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Acoustic Specification

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1 APPLICATION OF THIS SPECIFICATION

The requirements or standards contained 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 requirement. Where multiple performance requirements are stated the systems installed shall comply with all requirements.

This specification has been prepared in order to meet the acoustic requirements of the following controls:

- The Building Code of Australia.

2 ARCHITECTURAL ELEMENTS

Refer to Appendix 1 for detailed drawings of all wall, floor, riser, pipework constructions recommended in this section.

2.1 WALLS

2.1.1 General Requirements

Select and install all walls to comply with the requirements of the Building Code of Australia unless this brief nominates a higher standard of treatment.

2.1.2 Minimum STC/R_w Requirements

Following is a list of minimum requirements. Refer to appendix 1 for detailed drawings.

Wall Type	BCA Requirement
Inter-tenancy Walls Dividing Wet Areas from Habitable areas	R_w+C_{tr} 50 + Discontinuous construction
Inter-tenancy Walls Dividing Habitable areas	R_w+C_{tr} 50
Inter-tenancy Walls Dividing Wet areas	R_w+C_{tr} 50
Walls Between Tenancies and Common Corridors	R_w 50
Walls Between Tenancies and Public Stairwells, etc.	R_w 50
Walls Between Tenancies and Plant Areas/Lift Shaft	R_{w+}50 + Discontinuous Construction
Walls Between Tenancies and Services Ducts/Risers	R_w+C_{tr} 40
Walls Between Bathrooms and services Ducts/Risers	R_w+C_{tr} 25

Note: *Or equivalent performance based solution

Carry out the installation of all walls/partitions in a manner that will not reduce the performance of the walls below the tabled R_w / R_w+C_{tr} 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.

2.1.3 Penetrations

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

No penetrations are to be made into the wall constructions unless specified or shown in the drawings. If a penetration is made where it is not required it should be made good.

2.1.4 Wall Junctions

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 fire rated 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.

2.1.5 Brick/Blockwork

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

Seal vertical and horizontal wall junctions/joints using a fire rated 100% polyurethane 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 100% polyurethane flexible sealant (10-15mm wide joint with minimum 10mm sealant bead depth, plus foam backing rod).

2.1.6 Sealants

Carry out sealing of joints in acoustic walls using a fire rated 100% polyurethane flexible sealant equal to Selleys Proseries Fireblock. If it is proposed to use a sealant other than that nominated, then approval must first be gained from the Acoustic Consultant.

2.1.7 Manufacturer's Recommendations

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

2.1.8 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.

2.2 FLOORS

2.2.1 General Requirements

Select and install all floors to comply with the requirements of the Building Code of Australia unless this brief nominates a higher standard of treatment.

2.2.2 Minimum STC/R_w Requirements

Following is list of minimum requirements.

Floor Type	BCA required rating
Under Apartment Habitable Rooms to Habitable Rooms in another apartment	R_w+C_{tr} 50
Under Apartment Kitchens to another apartment	R_w+C_{tr} 50
Under Apartment wet areas to another apartment	R_w+C_{tr} 50
Under Apartment Habitable Rooms to wet areas/kitchen in another apartment	R_w+C_{tr} 50

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.

2.2.3 Minimum Impact Noise Attenuation Requirements

Following is list of minimum requirements.

Floor Type	BCA Criteria	Project Criteria
Floor separating habitable rooms of sole occupancy units	$L_{ntw} + C_1 \leq 62$	IIC 50
Floor separating a sole occupancy unit from plant room, stairway, public corridor or the like	$L_{ntw} + C_1 \leq 62$	IIC 50
Floor separating wet areas of sole occupancy unit to a habitable areas below	$L_{ntw} + C_1 \leq 62$	FIIC 55
Floor separating wet areas of sole occupancy units	$L_{ntw} + C_1 \leq 62$	-

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 installation of acoustic underlays; prevention of flanking around underlay; prevention of screed/grout/tile adhesive falling between underlay sheets, prevention of contact between tiles/ screed/grout/tile adhesive and walls/joinery/kick plates/floor grates/etc; no mechanical fixing through the acoustic underlay.

A schedule of all areas requiring the application of impact isolation treatment shall be issued to the Acoustic Consultant for approval.

2.2.4 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. If a penetration is made where it is not required it should be made good.

2.2.5 Floor joints

Unless otherwise detailed in this acoustic specification, seal construction joints using a fire rated 100% polyurethane flexible sealant (10-15mm high joint with minimum 10mm sealant bead depth, plus foam backing rod).

2.2.6 Sealants

Carry out sealing of joints in floors using a fire rated 100% polyurethane flexible sealant equal to Selleys Proseries Fireblock. If it is proposed to use a sealant other than that nominated, then approval must first be gained from the Acoustic Consultant.

2.2.7 Manufacturer's recommendations

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

2.3 CEILINGS

2.3.1 General Requirements

Select and install all ceilings to comply with the requirements of the Building Code of Australia unless this brief nominates a higher standard of treatment.

2.3.2 MINIMUM R_w REQUIREMENTS

Following is list of minimum requirements. Refer to appendix 1 for acoustic details.

Ceiling Type	Minimum Rating
Apartment wet area ceilings (bath, ensuite laundry)*	R_w+C_{tr} 25 (equivalent). Constructed from one layer of 13mm plasterboard minimum 250mm below slab with 75mm thick 11kg/m^3 glass wool blanket.
Apartment ceilings outside wet areas.	R_w+C_{tr} 40 (equivalent). Constructed from one layer of 13mm plasterboard. Any pipework to be wrapped with 5kg/m^2 foam backed loaded vinyl lagging and 75mm thick 11kg/m^3 glass wool blanket laid on ceiling for 500mm either side of piping.

*Treatments based on the assumption that wet area perimeter walls run slab to slab.

Carry out the installation of all walls/partitions in a manner that will not reduce the performance of the walls below the tabled R_w / R_w+C_{tr} requirements. This includes but not limited to the proper filling of joints between sheets, sealing of joints ceiling to wall junctions.

2.3.3 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. If a penetration is made where it is not required it should be made good.

2.3.4 SEALANTS

Carry out sealing of joints in acoustic walls using a fire rated 100% polyurethane flexible sealant equal to Selleys Proseries Fireblock. If it is proposed to use a sealant other than that nominated, then approval must first be gained from the Acoustic Consultant.

2.3.5 Manufacturer's recommendations

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

2.3.6 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.

2.3.7 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.

2.4 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 R_w 30. Alternatives shall be submitted to the Acoustic Consultant for approval.

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.

2.5 DOORS

2.5.1 General Requirements

With the exception of apartment entrance doors provide acoustically rated doors where they are installed in walls required to have an acoustic rating.

2.5.2 MINIMUM REQUIREMENTS

Following is list of minimum requirements.

Door	Minimum Requirement
Apartment Entry Doors to Internal Common Areas	35mm solid core door with gaps minimised under door.
Plant Rooms	Minimum 45mm thick solid core doors set into door frames. Raven RP-10 door seals or Schlegel FSN 107S seals should be installed on top and sides with Raven RP38 or Schlegel FSN 220 seal.

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

- Ensuring 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 aluminium threshold plate under door seals where door seals close onto carpet.
- Installing seals with minimum gaps at joints/junctions.
- 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.

2.5.3 Manufacturer's recommendations

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

2.6 ACOUSTIC DETAILS

Refer to appendix 1.

3 MECHANICAL SERVICES - NOISE AND VIBRATION

Refer to Appendix 1 for detailed drawings of all constructions recommended in this section.

3.1 PROJECT NOISE AND VIBRATION 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.

Maximum noise levels in residential apartments and other areas are listed in Table 3.1 and 3.2. Areas not listed in these tables shall be designed to comply with the relevant recommended design sound level as detailed in Australian/New Zealand Standard 2107-2000 'Acoustics – Recommended design sound levels and reverberation times for building interiors'.

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.

Table 3.1 - Noise Criteria For Residential Areas

Space/Activity Type	Recommended Noise Level - dB(A)L_{eq}
Bedrooms	30 for continuously operating plant 35 for air-conditioning fan coil unit at design speed
Living, dining Room and other habitable rooms	35 for continuously operating plant 40 for air-conditioning fan coil unit at design speed
Kitchens	40
Bathrooms	45
Laundry	50

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

Table 3.2 Noise Criteria For Common and Non-Residential Areas

Space/Activity Type	Recommended Noise Level - dB(A)L_{eq}
Carpark, Carpark Lift Lobbies and Loading Docks	65
Lift Lobbies on Apartment Levels	50
Corridors Outside Apartments	45
Basement and Garbage Rooms	65

3.1.2 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.

3.1.3 EXTERNAL NOISE EMISSIONS

3.1.3.1 Property Boundaries

Noise levels emitted by the mechanical plant at all property boundaries and nearby buildings on adjacent properties are not to exceed the following, whichever is more stringent.

1. Local Council Requirements.
2. New South Wales EPA Industrial Noise Policy; and
3. Any other relevant statutory authority.

3.1.3.2 Outdoor Areas on the Development Site

Noise levels emitted by the mechanical plant to terraces, balconies and outside facades containing apartment windows on the development site to not exceed the A-weighted background noise level (i.e. the L_{90} noise level) at any time during the day or night.

3.1.4 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.

3.1.5 VIBRATION PRODUCED BY PLANT

Tactile structure vibration levels produced by the plant shall not exceed the criteria given in AS 2670.2-1990. Where the standard recommends a range of criteria for a particular occupancy, the low end of the range shall be used, except for residences where the base curve shall be used to assess vibration in all cases.

3.2 TESTING ON COMPLETION

Following installation the Sub-Contractor is to carry out noise tests to all apartments and perform external compliance measurements to confirm compliance with the criteria given in this section.

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.

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).

The sound level meter used for the noise tests shall comply with the type 2 instrument brief in AS 1259, Part 2 Sound Level Meters - Precision. Testing method shall be in accordance with AS 2107-1987 Clause 5 except that all openable windows shall be closed during the test.

If the noise or vibration levels exceed those specified carry out rectification work and remeasure noise levels to demonstrate compliance with the brief. All testing and rectification work is at the Contractor's expense.

3.3 NOISE GENERATED BY THE AIR DISTRIBUTION SYSTEM

Noise from the air distribution system shall be minimised by:

1. Selecting grilles, diffusers, dampers and accessories to meet the specified noise levels.

2. 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.

3. 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. Spigots plenum boxes should maintain the full internal cross section of the duct connecting into the plenum box.

4. Seal duct joints adequately so there is no noise resulting from air leakage.

5. Ensure plenums behind supply and exhaust grilles are correctly sized to ensure even flow over the grille/diffuser.

6. Flexible duct diameters shall be selected so as not to exceed the following velocities (including velocity at plenum spigot):

Commercial Receivers – Noise Emission Criteria

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

3.4 STRUCTURE BORNE NOISE AND VIBRATION

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

1. 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.

2. Providing isolation mounts or hangers for vibrating plant and equipment.

3. Providing inertia blocks where indicated to limit the vibration amplitude.

4. Isolating piping, electrical conduit, etc subject to vibration from the building structure.

5. Providing flexible connections where ducts and piping is connected to vibrating plant and machinery.

Submit a schedule of isolation mounts for approval by Acoustic Logic indicating make, model, rated load and static deflection, actual load and static deflection, unloaded height and fully loaded height.

3.4.1 ANTI-VIBRATION MOUNTS AND ISOLATORS

3.4.1.1 Selection Of Equipment Isolation Mounts

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

Isolator Schedule

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
Apartment fan/coil and air conditioning units	M1/H1/HE1	1.5-2 mm
Cooling Towers	M2	6mm
Boiler	M1	6 mm
Air-conditioning condenser Units	M1	2mm
Chillers / Pumps / Generator*	M4	25mm*

*Plant also to be installed on isolated plinth, as per 3.4.2.

3.4.1.2 Piping Isolation Mounts

Piping within 20m of any pump or chiller (except small diameter piping runouts to fan/coil units) shall be vibration isolated using type M4 or H2, 25mm static deflection isolators for piping fixed to the plant room floor slab or walls of the apartments; 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 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.

Isolate piping within 20m of any cooling towers or any other main piping runs fixed to the walls of the apartments using type M3/H1, 10mm static deflection mounts.

3.4.1.3 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. Rubber grommets (rubber sleeve around fixing bolt) to be used to prevent direct contact between fan fixing plate and bolt (which itself is fixed into slab).

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.

3.4.1.4 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.

3.4.2 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.

Chillers and pumps are to be mounted on strip plinths which are themselves are isolated from the structural slab using 10mm Vibramat acoustic matting.

3.4.3 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.

3.5 PENETRATIONS

3.5.1 GENERAL

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

1. Decrease the required sound rating isolation rating of the wall, floor, ceiling, etc.
2. 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 having an acoustic rating as required by the Building Code of Australia 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, with a ninety degree 25mm internally insulated sheet metal plenum box fitted over the exhaust grilles.

3.5.2 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.

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

3.5.3 DUCT PENETRATIONS

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

SPACES	WALL/FLOOR CONSTRUCTION	SEAL TYPE
All	Masonry	Type DA or DB seal
All	Plasterboard	Type DC

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

3.5.4 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.

3.6 SILENCERS AND INTERNALLY LINED DUCTING - GENERAL

3.6.1 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/m^3. Lining acoustic absorption shall exceed the following performance when measured in accordance with AS 1045-1988:

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

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.

3.6.2 Flexible Ducting

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

3.7 SILENCERS

3.7.1 Performance

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

3.7.2 Construction

3.7.2.1 General

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

1. 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.

2. 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.

3. 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 exceedences 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.

3.7.2.2 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.

3.7.2.3 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 Bradford Ultraphon or equal insulation with factory applied weatherproof acoustically transparent facing.

3.8 ELECTRICAL

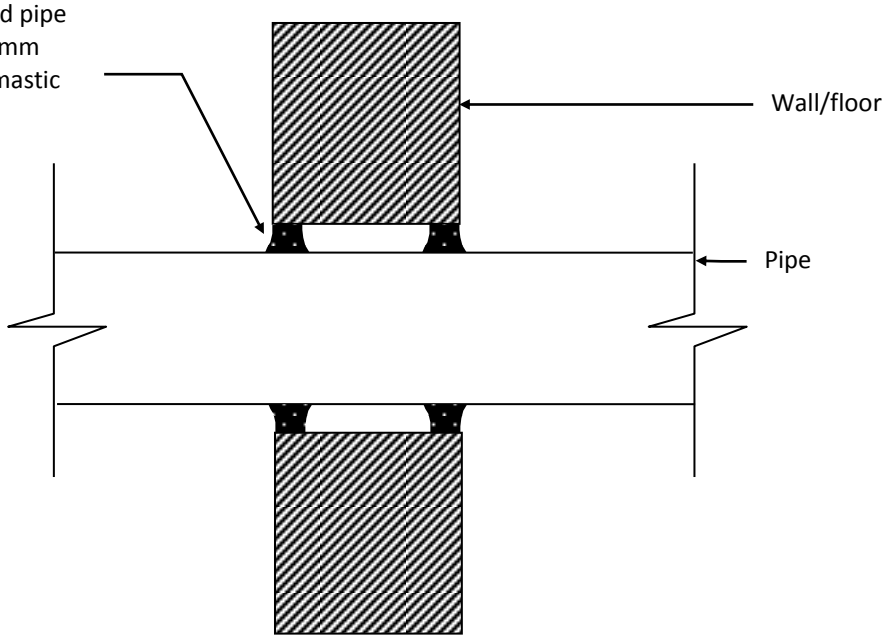
3.8.1 BELT DRIVEN PLANT

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.

3.8.2 CONTACTORS/STARTERS/CONTROLLERS

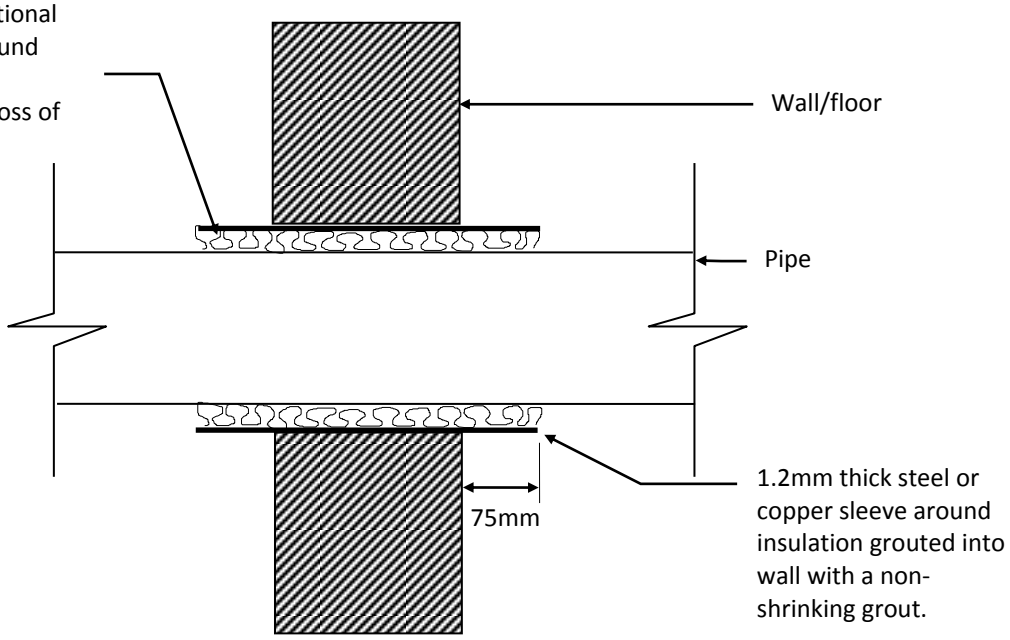
Noise from contactors, starters and controllers shall be inaudible inside rooms having a noise of 45dB(A) or lower, on adjacent properties and on residential terraces/external spaces. Provide enclosures around these items and/or vibration isolate the items from building elements where they may give rise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

10-15mm clear gap around pipe filled for min. depth of 12mm with non-setting flexible mastic similar to Selleys Proseries Fireblock.

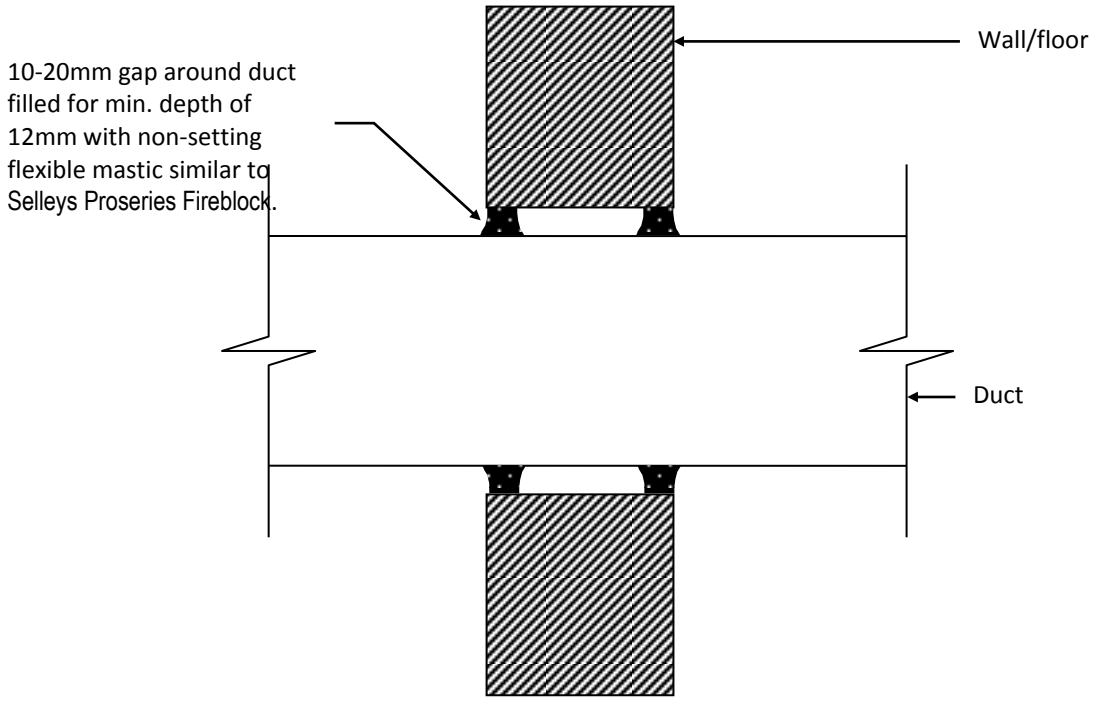


TYPE PA PIPE SEAL

25mm thick rockwool sectional pipe sleeve insulation around pipe Rockwool is to be encapsulated to prevent loss of fibres.

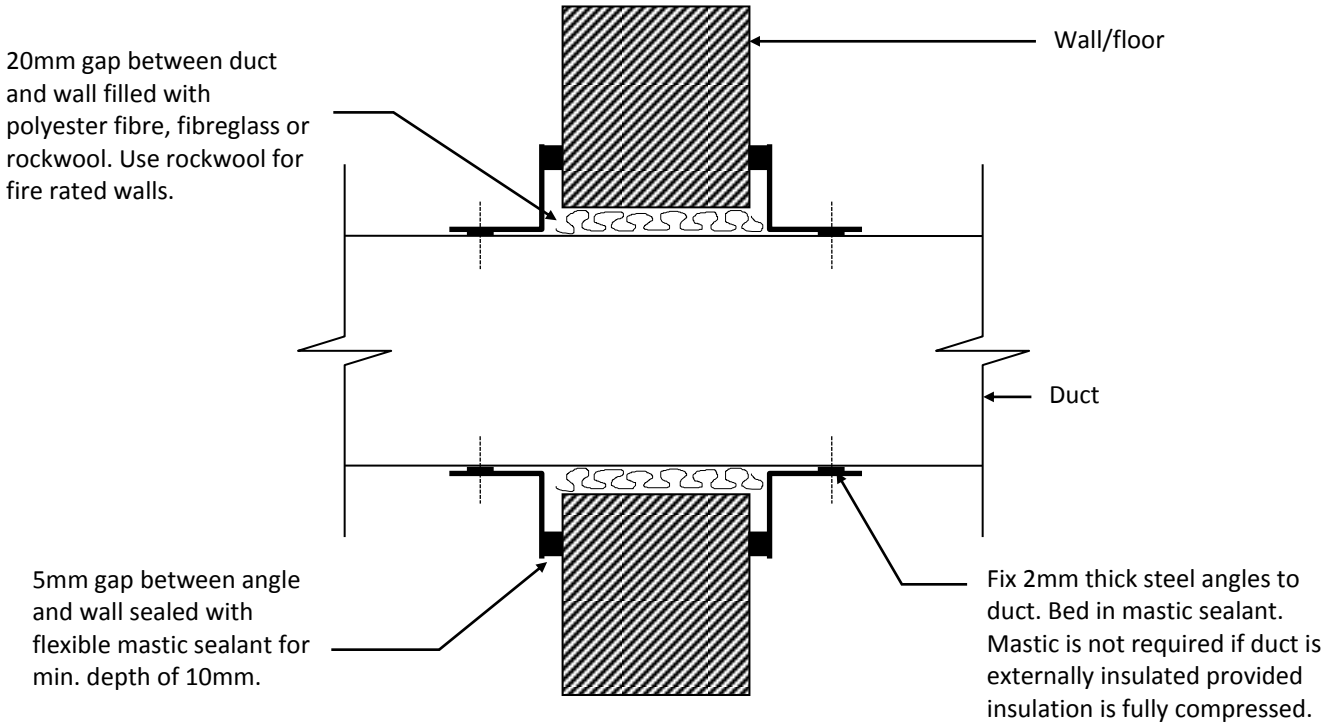


TYPE PB PIPE SEAL



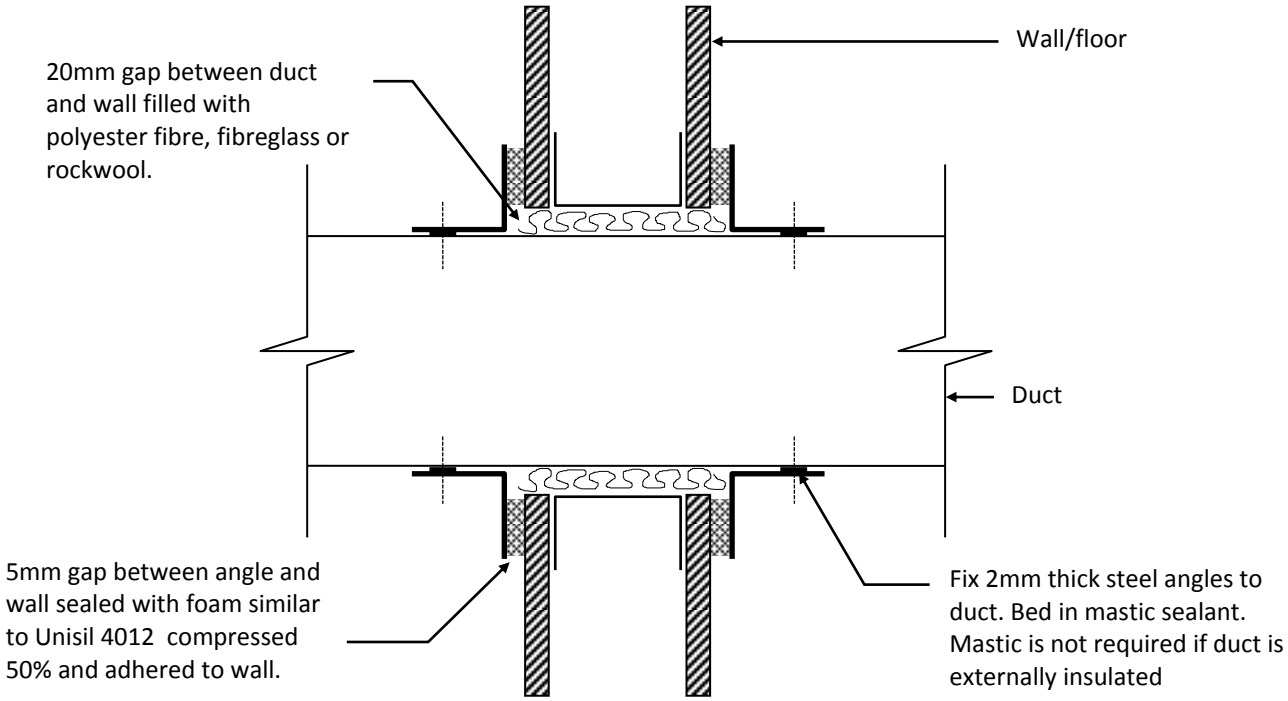
TYPE DA DUCT SEAL

(Note: Typical fire damper detail is also adequate provided any gaps are sealed with Selleys Proseries Fireblock)



TYPE DB DUCT SEAL

(Note: Typical fire damper detail is also adequate provided flange is sealed to wall with Selleys Proseries Fireblock)



TYPE DC DUCT SEAL

(Note: Typical fire damper detail is also adequate for fire rated walls provided flange is sealed to wall with Selleys Proseries Fireblock)

3.9 SPECIFIC TREATMENT TO PLANT ITEMS

Mechanical plant items are not typically selected at selected at DA stage as selection of plant and equipment has not been conducted at this time.

Detailed review of all external mechanical plant will be undertaken at construction certificate stage (once plant selections and locations are finalised). Acoustic treatments should be determined in order to control plant noise emissions to the levels set out in section 3.1 of this report.

All plant can be satisfactorily attenuated to levels complying with noise emission criteria through appropriate location and (if necessary) standard acoustic treatments such as noise screens, enclosures, in-duct treatments (silencers/lined ducting) or similar. Experiences with similar developments indicate that suitable acoustic treatments are both possible and practical.

4 HYDRAULIC SERVICES - NOISE AND VIBRATION

Refer to Appendix 1 for detailed drawings of all constructions recommended in this section.

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 PROJECT NOISE AND VIBRATION 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 residential apartments and other areas are listed in Table 4.1 and Table 4.2. Areas not listed in these tables shall be designed to comply with the relevant recommended design sound level as detailed in Australian/New Zealand Standard 2107-2000 'Acoustics – Recommended design sound levels and reverberation times for building interiors'.

Allow for any additional treatment to fully comply with the internal and external noise level requirements notwithstanding the equipment noise ratings indicated or the acoustic treatments indicated in the hydraulics services specification or drawings.

Table 4.1 - Noise Criteria For Residential Areas

SPACE/ACTIVITY TYPE	NOISE LEVEL dB(A)L_{eq}
Bedrooms	30
Living, dining Room and other habitable rooms	35
Kitchens	40
Bathrooms	45
Laundry	50

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

Table 4.2 - Noise Criteria For Common and Non-Residential Areas

SPACE/ACTIVITY TYPE	NOISE LEVEL dB(A)L_{eq}
Commercial Space	**45**
Retail	**50**
Indoor Pool / Gym	45
Carpark, Carpark Lift Lobbies and Loading Docks	65
Lift Lobbies on Apartment Levels	50
Corridors Outside Apartments	45
Basement and Garbage Rooms	65

4.2.2 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.

4.2.3 EXTERNAL NOISE LEVELS

4.2.3.1 Property Boundaries

Noise levels emitted by the plant at all property boundaries and nearby buildings on adjacent properties shall be treated to ensure background noise levels are not increased any time, day or night. In addition they shall also achieve the following whichever is more stringent.

1. Local Council Requirements.
2. New South Wales EPA Industrial Noise Policy; and
3. Any other relevant statutory authority.

4.2.3.2 Outdoor Areas On The Development Site

Noise levels emitted by the plant to terraces, balconies and outside facades containing apartment windows on the development site shall not exceed the A-weighted background noise level (i.e. the L_{90} noise level) at any time during the day or night.

4.2.4 PLANT NOISE LEVELS

The contractor shall ensure 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.

4.2.5 VIBRATION PRODUCED BY PLANT

Tactile structure vibration levels produced by the plant shall not exceed the criteria given in AS 2670.2-1990. Where the standard recommends a range of criteria for a particular occupancy, the low end of the range shall be used, except for residences where the base curve shall be used to assess vibration in all cases.

4.3 TESTING ON COMPLETION

Following installation, the Sub-Contractor is to carry out as a minimum noise and vibration level tests to all apartments adjacent to plant rooms, plus a minimum of a further 10% of the remaining apartments randomly selected and covering all typical apartment layouts, internal and external compliance measurements to confirm compliance with the criteria given in this Section.

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.

The sound level meter used for the noise tests shall comply with the type 2 instrument brief in AS 1259, Part 2 Sound Level Meters - Precision. Testing method shall be in accordance with AS 2107-1987 Clause 5 except that all openable windows shall be closed during the test.

If the noise or vibration levels exceed those specified carry out rectification work and remeasure noise levels to demonstrate compliance with the brief. All testing and rectification work is at the Contractor's expense.

4.4 NOISE GENERATED BY THE HYDRAULICS SYSTEM

Noise from the hydraulics system should be minimised by:

1. Limiting pipe velocities in water systems to not more than 1.5m/s.

2. 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.

3. Selecting valves and fittings that minimise the generation of noise.

4. Installing pressure reducing stations as required to eliminate excessive pressure at the terminal valves.

5. 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.

6. Routing piping to avoid noise sensitive locations such as apartment bedrooms and living rooms.

7. Provision of water hammer arrestors in reticulation piping to dishwashers and washing machines.

8. Fixing piping and caulking stud penetrations to prevent pipe movement within studwork.

9. Locate waste pipes floor penetrations so that they do not fall within or near sound rated walls.

10. Do not run piping along the head of walls, orin front of the head of sound rated walls that prevents access to the wall for caulking.

4.5 STRUCTURE BORNE NOISE AND VIBRATION

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

1. 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.

2. Providing isolation mounts or hangers for vibrating plant and equipment.

3. Providing inertia blocks where required to limit the vibration amplitude.

4. Isolating piping, electrical conduit, etc subject to vibration from the building structure.

5. Providing flexible connections where piping is connected to vibrating plant and machinery.

6. Where pipes is 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

4.5.1.1 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.

4.5.1.2 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.

4.5.2 ANTI-VIBRATION MOUNTS AND ISOLATORS

4.5.2.1 Selection Of Equipment Isolation Mounts

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

Isolator Schedule

PLANT	ISOLATOR TYPE	MINIMUM STATIC DEFLECTION
Basement Pumps	M3	10 mm
Pumps	M4	25 mm
Water tanks	M1/H1/HE1	2mm
Boilers	M2	6 mm
Hot water units	M2	6mm
Electric Fire Pumps	M3	10mm
Diesel Fire Pumps	M4	25mm

4.5.2.2 Piping Isolation Mounts

Piping within 20m of any pump shall be vibration isolated using type M4 or H2, 25mm static deflection isolators for piping fixed to the plant room floor slab or walls of the apartments; 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 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.

4.5.2.3 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 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.

4.5.2.4 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.

4.5.3 EQUIPMENT BASES

Pumps shall be installed on concrete plinth which itself is isolated from the structural slab on a layer of 10mm thick Vibramat 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.

4.5.4 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

Pipe and electrical penetrations through walls, floors etc shall not:

1. Decrease the sound rating isolation rating of the wall, floor, etc.

2. 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

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

4.6.3 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.

4.6.4 Location of Penetrations in Acoustically Rated Walls

Where possible where pipes and cables running though 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.

4.6.5 Waste and Stormwater Pipes

Unless a higher standard is specified, all waste pipes shall be treated to comply with the requirements of the Building Code of Australia.

The following schedule lists the required minimum acoustic treatment to piping. **Refer to appendix 1 for detailed drawings of the systems described below.**

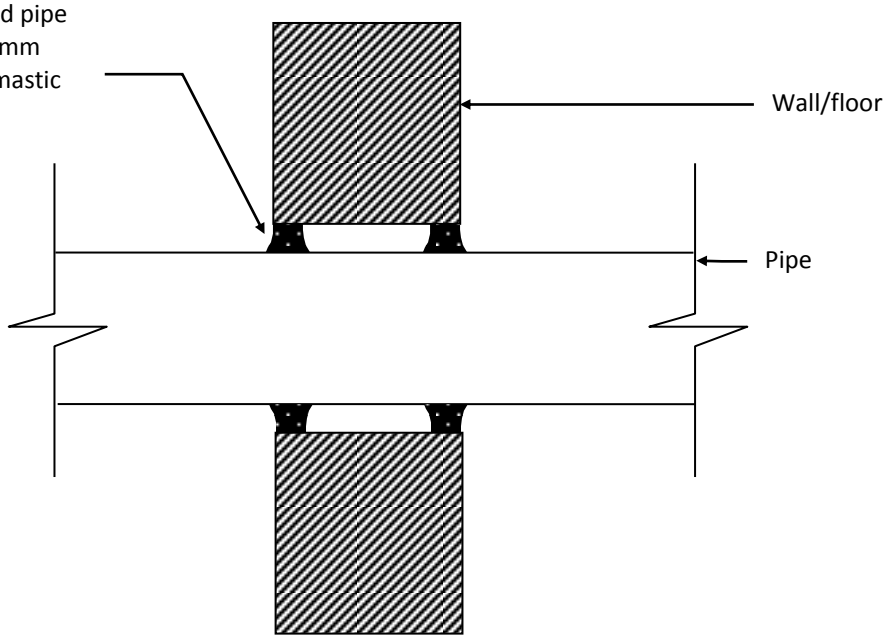
Waste and Stormwater Pipes Generally

Service	Location	Pipe Treatment
Waste and Stormwater Piping (including siphonic piping)	Bathroom Ceiling	Pipes wrapped with5 kg/m^2 loaded vinyl / 25mm thick foam sandwich
	Laundries Generally	Pipes wrapped with5 kg/m^2 loaded vinyl / 25mm thick foam sandwich.
	Apartment ceiling outside bathrooms and laundries	Pipes wrapped with5 kg/m^2 loaded vinyl / 25mm thick foam sandwich and 50mm thick glass wool insulation laid in ceiling cavity in one metre band directly below pipe run.
	Common areas and common corridors	Nil

Pipes required to be externally lagged using 5 kg/m^2 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 that 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 Selleys Proseries Fireblock. Lagging shall be equal to Vibralag from Acoustic Supplies.

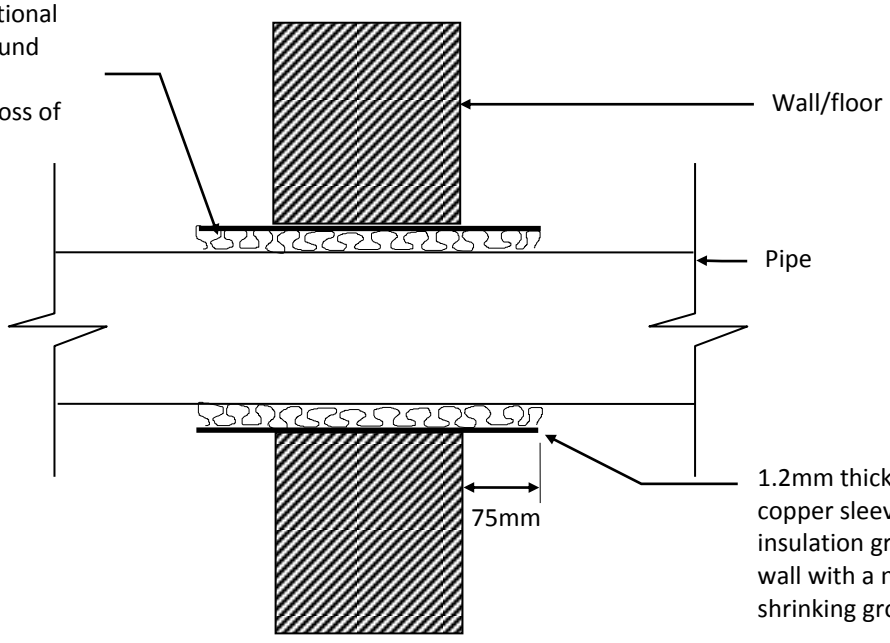
All waste/stormwater pipes/lagging shall be kept a minimum of 20mm clear of any part of the structure including walls, ceilings, ceiling hangers, etc. Waste pipe penetrations shall be sealed as recommended above for pipe penetrations. Mortar or render shall be kept clear of the penetrations so as to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

10-15mm clear gap around pipe filled for min. depth of 12mm with non-setting flexible mastic similar to Selleys Proseries Fireblock 1.



TYPE PA PIPE SEAL

25mm thick rockwool sectional pipe sleeve insulation around pipe Rockwool is to be encapsulated to prevent loss of fibres.



1.2mm thick steel or copper sleeve around insulation grouted into wall with a non-shrinking grout.

TYPE PB PIPE SEAL

4.7 ELECTRICAL

4.7.1 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.

4.7.2 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 – NOISE AND VIBRATION

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 GPOs 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.. In hebel walls – box is not required on direct stick side of wall.

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.

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).

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 30dB(A) when measured in bedroom and 35dB(A) in a living room. Lift motors and associated equipment shall be vibration isolated.

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 on this project it is required that any auditory lift call system must be low in volume and dull in nature.

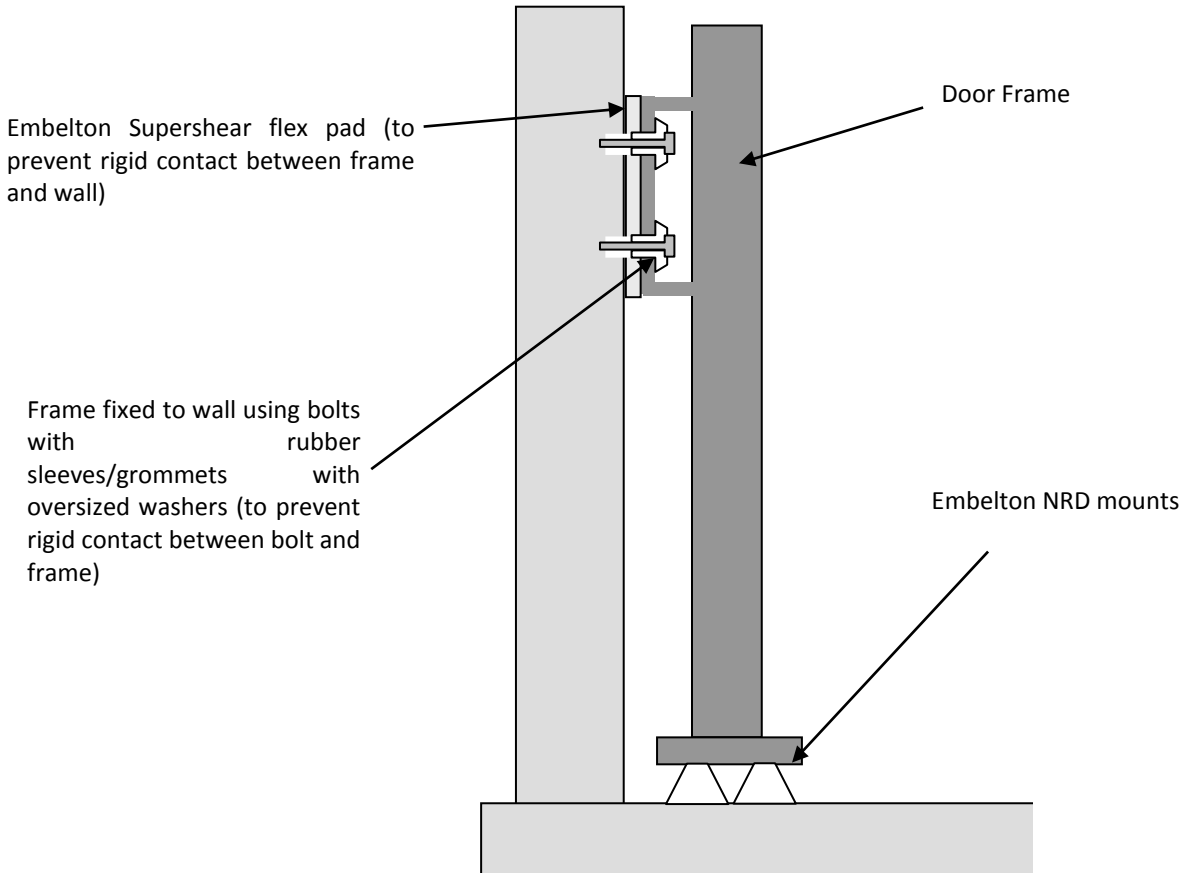
6.3 NOISE WITHIN LIFT CAR

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

7 GARAGE DOOR – NOISE AND VIBRATION

Vibration from the operation of automatic doors shall be vibration isolated from the building structure so as to prevent door operation from being audible within occupied spaces.

Doors shall be quiet in operation and should be isolated from the building structure as illustrated below. Ensure that no part of the garage door frame (including any cover plates) contacts the building structure. Install Teflon guides install in all rails, ensure that door panels do not rattle and the operation of any door guides, rollers, etc is smooth. Door guides should be fitted with vibration isolated fixings where fixed into structure as detailed above.



Door motors shall be fitted with a soft start/stop controller to minimise noise while the door shall be stopped approximately 5 mm from the slab/ground to ensure the base of the door does not contact the concrete surface. Door motor, if fixed to building structure, to be fixed using Embelton NRD mounts/hangers or equal.

8 GARBAGE CHUTES

Structure-borne noise from garbage chutes is generated by objects falling through the chute striking the sides of the chute. This impact causes vibration in the chute walls, which transmits through the building structure and is heard as noise.

To limit this source of noise, the garbage chutes shall be resiliently attached to the building structure. This can be achieved in the following manner, namely;

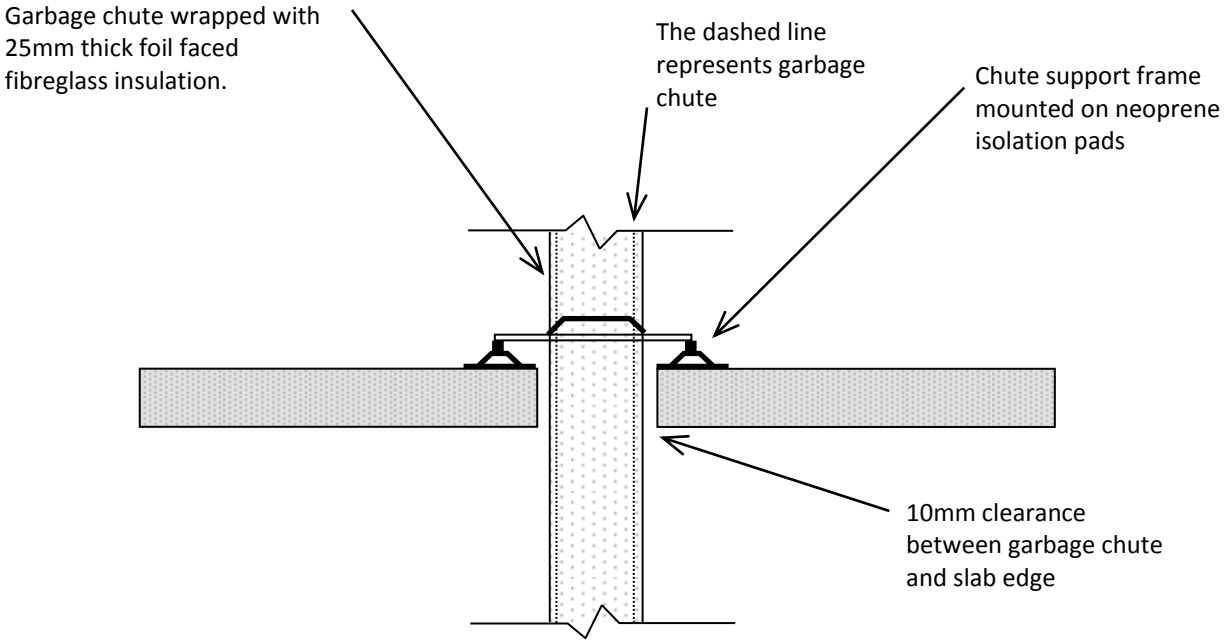
1. The isolation brackets used to support the chute should be set on neoprene isolation mounts. The mounts should be designed to have a maximum static deflection of 5mm when fully loaded.

2. Garbage chutes are normally contained in a fire rated compartment within the building. Hence, there is no requirement to seal the slab penetrations where the chute passes from floor to floor. In order to control the transmission of structure-borne noise a 10mm gap should be left around the entire perimeter of the chute.

3. Alternatively, if it is required to seal the slab penetrations, then a resilient fire rated mastic compound, such as Selleys Proseries Fireblock should be used. This should be applied to a 10mm gap, fitted with a backing rod.

4. The garbage chute should be externally wrapped with 25mm thick foil faced fibreglass insulation or other dampening material.

A schematic representation of the proposed treatment is shown below:



9 ENVIRONMENTAL NOISE CONTROL – GLAZING & BUILDING SHELL CONSTRUCTION

The determination of an acceptable level of traffic noise within the residential spaces requires consideration of the activities carried out within the space and the degree to which noise will interfere with those activities

As sleep is the activity most affected by traffic noise, bedrooms are the most sensitive rooms. Higher levels of noise are acceptable in living areas without interfering with activities such as reading, listening to television, etc. Noise levels in utility spaces such as kitchens, bathrooms, laundries, etc can be higher.

Table 3 – Indoor Design Sound Levels for Aircraft Noise Reduction Assessment

Type of Occupancy	Space	Recommended Design Sound Level
Residential developments	Sleeping Areas (Night time only 10pm – 7am)	40 dB(A)$L_{eq(9hr)}$
	Living Areas (15 hrs a day)	45 dB(A)$L_{eq(15hr)}$

9.1 RECOMMENDED CONSTRUCTIONS

The recommended glazing assemblies for the apartment are indicated in the Table below. The glazing thicknesses recommended are those needed to satisfy acoustic requirements and do not take into account other requirements such as structural, safety or other considerations. These additional considerations may require the glazing thickness to be increased beyond the acoustic requirement.

Façade Location	Room Type	Glazing Thickness	Acoustic Seals
Northern Façade	Bedroom	10.38mm laminated	Yes
	Living Rooms	6.38mm laminated	
	Wet Areas	6mm float	
Eastern Façade	Bedroom	10.38mm laminated	
	Living Rooms	6.38mm laminated	
	Wet Areas	6mm float	
Southern Façade	Bedroom	6.38mm laminated	
	Living Rooms	6.38mm laminated	
	Wet Areas	6mm float	
Western Façade	Bedroom	6.38mm laminated	
	Living Rooms	6.38mm laminated	
	Wet Areas	6mm float	

In addition to complying with the minimum scheduled glazing thickness, the STC rating of the glazing fitted into operable frames and fixed into the building opening should not be lower than the values listed in the table below. Where nominated, this will require the use of acoustic seals equal to Schlegel Q-lon series *(acoustic bulb seal)* around the full perimeter of operable frames. The frame will need to be sealed into the building opening using a flexible 100% polyurethane sealant equal to Selleys Proseries Fireblock. Note that mohair seals and/or mohair/plastic fin combination seals in windows and doors are **not** acceptable where acoustic seals are required.

It is recommended that only window systems have test results indicating compliance with the required ratings obtained in a certified laboratory be used where windows with acoustic seals have been recommended.

Glazing Assembly	Acoustic Seals	Minimum STC of Installed Window
6mm Float	Yes	29
6.38mm Laminated	Yes	30
10.38mm Laminated	Yes	35

9.1.1 External Walls

External masonry walls do not require any additional acoustic treatment. There should not be vents on the internal skin of external walls. All penetrations in the internal skin of external walls should be acoustically sealed.

9.1.2 Roof

The proposed concrete roof is sufficient to control traffic noise intrusion therefore no additional acoustic treatment is required.

9.2 ACOUSTIC SEALING OF WINDOW FRAMES

Where glazing is required to achieve a nominated acoustic performance the perimeter of the window frame shall be acoustically sealed into the window opening so there is no leakage of noise between the window frame and the building opening. The sealing method selected shall take into account and allow for any movement of the window frame relative to the building opening and so that the acoustic performance is maintained.

One of the following two methods shall be used to seal the gap between the window and the building opening. These shall be followed even if there is internal or external cladding butting against the window frame.

Method 1

A 10-15mm wide gap shall be left between the window frame and the building opening.

The gap between the window frame and the building opening shall be caulked with an elastomeric sealant having a cured density of not less than 1000 kg/m^3. Minimum 10mm thick caulking shall be applied near the external face of the mullion with additional 10mm thick caulking near the inner face.

Provide backing rods and bond breaker tapes as specified or required by sealant manufacturer.

If the gap between the mullion and the building opening exceeds 15mm the gap shall be packed with 8 kg/m^3 fibreglass or polyester fibre insulation.

Method 2

A 10-15mm wide gap shall be left between the window frame and the building opening. This gap shall be covered with 3mm thick aluminium angles for all 12.38mm thick (or greater) single glazing, and 1.5mm thick angles for single glazing less than 12.38mm thickness.

The flange of the angle sections shall seat onto the building opening, and the other flange shall seat onto the window mullion. The angle flanges should be fixed in position, with the faces of the flanges seating against the mullion and building opening bedded in flexible sealant to seal all gaps.

One set of angles is required on the inside face of the window and one set is required on the outside face of the window frame.

If the gap between the mullion and the building opening exceeds 15mm the gap shall be packed with 8 kg/m^3 fibreglass or polyester fibre insulation.

9.2.1 Sprinkler Pipes

The following treatment is required where sprinkler pipes are required to penetrate the cover/in-fill plate between the mullion and the building opening at the top of windows, in rooms required to have a sound rating.

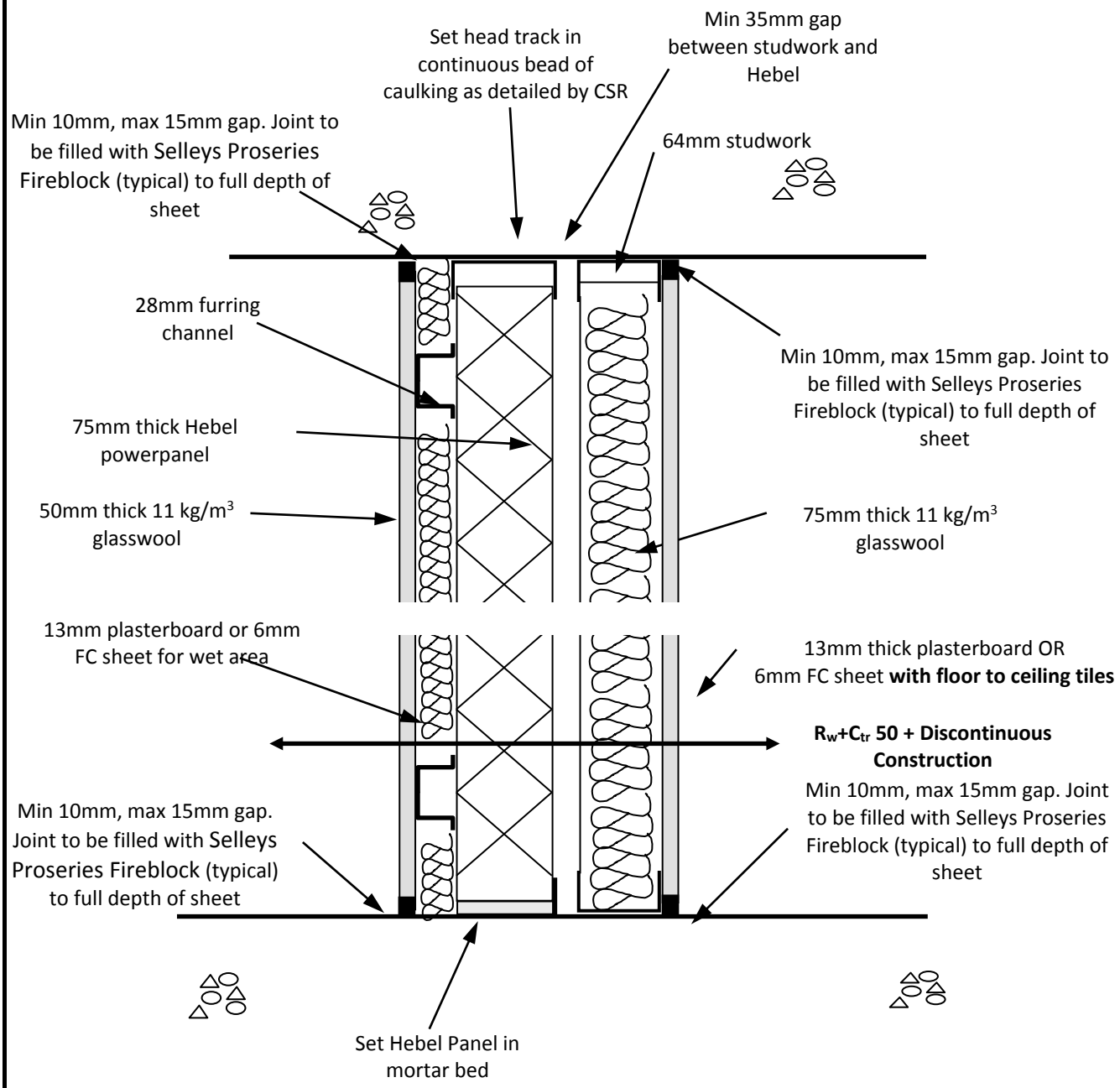
1. The cover/in-fill plate where the pipes pass through shall be min. 3mm thick aluminium for all double glazing and 10.38mm thick single glazing, and 1.5mm thick for single glazing less that 10.38mm thickness. One cover/in-fill plate shall be provided on the external face of the mullion and one cover/in-fill plate shall be provided on the inside face of the window mullion.

2. The cover/in-fill plate should seat against flanges fixed into the building opening and onto the window mullion. All gaps shall be fully sealed using a flexible sealant.

3. A 2-5mm wide gap should be left around the sprinkler pipe that shall be fully caulked on both cover/in-fill plates between the window frame and the building opening using a flexible sealant.

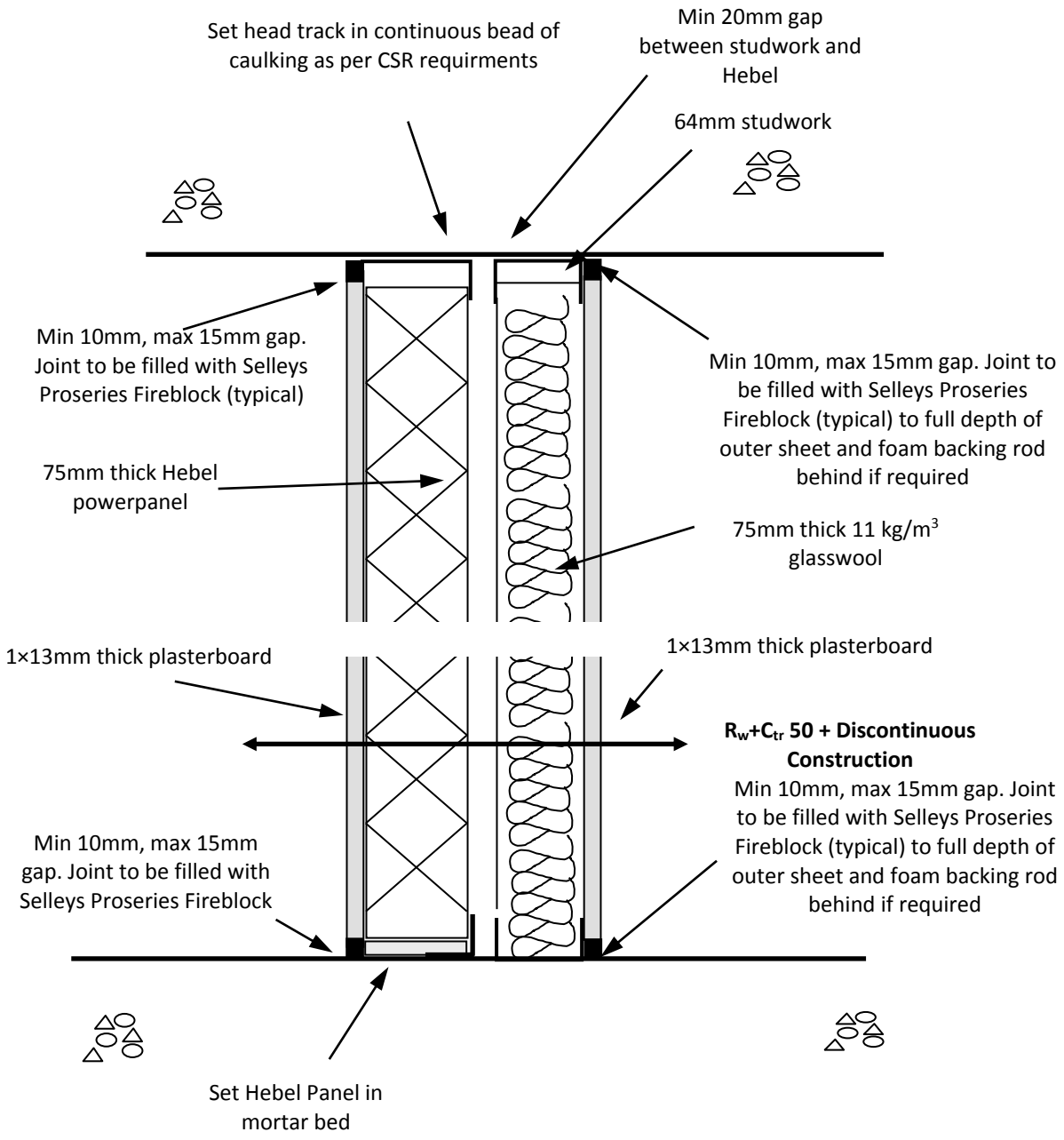
   The gap between the mullion and the building opening shall be packed with 8 kg/m^3 fibreglass or polyester fibre insulation.

Appendix 1 - Acoustic Details



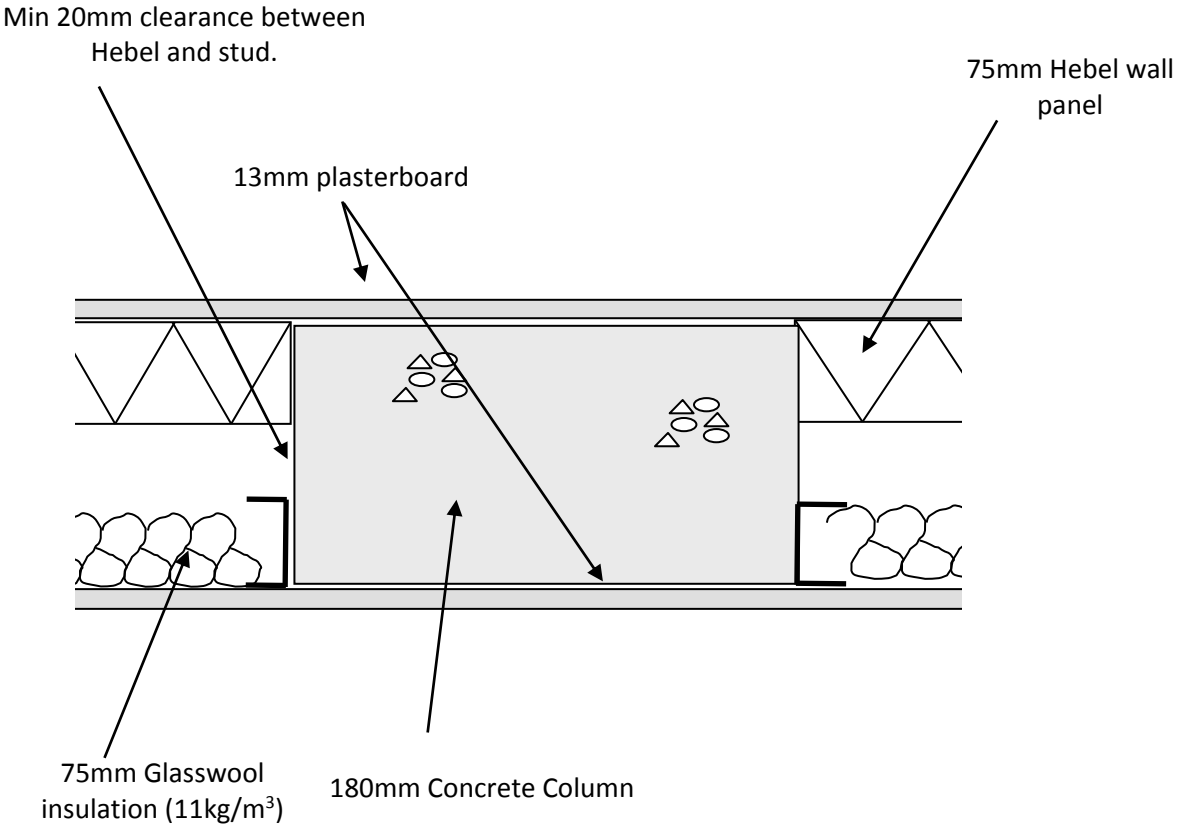
INTER-TENANCY WALL **R_w +C_{tr} 50**	**Acoustic Logic Consultancy Pty Ltd** 9 Sarah Street, Mascot **Tel: 8338 9888 Fax: 8338 8399**
	1 VILLAWOOD PLACE, VILLAWOOD

Date:	**Drawn:**	**Checked:**	**Project No:**	**Drawing No:**
April, 2015	MAS	BW	20141421.1	AC001a
Issue	**Scale:**	**Approved**		
R0	NTS	BW		



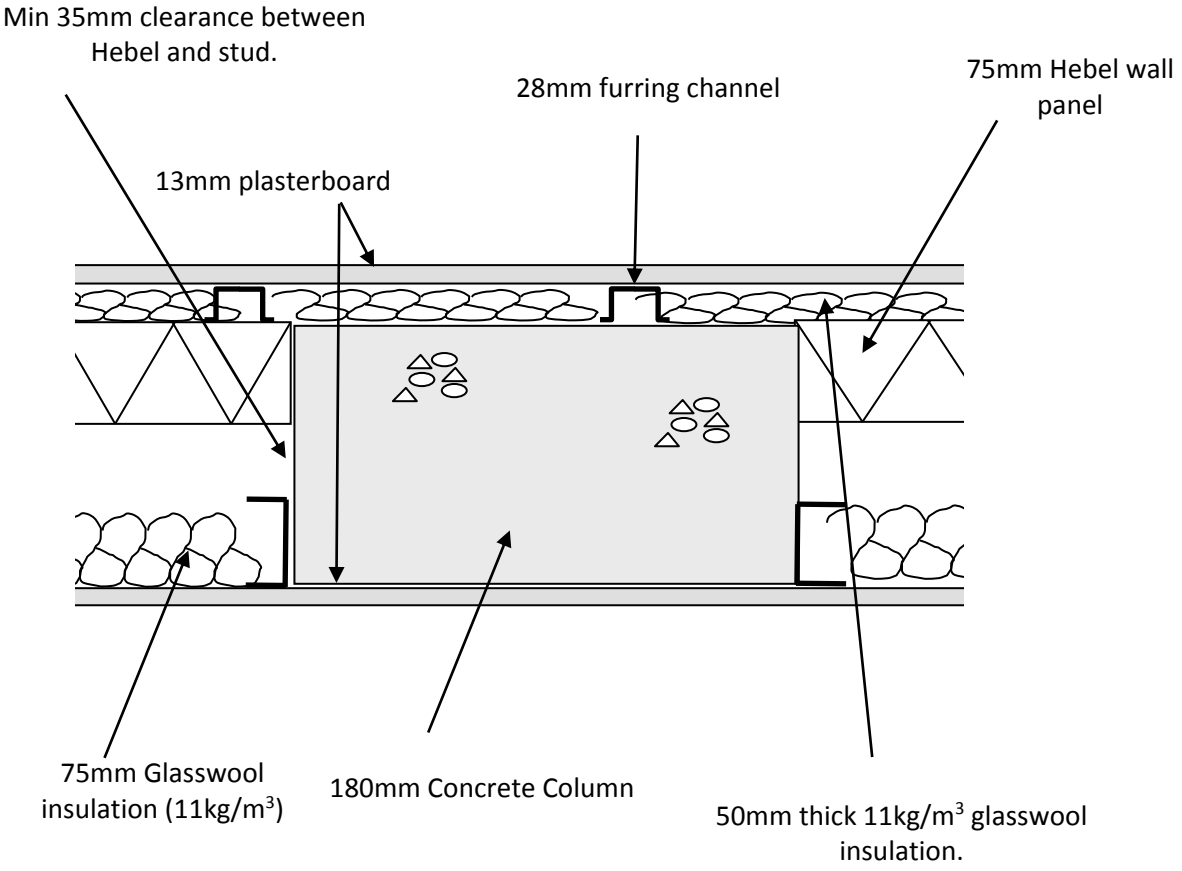
INTER-TENANCY WALL **R_w +C_{tr} 50**	**Acoustic Logic Consultancy Pty Ltd** 9 Sarah Street, Mascot **Tel: 8338 9888 Fax: 8338 8399**
	1 VILLAWOOD PLACE, VILLAWOOD

Date:	**Drawn:**	**Checked:**	**Project No:**	**Drawing No:**
April, 2015	MAS	BW	20141421.1	AC001b
Issue	**Scale:**	**Approved**		
R0	NTS	BW		



Note: Any downpipes cast into the column to be wrapped in 4mm Softlon 3000 with minimum 30mm concrete cover

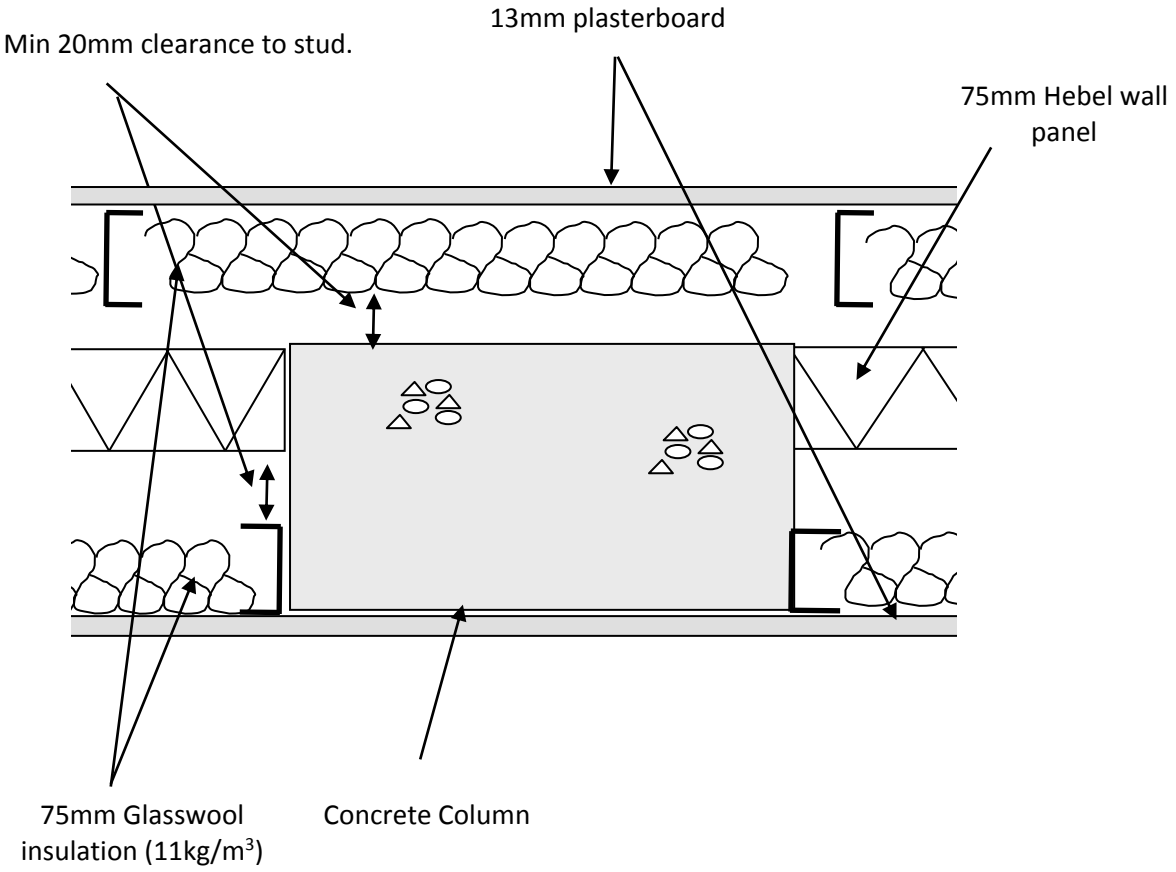
Inter-Tenancy Wall/Column Detail **(Habitable Area to Habitable Area OR Wet Area to Wet Area)**			**Acoustic Logic Consultancy Pty Ltd** 9 Sarah Street, Mascot **Tel: 8338 9888 Fax: 8338 8399** **1 VILLAWOOD PLACE, VILLAWOOD**	
Date:	**Drawn:**	**Checked:**	**Project No:**	**Drawing No:**
April, 2015	MAS	BW	20141421.1	AC002a
Issue	**Scale:**	**Approved**		
R0	NTS	BW		



Note: Any downpipes cast into the column to be wrapped in 4mm Softlon 3000 with minimum 30mm concrete cover

Inter-Tenancy Wall/Column Detail **(Habitable Area to Habitable Area OR Wet Area to Wet Area)**			**Acoustic Logic Consultancy Pty Ltd** 9 Sarah Street, Mascot **Tel: 8338 9888 Fax: 8338 8399**	
			1 VILLAWOOD PLACE, VILLAWOOD	
Date:	**Drawn:**	**Checked:**	**Project No:**	**Drawing No:**
April, 2015	MAS	BW	20141421.1	AC002b
Issue	**Scale:**	**Approved**		
R0	NTS	BW		

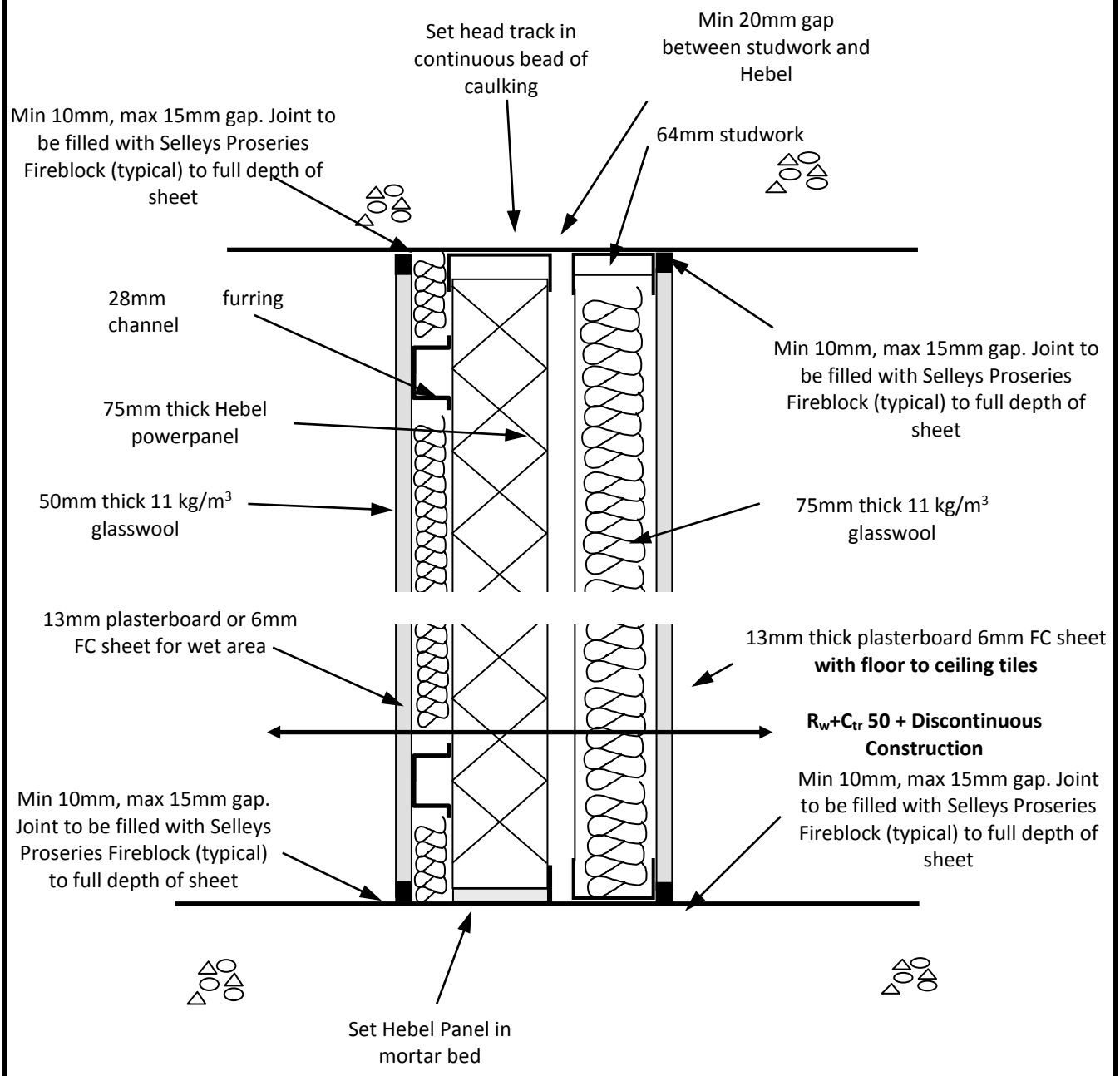
WET AREA



HABITABLE AREA

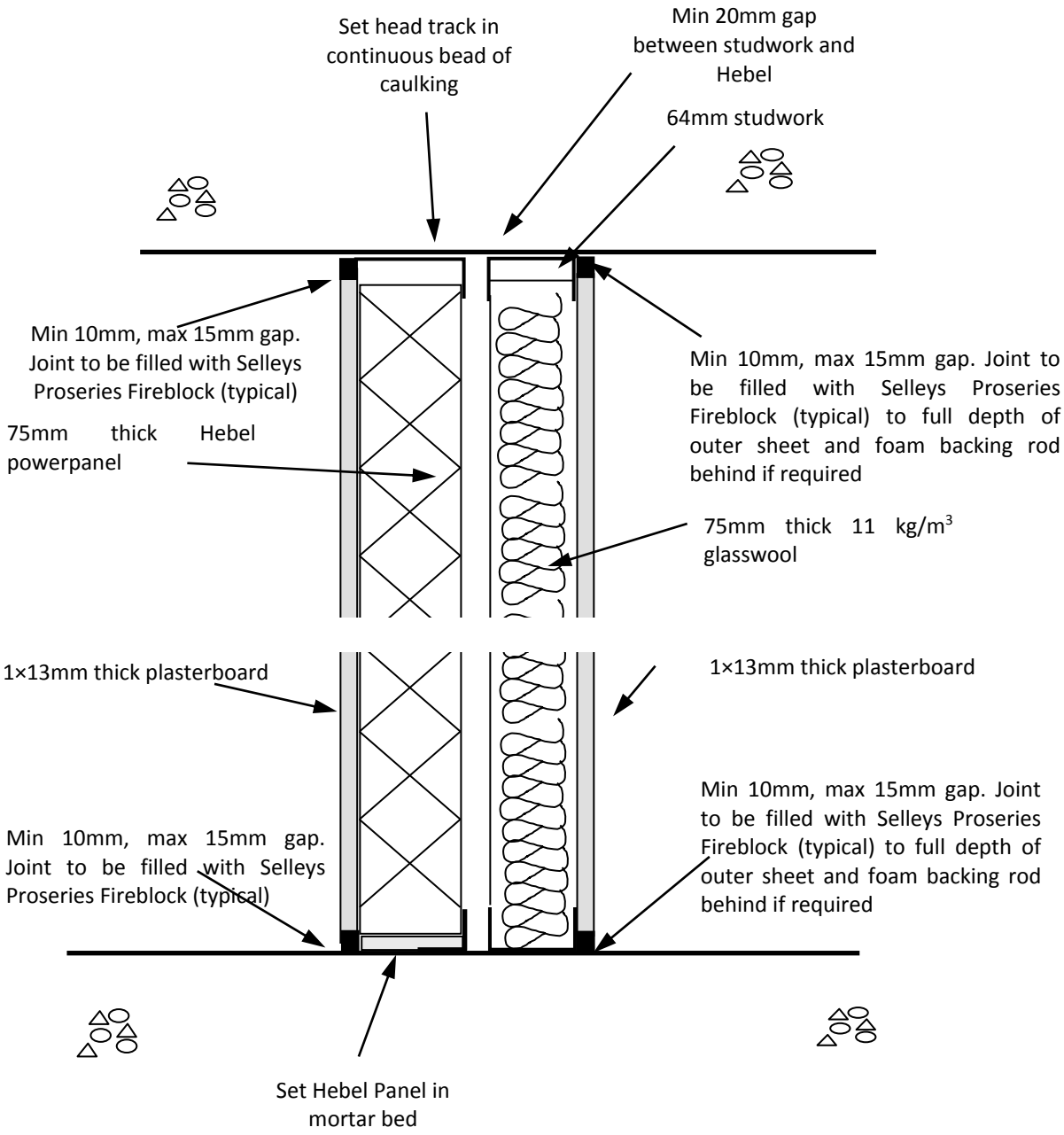
Inter-Tenancy Wall/Column Detail **Habitable Area to Wet Area (Discontinuous Construction)**	**Acoustic Logic Consultancy Pty Ltd** 9 Sarah Street, Mascot **Tel: 8338 9888 Fax: 8338 8399** **1 VILLAWOOD PLACE, VILLAWOOD**

Date:	**Drawn:**	**Checked:**	**Project No:**	**Drawing No:**
April, 2015	MAS	BW	20141421.1	AC002c
Issue	**Scale:**	**Approved**		
R0	NTS	BW		



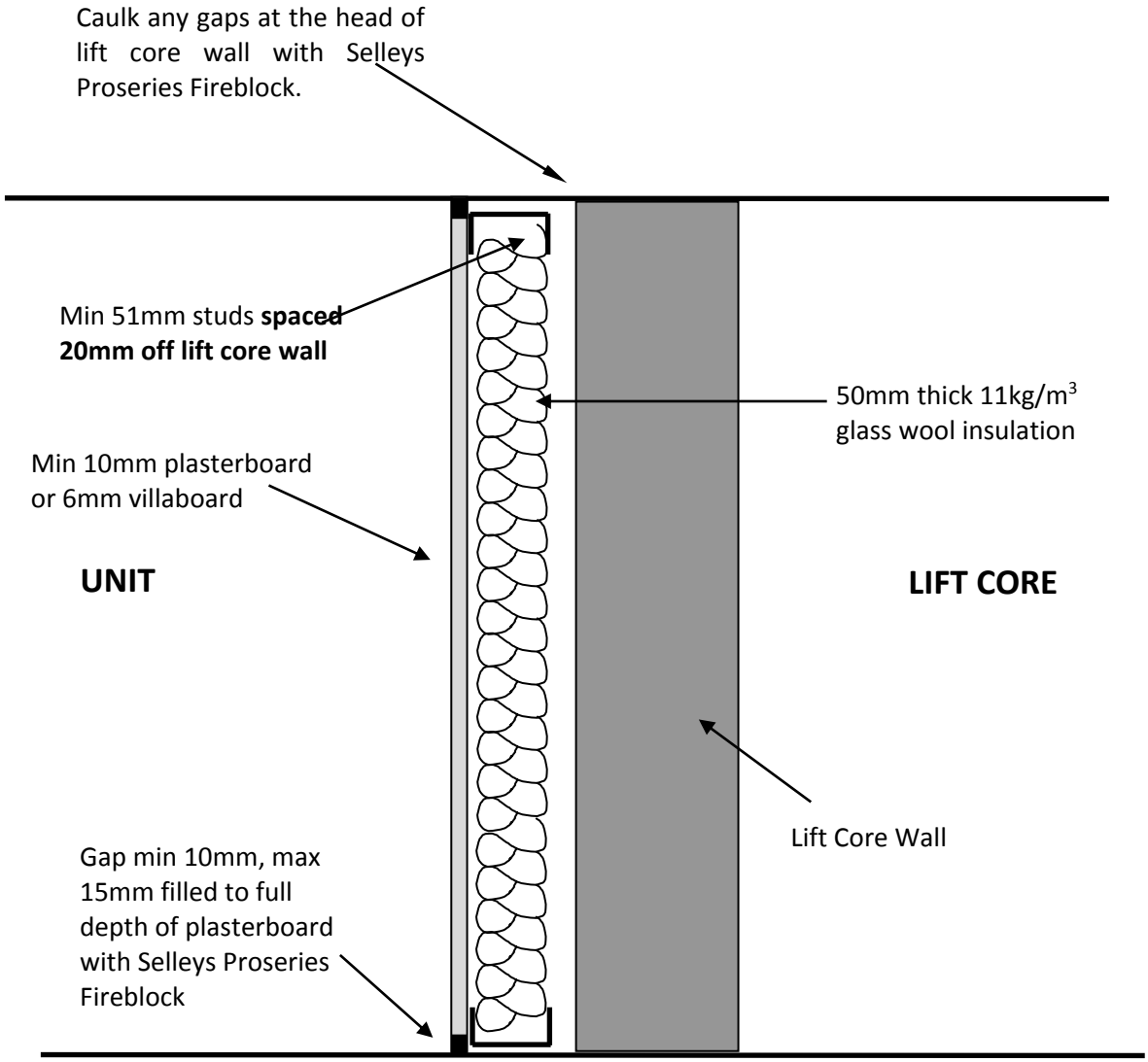
CORRIDOR / FIRE STAR WALL **Rw 50**	**Acoustic Logic Consultancy Pty Ltd** 9 Sarah Street, Mascot **Tel: 8338 9888 Fax: 8338 8399**
	1 VILLAWOOD PLACE, VILLAWOOD

Date:	**Drawn:**	**Checked:**	**Project No:**	**Drawing No:**
April, 2015	MAS	BW	20141421.1	AC003a
Issue	**Scale:**	**Approved**		
R0	NTS	BW		



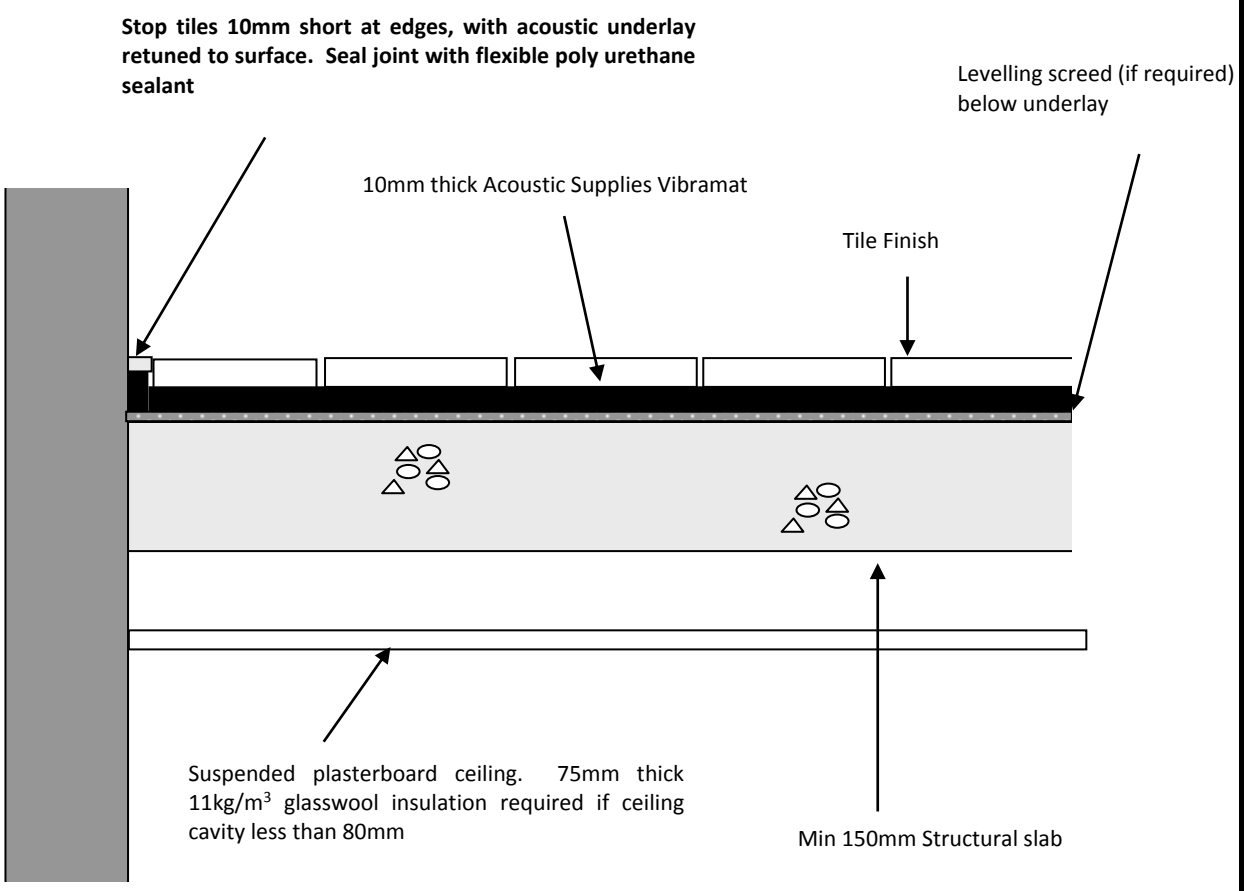
CORRIDOR / FIRE STAR WALL **Rw 50**	**Acoustic Logic Consultancy Pty Ltd** 9 Sarah Street, Mascot **Tel: 8338 9888 Fax: 8338 8399**
	1 VILLAWOOD PLACE, VILLAWOOD

Date:	**Drawn:**	**Checked:**	**Project No:**	**Drawing No:**
April, 2015	MAS	BW	20141421.1	AC003b
Issue	**Scale:**	**Approved**		
R0	NTS	BW		

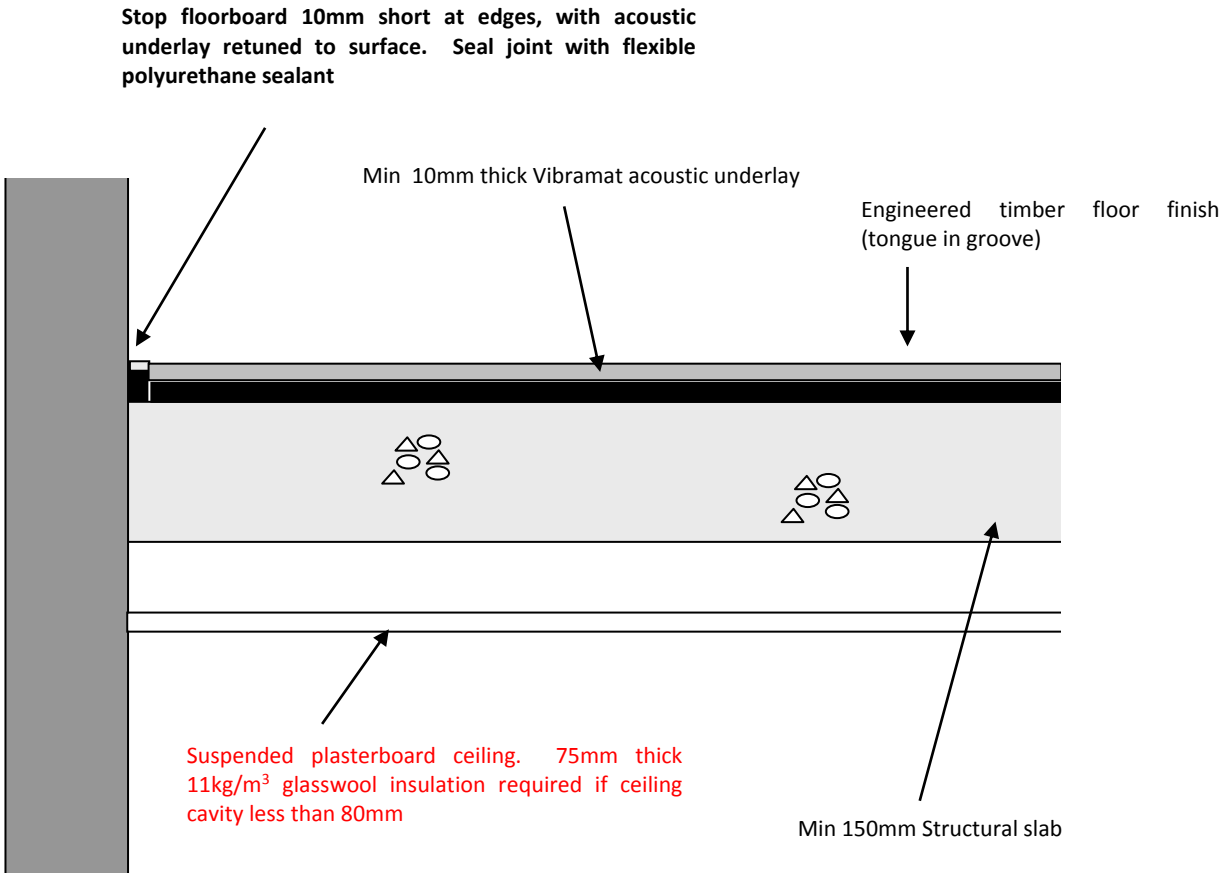


Note: No connection between the studwork and any lift core wall or services permitted. If services serving another unit are to run in the cavity and adjacent room is habitable, the pipes must be lagged and 13mm plasterboard must be used. Otherwise, services may run in the cavity without any additional treatment.

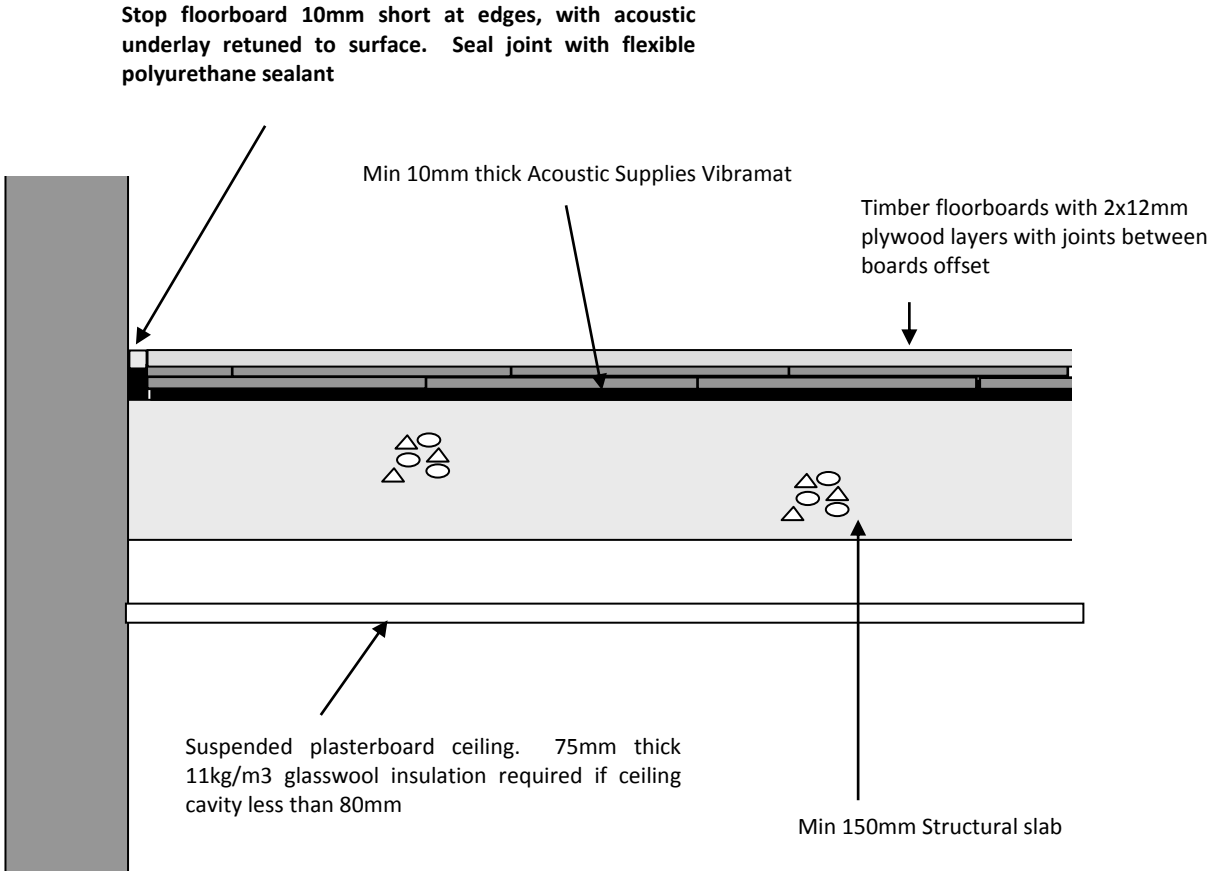
LIFT CORE WALL **Rw 50 + Discontinuous Construction**			**Acoustic Logic Consultancy Pty Ltd** 9 Sarah Street, Mascot **Tel: 8338 9888 Fax: 8338 8399** **1 VILLAWOOD PLACE, VILLAWOOD**	
Date:	**Drawn:**	**Checked:**	**Project No:**	**Drawing No:**
April, 2015	MAS	BW	20141421.1	AC004
Issue	**Scale:**	**Approved**		
R0	NTS	BW		



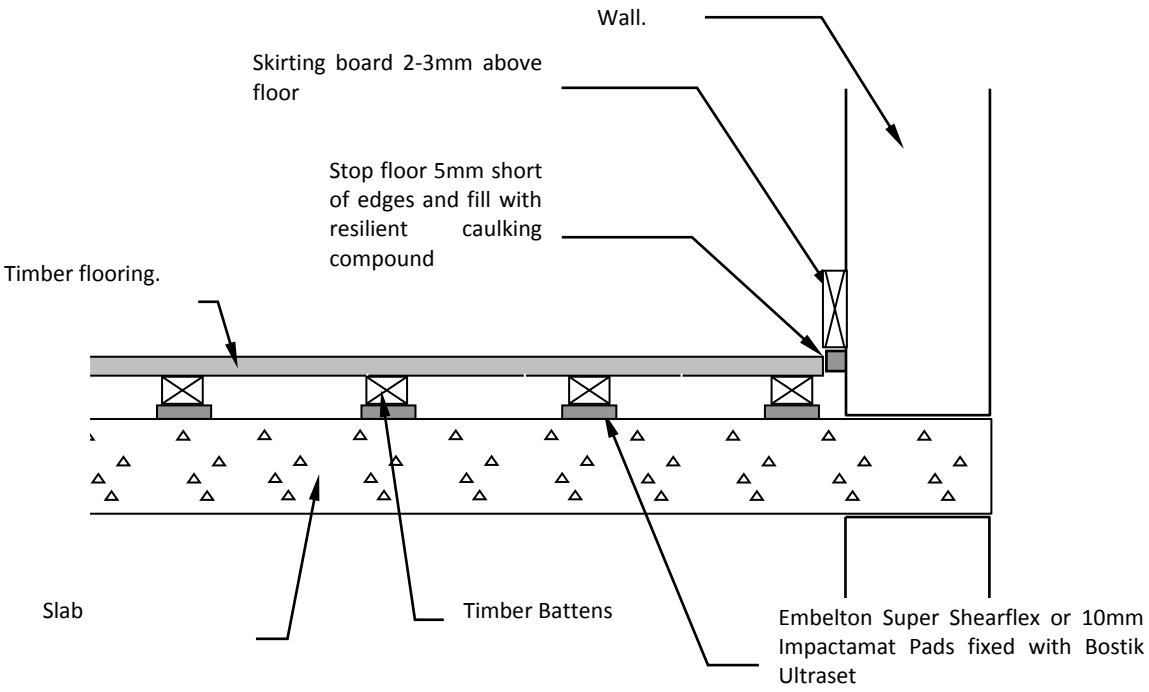
TILED FLOOR TREATMENTS (INCLUDING BALCONIES) OVER HABITABLE AREA OF ANOTHER APARTMENT **Impact Noise - $L_{NW}+C_1<62$** **Airborne Noise - R_w+C_{tr} 50**			**Acoustic Logic Consultancy Pty Ltd** 9 Sarah Street, Mascot **Tel: 8338 9888 Fax: 8338 8399**	
			1 VILLAWOOD PLACE, VILLAWOOD	
Date:	**Drawn:**	**Checked:**	**Project No:**	**Drawing No:**
April, 2015	MAS	BW	20141421.1	AC005a
Issue	**Scale:**	**Approved**		
R0	NTS	BW		



ENGINEERED TIMBER FLOOR TREATMENTS (INCLUDING BALCONIES) OVER ANOTHER APARTMENT **Impact Noise - $L_{NW}+C_1<62$, $L_{DB}<55$** **Airborne Noise - R_w+C_{tr} 50 / R_w 55**			**Acoustic Logic Consultancy Pty Ltd** 9 Sarah Street, Mascot **Tel: 8338 9888 Fax: 8338 8399**	
			1 VILLAWOOD PLACE, VILLAWOOD	
Date:	**Drawn:**	**Checked:**	**Project No:**	**Drawing No:**
April, 2015	MAS	BW	20141421.1	AC005b
Issue	**Scale:**	**Approved**		
R0	NTS	BW		



TIMBER FLOORBOARD TREATMENTS (INCLUDING BALCONIES) AREAS OVER ANOTHER APARTMENT **Impact Noise - $L_{NW}+C_1<62$, $L_{DB} < 55$** **Airborne Noise - $R_w + C_{tr}$ 50 / R_w 55**			**Acoustic Logic Consultancy Pty Ltd** 9 Sarah Street, Mascot **Tel: 8338 9888 Fax: 8338 8399**	
			1 VILLAWOOD PLACE, VILLAWOOD	
Date:	**Drawn:**	**Checked:**	**Project No:**	**Drawing No:**
April, 2015	MAS	BW	20141421.1	AC005c
Issue	**Scale:**	**Approved**		
R0	NTS	BW		



BALCONY TREATMENT OVER ANOTHER APARTMENT **Impact Noise - $L_{NW}+C_1<62$, $L_{DB}<55$** **Airborne Noise - R_w+C_{tr} 50 / R_w 55**			**Acoustic Logic Consultancy Pty Ltd** 9 Sarah Street, Mascot **Tel: 8338 9888 Fax: 8338 8399**	
			1 VILLAWOOD PLACE, VILLAWOOD	
Date:	**Drawn:**	**Checked:**	**Project No:**	**Drawing No:**
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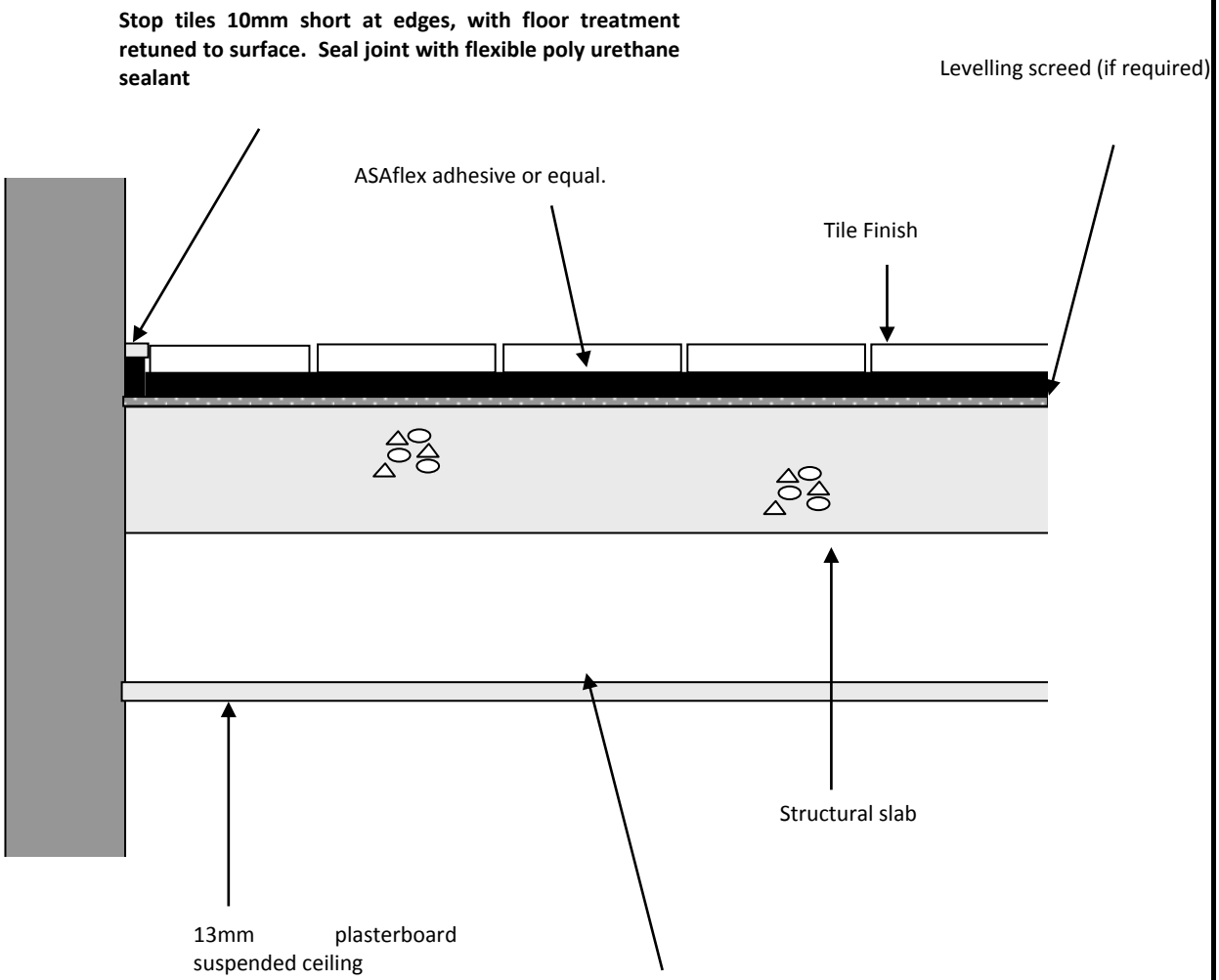
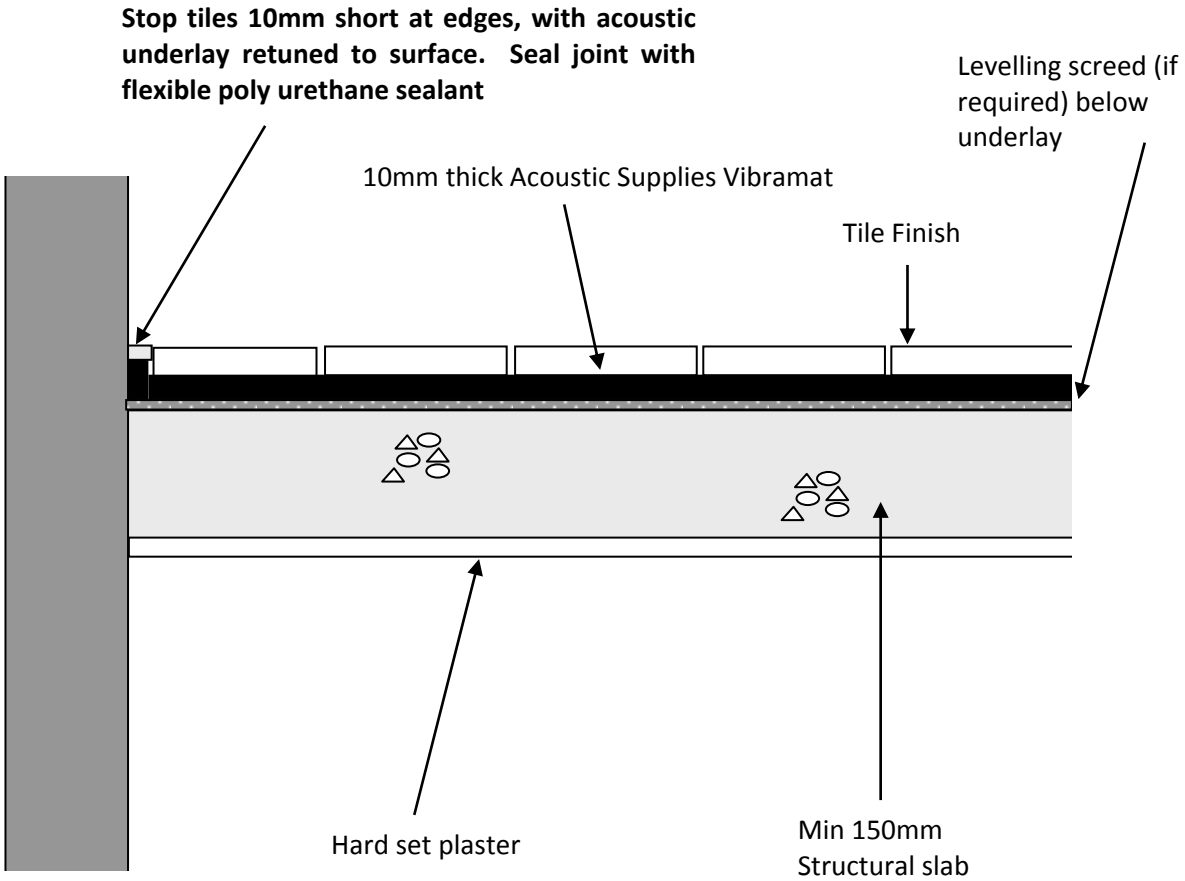
Issue	**Scale:**	**Approved**		
R0	NTS	BW		



TILED FLOOR TREATMENTS OVER WET AREA OF ANOTHER APARTMENT **Airborne Noise - R_w +C_{tr} 50 / R_w 55**	**Acoustic Logic Consultancy Pty Ltd** 9 Sarah Street, Mascot **Tel: 8338 9888 Fax: 8338 8399**
	1 VILLAWOOD PLACE, VILLAWOOD

Date:	**Drawn:**	**Checked:**	**Project No:**	**Drawing No:**
April, 2015	MAS	BW	20141421.1	AC005e
Issue	**Scale:**	**Approved**		
R0	NTS	BW		



TILED FLOOR TREATMENTS (INCLUDING BALCONIES) OVER HABITABLE AREA OF ANOTHER APARTMENT **Impact Noise - $L_{NW}+C_1<62$, $L_{DB}<55$** **Airborne Noise - R_w+C_{tr} 50 / R_w 55**	**Acoustic Logic Consultancy Pty Ltd** 9 Sarah Street, Mascot **Tel: 8338 9888 Fax: 8338 8399** **1 VILLAWOOD PLACE, VILLAWOOD**

Date:	**Drawn:**	**Checked:**	**Project No:**	**Drawing No:**
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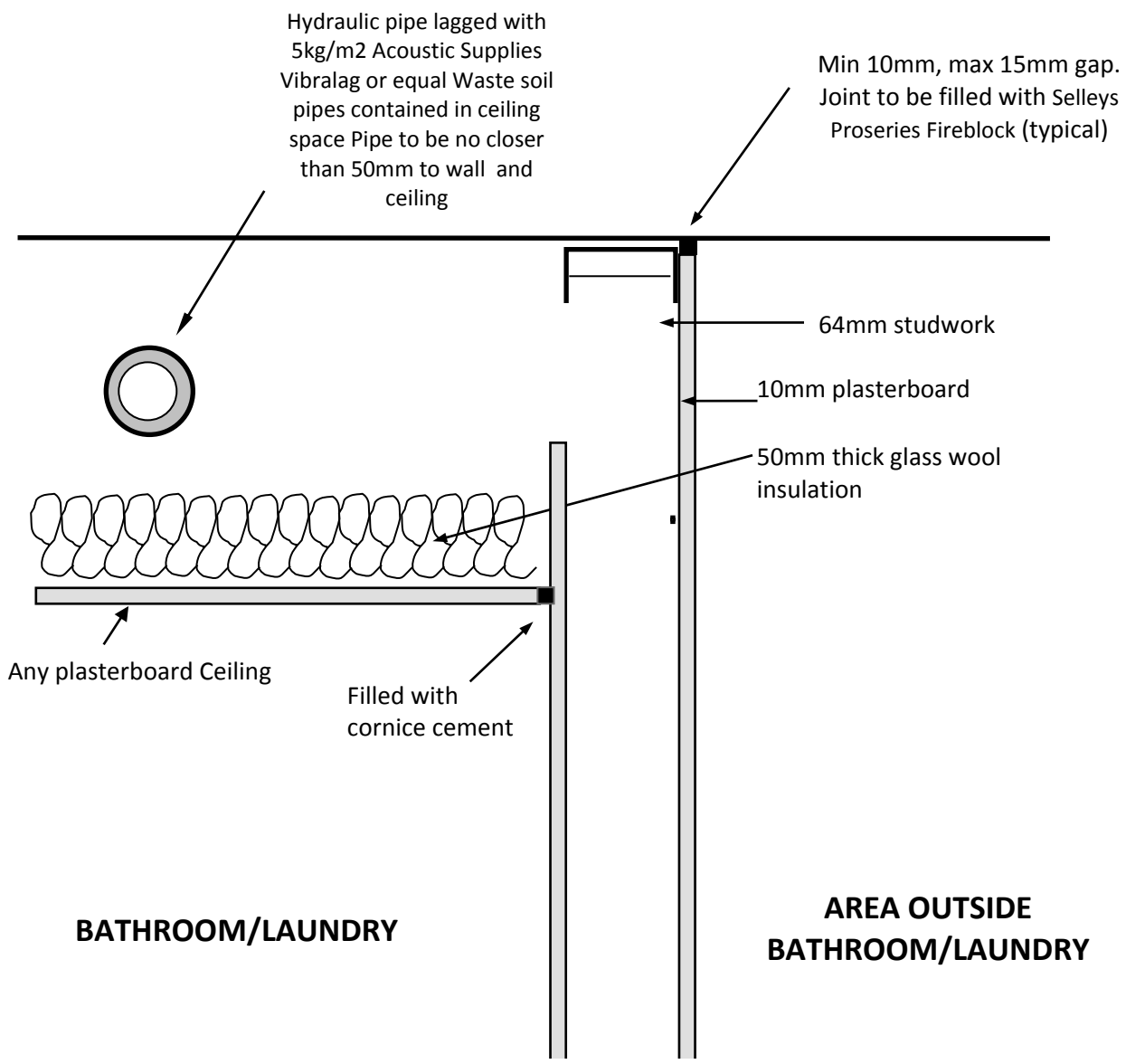
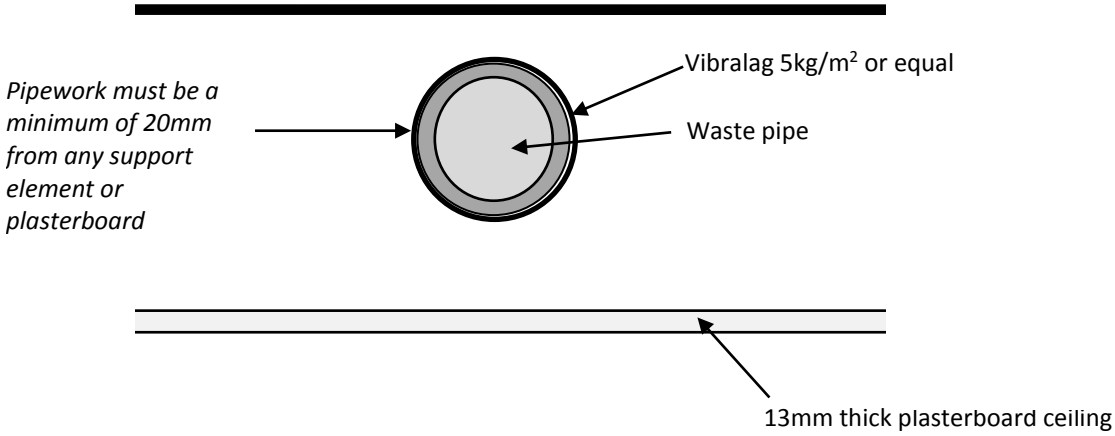
Issue	**Scale:**	**Approved**		
R0	NTS	BW		



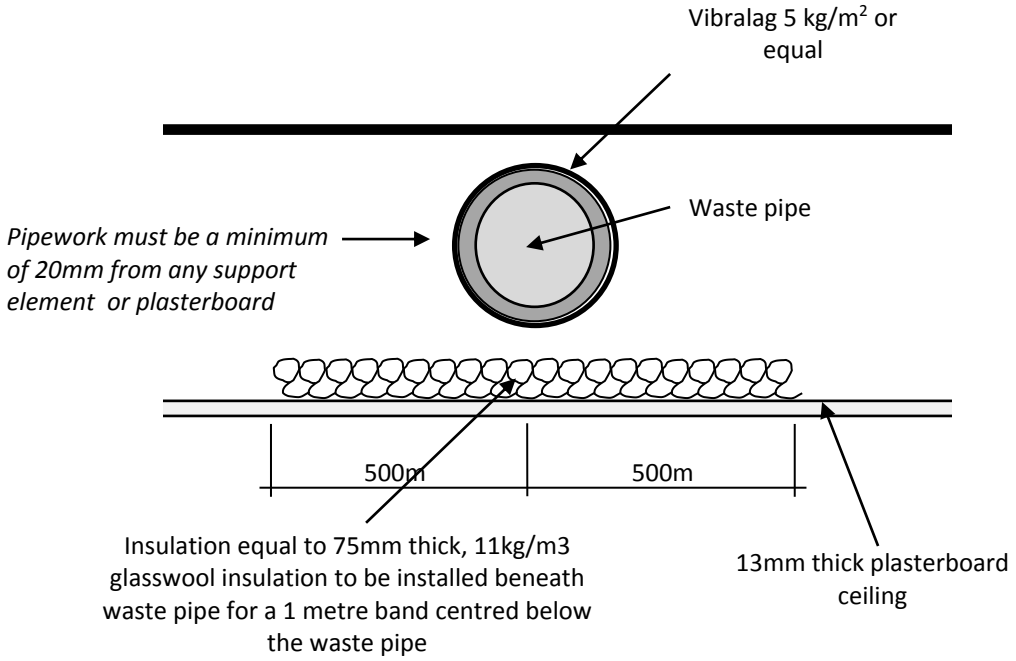
SECTIONAL ELEVATION OF WALL/ CEILING REQUIREMENTS FOR WET AREA PERIMETER WALL (INTRA- APARTMENT) **Pipes Wrapped**	**Acoustic Logic Consultancy Pty Ltd** 9 Sarah Street, Mascot **Tel: 8338 9888 Fax: 8338 8399** **1 VILLAWOOD PLACE, VILLAWOOD**

Date:	**Drawn:**	**Checked:**	**Project No:**	**Drawing No:**
April, 2015	MAS	BW	20141421.1	AC006
Issue	**Scale:**	**Approved**		
R0	NTS	BW		



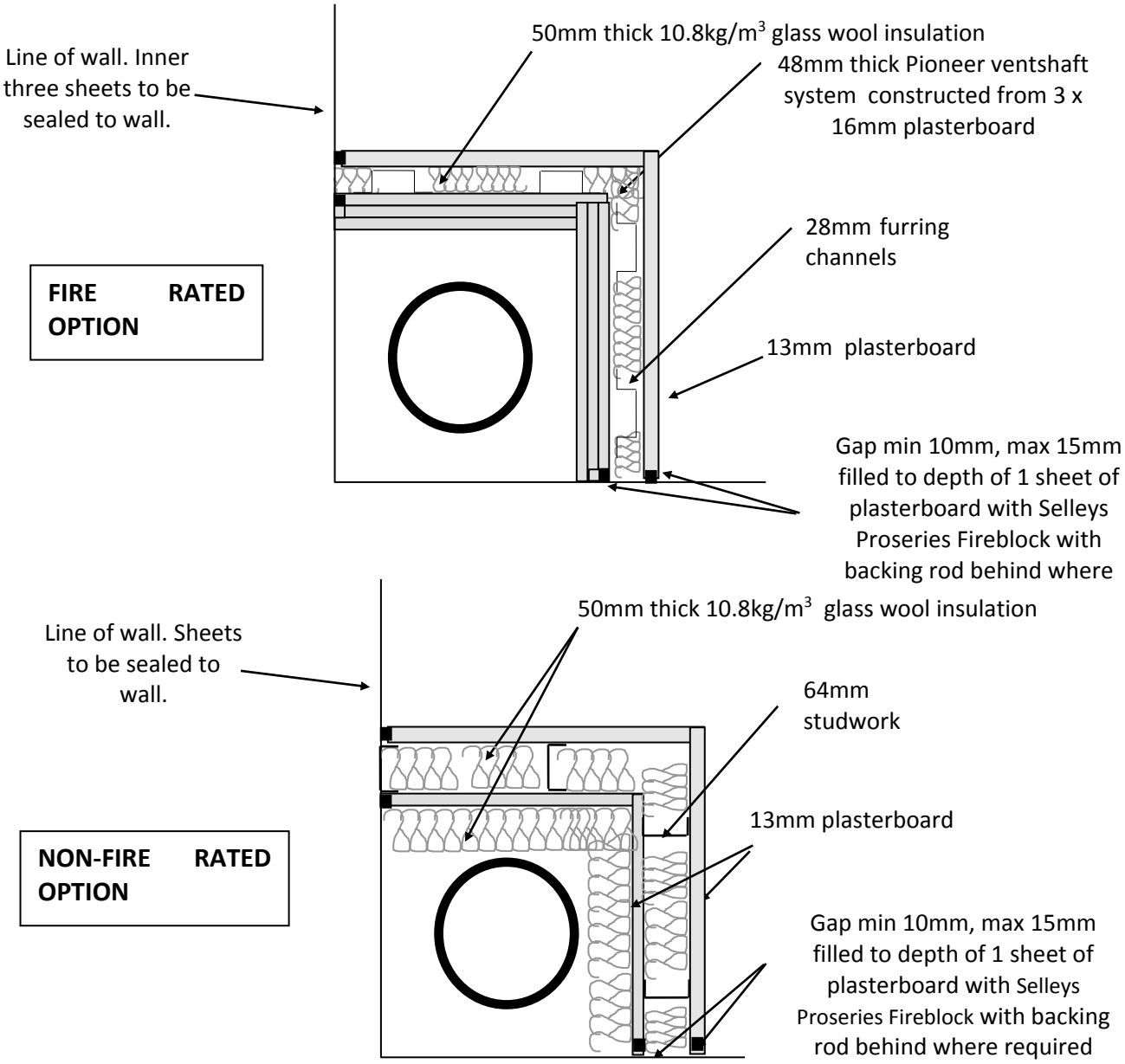
Note: Overlap lagging joints by 50mm and tape airtight with aluminium tape

WASTE PIPE TREATMENT ABOVE WET AREAS PERFORMANCE EQUAL TO Rw + Ctr 25			**Acoustic Logic Consultancy Pty Ltd** 9 Sarah Street, Mascot 2020 **Tel: 8338 9888 Fax: 8338 8399**	
			1 VILLAWOOD PLACE, VILLAWOOD	
Date:	**Drawn:**	**Checked:**	**Project No:**	**Drawing No:**
April, 2015	MAS	BW	20141421.1	AC007a
Issue	**Scale:**	**Approved**		
R0	NTS	BW		



Note: Overlap lagging joints by 50mm and tape airtight with aluminium tape

WASTE PIPE TREATMENT ABOVE HABITABLE AREAS PERFORMANCE EQUAL TO Rw + Ctr 40			**Acoustic Logic Consultancy Pty Ltd** 9 Sarah Street, Mascot 2020 **Tel: 8338 9888 Fax: 8338 8399**	
			1 VILLAWOOD PLACE, VILLAWOOD	
Date:	**Drawn:**	**Checked:**	**Project No:**	**Drawing No:**
April, 2015	MAS	BW	20141421.1	AC007b
Issue	**Scale:**	**Approved**		
R0	NTS	BW		



Note – No access panels in riser walls outside of wet areas

WASTE PIPE RISER DETAIL ADJACENT TO HABITABLE AREAS **R_W +C_{tr} 40**	**Acoustic Logic Consultancy Pty Ltd** 9 Sarah Street, Mascot **Tel: 8338 9888 Fax: 8338 8399** **1 VILLAWOOD PLACE, VILLAWOOD**

Date:	**Drawn:**	**Checked:**	**Project No:**	**Drawing No:**
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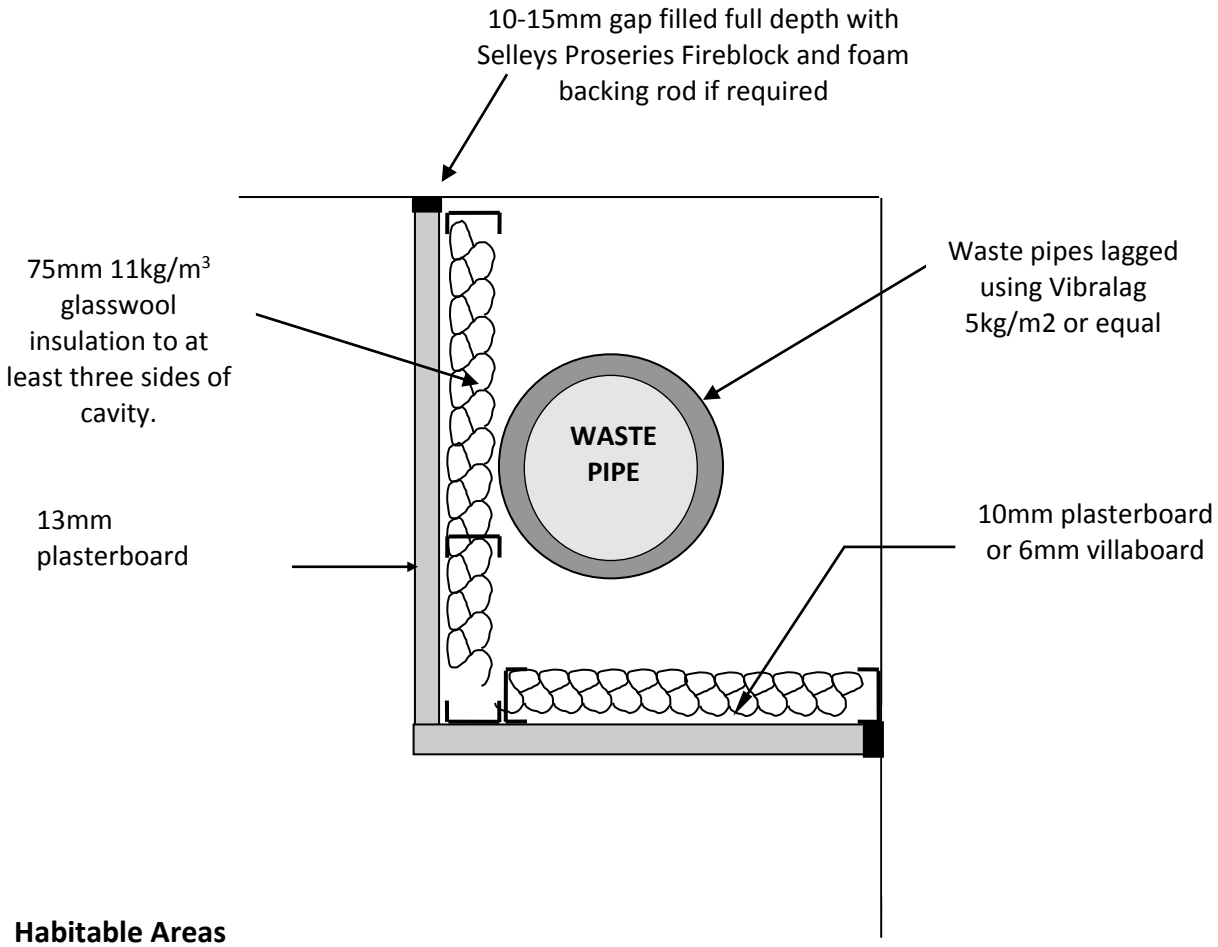
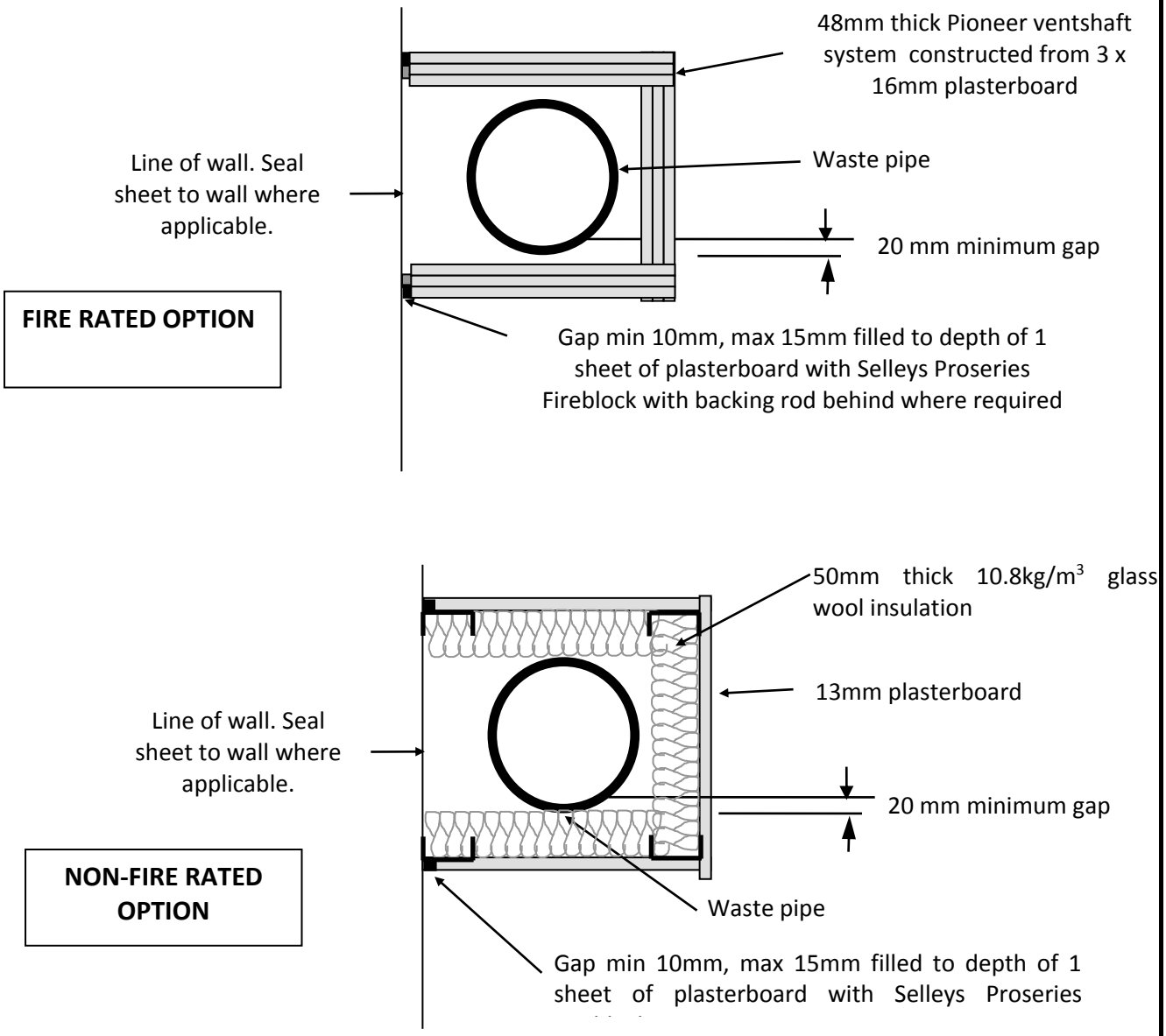
R0	NTS	BW		



Habitable Areas

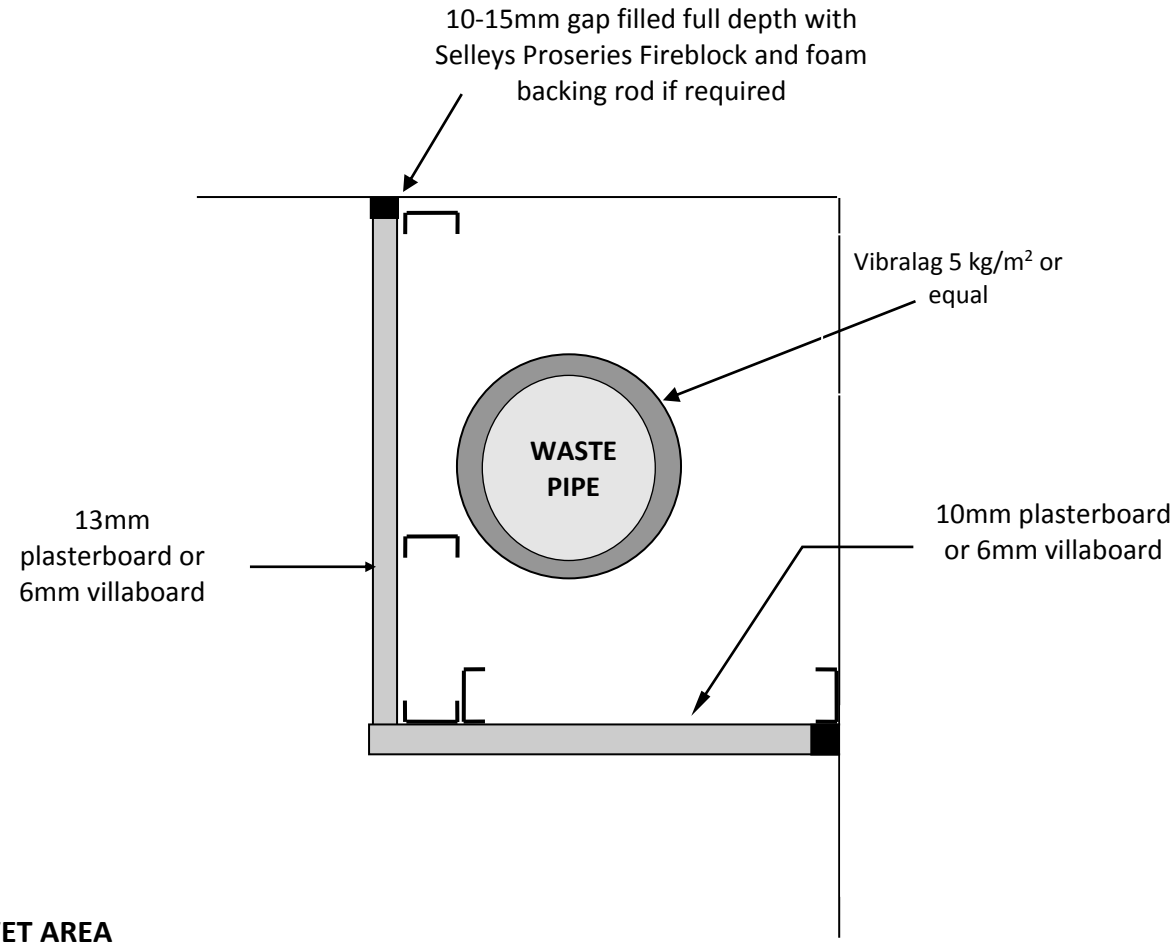
WASTE PIPE RISER DETAIL ADJACENT TO HABITABLE AREAS **R_W +C_{tr} 40**	**Acoustic Logic Consultancy Pty Ltd** 9 Sarah Street, Mascot **Tel: 8338 9888 Fax: 8338 8399** **1 VILLAWOOD PLACE, VILLAWOOD**

Date:	**Drawn:**	**Checked:**	**Project No:**	**Drawing No:**
April, 2015	MAS	BW	20141421.1	AC008b
Issue	**Scale:**	**Approved**		
R0	NTS	BW		



WASTE PIPE RISER DETAIL ADJACENT TO WET AREAS **R_W +C_{tr} 25**	**Acoustic Logic Consultancy Pty Ltd** 9 Sarah Street, Mascot **Tel: 8338 9888 Fax: 8338 8399** **1 VILLAWOOD PLACE, VILLAWOOD**

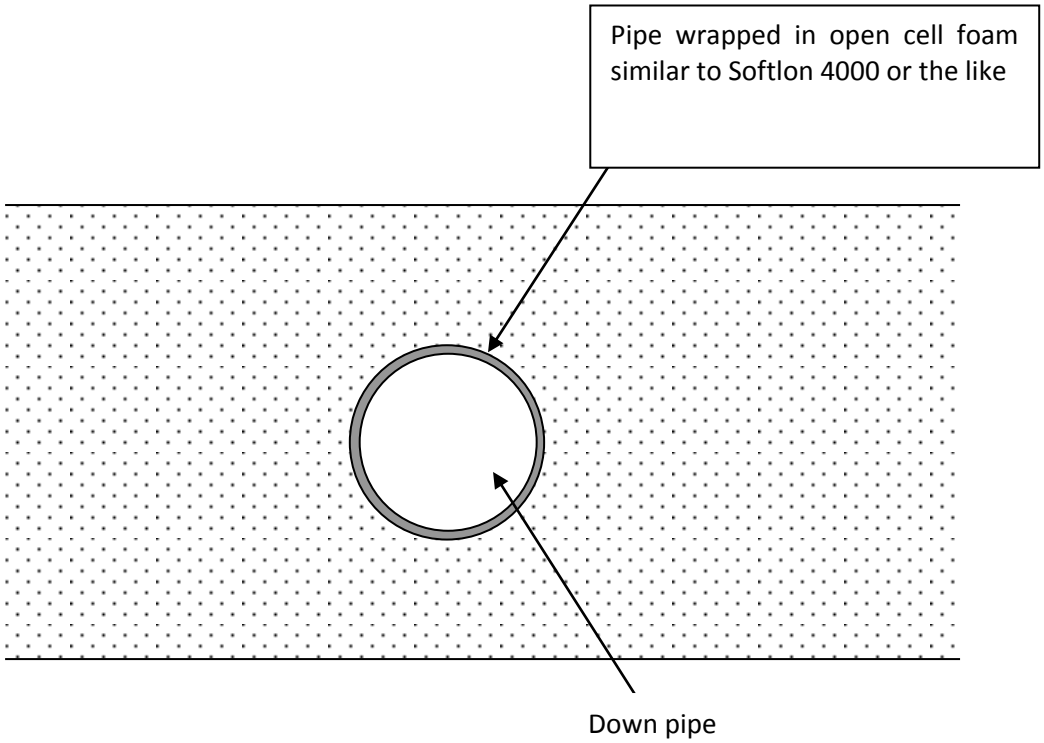
Date:	**Drawn:**	**Checked:**	**Project No:**	**Drawing No:**
April, 2015	MAS	BW	20141421.1	AC009a
Issue	**Scale:**	**Approved**		
R0	NTS	BW		



WET AREA

WASTE PIPE RISER DETAIL ADJACENT TO WET AREAS **R_W +C_{tr} 25**	**Acoustic Logic Consultancy Pty Ltd** 9 Sarah Street, Mascot **Tel: 8338 9888 Fax: 8338 8399** **1 VILLAWOOD PLACE, VILLAWOOD**

Date:	**Drawn:**	**Checked:**	**Project No:**	**Drawing No:**
April, 2015	MAS	BW	20141421.1	AC009b
Issue	**Scale:**	**Approved**		
R0	NTS	BW		



NOTE: Treatment to pipes within columns is only required in the following areas;

1. Storm water pipes within concrete columns/blade walls within apartments (not including external walls).
2. Waste pipes within concrete columns/blade walls within apartments (including external walls).

ACOUSTIC TREATMENT TO DOWN PIPES WITHIN COLUMNS			**Acoustic Logic Consultancy Pty Ltd** 9 Sarah Street, Mascot **Tel: 8338 9888 Fax: 8338 8399**	
			1 VILLAWOOD PLACE, VILLAWOOD	
Date:	**Drawn:**	**Checked:**	**Project No:**	**Drawing No:**
April, 2015	MAS	BW	20141421.1	AC010
Issue	**Scale:**	**Approved**		
R0	NTS	BW		