noise generated at dampers near grilles, the branch dampers shall be readjusted to eliminate excessive dampering and noise at the grilles.
- Installing ductwork with a minimum number of bends, offsets, etc. Flexible ducts should not be kinked or have excessively bends, particularly near grilles, etc. Ensure there are no protrusions inside the duct that could generate noise. Unless indicated otherwise, install turning vanes in tee's and bends or use long radius bends to minimise turbulence.
- Seal duct joints adequately so there is no noise resulting from air leakage.
- Ensure plenums behind supply and exhaust grilles are correctly sized to ensure even flow over the grille/diffuser.
- Flexible duct diameters shall be selected so as not to exceed the following velocities:

Space Noise Criterion dB(A)	Maximum Velocity (m/s)
35	2.75
40	3.3
45	4.0

Table 8 – Flexible Ducting – Recommended Air Speeds

3.3 Plant Noise Levels

Adjust and balance all systems so that excessive noise is not created, and the scheduled internal and external noise levels are complied with.

3.4 Testing on Completion

Following the installation of mechanical plant and equipment and their subsequent treatments, a qualified Acoustic Consultant is to carry out internal noise level measurements within various rooms of the hospital development and perform external compliance measurements to confirm compliance with the criteria outlined in the sections above.

The locations selected for measurement shall include all critical occupancies close to plant including residences located near plant rooms; balconies; roof terraces; carpark areas, lobbies/corridors and gymnasium.

Noise levels should be measured in the worst affected part of the room/occupancy, at least 1.5m from the grilles located within the room (or the middle of the room, if this is not possible).

3.5 Vibration Criteria

3.5.1 General Areas

Vibration levels caused by activities on the site (including plant) should not exceed the levels specified by the local Authority at any place of different occupancy at and around the site.

When such standard or guidelines is not available, the recommended maximum weighted vibration levels for continuous vibration sources, such as mechanical services plant, and for impulsive vibration sources found in British Standard BS 6472:2008 "Evaluation of human exposure to vibration in buildings (1 Hz to 80 Hz)" can be referenced. The weighted curves in this BS includes guidance for the assessment of human response to building vibration including continuous vibrations caused by mechanical plant and equipment.

Human response to vibration has been shown to be biased at particular frequencies which are related to the orientation of the person. This standard provides curves of equal annoyance for various orientations. These curves are applied as correction filters such that an overall weighted acceleration level is obtained. As the orientation of the resident is unknown or varying the weighting filter used is based on the combined base curve as given in ISO 2631 & Australian Standard 2670 "Evaluation of Human Exposure to Vibration and Shock in Buildings (1 to 80Hz)" which represents the worst case of the X, Y and Z axes. Filtered measurements are made in all three co-ordinate axes and the highest value axis used.

The standard assesses the annoyance of intermittent vibration (which are generally associated with vibrations induced by trains etc.) by using the Vibration Dose Value (VDV). Alternatively the VDV may be estimated by the eVDV which is derived by a simpler calculation using an empirical factor. The VDV or eVDV is calculated for the two periods of the day being the "Daytime" (7am-10pm) and "Night time" (10pm-7am).

The vibration limits recommended for maintaining human comfort in residences and offices are shown in the table below.

Location	Maximum z-axis weighted RMS vibration acceleration (m/s ²)		Vibration Dose Value (m/s ^{1.75})
	Continuous	Impulsive	Intermittent
Inpatient Unit/ ICU/ CCU	0.010	0.30	0.20

Office areas	0.020	0.64	0.40
Workshops	0.040	0.64	0.80

Table 9 – Vibration Limits for different types of occupancy

3.5.2 Critical Areas

- Recommended vibration criteria for critical areas of the hospital development are as follows.
 - Theatres – R1 (“Operating Room”) curve.
- Relevant curves are extracted below.

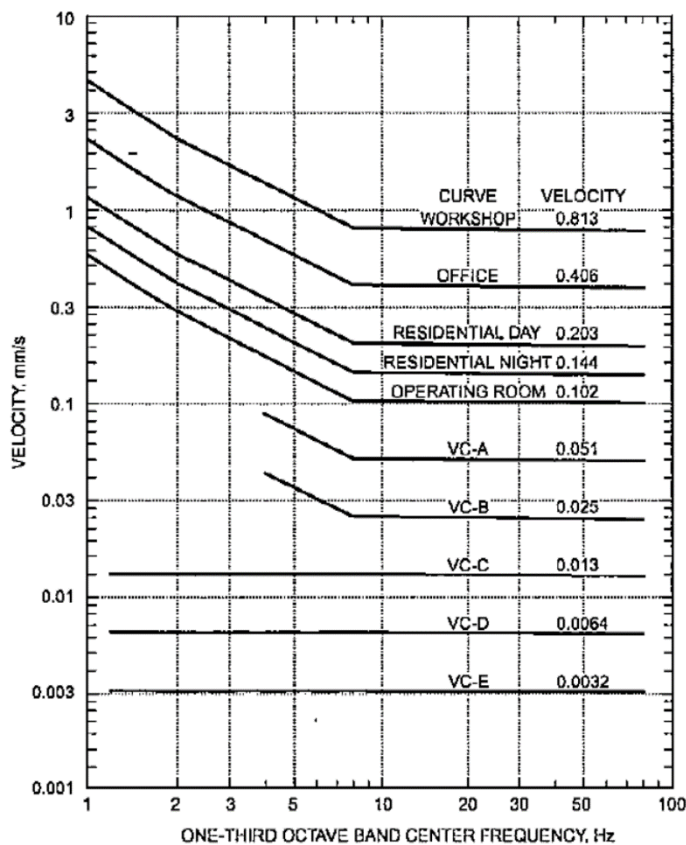


Figure 4 – ASHRAE Equipment Vibration Criteria

Note:

- When the vibration source is constant (as generated by plant), the rms (average) level is to be used.
- When the vibration source is intermittent (as generated by footfall during normal walking), the rms (max 1 second) level is to be used.

These are the proposed test scenarios for any future compliance measurement.

3.6 Ameliorative Treatments to Structure Borne Noise and Vibration

Minimise the transmission of vibration to the building structure to ensure the noise and vibration criteria are achieved by:

- Statically and dynamically balancing rotating plant and equipment. Out of balance not to exceed 0.03mm kg/kg of rotating element after installation. Where specified, provide

balancing test certificates.

- Providing isolation mounts or hangers for vibrating plant and equipment.
- Providing inertia blocks where indicated to limit the vibration amplitude.
- Isolating piping, electrical conduit, etc subject to vibration from the building structure.
- Providing flexible connections where ducts and piping is connected to vibrating plant and machinery.

3.6.1 Anti-Vibration Mounts and Isolators

Selection of Equipment Isolation Mounts

Select isolation mount type and minimum static deflection according to the following table (refer below for isolator types).

Plant	Isolator type	Minimum static deflection
In-line Centrifugal Fans and Small Axial Fans	M3/H1	10 mm
Axial Fans (>450mm diameter), Centrifugal Fans and Pumps	M4	25 mm
Fan/coil and air conditioning units	M1/H1/HE1	2 mm
Cooling Towers	M2	6 mm
Boiler	M1	6 mm
Air-conditioning condenser Units	M1	2 mm
Chillers	M4	25 mm* with 17 mm Super shear flex base pad
Pumps	M4	25 mm*
Air Handling Unit Casing (fan internally spring using 25mm static deflection fan)	M1/H1/HE1	2 mm

Table 10 – Vibration Isolator Schedule

*Plant to be installed on isolators as specified above. Isolators are then to be installed on an isolated plinth (plinth to be separated from structural slab using shear flex pads).

Piping Isolation Mounts

Piping within 20m of the generators (tri-gen or diesel), pumps or chillers shall be vibration isolated using type M4 or H2, 25mm static deflection isolators.

All hangers used to support chiller pipework must incorporate a neoprene pad (as per H2).

Isolate any other small diameter piping runouts to fan coil units within 20m of the pumps or chillers using a flexible 12mm thick foam sleeve between the pipe and the clamp similar to Poron 4701-12- 20250-1604 (2 layers) (suppliers: Mason Grogan 748 3838) fitted between the pipe and the clamp. The clamp should then be tightened just sufficiently to hold the pipe, but not over tightened.

Isolation Mount Types

Type M1 - Waffle Pad Mounts

Waffle pad mounts shall be: minimum 17mm thick neoprene rubber (nitrile rubber where oil contamination is possible); cross ribbed with alternately raised ribs on both faces of the pad; loaded within the load range of the isolator with a minimum static deflection of 1.5mm.

Type M2 - Multiple Layer Waffle Pad Mounts

Multiple layer waffle pad mounts incorporating; specified number of layers of Type M1 Waffle Pad Mount; 1.5mm thick metal shim plate between the pad layers; minimum 1.5mm static deflection per layer.

Type M3 - Neoprene Mounts

Neoprene mounts should be selected to give the static deflections under load nominated for the item of plant and incorporate: separate steel top and base plates completely embedded in elastomer; elastomer colour coded for identification of load rating; non-skid mounting surfaces; bolt holes for bolting down plant.

Type M4 - Spring/Neoprene Mounts

Spring/neoprene mounts should be selected to give the static deflections under load nominated for the item of plant and: be laterally stable without any housing or other lateral support; be capable of an additional travel to solid of at least 50% of the rated static deflection; incorporate a levelling facility; a spring diameter not less than 0.8 of the loaded height; incorporate a 6mm thick neoprene base pad to isolate acoustical frequencies. Isolators exposed to weather should have zinc plated springs and housings coated with a flexible epoxy to prevent corrosion.

Isolation Hanger Types**Type HE1 - Neoprene Hanger Elements**

Neoprene hanger elements should be selected to give the static deflections under load nominated for the item of plant and incorporate: separate steel top and base plates completely embedded in elastomer which should interlock in the event of fire or mechanical failure; elastomer colour coded for identification of load rating; hole for locating hanger and a lip to locate the element within in the mounting hole.

Type H1 - Neoprene Hangers

Neoprene hanger elements should be selected to give the static deflections under load nominated for the item of plant and incorporate: Type HE1 - Neoprene Hanger Element located within a galvanised steel cage with provision for threaded hanger rods to screw into the hanger element; provide sufficient clearance around the threaded hanger rod to ensure it cannot touch the hanger cage.

Type H2 - Spring/Neoprene Hangers

Spring/neoprene hangers should be selected to give the static deflections under load nominated for the item of plant and: be laterally stable without any housing or other lateral support; be housed in a galvanised steel cage; be capable of an additional travel to solid of at least 50% of the rated static deflection; incorporate a levelling facility; a spring diameter not less than 0.8 of the loaded height; incorporate a neoprene base pad to isolate acoustical frequencies. Isolators exposed to weather should have zinc plated springs and housings coated with a flexible epoxy to prevent corrosion, and self-draining cups.

3.6.2 Equipment Bases

Generally - Mount equipment on rigid bases. The bases shall be sufficiently rigid not to deform under the weight of the machinery or during operation and reduce the effectiveness of the isolation mounts.

Tri Gen, Diesel generators, Chillers and pumps to be mounted on strip plinths which themselves are isolated from the structural slab using 10mm acoustic matting.

3.6.3 Installation of Vibration Isolation Mounts

Level the mounts once the equipment is fully loaded in its operating condition with a minimum clearance between the machine and the structure of 20mm, and adjusted to ensure that the isolators are loaded correctly. Ensure that the isolators are not bridged by mounting bolts or contact between any part of the machine or an unisolated part of the isolation mounts and the structure.

Select the number and spacing of the mountings to minimise machine rocking. Consider static and dynamic forces during operation and start-up when selecting the mounts.

Where there is a possibility of significant lateral loads occurring use hold down bolts, lateral restraints, or housed mounts to locate equipment.

3.7 Penetrations

3.7.1 General

Duct, pipe and electrical penetrations through walls, floors etc shall not:

- Decrease the required sound rating isolation rating of the wall, floor, ceiling, etc.
- Allow the transmission of vibration from pipes and ducts to the wall, floor, etc.

Do not penetrate full height walls with flexible ducts. Where ducts pass through above ceiling barriers or full height walls, the main sheet metal duct should be taken through the penetration to over the room served by the flexible duct, and the flexible duct runout to the grille connected. Alternatively, the flexible duct may be drawn through a 700mm long sheet metal sleeve that is grouted into the wall. An insulated 4 zero fire rated flexible duct should be used and the outside diameter of the sleeve should be the same as the flexible duct outside diameter.

Treat penetrations in wet area ceilings so as not to decrease the ceiling sound rating performance. This will require, as a minimum, the use of minimum 1m length of 25mm insulated four zero rated acoustic flexible ducting with an inner aluminium fabric core and outer aluminium wrapping to connect the rigid sheet metal ducting to the grille.

3.7.2 Pipe Penetrations

Seal pipes penetrating slabs or walls, as follows:

Project noise criterion in adjacent spaces	Seal type
Within 20m of a pump and condenser water pipes	Type PB seal
Other pipes including hot and cold water	Type PA or PB seal

Table 11 – Pipe Penetration Seal Types

Where the building element penetrated consists of one or more leaves then all leaves shall be acoustically sealed.

3.7.3 Duct Penetrations

Seal ducts penetrating slabs, walls and above ceiling baffles as follows:

Spaces	Wall/floor construction
All	Masonry
All	Plasterboard

Table 12 – Pipe Penetration Seal Types

Where the building element penetrated consists of one or more leaves then all leaves shall be acoustically sealed.

3.8 Silencers and Internally Lined Ducting - General

3.8.1 Lined Ducting

Internal duct insulation should be of a resin bonded mineral wool insulation in a batt or board form having a minimum density of 32kg/m³. Lining acoustic absorption shall exceed the following performance:

Insulation Thickness	Minimum Absorption Coefficient					
	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
25mm	0.08	0.30	0.64	0.90	0.90	0.90
50mm	0.35	0.72	0.95	0.95	0.95	0.95
75mm	0.45	0.8	0.95	0.95	0.95	0.95
100mm	0.5	0.9	0.95	0.95	0.95	0.95

Table 13 – Internal Duct Insulation

Insulation shall be either factory faced with perforated aluminium foil similar to Sisilation 450 or faced with 30% open area perforated zincanneal steel sheet. Perforated steel sheet shall be used whenever airflow velocities in the duct exceed 10m/s, or where specified elsewhere.

3.8.2 Flexible Ducting

All flexible ducting for air-conditioning to be 4 zero fire rated acoustic flexible duct equal to Bradford Acoustiflex with minimum 25mm thick insulation and minimum 1.5m length.

3.8.3 Silencers

Performance

Unless stated otherwise comply with the scheduled minimum silencer performance requirements for insertion loss, airflow pressure drop and regenerated noise.

Construction

General

Acoustic silencers shall be manufactured by a specialist manufacturer approved by the acoustic consultant and shall comprise:

- A minimum 1.6mm thick galvanised outer casing, stiffened as required to ensure that deformation of the silencer does not occur during installation and operation.
- Acoustically absorbent internal splitters constructed of perforated zincanneal steel sheet with acoustically absorbent, heavy density mineral fibre infill. The ends of the splitters shall be shaped to minimise airflow resistance and regenerated noise.

- Heavy gauge flanges where the silencer is to be connected to ducting. Flanges shall be corrosion protected with an approved finish.

Allow for duct transition sections before and after the silencers, if required. Select and install silencers to ensure that airflow generated noise levels do not cause exceedances of the specified levels in Section 3.1. Where silencers are installed in risers, behind louvres, etc seal around the perimeter of the silencer to the building opening with minimum 1.6mm thick sheet metal, fixed and caulked in a similar to that indicated in the “PB” duct penetration detail.

Silencers for Kitchen Exhaust Ducts and Similar

Wherever possible, quiet running kitchen exhaust fans are to be selected for kitchen exhausts to avoid the need for silencer treatment. Where required, silencers used in kitchen exhaust ducts or other ducts carrying contaminated air shall be have a 12µm thick Melinex sheet between the splitter perforated metal facings and the absorptive infill to prevent the ingress of grease, dirt, etc into the infill material. Connect silencers to ductwork and maintain access so that the silencers are easily removable for cleaning.

Silencers and Internally Lined Ductwork Exposed to Moisture

Use hydrophobic grade rockwool absorbent lining faced with perforated zincanneal steel sheet in all silencers and all internally insulated ductwork carrying moisture laden air or that are internally exposed to the weather. Alternatively, use acceptable equivalent insulation with factory applied weatherproof acoustically transparent facing.

3.9 Electrical

3.9.1 Belt Driven Plant

Fit belt driven intermittently operating plant having motors rated at greater than 2.5kW with motor starters that limit the build-up in motor speed at start-up. These are required to eliminate the possibility (especially in the future after belt wear has occurred) of belt squeal being audible in occupied spaces having a noise criterion of 45dB(A) or lower, on adjacent properties and on residential terraces/external spaces.

3.9.2 Electrical Wiring

Individual electrical cables can be sealed with fire-rated intumescent, low modulus, one component and Class A polyurethane sealant. Bunches of cables shall be drawn through a 5mm thick, 600mm long PVC conduit packed with polyester fibre, fibreglass or rockwool insulation. Seal around the conduit by filling with a non-shrinking grout.

3.10 Contactors/Starters/Controllers

Noise from contactors, starters and controllers shall be inaudible inside rooms having a noise of 45dB(A) or lower, on adjacent properties and on residential terraces/external spaces. Provide enclosures around these items and/or vibration isolate the items from building elements where they may give rise to the transmission of structure-borne noise.

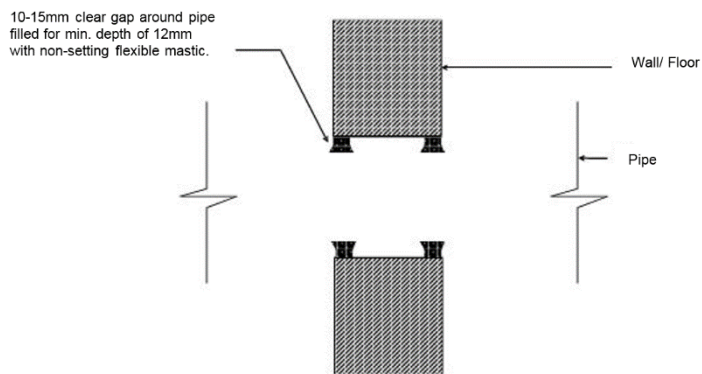


Figure 5 – Type PA Pipe Seal

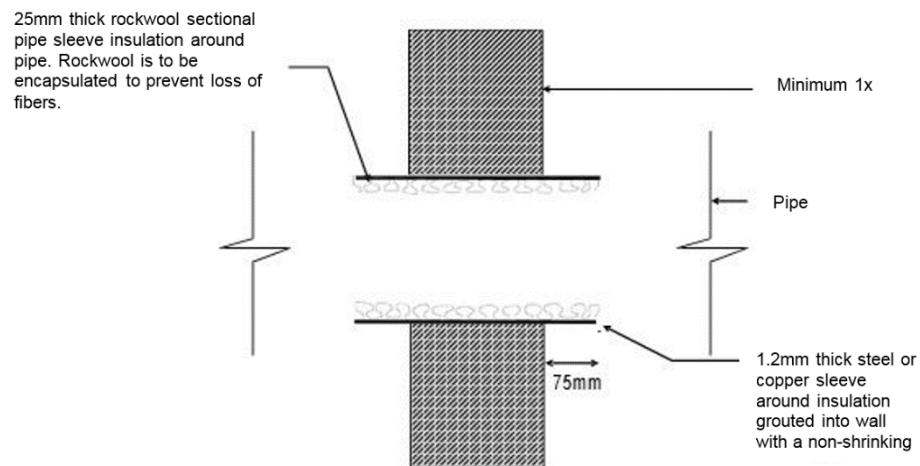


Figure 6 – Type PB Pipe Seal

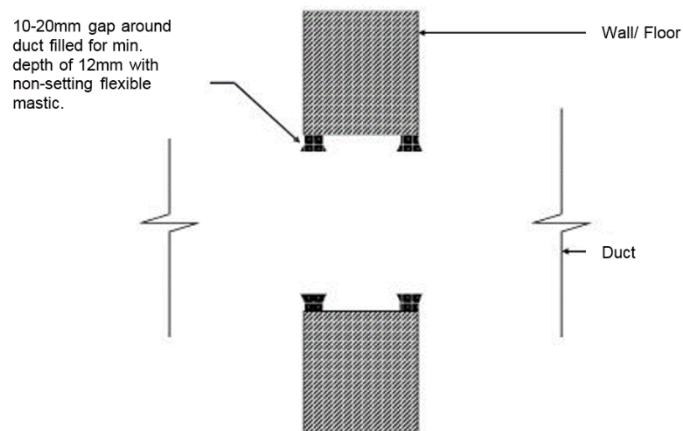


Figure 7 – Type DA Duct Seal

(Note Typical fire damper detail is also adequate provided gaps are sealed with non-setting flexible mastic)

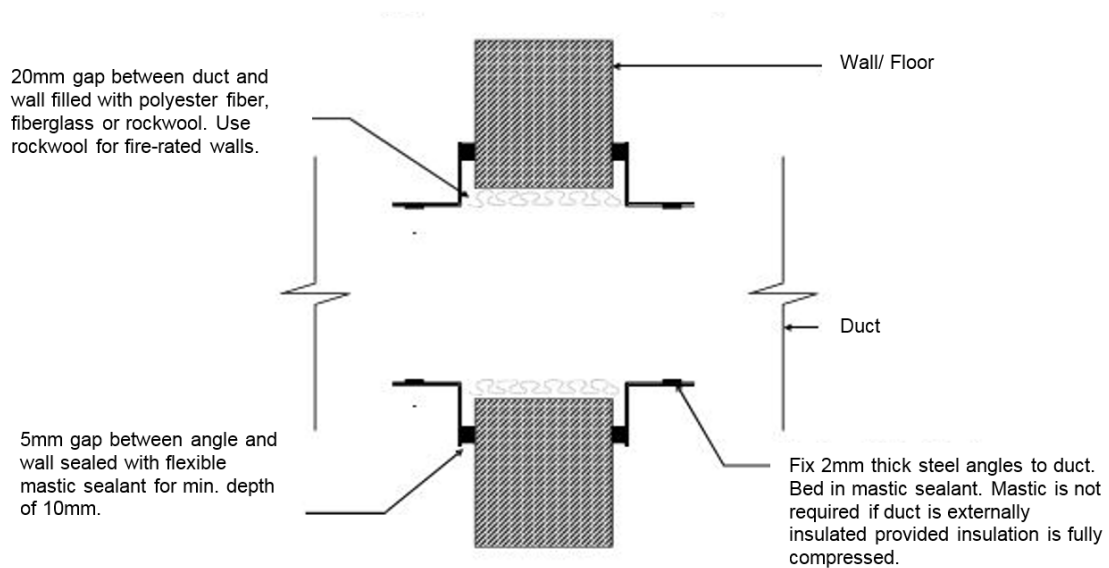


Figure 8 – Type DB Duct Seal

(Note Typical fire damper detail is also adequate provided flange is sealed with non-setting flexible mastic)

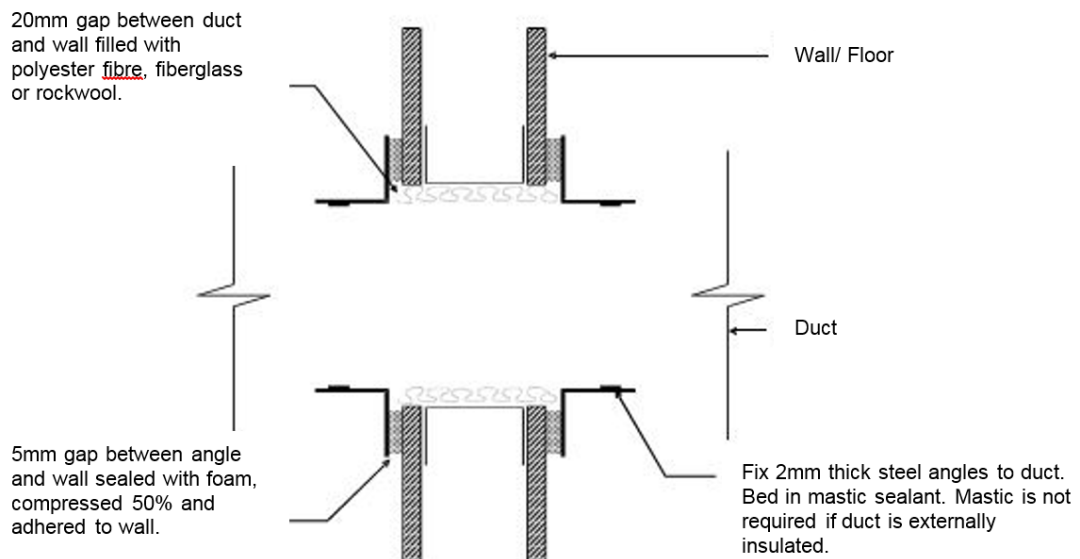


Figure 9 – Type DC Duct Seal

(Note Typical fire damper detail is also adequate for fire-rated walls provided flange is sealed with non-setting flexible mastic)

4. Hydraulic Services – Noise and Vibration

Refer also to acoustic details – Appendix 1

4.1 Application of this specification

The requirements or standards constrained within this acoustic specification are in addition to any other non-acoustic requirements such as structural integrity, fire rating, material, compatibility etc.

Where the acoustic requirements or standards contained in this specification exceed those stated in another specification or drawing then the requirements of this specification shall override the other requirements. Where multiple performance requirements are stated the systems installed shall comply with all requirements.

Install all systems in accordance with the manufacturer's requirements and recommendations unless this specification required a higher standard.

4.2 Noise Criteria

4.2.1 Internal Noise levels

Noise from hydraulics plant inside the development shall not exceed the levels given below. Unless stated otherwise, the noise level criteria shall not be exceeded with the plant operating under normal operating conditions, and at start-up for intermittently operating plant items.

Maximum noise levels in typical areas are listed in the table below:

Space/Activity Type	Noise Level dB(A)Leq
Wards	35
Consult Rooms, Meeting, Procedure, Private Office, Interview	40
Operating Theatre, Open plan office, Staff Room, Recovery	45
Lobby / Reception	45
Toilets / Store Rooms	50

Table 14 – Recommended Design Internal Noise Level Criteria for different areas

Noise within rooms shall be free of tones or other undesirable characteristics.

4.2.2 Noise during a Fire Emergency

Noise from all plant during a fire emergency shall comply with the requirements of the local Standard or requirements. As a guide, noise levels during a fire emergency should not exceed 80 dB(A) within fire isolated passageways or 65 dB(A) within occupied spaces. Noise levels inside the fire control room shall not exceed 65dB(A) during a fire emergency.

4.2.3 External Noise Levels

Intrusiveness criteria permit noise generation to be no more than 5dB(A) above existing background noise levels.

Location	Time of Day	Background noise Level – dB(A)L90	Intrusiveness Noise Objective dB(A)Leq(15min) (Background + 5dB)
	Day Time (7am - 6pm)	38	43
	Evening (6pm - 10pm)	38	43
	Night (10pm - 7am)	31	36

Table 15 – Intrusiveness Assessment

INP - Amenity Assessment

The Amenity criteria set additional criteria based on the land use of the noise sensitive receivers. Amenity criteria are as follows:

Receiver Location	Land Type	Time of Day	Amenity Noise Objective dB(A) Leq(Period)
All Potentially Affected Residential Properties	Suburban	Day Time (7am – 6pm)	55
		Evening (6pm – 10pm)	45
		Night (10pm-7am)	40
Commercial		When in use	65

Table 16 – Amenity Assessment

4.2.4 Outdoor Areas on the Development Site

Noise emissions to external areas on the site are to comply with the specified levels below:

- Public Spaces (areas where people may sit): <55dB(A)Leq
- Public Spaces (thoroughfares): <60dB(A)Leq

4.3 Plant Noise Levels

It should be ensured that systems are installed, adjusted and balanced so that excessive noise is not created, and the scheduled internal and external noise levels are complied with.

4.3.1 Noise Generated by Hydraulic System

Noise from the hydraulics system should be minimised by:

- Limiting pipe velocities in water systems to not more than 1.5m/s.
- Laying out pipes to minimise the number of changes in direction and installing pipes so that the effective cross-sectional area of the pipe is maintained at pipe bends and junctions.
- Selecting valves and fittings that minimise the generation of noise.
- Installing pressure reducing stations as required to eliminate excessive pressure at the terminal valves.
- Controlling structure-borne noise (i.e. plant and pipe vibration transmitted into the building structure) with the use of plant isolation mounts, resilient sleeves, etc
- Routing piping to avoid noise sensitive locations such as meeting rooms.
- Provision of water hammer arrestors in reticulation piping to dishwashers and washing machines.

- Fixing piping and caulking stud penetrations to prevent pipe movement within studwork.
- Locate waste pipes floor penetrations so that they do not fall within or near sound rated walls.
- Do not run piping along the head of walls, or in front of the head of sound rated walls that prevents access to the wall for caulking.

4.4 Vibration Criteria

4.4.1 General Areas

Vibration levels caused by activities on the site (including plant) should not exceed the levels specified in the EPA document “Assessing Vibration Guideline” at any place of different occupancy at and around the site. The Assessing Vibration guideline provides operational vibration criteria for maintaining human comfort within different space uses.

The Assessing Vibration Guideline recommends maximum weighted vibration levels for continuous vibration sources, such as mechanical services plant, and for impulsive vibration sources. The weighted curves outlined in the British Standard BS 6472:2008 “Evaluation of human exposure to vibration in buildings (1 Hz to 80 Hz)” includes guidance for the assessment of human response to building vibration including continuous vibrations caused by mechanical plant and equipment.

Human response to vibration has been shown to be biased at particular frequencies which are related to the orientation of the person. This standard provides curves of equal annoyance for various orientations. These curves are applied as correction filters such that an overall weighted acceleration level is obtained. As the orientation of the resident is unknown or varying the weighting filter used is based on the combined base curve as given in ISO 2631 & Australian Standard 2670 “Evaluation of Human Exposure to Vibration and Shock in Buildings (1 to 80Hz)” which represents the worst case of the X, Y and Z axes. Filtered measurements are made in all three co-ordinate axes and the highest value axis used.

The standard assesses the annoyance of intermittent vibration (which are generally associated with vibrations induced by trains etc.) by using the Vibration Dose Value (VDV). Alternatively the VDV may be estimated by the eVDV which is derived by a simpler calculation using an empirical factor. The VDV or eVDV is calculated for the two periods of the day being the “Daytime” (7am-10pm) and “Night time” (10pm-7am).

The vibration limits recommended for maintaining human comfort in residences and offices are shown in the table below.

Location	Maximum z-axis weighted RMS vibration acceleration (m/s ²)		Vibration Dose Value (m/s ^{1.75})
	Continuous	Impulsive	
Inpatient Unit/ ICU/ CCU	0.010	0.30	0.20
Office areas	0.020	0.64	0.40
Workshops	0.040	0.64	0.80

Table 17 – Vibration Limits for different types of occupancy

4.4.2 Critical Areas

Recommended vibration criteria for critical areas of the hospital development are as follows.

- Theatres – R1 (“Operating Room”) curve.

Relevant curves are extracted below.

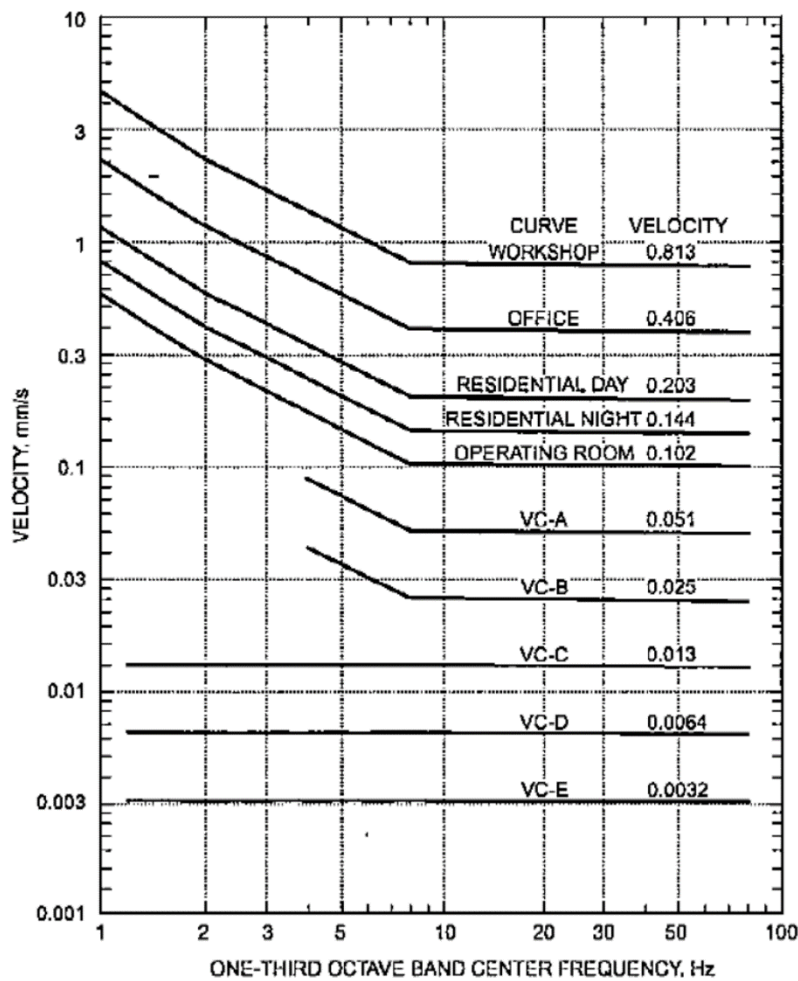


Figure 10 – ASHRAE Equipment Vibration Criteria

Note:

- When the vibration source is constant (as generated by plant), the rms (average) level is to be used.
- When the vibration source is intermittent (as generated by footfall during normal walking), the rms (max 1 second) level is to be used.

4.5 Ameliorative Treatments to Structure Borne Noise and Vibration

Minimise the transmission of vibration to the building structure to ensure the noise and vibration criteria are achieved by:

- Statically and dynamically balancing rotating plant and equipment. Out of balance shall not exceed 0.03mm kg/kg of rotating element after installation. Where specified, provide balancing test certificates.
- Providing isolation mounts or hangers for vibrating plant and equipment.
- Providing inertia blocks where required to limit the vibration amplitude.
- Isolating piping, electrical conduit, etc subject to vibration from the building structure.
- Providing flexible connections where piping is connected to vibrating plant and machinery.
- Where pipes are fixed to stud walls no part of the piping, fixtures and valves or noggings to

support the pipes and valves shall contact or bridge between the stud wall and any other independently supports wall element.

4.5.1 Anti-Vibration Mounts and Isolators

Selection of Equipment Isolation Mounts

Select isolation mount type and minimum static deflection according to the following table (refer above for isolator types).

Plant	Isolator type	Minimum static deflection
Small Vertical and In-line Pumps < 1 kW motor	M3	10 mm
Pumps > 1 kW motor	M4	25 mm
Water tanks	M1/H1/HE1	2 mm
Boilers	M2	6 mm
Hot water units	M2	6 mm
Electric Fire Pumps	M3	10 mm
Diesel Fire Pumps	M4	25 mm

Table 18 – Isolator Schedule

Isolation Mounts

Type M1 - Waffle Pad Mounts

Waffle pad mounts shall be: minimum 17mm thick neoprene rubber (nitrile rubber where oil contamination is possible); cross ribbed with alternately raised ribs on both faces of the pad; loaded within the load range of the isolator with a minimum static deflection of 1.5mm.

Type M2 - Multiple Layer Waffle Pad Mounts

Multiple layer waffle pad mounts incorporating; specified number of layers of Type M1 Waffle Pad Mount; 1.5mm thick metal shim plate between the pad layers; minimum 1.5mm static deflection per layer.

Type M3 - Neoprene Mounts

Neoprene mounts should be selected to give the static deflections under load nominated for the item of plant and incorporate: separate steel top and base plates completely embedded in elastomer; elastomer colour coded for identification of load rating; non-skid mounting surfaces; bolt holes for bolting down plant.

Type M4 - Spring/Neoprene Mounts

Spring/neoprene mounts should be selected to give the static deflections under load nominated for the item of plant and: be laterally stable without any housing or other lateral support; be capable of an additional travel to solid of at least 50% of the rated static deflection; incorporate a levelling facility; a spring diameter not less than 0.8 of the loaded height; incorporate a 6mm thick neoprene base pad to isolate acoustical frequencies. Isolators exposed to weather should have zinc plated springs and housings coated with a flexible epoxy to prevent corrosion.

Isolation Hanger Types

Type HE1 - Neoprene Hanger Elements

Neoprene hanger elements should be selected to give the static deflections under load nominated for the item of plant and incorporate: separate steel top and base plates completely embedded in elastomer which should interlock in the event of fire or mechanical failure; elastomer colour coded for identification of load rating; hole for locating hanger and a lip to locate the element within in the mounting hole.

Type H1 - Neoprene Hangers

Neoprene hanger elements should be selected to give the static deflections under load nominated for the item of plant and incorporate: Type HE1 - Neoprene Hanger Element located within a galvanised steel cage with provision for threaded hanger rods to screw into the hanger element; provide sufficient clearance around the threaded hanger rod to ensure it cannot touch the hanger cage.

Type H2 - Spring/Neoprene Hangers

Spring/neoprene hangers should be selected to give the static deflections under load nominated for the item of plant and: be laterally stable without any housing or other lateral support; be housed in a galvanised steel cage; be capable of an additional travel to solid of at least 50% of the rated static deflection; incorporate a levelling facility; a spring diameter not less than 0.8 of the loaded height; incorporate a neoprene base pad to isolate acoustical frequencies. Isolators exposed to weather should have zinc plated springs and housings coated with a flexible epoxy to prevent corrosion, and self-draining cups.

Piping Isolation Mounts

Piping within 15m of any pump shall be vibration isolated using type M4 or H2, 25mm static deflection isolators; type M3/H1, 10mm static deflection mounts elsewhere within 20m of the pumps or chillers.

Isolate any other small diameter piping runouts to fan coil units further than 20m of the pumps using a flexible 12mm thick foam sleeve between the pipe and the clamp (2 layers) fitted between the pipe and the clamp. The clamp should then be tightened just sufficiently to hold the pipe, but not over tightened.

Resilient Pipe Sleeves

Where required, install resilient pipe sleeves between the pipe and pipe clamps to isolate pipe vibration from the clamps. Sleeves should be 12mm thick foam (2 layers) fitted between the pipe and the clamp. The clamp should then be tightened just sufficiently to hold the pipe, but not over-tightened.

Flexible Pipe Connections

Flexible connections shall be fitted to all pump piping connections. These shall be twin sphere reinforced-rubber elements, be capable of withstanding internal pressure and other forces and be compatible with the fluid in the pipe.

Equipment Bases

Pumps shall be installed on concrete plinth which itself is isolated from the structural slab on a layer of 10mm thick matting. The mass of the plinth shall be at least 1.5 times the mass of the equipment being supported including pipe fittings, etc. Bases shall minimise the height of the centre of gravity of the machine/base.

25mm static deflection spring isolator required between the plinth and the pump base.

Installation of Vibration Isolation Mounts

The mounts shall be levelled once the equipment is fully loaded in its operating condition with a minimum clearance between the machine and the structure of 15mm, and adjusted to ensure that the isolators are loaded correctly. Ensure that the isolators are not bridged by mounting bolts or contact between any part of the machine or an unisolated part of the isolation mounts and the structure.

The number and spacing of the mountings shall be selected to minimise machine rocking. Static and dynamic forces during operation and start-up shall be considered when selecting the mounts.

During construction, pump isolation mounts shall be bridged with a timber block to prevent the possibility of overloading of the mounts during the installation of the piping.

Piping hangers and mounts shall be adjusted so that there is minimum strain on piping with the system operating in its normal condition.

Where there is a possibility of significant lateral loads occurring use hold down bolts, lateral restraints, or housed mounts to locate equipment.

4.6 Penetrations

4.6.1 General

- Decrease the sound rating isolation rating of the wall, floor, etc.
- Allow the transmission of vibration from pipes and ducts to the wall, floor, etc.

4.6.2 Pipe Penetrations

Seal pipes penetrating slabs or walls, as follows:

Project noise criterion in adjacent spaces	Seal type
Domestic water within 25m of Pump	Type PB seal
Elsewhere including waste pipes	Type PA or PB seal

Table 19 – Pipe Penetration Seal Types

Where the building element penetrated consists of one or more leaves then all leaves shall be acoustically sealed.

4.6.3 Location of Penetrations in Acoustically Rated Walls

Where possible where pipes and cables running through ceiling voids enter or pass through an acoustically rated wall (or pass into a wall cavity forming part of an acoustically rated wall) the pipes/cable shall be as close as possible to the head of the wall.

Locate pipe and duct penetrations away from corners and other inaccessible locations that prevent access to seal the penetration.

4.7 Waste and Stormwater Pipes

The following schedule provides the recommended acoustic treatment to piping. Refer also to Part G - Appendix I for detailed drawings.

Service	Location*	Pipe Treatment
Waste Piping / Stormwater Piping (not siphonic)	Meeting Room, Office/Open Plan Office, Consult, Theatre, Interview, Lounge, Staff room, Waiting area	Pipes wrapped with Acoustic Supplies 5 kg/m ² .
	Meeting Room, Office/Open Plan Office, Consult, Theatre, Interview, Lounge, Staff, with perforated/slotted ceiling below	Pipes wrapped with 2 layers of Acoustic Supplies 5 kg/m ² .
	Lobbies/waiting areas with perforated or slotted ceiling below.	Pipes wrapped with Acoustic Supplies 5 kg/m ² .
	Wards/In-patient units.	Pipes wrapped with Acoustic Supplies 5 kg/m ² .
Siphonic Drainage	All Areas	Pipes wrapped with Acoustic Supplies 5 kg/m ² . Wrap with 2 layers if located over perforated/ slotted ceiling.

Table 20 – Acoustic Treatment to Waste and Stormwater Pipes Generally

*If the walls around the rooms nominated do not run full height – lagging should extend minimum one metre past the line of the wall below.

Pipes required to be externally lagged using 5 kg/m² loaded vinyl shall have an outer aluminium foil backing. The loaded vinyl shall be separated from the pipe with a layer of minimum 25mm thick open cell foam. Overlap all joints by minimum of 50mm and tape airtight with aluminium tape. In addition all pipes which are required to be lagged which penetrate slab soffits, walls, risers or like shall have the pipe lagging flanged (minimum 50mm lap) to the meeting surface or sealed with a flexible sealant equal to Bostik 2637.

All waste pipes shall be kept a minimum of 20mm clear of any part of the structure including walls, ceilings, ceiling hangers, etc. Waste pipe penetrations shall be sealed as recommended above for pipe penetrations. Mortar or render should be kept clear of the penetrations so as to prevent any bridging between the pipe and the wall.

4.8 Electrical

4.8.1 Belt Driven Plant

Belt driven intermittently operating plant having motors rated at greater than 2.5kW shall be fitted with motor starters that limit the build-up in motor speed at start-up. These are required to eliminate the possibility (especially in the future after belt wear has occurred) of belt squeal being audible in occupied spaces having a noise criterion of 45dB(A) or lower, on adjacent properties and on residential terraces/external spaces.

4.8.2 Electrical Wiring

Individual electrical cables can be sealed with Selleys Proseries Fireblock sealant or equal. Bunches of cables shall be drawn through a 5mm thick, 600mm long PVC conduit packed with polyester fibre, fibreglass or rockwool insulation. Seal around the conduit by filling with a non-shrinking grout or flexible polyurethane sealant

4.8.3 Contactors/Starters/Controllers

Noise from contactors, starters and controllers shall be inaudible inside rooms having a noise of 45dB(A) or lower, on adjacent properties and on residential terraces/external spaces. Provide enclosures around these items and/or vibration isolate the items from building elements where they may give rise to the transmission of structure-borne noise.



5. Electrical Services

Penetrations in sound rated ceilings or walls or floors should maintain the acoustic performance of the ceiling/wall/floor. Where required provide acoustic boxes or other treatment.

Where penetrations are made in sound rated walls (including floor mounted air-conditioning unit cupboards) for either power outlets (PO's) or light switches, these should be backed using the HPM 430 Fire/Acoustic wall box. The boxes may be used in a back to back arrangement.

Individual electrical cables can be sealed with low modulus, non-slumping PSA composite acoustic sealant. Bunches of cables shall be drawn through a 5mm thick, 600mm long PVC conduit packed with polyester fibre, fibreglass or rockwool insulation. Seal around the conduit by filling with a non-shrinking grout.

Light fittings penetrating sound rated ceilings over wet areas shall be treated with acoustic boxes themselves as required to maintain the acoustic performance of the ceiling, or fittings having a solid face plate (with no gaps to the ceiling void).

Refer to Appendix 1 for detail of walls requiring acoustic boxes for GPO's and acoustically sealed ceilings.

Ducted skirtings - Rw 45 or higher walls – Where a ducted skirting or a sill/subsill is continuous through a Rw 45 wall – pack the skirting/sill with 32kg/m³ mineral wool insulation for 300mm on each side of the wall.



6. Lift Specification

6.1 Noise within Occupied Areas

Lifts motors and control equipment shall be vibration isolated from the building structure. The maximum noise level produced by the lift car operation shall not exceed 40dB(A) L_{max} when measured in patient room, meeting room, interview room, treatment room.

6.2 Lift Call Bells and Lobby Noise Levels

It is standard practice that when a lift arrives at a floor a bell or auditory call signal is activated to let the waiting passenger know of the lifts arrival. This type of lift call system can be highly annoying for noise sensitive spaces such as offices located near the lifts. Therefore, it is common to request any auditory lift call system must be low in volume and dull in nature.

6.3 Noise within Lift Car

Maximum noise level within the lift car during operation of 55 dB(A).

7. Appendix I – Wall Constructions

Refer to overleaf for various construction details to suit the required acoustic requirement.

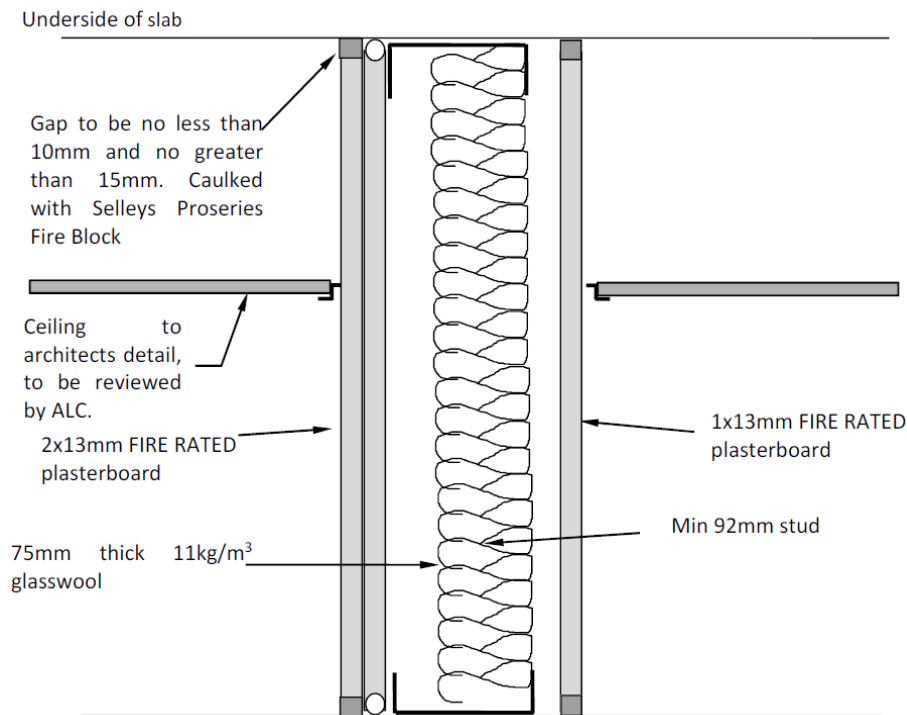


Figure 1 - Rw50 (Typical) Wall Construction

Note:

All wall ceiling penetrations to be acoustically sealed. Pos to have acoustic box behind. Drawings is not to scale.

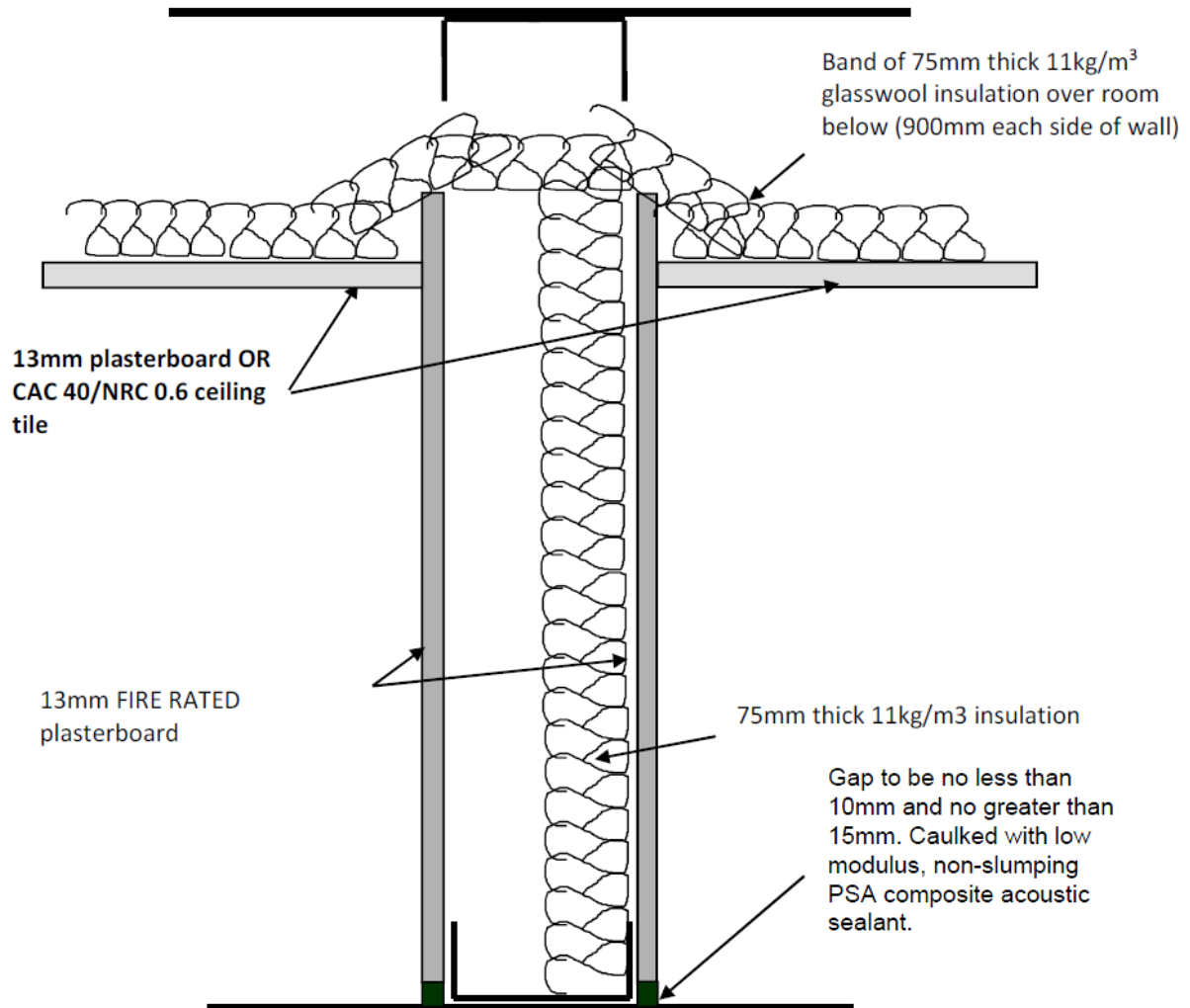


Figure 2 - Rw45 (Typical) Wall Construction

Note:

No untreated ceiling penetrations. Supply/ return air grilles to have insulated ducts behind.

All wall/ ceiling penetrations to be acoustically sealed. PO's to have acoustic box behind or offset minimum 600mm.

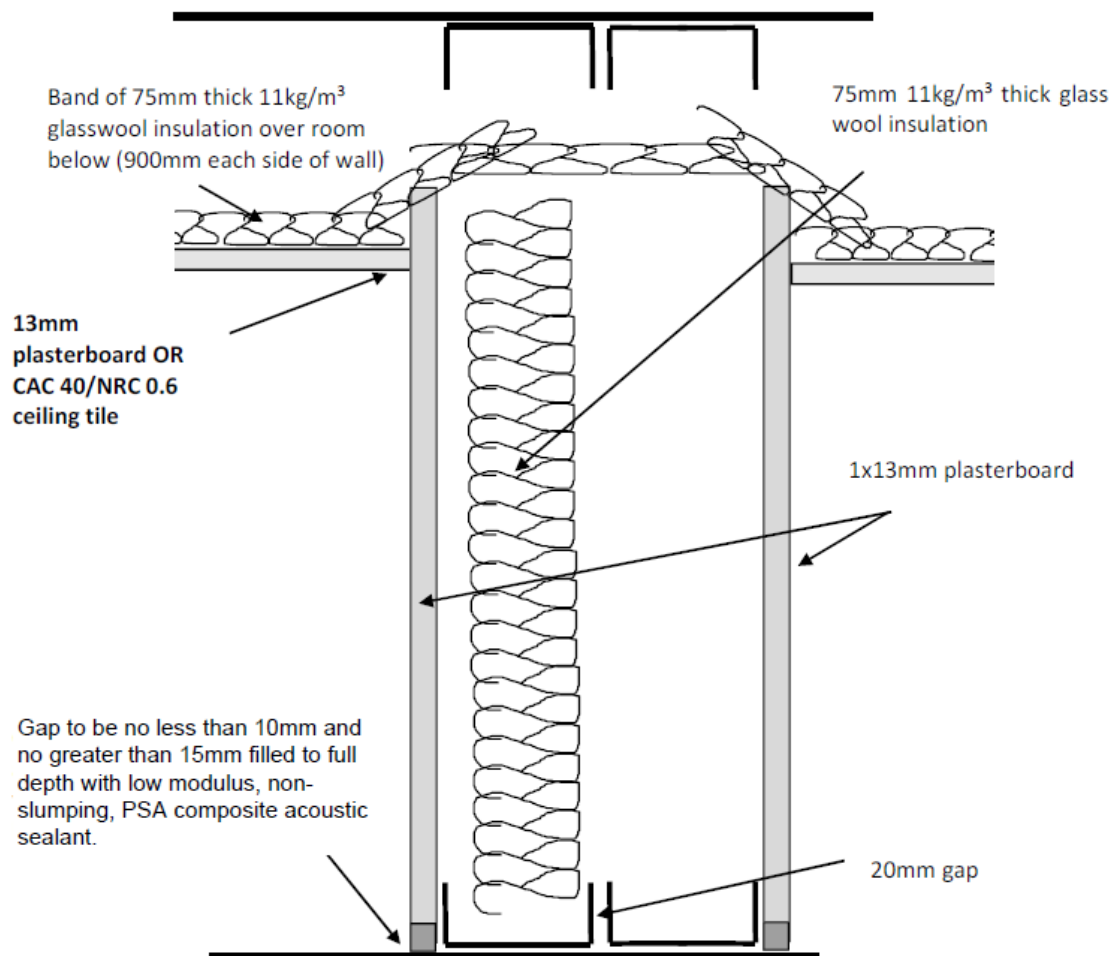


Figure 3 - Rw45 (Operating Theatres) Wall Construction

Note:

No untreated ceiling penetrations. Supply/ return air grilles to have insulated ducts behind.

All wall/ ceiling penetrations to be acoustically sealed. PO's to have acoustic box behind or offset minimum 600mm.

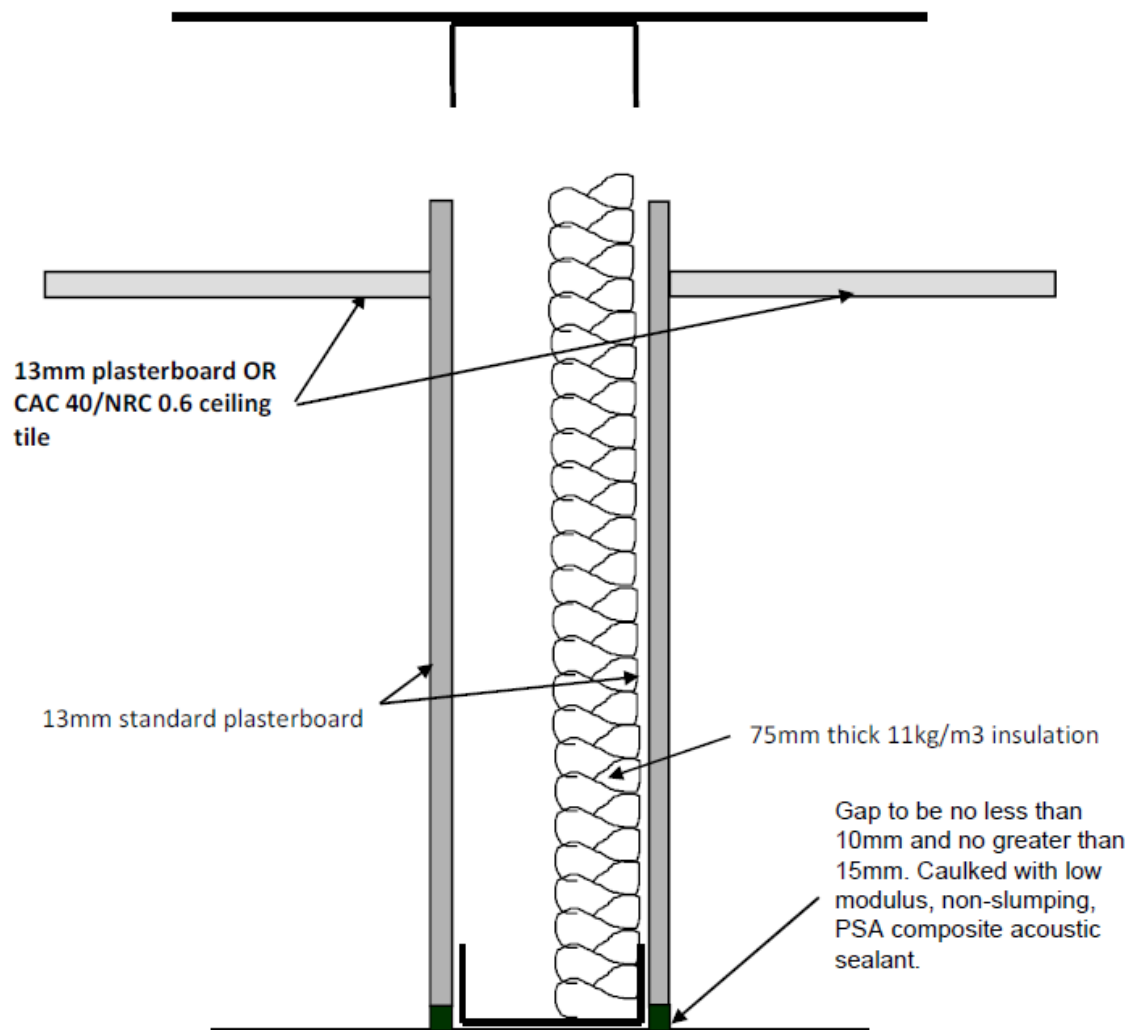


Figure 4 - Rw40 (Typical) Wall Construction

Note:

No untreated ceiling penetrations. Supply/ return air grilles to have insulated ducts behind.

All wall/ ceiling penetrations to be acoustically sealed. PO's to have acoustic box behind or offset minimum 600mm.

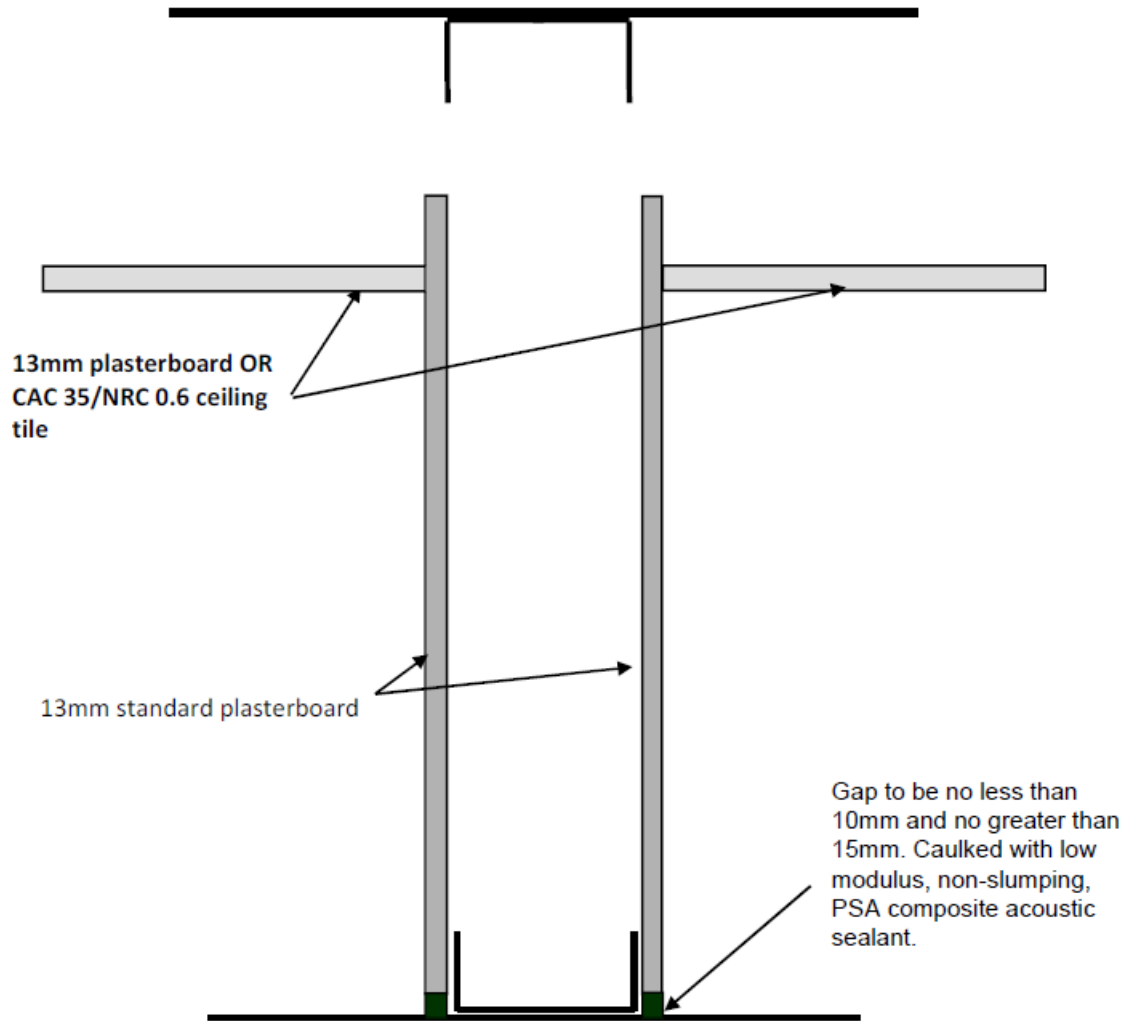


Figure 5 - Rw35 (Typical) Wall Construction

Note:

No untreated ceiling penetrations. All wall/ ceiling penetrations to be sealed.

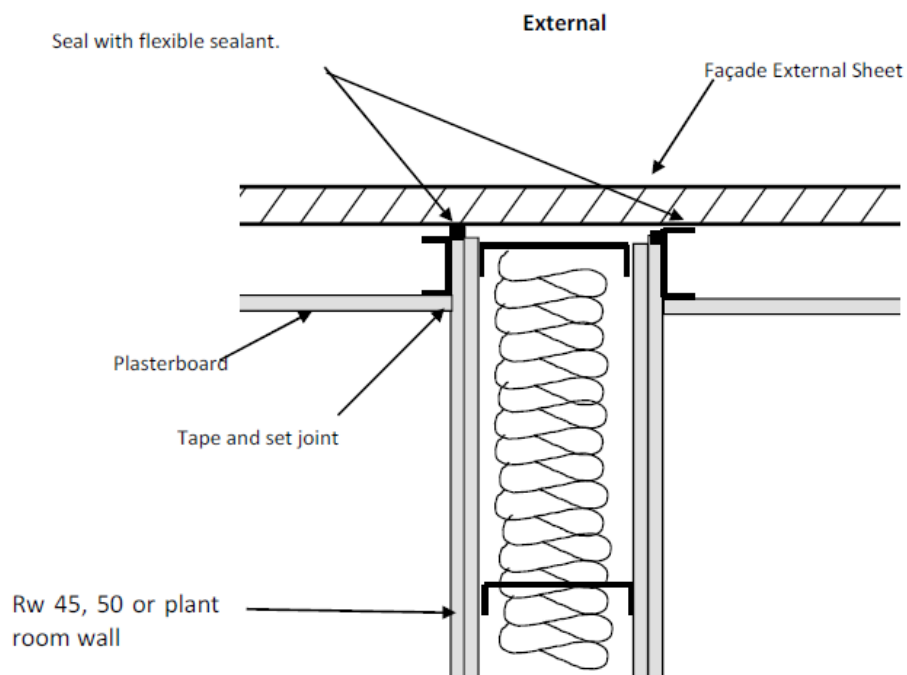


Figure 6 - Rw45 and Rw50 (Partition to External Wall Junction) Wall Construction

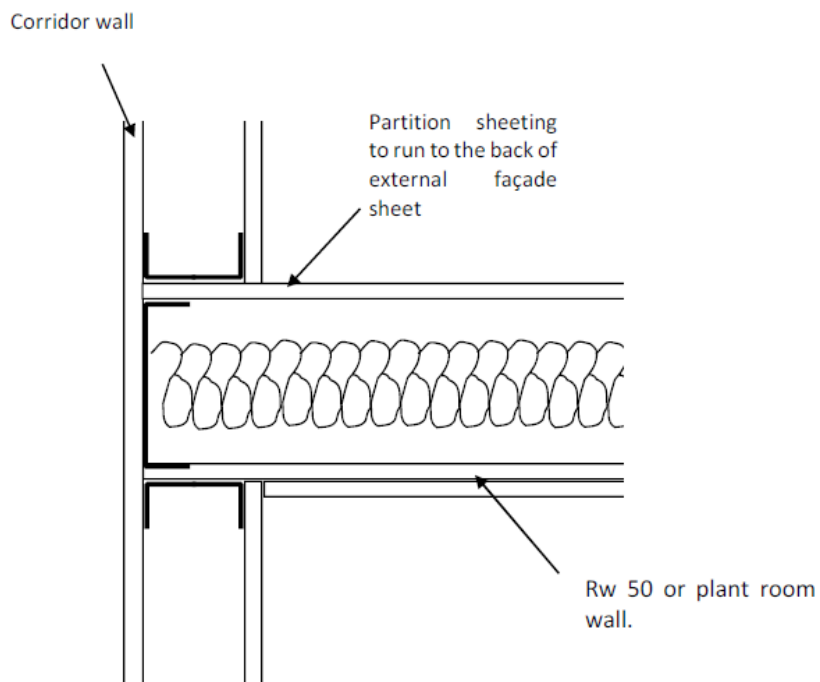


Figure 7 - Rw50 (Plant Room Wall to Corridor Wall Junction) Wall Construction

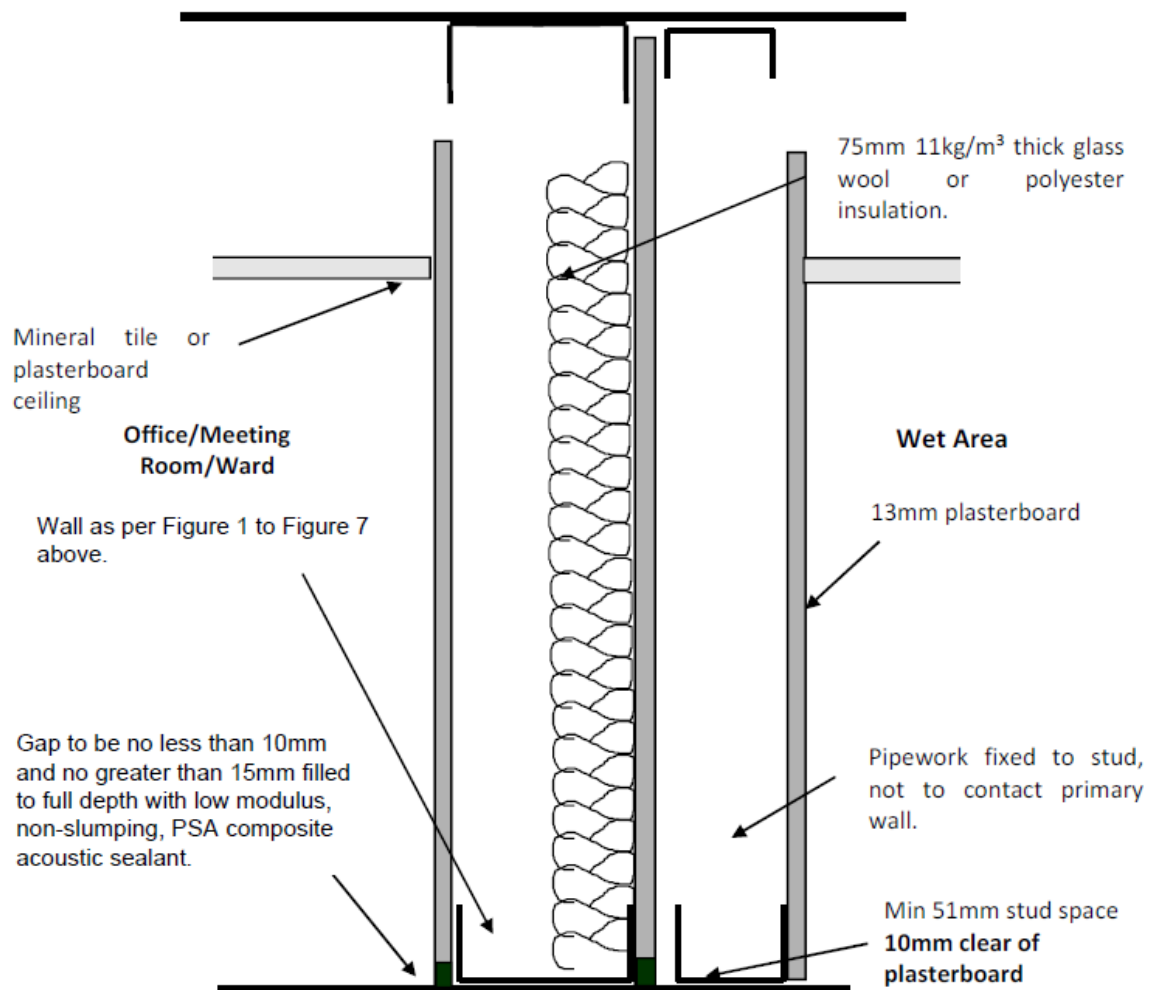


Figure 8 - Dummy Wall Detail

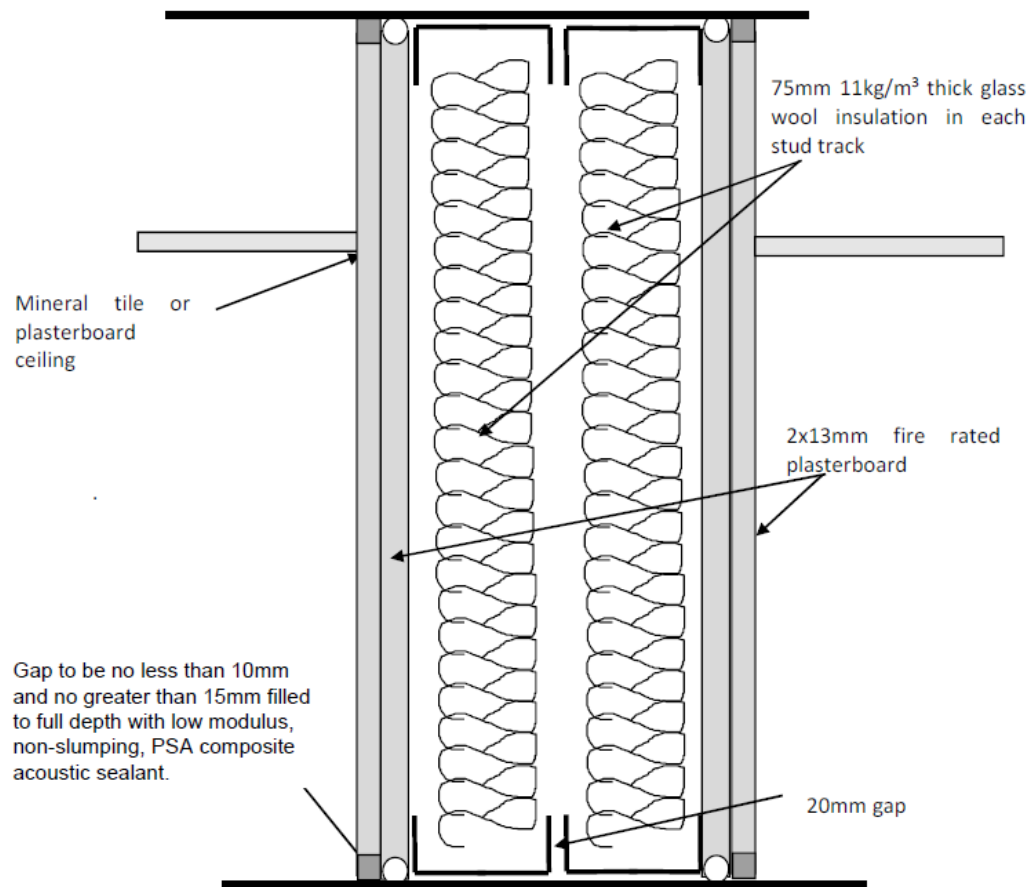


Figure 9 - Plant Room adjacent to Office/ Consult Room Wall Detail

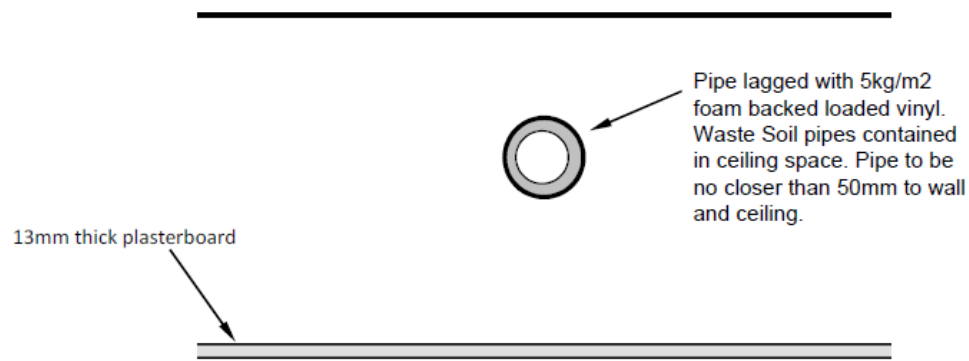


Figure 10 - Treatment of Waste and Stormwater pipes over Patient rooms, Offices, Consult/ Exam Rooms, Group rooms, Treatment rooms, Interview rooms and Meeting rooms

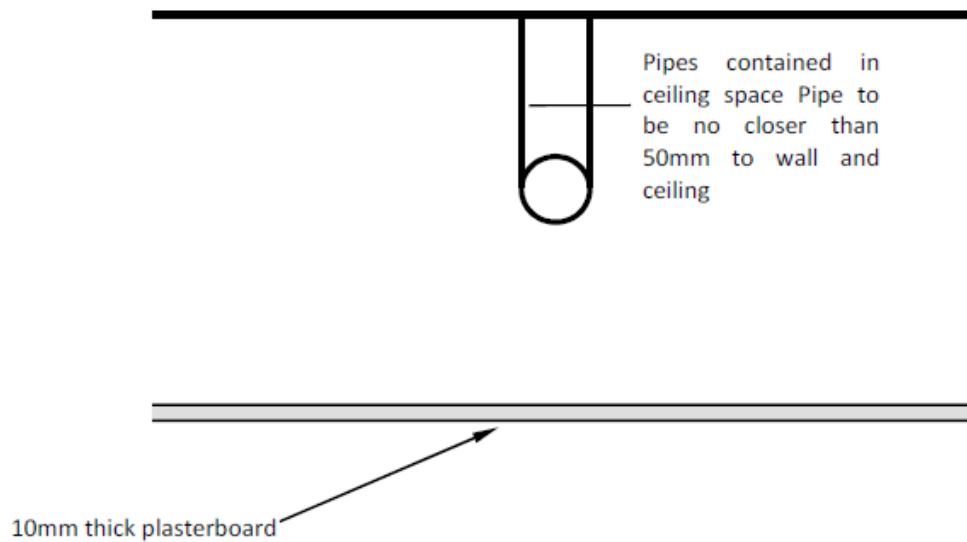


Figure 11 - Waste pipes above Wet/ Utilities areas