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Acoustic Specification – For Tender

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1 INTRODUCTION

This document presents the Acoustic Specification for the Graythwaite Rehabilitation Centre located at Ryde Hospital.

The principal areas where acoustic input has been provided on this project are:

- Determination of internal partition systems,
- Assessment of external noise intrusion,
- Specification of internal noise levels from building services including mechanical and hydraulic services.

2 OVERVIEW

The acoustic design input on the Royal Rehabilitation Centre has been based generally in accordance with acoustic recommendations detailed within the NSW Health Infrastructure Guidelines and Acoustic Logic Consultancy (ALC) experience on similar health projects. The requirements presented in the brief are critically analysed on a space by space basis, taking into account the acoustic requirements of each space, and the spaces to which it adjoins.

The overriding premise in this process was to develop a pragmatic and functional approach to the acoustics on this project. The intent in acoustic design is to provide an environment which would satisfy the day to day requirements of the centre, whilst taking issues such as buildability and utility into consideration.

3 WALL PARTITION SYSTEMS

This section presents our recommendation for the acoustic separation of spaces within the proposed development.

The objective of this report is to examine the acoustic requirements of the various space types and formulate suitable criteria to represent these requirements. The level of acoustic separation and background noise required is dependant on the nature and type of activities which take place in the various areas and rooms within the Rehabilitation Centre.

To determine suitable sound transmission class ratings for the various space types the following information was examined and evaluated.

1. The project specified STC/R_w ratings for the various space types.
2. The architectural layouts for the Rehabilitation Centre. These indicate the various space/activity relationships which will exist on this project.
3. Practices applied on other medical facilities and their degree of success.
4. Previous studies carried out to determine the perception of human speech with varying degrees of STC/R_w rated partitions.

The last point is of particular importance, as these studies have been performed for a number of recent projects with the aim of distilling the minimum acceptable sound for sound rated partitions system, taking into consideration both acoustic performance and buildablity. An understanding of the perception of sound and general audibility and intelligibility of human speech with different sound rated partitions is fundamental to the determination the of correct STC/R_w ratings for this project.

A second principle in this process which requires consideration is that the attainment of the exact STC/R_w ratings and background noise levels should be balanced against the attainment of other project requirements such as reverberation control, provision of clear passage above ceiling spaces for the routing of the myriad of services.

3.1 GENERAL APPROACH

The acoustic advice for this project has been developed to encompass the broader requirements of this facility. The consulting rooms, offices, wards and specialised areas of the centre are seen as the most critical, requiring adequate acoustic isolation to maintain speech and acoustic privacy. Other associated spaces such as waiting areas, patient wards, general treatment and medical areas will require acoustic standards which provide speech privacy under normal conditions. That is when people are talking at normal volumes, these conversations will not be clearly audible in adjoining spaces. Loud events such as screaming or shouting are not seen a normal and hence do not require consideration in these space.

The location of the space is also important in determining the required STC/R_w rating. For example a tutorial or consulting room located in the middle of a corridor and adjoined by storage areas should require a lower STC/R_w rating than the same room types adjoining a patient ward or another consulting room. Note corridors are transitory spaces, where people either pass along or spend short periods of time, and differ greatly from spaces where people are stationed and are in a position to hear or be disturbed by sound in an adjoining area.

3.2 ACOUSTIC DESIGN APPROACH

A suitable acoustic standard for the different space types was determined by evaluating space function against specific acoustic requirements. Accordingly, the required acoustic environment for a space can be seen as a composite of four elements, namely;

1. The perceived sound privacy requirements.

2. The ambient acoustic environment (background noise levels); this is a direct function of the activities which occur and mechanical services noise.

3. The acoustic character of the space.

4. The levels of noise which are likely to be generated within a space, and how they will affect adjoining spaces.

This evaluation process was carried out to determine the acoustic requirements of the various spaces within this development.

3.3 IMPORTANCE OF SPACE CHARACTER TO PERCEPTION OF SOUND

The acoustic character of a room will determine the quality of the sound, and may lead to a space being perceived to be noisy. Acoustic character specifically refers to the sound absorption properties of the room finishes and the resulting nature of sound. A space with little acoustic absorption will sound reverberant and hollow. Noise heard in such a space tends to sound loud and sharp. Where adequate acoustic absorption is provided, sounds tend to be more natural and intelligible. This also makes the space sound quieter and therefore aurally more comfortable. For this development, it is proposed to provide a room character which is suitable for a heath facility environment, i.e. quiet and comfortable.

3.4 DETERMINATION OF REQUIRED ACOUSTIC MEASURES

In order to determine suitable acoustic measures for this project it is first necessary to understand the level of sound isolation provide by differently rated partition systems. (Note: a partition system as used in this report refers to the total performance of the wall and ceiling).

The best manner in which to describe the level of sound privacy provided by different partitions systems is by conducting a comparison between the levels of acoustic privacy provided by three differently rated partitions. In this discussion we will demonstration the level of acoustic privacy afforded by partitions having STC/R_w ratings of STC/R_w 30, 35 and 45. The data presented below was obtained in a simulation performed to actually demonstrate noise heard with each of the above ratings.

The table below provide an indication of various volumes of speech and resultant audibility with different partitions systems.

Table 3-1 – Partition noise Perception

Speech Noise Level	Represents	STC/R_w Rating of partitions	Audibility of Speech In Adjacent Office
60 dB(A)	Normal conversation	25	Speech clearly audible
60 dB(A)	Normal conversation	30 partition	Speech barely audible. Content of speech not recognisable.
70 dB(A)	Raised voice	30 partition	Speech clearly audible. Content of speech not fully recognisable.
60 dB(A)	Normal conversation	35[1] partition	Speech generally not audible. Content of speech not recognisable.
70 dB(A)	Raised voice	35[2] partition	Speech audible. Content of speech not recognisable. Similar to STC 30 partition but not quite as loud.
70 dB(A)	Raised voice	45 partition	Speech inaudible.

1. With the increase to STC/R_w 38 speech would not be audible and contents not recognisable. Note: this is the standard generally used for middle management offices in the private sector

2. With the increase to STC/R_w 38 speech would generally not be audible. STC/R_w 38 represents an improvement on STC/R_w 35.

3. It is evident, that increasing the ratings beyond Rw45 for 'Raised Voice' does not generally provide an noticeable benefit.

From the above table it can be determined that;

- An STC/R_w 30 partition provides a moderate level of privacy for normal conversation levels.

- Raised conversation levels through an STC/R_w 30 partition would be clearly audible in an adjacent space.

- Increasing the rating from STC/R_w 30 to 35 marginally reduces the noise level from raised conversation in the adjacent room. However, speech was still audible, and the content of the speech still intermittently recognisable. However normal conversation levels are not audible.

- raising standard to STC/R_w 40 provides suitable level of speech privacy for normal and raised voices.

- An STC/R_w 43 partition would provide complete privacy from normal levels of speech.

From the above discussion it can be concluded that an STC/R_w 30 partition system provides adequate isolation for normal speech, but is not effective in isolating raised voices.

An STC/R_w 35 rating is similar to STC/R_w 30, but provides better isolation for raised voices.

An STC/R_w 40 rating provides a suitable level of isolation for normal and raised voices.

An STC/R_w 43 partitions was found to provide complete privacy for normal and raised voices.

3.5 APPLICATION OF ABOVE STUDY TO THIS PROJECT

The findings discussed in the previous section generally indicate that three levels of STC/R_w rating would be adequate to address the acoustic privacy requirements for this project. This would be STC/R_w 35 for general spaces without strict privacy requirement, STC/R_w 40 where a moderate level of speech privacy is required and STC/R_w 43 where high levels of privacy are required.

However, prior to finalising the ratings which will be used for this project, it is necessary to refer back to the planned space relationships.

The determination of which space assigned the various sound separation grading is then a function of the following;

- Space and activity type.
- Relative location of space to other spaces
- Level of sound privacy required for a space type.
- Level of space privacy experienced in a particular space type. For example it can be stated that minimal acoustic privacy exists in a 2 and 4 bed ward, where as the opposite is true for a 1 bed ward.
- Background noise levels which will occur in the space type.
- Reverberant conditions in the space type.
- Is a door fitted to the space

From the above requirements three basic ratings were derived for this project and allocated accordingly.

These ratings are:

Classification	Acoustic performance	Discussion
Low-Medium	STC/R_w 35	To be applied to spaces requiring speech privacy under normal conversation levels
Medium	STC/R_w 40	To be applied to spaces requiring speech privacy under normal and raised conversation levels
High	STC/R_w 43	To be applied to spaces requiring high degrees of privacy

Notes:

1 *STC/R_w 30 is not included on this project as it does not provide good isolation against raised voice.*

2 *An STC/R_w 40 rating provides a superior isolation against raised speech and represents a higher levels of sound isolation than STC/R_w 35.*

Suitable wall details to achieve the above ratings attached to this report.

3.6 NOMINATED STC/R_W RATINGS

The nominated STC/R_w ratings for the various spaces types selected following the methodology described above are shown in the table which follows. The ratings are generally in accordance with the brief.

Table 2 – Nominated Minimum STC / R_w Ratings

SPACE TYPE	NOMINATED R_w / STC VALUES
Ward/Bedrooms dividing walls	40
Ward/Bedrooms corridor walls	35
Ensuit party and corridor walls	40
Therapy Rooms	45
Private Offices	43
General Offices	40
Consulting Rooms	45
Treatment Rooms	45
Staff Stations	35
Store Rooms	35
Quiet Rooms	40
Toilets and Change Rooms	43
Plantrooms	50
Speech Therapy	50
Library	43
Meeting Rooms	43
Library	35
TV/Video	43
Dining to Ward/ Bedroom	45

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 all walls/partitions in a manner that will not reduce the performance of the walls below the tabled R_w/STC/FSTC 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.

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

3.6.2 Wall Junctions

Unless otherwise detailed in this acoustic specification, with the exception of set plasterboard-to-plasterboard sheet joints or Hebel to Hebel panel 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.

3.6.3 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).

3.6.4 Sealants

Carry out sealing of joints in acoustic walls using a fire rated 100% polyurethane flexible sealant equal to Bostik Fireban 1 or Bostik Seal'n'flex 1. If it is proposed to use a sealant other than that nominated, then approval must first be gained from the Acoustic Consultant.

3.6.5 Manufacturer's Recommendations

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

3.6.6 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.

3.7 GLASS PARTITIONS AND VIEWING PANELS

Areas such as office partitions with entry doors facing open plan areas will be limited by the acoustic performance of the door (typically R_W 20-25). For this reason the installation of glazing within these partitions will not reduce the acoustic environment within the office area. The recommended glazing thickness for acoustics to partition separating offices and corridors is 6.38mm laminated glazing with an R_W performance no less than 30.

Installation of glazing within other partitions such as office to office, interview rooms, examination rooms and the like will result in a reduction in the overall performance of the wall. By minimising the area of glazing within a partition the acoustic performance of the glazing will be increased. In the event client expectations include glazed partitions the resulting acoustic performance of Rw 34 for 10.38mm laminated and R_W 30 for 6.38mm laminated will be achieved.

10.38mm laminated glazing is recommended to glass partitions which will result in a performance of R_w 34, providing these partitions separate offices, meeting rooms and the like to corridors or open plan offices this will be acoustically acceptable.

Recommended construction of glass partitions and viewing panels as follows:

- Meeting Room, Examination, Glass corridor walls – 10.38mm laminated glass (overall acoustic rating of wall/door system will be limited to approximately R_w 25-30).

- Offices Glass corridor wall – 6.38mm laminated glass (overall acoustic rating of wall/door system will be limited to approximately R_w 20).

3.8 FLOORS

3.8.1 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.

3.8.2 Minimum STC/R_w Requirements

Following is list of minimum requirements.

Table 3 – Minimum STC/R_W rating for Floors

Floor Type	NOMINATED R_w/STC VALUES*
Between Floor Areas - Generally	45

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.

3.8.3 Penetration

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.

3.8.4 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).

3.8.5 Sealants

Carry out sealing of joints in floors using a fire rated 100% polyurethane flexible sealant equal to Bostik Fireban 1. If it is proposed to use a sealant other than that nominated, then approval must first be gained from the Acoustic Consultant.

3.8.6 Manufacturer's recommendations

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

3.9 CEILING AND ROOF

3.9.1 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.

3.9.2 Ceiling construction generally - Minimum STC/R_w Requirements

The table below presents recommended ceiling constructions in order to maintain the required level of acoustic privacy between adjacent spaces (to prevent room to room noise transmission via the ceiling cavity. Refer to Appendix 1 for acoustic details.

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/STC/FSTC requirements. This includes but not limited to the proper filling of joints between sheets, sealing of joints ceiling to wall junctions.

3.9.3 Ceiling tiles

Ceiling tiles should be selected to achieve the recommended CAC rating for the corresponding wall type (refer to wall/ceiling details in Appendix 1).

In rooms (other than wet areas) mineral ceiling tiles should have minimum NRC of 0.65.

3.9.4 Box Gutters

Box gutters located over meeting rooms, treatment rooms, consulting rooms, interview rooms and ward rooms to be acoustically treated as per Appendix 1, detail AC010.

3.9.5 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.

3.9.6 Sealants

Carry out sealing of joints in acoustic walls using a fire rated 100% polyurethane flexible sealant equal to Bostik Fireban 1. If it is proposed to use a sealant other than that nominated, then approval must first be gained from the Acoustic Consultant.

3.9.7 Manufacturer's recommendations

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

3.9.8 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.

3.10 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.

3.11 RISERS

The required construction for risers is presented below.

Details of corresponding wall types are presented in Appendix 1.

Table 4 – Recommended Rises Constructions

SPACE TYPE	ALC Wall Type (refer to Appendix 1)
Riser in wet areas	AC007
Riser outside wet areas	AC008

3.12 DOORS

Minimum Requirements

Following is list of minimum requirements.

Table 5 – Minimum Door Construction Requirements

Door	Minimum Requirement
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.
Doors to noise sensitive spaces	Minimum 40mm 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.
Speech Therapy 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.
Interconnecting door between speech therapy rooms	A proprietary door should be installed with a minimum R_w 45.

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.

3.12.1 Manufacturer's recommendations

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

4 MECHANICAL AND HYDRAULIC SERVICES

This section nominates the acoustic standards for mechanical and hydraulic services.

The section will be separated into two sub-sections namely;

i. Mechanical services

ii. Hydraulic services

Refer to appendices B and C for complete specification for mechanical and hydraulic services.

Note that compliance with the recommended maximum noise levels detailed in this specification would represent compliance with the project noise level criteria.

4.1 MECHANICAL SERVICES

Another important consideration on building projects is noise from mechanical services.

Criteria are required to address the following;

- Internal noise levels
- Environmental noise conditions
- Vibration levels from plant to all habitable spaces.

4.1.1 NOISE AND VIBRATION CRITERIA

Noise from mechanical plant inside the development will be designed to meet the criteria presented below. These criteria apply to noise levels with the plant operating under all normal operating conditions, and at start-up for intermittently operating plant items.

The criteria set out in this section are represented as dB(A) values, this is consistent with the normal practice in Australia and in line with the format used for hospitals in Australian and New Zealand Standard AS/NZS 2107-2000 “Acoustics - Recommended Design Sound Levels and Reverberation Times for Building Interiors”

The table, which follows, presents the recommended criteria for this project in a standardised form.

Table 4-1 – Noise Criteria for mechanical services in health buildings AS2107

SPACE/ACTIVITY TYPE	NOISE LEVEL L_{eq} dB(A)	
	Satisfactory Level	Maximum Level
Corridor and lobby spaces	40	50
Consulting rooms	40	45
Treatment Rooms	40	45
Offices	40	45
Office Areas	40	45
Conference Rooms	35	40
Staff Stations	40	45
Ward Spaces	30	35
Store Rooms	45	50
Waiting Rooms Reception	40	45
Toilets and Change Rooms	45	50

4.1.2 Noise During a Fire Emergency

Noise from all plant during a fire emergency shall comply with the requirements of AS1668. Noise levels inside the fire control room shall not exceed 65dB(A) during a fire emergency.

4.1.3 EXTERNAL NOISE LEVELS

Property Boundaries

Noise levels emitted by the mechanical plant at all property boundaries and nearby buildings on adjacent properties shall meet the requirements of:

- Local Council criteria and DA conditions.
- DECCW
- Any other relevant statutory authority.

4.1.4 Outdoor Areas On The Development Site

Noise levels emitted by the mechanical plant to outdoor public and private areas on the development site shall not exceed the A-weighted background noise level (ie the L_{90} noise level) by more than 5 dB(A).

4.1.5 Vibration Produced By Plant

Tactile structure vibration levels produced by the plant should not exceed the criteria given in AS2670.2-1990. Where the standard recommends a range of criteria for a particular occupancy, the low end of the range shall be used.

4.2 HYDRAULIC SERVICES

The principal requirements for noise from the hydraulic services is that all waste soil pipe passing through the various spaces of the hospital development comply with satisfactory noise levels. The actual treatment of the waste pipe work will be dependant of the receiver space configuration, the ceiling construction system, the material from which the pipework is constructed and the hydraulic practices adopted on the project.

For the purpose of this schematic design report a series of design criteria is presented, these criteria are based on the maximum design levels presented in AS2107.

Table 4-2 - NOISE CRITERIA FOR HYDRAULIC SERVICES BASED ON AS2107

SPACE/ACTIVITY TYPE	NOISE LEVEL L_{eq} dB(A)	
	Satisfactory Level	Maximum Level
Corridor and lobby spaces	40	50
Consulting rooms	40	45
Treatment Rooms	40	45
Offices	40	45
Office Areas	40	45
Conference Rooms	35	40
Staff Stations	40	45
Ward Spaces	30	35
Store Rooms	45	50
Waiting Rooms Reception	40	45
Toilets and Change Rooms	45	50

Noise within the development shall be free of pure tones or other undesirable characteristics.

5 MECHANICAL REVIEW

A full acoustic review of mechanical services will be conducted upon final selection of plant equipment such that noise emissions satisfy the internal and external noise criteria detailed in Section 4 and 5.

6 ACOUSTIC DETAILS SCHEDULE

Refer attached typical acoustic details.

Table 6-1 – Acoustic details

Type	Detail Number	Title
Partition wall details	AC001	R_w 50 – Stud – Full height
	AC002a	R_w 45 – Ceiling Tile
	AC002b	R_w 45 – Stud – Ceiling Tile
	AC003a	R_w 40 – Ceiling Tile
	AC003b	R_w 40 – Stud – Ceiling Tile
	AC003c	R_w 40 – Stud - Plasterboard Ceiling
	AC004a	R_w 38 – Ceiling Tile
	AC004b	R_w 38 – Stud – Ceiling Tile
	AC004c	R_w 38 – Stud – Plasterboard Ceiling
Ceiling Details	AC005	Waste Pipes Above Habitable Areas
Wall junction details	AC006	Plan Section of Mullion/Façade Junctions

Note: All 13mm plasterboard detailed within drawings can be replaced with 6mm FC for wet areas or impact resistance.

7 HYDROTHERAPY

An acoustically absorptive material should be installed to the underside of the slab soffit above the pool area within the hydro therapy room with a minimum NRC of 0.6 similar Sonacret or Luxalon, Hunter Douglas or similar.

APPENDICES

A – Mechanical Services Specification

B – Hydraulic Services

C – Electrical Specification

D – Acoustic Details

APPENDIX A – MECHANICAL SERVICES SPECIFICATION

The acoustic treatments in this specification override any acoustic requirements in the mechanical services specification or drawings.

PROJECT NOISE AND VIBRATION CRITERIA

0 INTERNAL NOISE LEVELS

Noise from mechanical plant inside the development should not exceed the levels given below. Unless stated otherwise, the noise level criteria should 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 specification or the acoustic treatments indicated in the mechanical services specification or drawings.

NOISE CRITERIA FOR MECHANICAL SERVICES IN HEALTH BUILDINGS FROM AS2107

SPACE/ACTIVITY TYPE	NOISE LEVEL L_{eq} dB(A)	
	Satisfactory Level	Maximum Level
Corridor and lobby spaces	40	50
Consulting rooms	40	45
Procedure/Treatment Rooms	40	45
Offices	40	45
Office Areas	40	45
Conference Rooms	35	40
Staff Stations	40	45
Ward Spaces	30	35
Store Rooms	45	50
Waiting Rooms Reception	40	45
Toilets and Change Rooms	45	50

Noise within the development shall be free of pure 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. Noise levels inside the fire control room shall not exceed 65dB(A) during a fire emergency.

0 EXTERNAL NOISE LEVELS

▪ Property Boundaries

Noise levels emitted by the mechanical plant at all property boundaries and nearby buildings on adjacent properties shall be treated to ensure that noise emissions comply with the following requirements whichever is more stringent.

1. Local Council and DA conditions.
2. Environment Protection Agency.
3. Any other relevant statutory authority.

▪ Outdoor Areas On The Development Site

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

0 PLANT NOISE LEVELS

The contractor should 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.

0 VIBRATION PRODUCED BY PLANT

Tactile structure vibration levels produced by the plant should 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.

• TESTING ON COMPLETION

Following installation, if requested, carry out noise and vibration level tests to confirm compliance with the criteria given in Section 1.

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 occupancy

The sound level meter used for the noise tests should comply with the type 2 instrument specification 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 specification. All testing and rectification work is at the mechanical sub-contractor's expense.

• NOISE GENERATED BY THE AIR DISTRIBUTION SYSTEM

Noise from the air distribution system should 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 should 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 excessive 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.

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

• STRUCTURE BORNE NOISE AND VIBRATION

The sub-contractor shall 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 to comply with Australian Standard AS3709-1989. 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 indicating make, model, rated load and static deflection, actual load and static deflection, unloaded height, fully loaded height.

0 ANTI-VIBRATION MOUNTS AND ISOLATORS

▪ Selection Of Equipment Isolation Mounts

Isolation mount type and minimum static deflection should be selected 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)	M4	25 mm
Centrifugal Fans and Pumps	M4	25 mm
Chillers	M4*	25mm
Fan/coil units	M1/H1/HE1	1 mm
Cooling Towers	M[2]	6mm
Boiler	M1	6 mm
Pump / Motor Set	M4	25 mm
Air-handling plant	M3/H1	10 mm

- **Piping Isolation Mounts**

Piping within 20m of the pumps or chillers (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 hospital; 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 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 overtightened..

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

- **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.

0 EQUIPMENT BASES

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.

0 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 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.

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.

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

• PENETRATIONS

0 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.

Flexible ducts shall not be taken through full height walls. 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 750mm 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.

Penetrations in wet area ceilings having an acoustic rating as required by the Building Code of Australia shall be treated 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.

Ducts penetrating acoustically rated walls that are closely positioned to the underside of the floor above are to be fully sealed for the entire perimeter with fireban 1 for fire rated walls or with sealant flex 1 for the remainder.

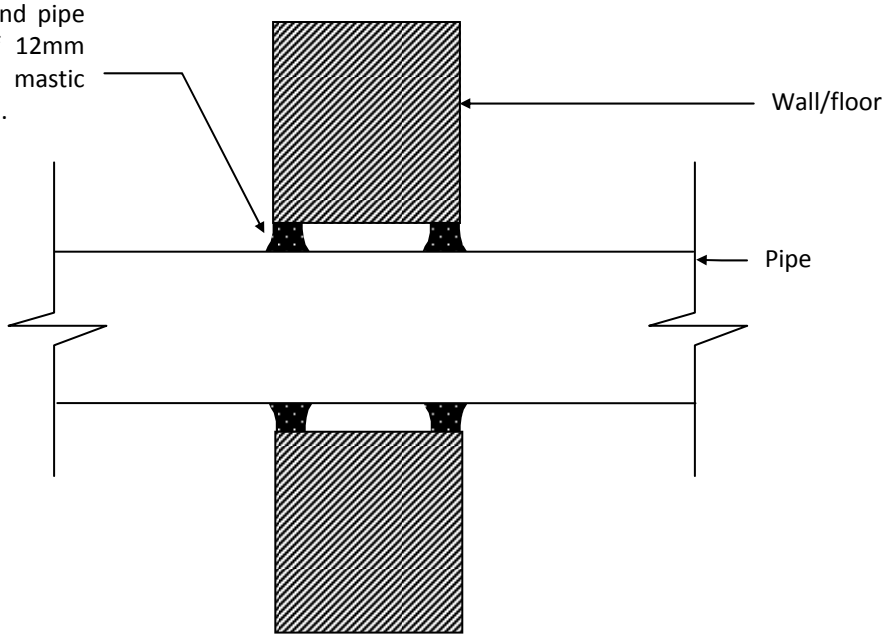
0 PIPE PENETRATIONS

Seal pipes penetrating slabs or walls, as follows:

Pipe Penetration Treatment

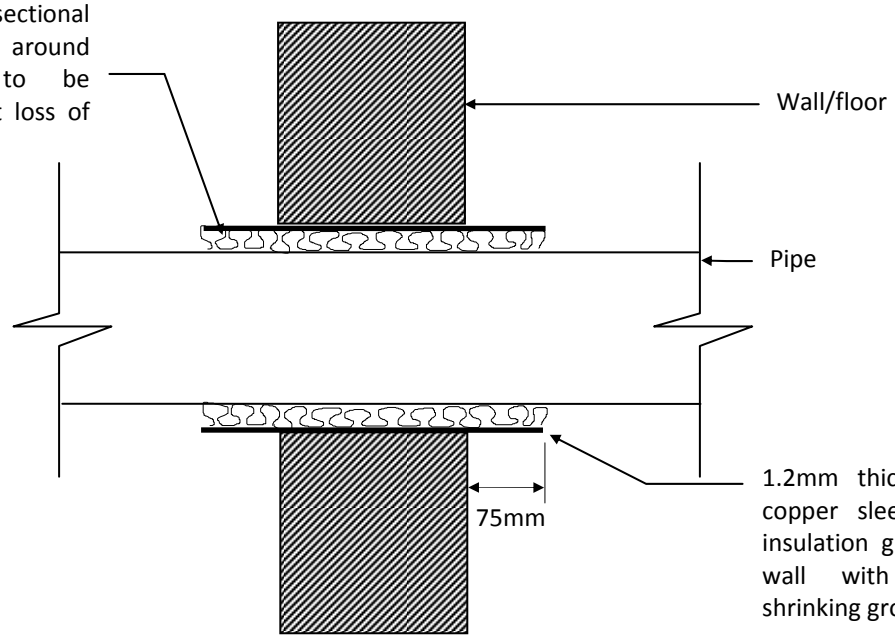
PROJECT NOISE CRITERION IN ADJACENT SPACES	SEAL TYPE
Within 20m of a pump and condenser water pipes	Type PB seal.
Other pipes including hot and cold water	Type PA or PB seal.

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

0 DUCT PENETRATIONS

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

Duct Penetration Treatment

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

0 ELECTRICAL WIRING

Individual electrical cables can be grouted into the wall or sealed with plaster. If there are any remaining gaps seal with Bostik Fireban 1 sealant or similar. Bunches of cables should 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.

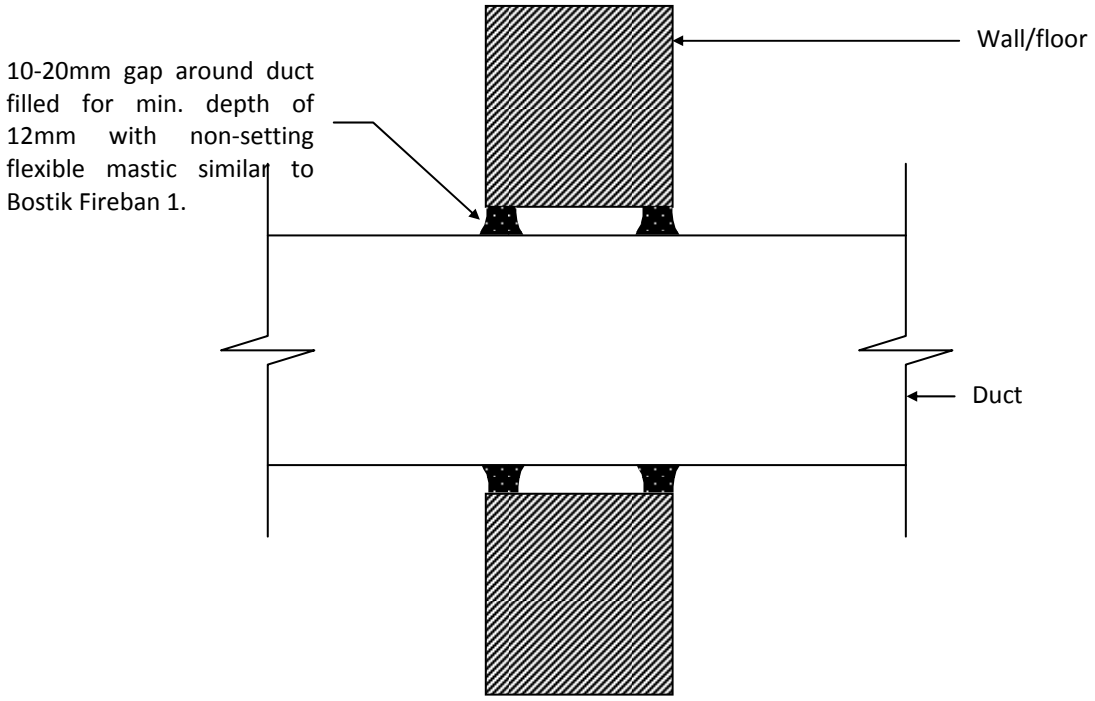
• SILENCERS AND INTERNALLY LINED DUCTING - GENERAL

0 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:

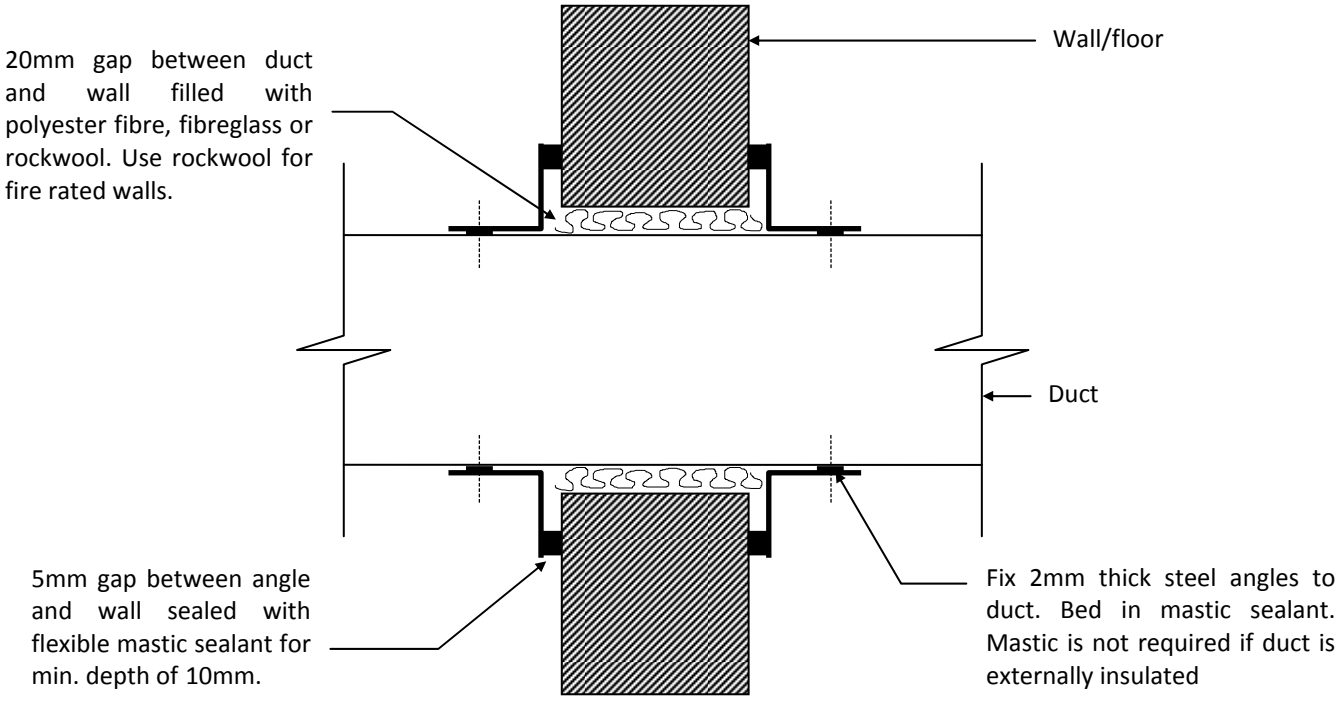
Insulation Absorption Coefficients

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



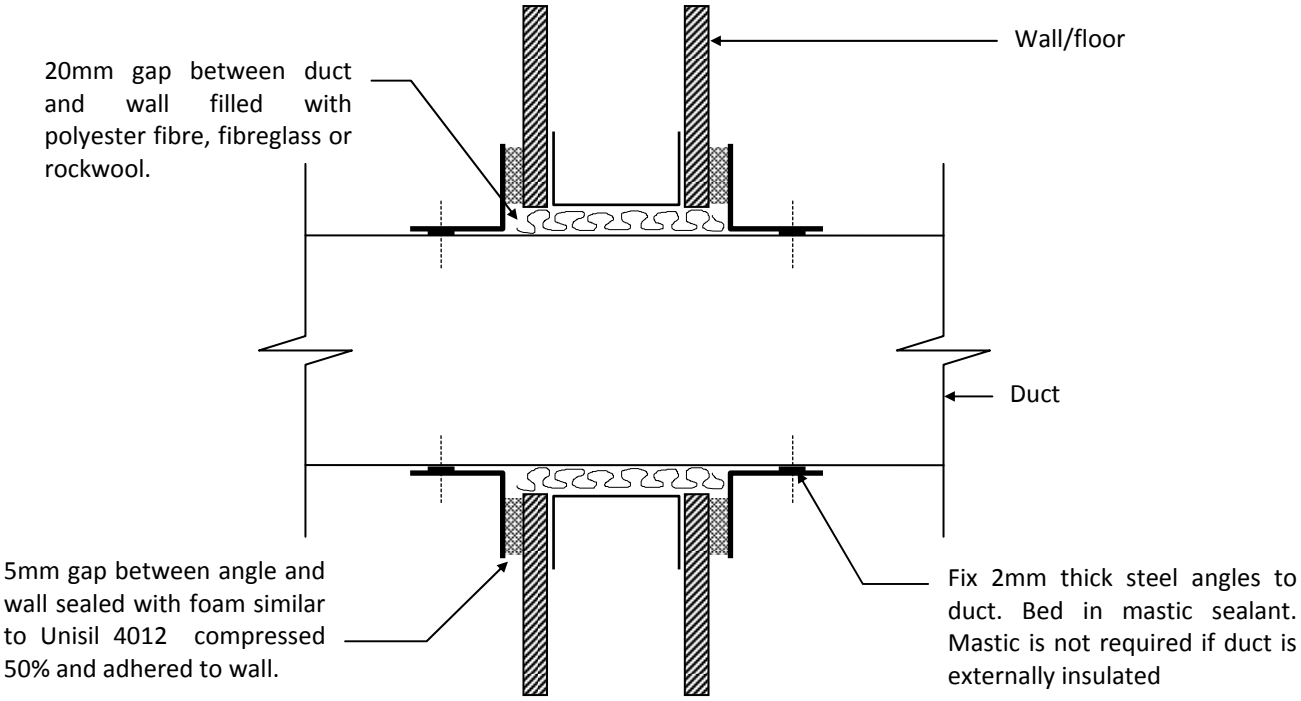
TYPE DA DUCT SEAL

(Note: Typical fire damper detail is also adequate)



TYPE DB DUCT SEAL

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



TYPE DC DUCT SEAL

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

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.

0 SILENCERS

▪ Performance

Submit with the tender performance data based on laboratory testing detailing silencer insertion loss, self generated noise, radiated noise, pressure drop and dimensions.

Unless stated otherwise silencer insertion loss and airflow pressure drop shall comply with the scheduled minimum performance requirements.

▪ Construction

General

Acoustic silencers shall be manufactured by an approved specialist manufacturer 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. 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.

0 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.

APPENDIX B – HYDRAULIC SERVICES SPECIFICATION

The acoustic treatments in this specification override any acoustic requirements in the hydraulics services specification or drawings.

PROJECT NOISE AND VIBRATION CRITERIA

0 INTERNAL NOISE LEVELS

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

Maximum noise levels in the development and other areas are listed in the Table below.

Noise Criteria For Mechanical Services in Health Buildings from AS2107

SPACE/ACTIVITY TYPE	NOISE LEVEL L_{eq} dB(A)	
	Satisfactory Level	Maximum Level
Corridor and lobby spaces	40	50
Consulting rooms	40	45
Procedure/Treatment Rooms	40	45
Offices	40	45
Office Areas	40	45
Conference Rooms	35	40
Staff Stations	40	45
Ward Spaces	30	35
Store Rooms	45	50
Waiting Rooms Reception	40	45
Toilets and Change Rooms	45	50

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

• 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 (ie 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 wards/sleeping areas and living rooms.

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

• STRUCTURE BORNE NOISE AND VIBRATION

The sub-contractor shall 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 to comply with Australian Standard AS3709-1989. 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.

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

0 ANTI-VIBRATION MOUNTS AND ISOLATORS

▪ 1 Isolation Mounts

Type M1 - Waffle Pad Mounts

Waffle pad mounts shall be: minimum 10mm 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.

Type M5 - Housed Spring/Neoprene Mounts

Type M4 spring/neoprene mounts in a laterally restrained housing having soft rubber stabilising snubbers (for control of lateral motion) in a steel housing.

- **Isolation Hangers**

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.

- **Pipe Vibration Isolation**

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.

Isolation Hangers

Where required install pipe vibration hangers or supports of the type indicated in the table below in Section **Error! Reference source not found.**.

Flexible Pipe Connections

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

0 EQUIPMENT BASES

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.

Where required, concrete inertia bases shall be installed. the mass of the base 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.

0 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 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.

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.

0 SELECTION OF ISOLATION MOUNTS

All basement pumps, blowers and other rotating plant shall be installed on min. 10mm static deflection type M3 mounts.

All other water pumps, blowers and other rotating plant shall be installed on min. 25mm static deflection type M4 mounts.

Water tanks, filters etc on floors directly above or below sensitive areas such as wards and sleeping/resting areas should be installed on type M1 mounts. Boilers directly above or below sensitive areas, such as wards and sleeping/resting areas should be installed on type M2 mounts having 6mm static deflection.

All piping (except fire services piping) within 25m of a pump shall be resiliently suspended using isolation hangers type H1 for pipe diameters >50mm, and resilient sleeves fitted to pipe clamps for pipe dimeters ^{2} 50mm. All piping shall be installed a minimum of 20mm clear of any walls, floors, ceilings or ceiling hangers, bulkheads, etc that would result in the transfer of vibration to the building structure.

• PENETRATIONS

0 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.

0 PIPE PENETRATIONS

Seal pipes penetrating slabs or walls, as follows:

Pipe Penetration Treatment

PROJECT NOISE CRITERION IN ADJACENT SPACES	SEAL TYPE
Domestic water within 25m of Pump	Type PB seal.
Condenser water pipes	Type PB seal.
Elsewhere including waste pipes	Type PA or PB seal.

0 ELECTRICAL WIRING

Individual electrical cables can be grouted into the wall or sealed with plaster. If there are any remaining gaps seal with Bostik Fireban 1 sealant or similar. Bunches of cables should 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.

• WASTE 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.

Wastepipe Treatment

Service	Location	Pipe Treatment
Waste Piping	Consulting & Interview Rooms	Pipes wrapped with Acoustic Supplies 5 kg/m2 Vibralagg or equivalent
	Private Offices of relative importance	Pipes wrapped with Acoustic Supplies 5 kg/m2 Vibralagg or equivalent
	Wards	Pipes wrapped with Acoustic Supplies 5 kg/m2 Vibralagg or equivalent
	Wet Aras	nil

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.

• ELECTRICAL

0 BELT DRIVEN PLANT

Belt driven intermittently operating plant having motors rated at greater than 2.5kW should be fitted with motor starters which 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 hospital terraces/external spaces.

0 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 hospital 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.

APPENDIX C – ELECTRICAL SERVICES SPECIFICATION

This section specifies the acoustic requirements for electrical services.

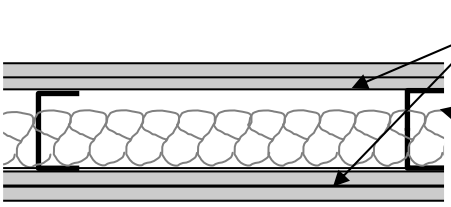
Penetrations in sound rated ceilings or walls or floors should maintain the acoustic performance of the ceiling. Where required provide acoustic boxes or other treatment.

Where penetrations are made in sound rated walls 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.

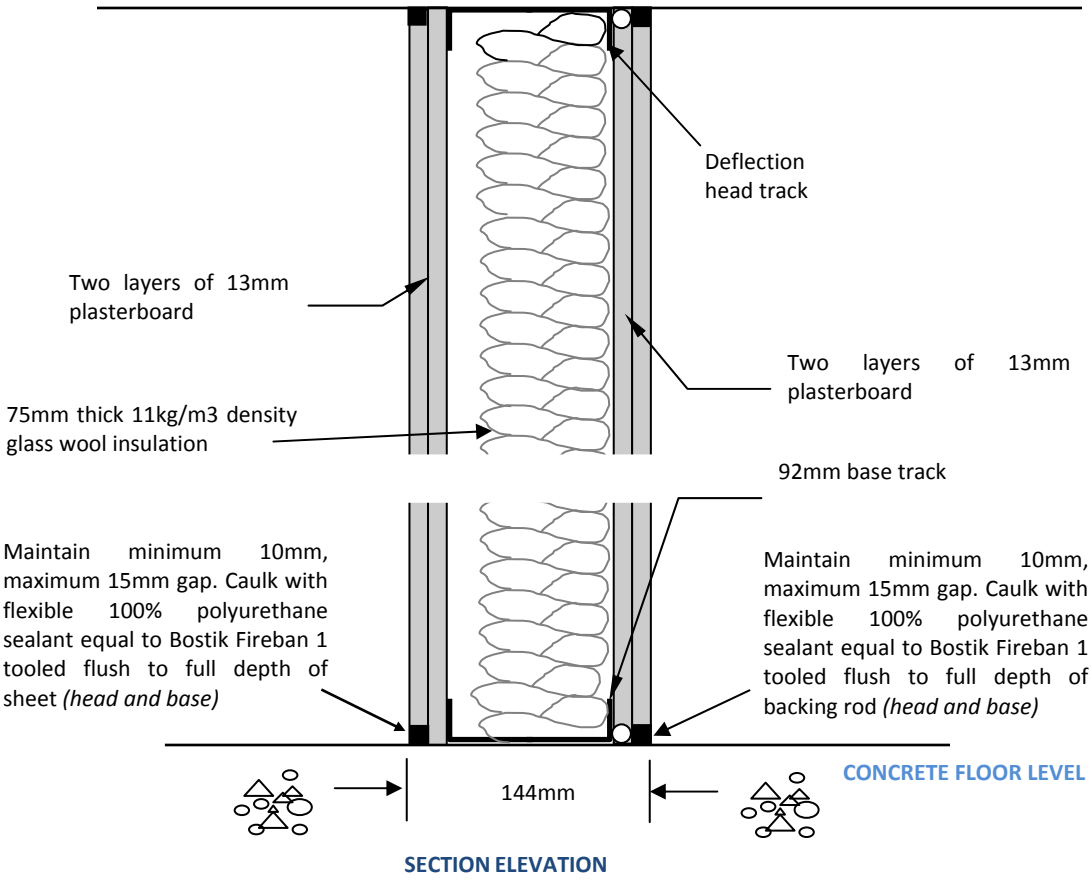
Light fittings penetrating sound rated ceilings over wet areas shall be treated with acoustic boxes themselves as required to maintain the acoustic performance of the ceiling.

APPENDIX D – ACOUSTIC DETAILS

PLAN



Note: 13mm plasterboard can be replaced with 1x6mm FC for one or both sheets of plasterboard or both sides of the wall.



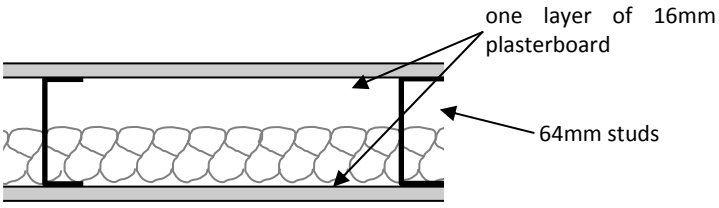
SECTION ELEVATION

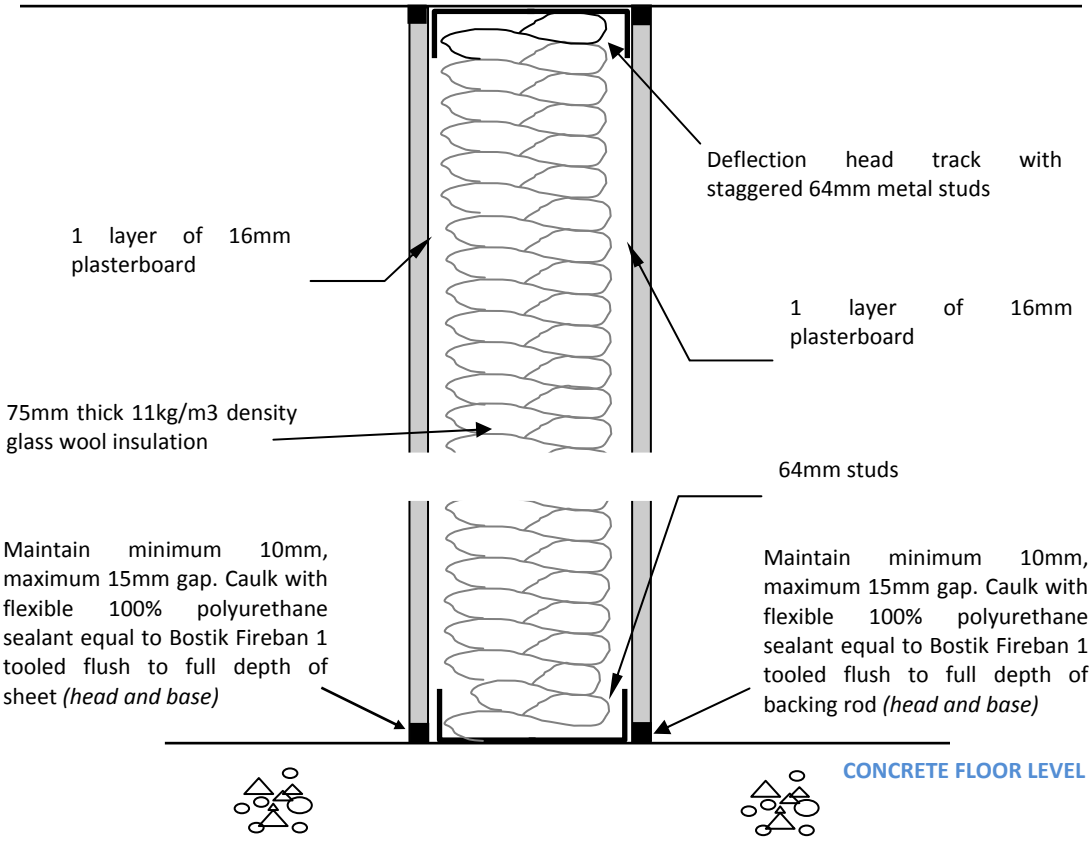
NOTE: ENSURE THAT ALL PENETRATIONS IN WALLS AND CEILINGS ARE ACOUSTICALLY SEALED.

SECTION ELEVATION **STC/R_w 50 Wall System**	**Acoustic Logic Consultancy Pty Ltd** **9 Sarah Street Mascot, 2020** **GRAYTHWAITE REHABILITATION CENTRE**

Date:	**Drawn:**	**Checked:**	**Project No:**	**Drawing No:**
June 2011	JS	BW	20110406	AC001
Issue	**Scale:**	**Approved**		
0	NTS			

PLAN



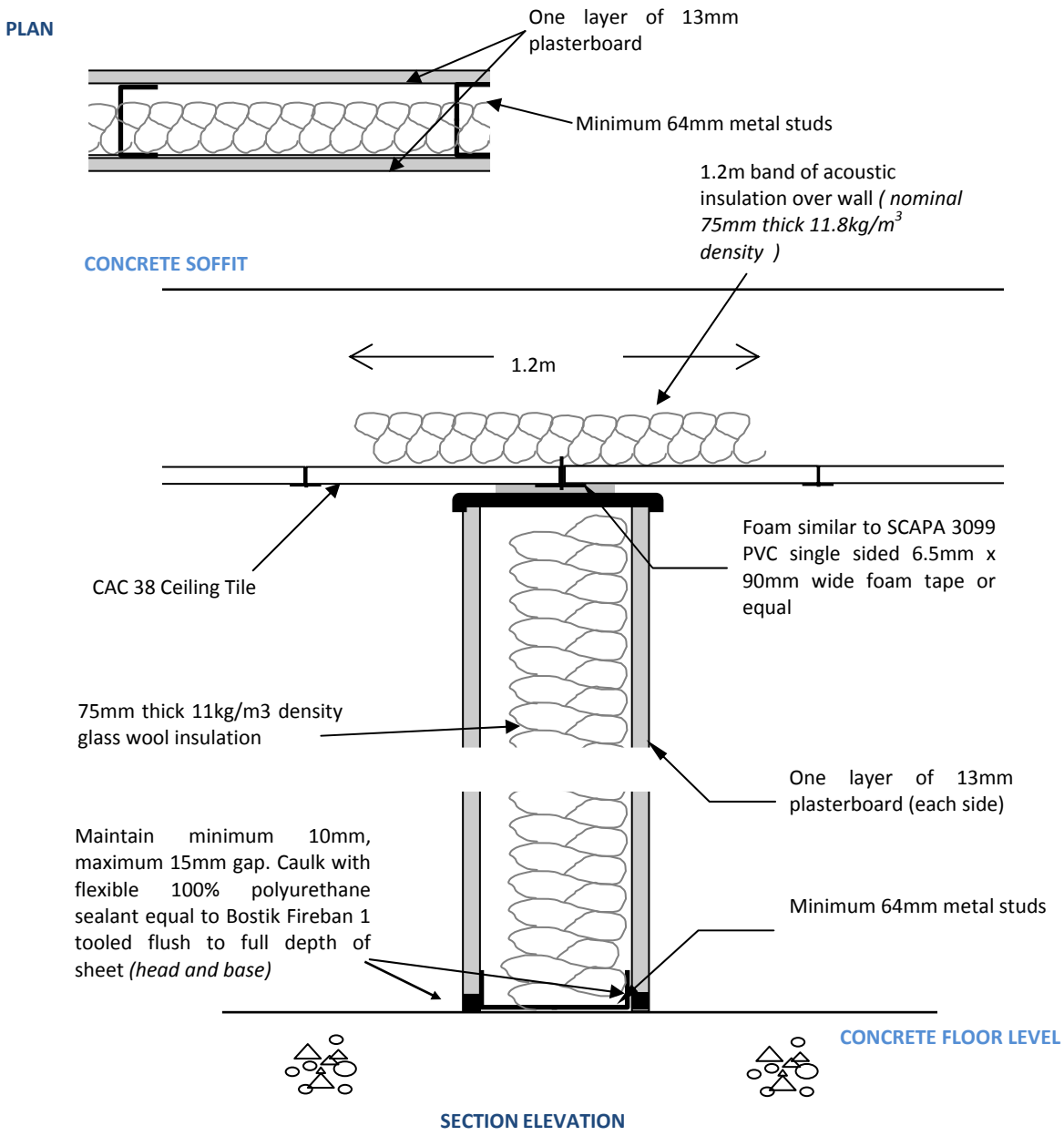


SECTION ELEVATION

NOTE: ENSURE THAT ALL PENETRATIONS IN WALLS AND CEILINGS ARE ACOUSTICALLY SEALED.

SECTION ELEVATION **STC/R_w 45 Wall System**	**Acoustic Logic Consultancy Pty Ltd** **9 Sarah Street Mascot, 2020** **GRAYTHWAITE REHABILITATION CENTRE**

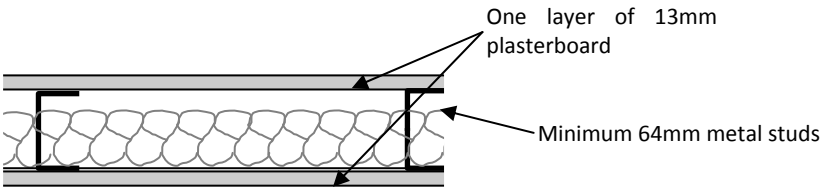
Date:	**Drawn:**	**Checked:**	**Project No:**	**Drawing No:**
June 2011	JS	BW	20110406	AC001b
Issue	**Scale:**	**Approved**		
0	NTS			

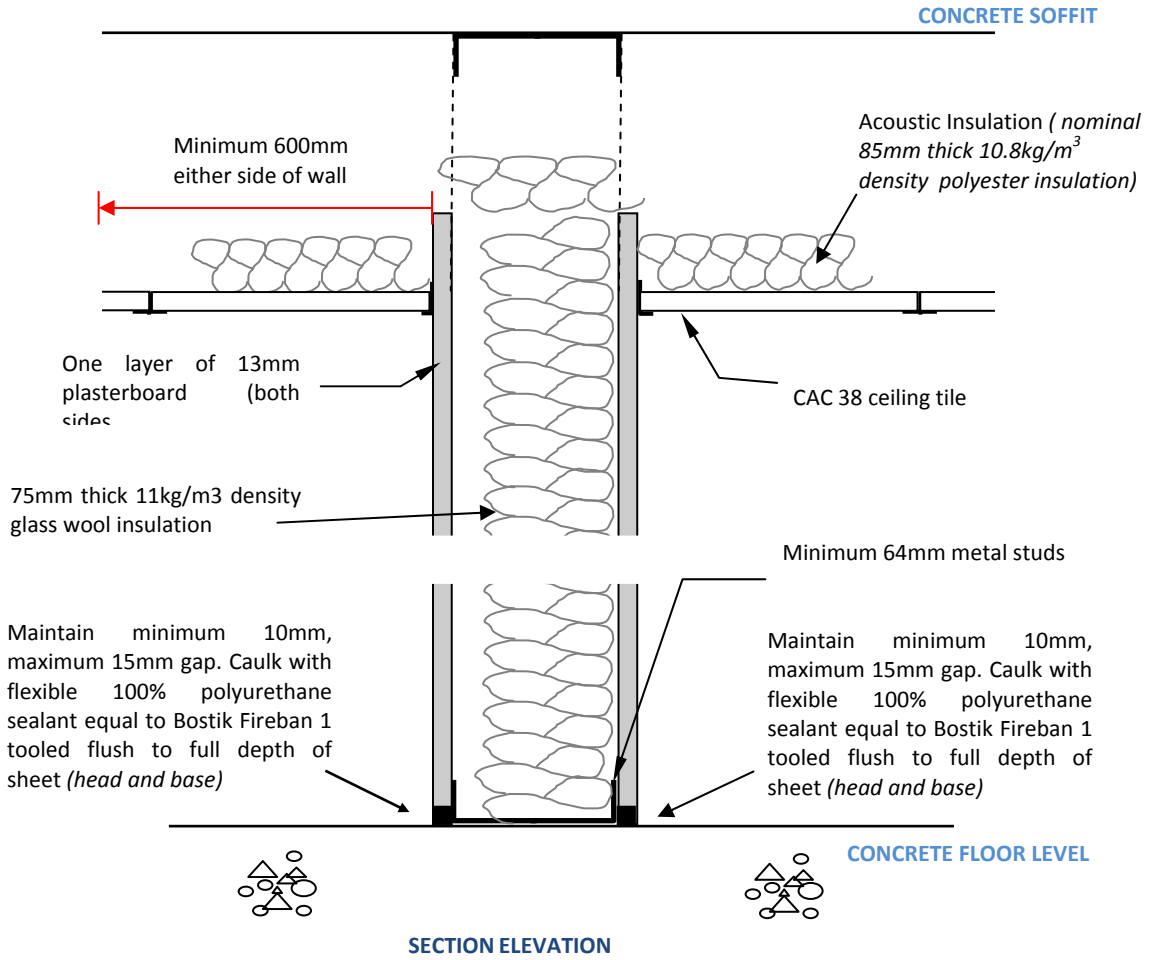


NOTE: ENSURE THAT ALL PENETRATIONS IN WALLS AND CEILINGS ARE ACOUSTICALLY SEALED

SECTION ELEVATION STC/R_w 43 Wall System Ceiling Tiles			**Acoustic Logic Consultancy Pty Ltd 9 Sarah Street Mascot, 2020**	
			GRAYTHWAITE REHABILITATION CENTRE	
Date:	**Drawn:**	**Checked:**	**Project No:**	**Drawing No:**
June 2011	JS	BW	2011506	AC002a
Issue	**Scale:**	**Approved**		
0	NTS			

PLAN



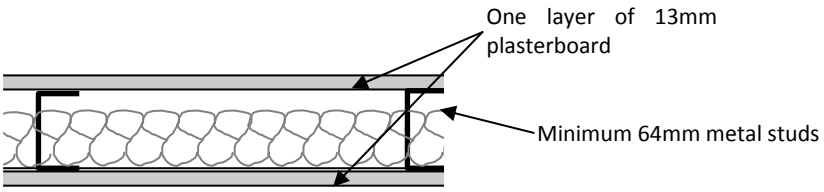


SECTION ELEVATION

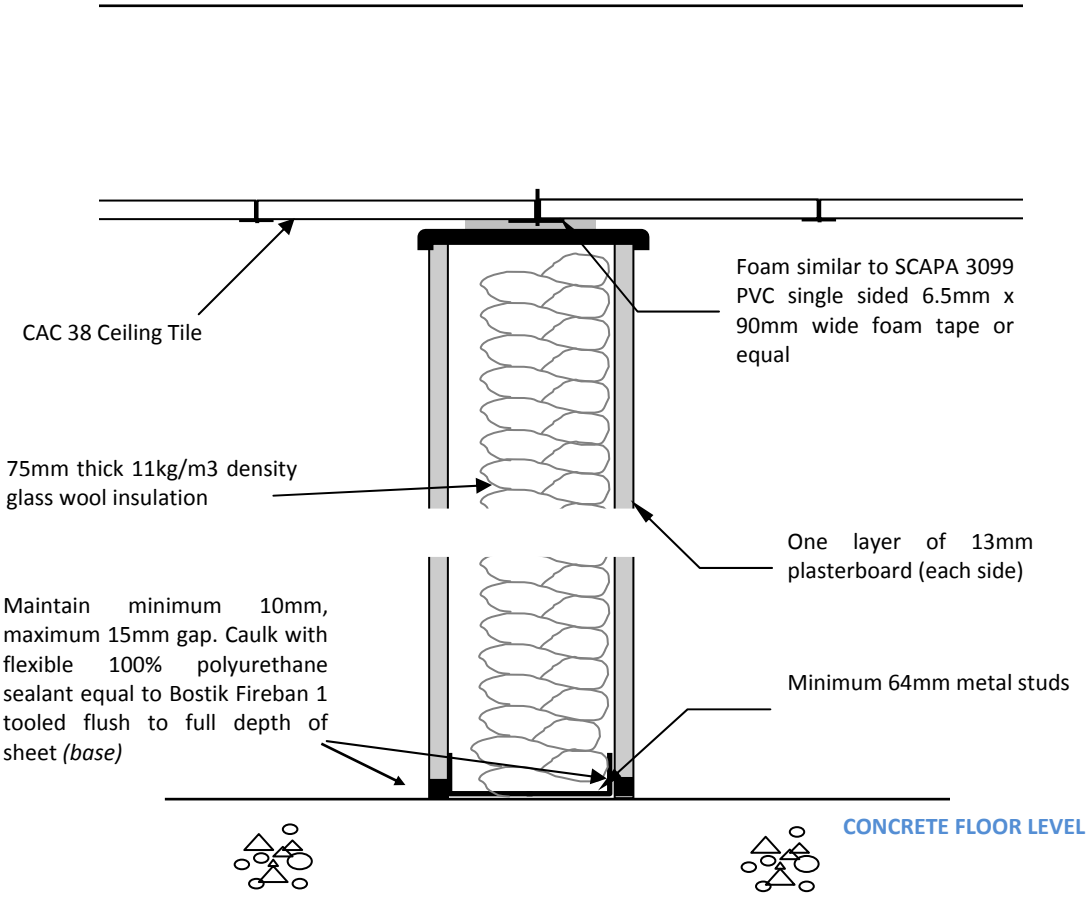
NOTE: ENSURE THAT ALL PENETRATIONS IN WALLS AND CEILINGS ARE ACOUSTICALLY SEALED

SECTION ELEVATION **STC/R_w 43 Wall System** **Non Full Height Walls – Ceiling Tiles**			**Acoustic Logic Consultancy Pty Ltd** **9 Sarah Street Mascot, 2020** **GRAYTHWAITE REHABILITATION CENTRE**	
Date:	**Drawn:**	**Checked:**	**Project No:**	**Drawing No:**
June 2011	JS	BW	20110406	AC002b
Issue	**Scale:**	**Approved**		
0	NTS			

PLAN



CONCRETE SOFFIT



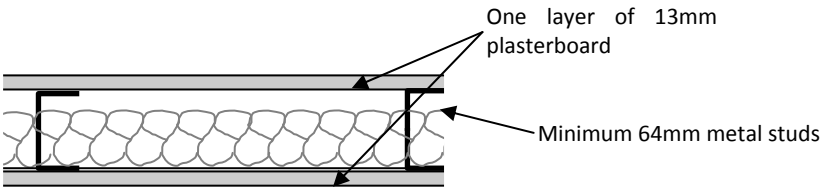
SECTION ELEVATION

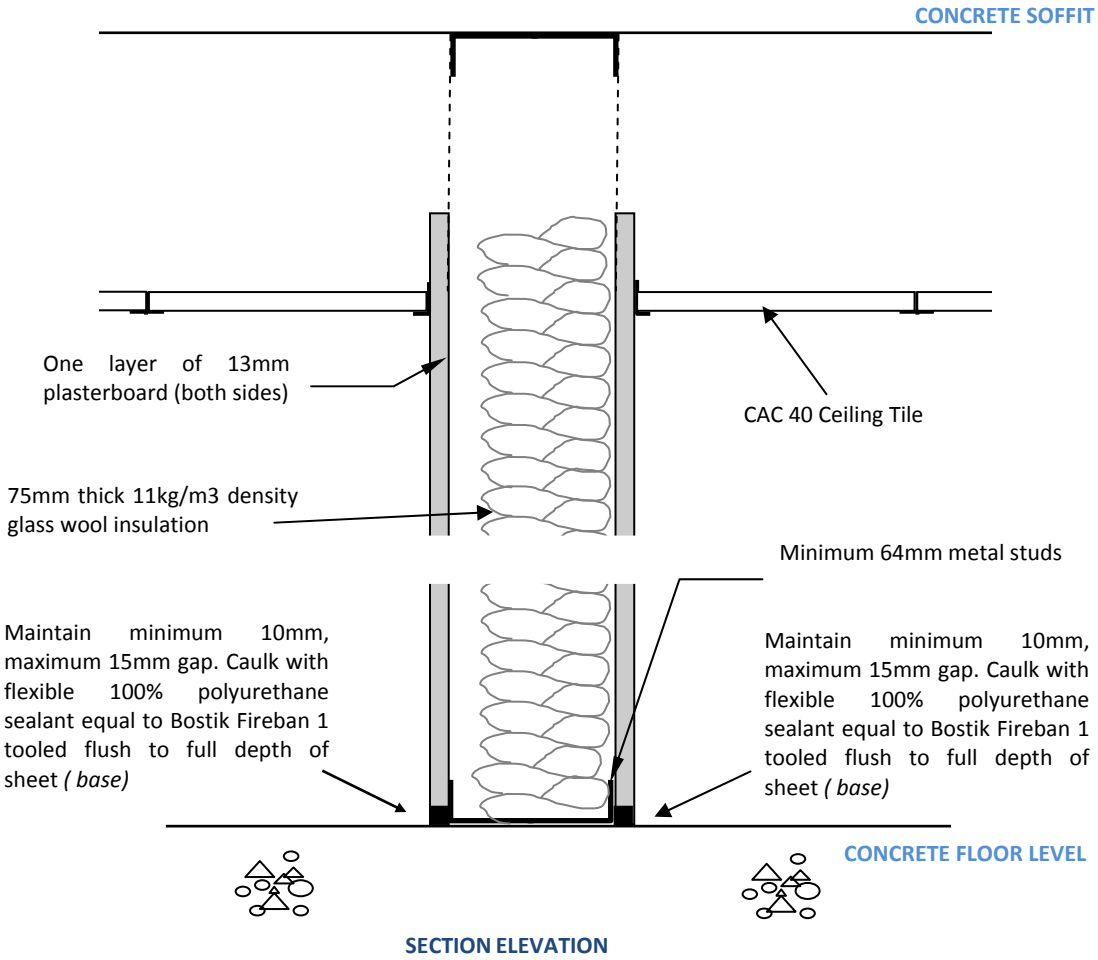
NOTE: ENSURE THAT ALL PENETRATIONS IN WALLS AND CEILINGS ARE ACOUSTICALLY SEALED

SECTION ELEVATION **STC/R_w 40 Wall System** **Ceiling Tile**	**Acoustic Logic Consultancy Pty Ltd** **9 Sarah Street Mascot, 2020** **GRAYTHWAITE REHABILITATION CENTRE**

Date:	**Drawn:**	**Checked:**	**Project No:**	**Drawing No:**
June 2011	JS	BW	20110406	AC003a
Issue	**Scale:**	**Approved**		
0	NTS			

PLAN



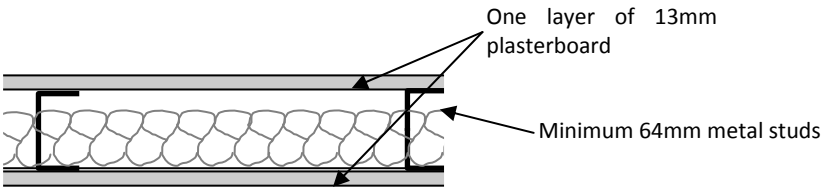


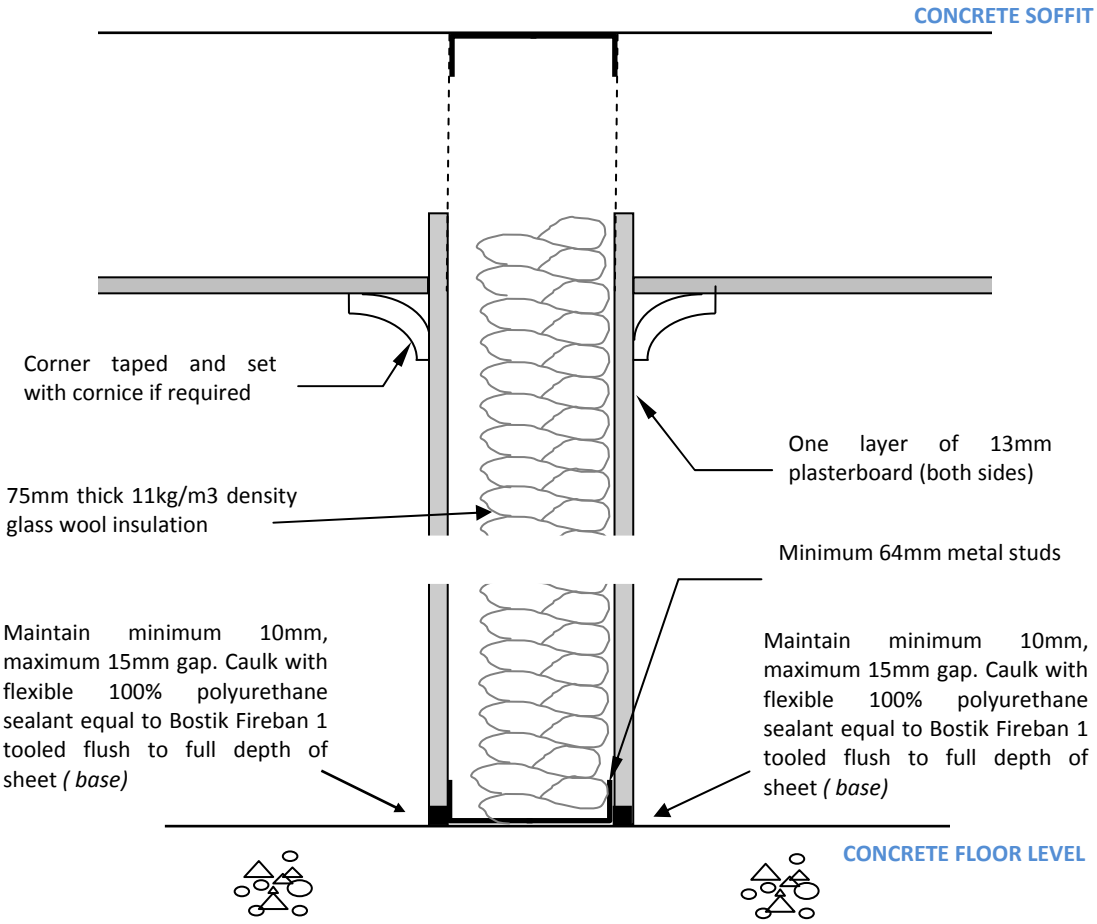
SECTION ELEVATION

NOTE: ENSURE THAT ALL PENETRATIONS IN WALLS AND CEILINGS ARE ACOUSTICALLY SEALED

SECTION ELEVATION **STC/R_w 40 Wall System** **Non Full Height Walls**			**Acoustic Logic Consultancy Pty Ltd** **9 Sarah Street Mascot, 2020** **GRAYTHWAITE REHABILITATION CENTRE**	
Date:	**Drawn:**	**Checked:**	**Project No:**	**Drawing No:**
June 2011	JS	BW	20110406	AC003b
Issue	**Scale:**	**Approved**		
0	NTS			

PLAN





SECTION ELEVATION

NOTE: ENSURE THAT ALL PENETRATIONS IN WALLS AND CEILINGS ARE ACOUSTICALLY SEALED

SECTION ELEVATION **STC/R_w 40 Wall System** **Non Full Height – Set PB**	**Acoustic Logic Consultancy Pty Ltd** **9 Sarah Street Mascot, 2020** **GRAYTHWAITE REHABILITATION CENTRE**

Date:	**Drawn:**	**Checked:**	**Project No:**	**Drawing No:**
June 2011	JS	BW	20110406	AC003c
Issue	**Scale:**	**Approved**		
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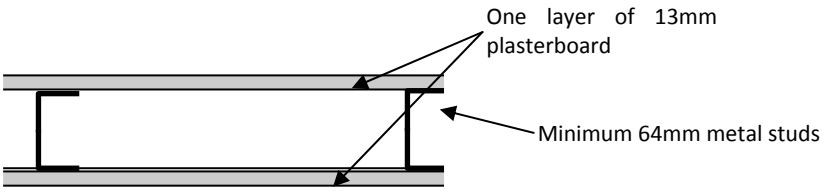
PLAN



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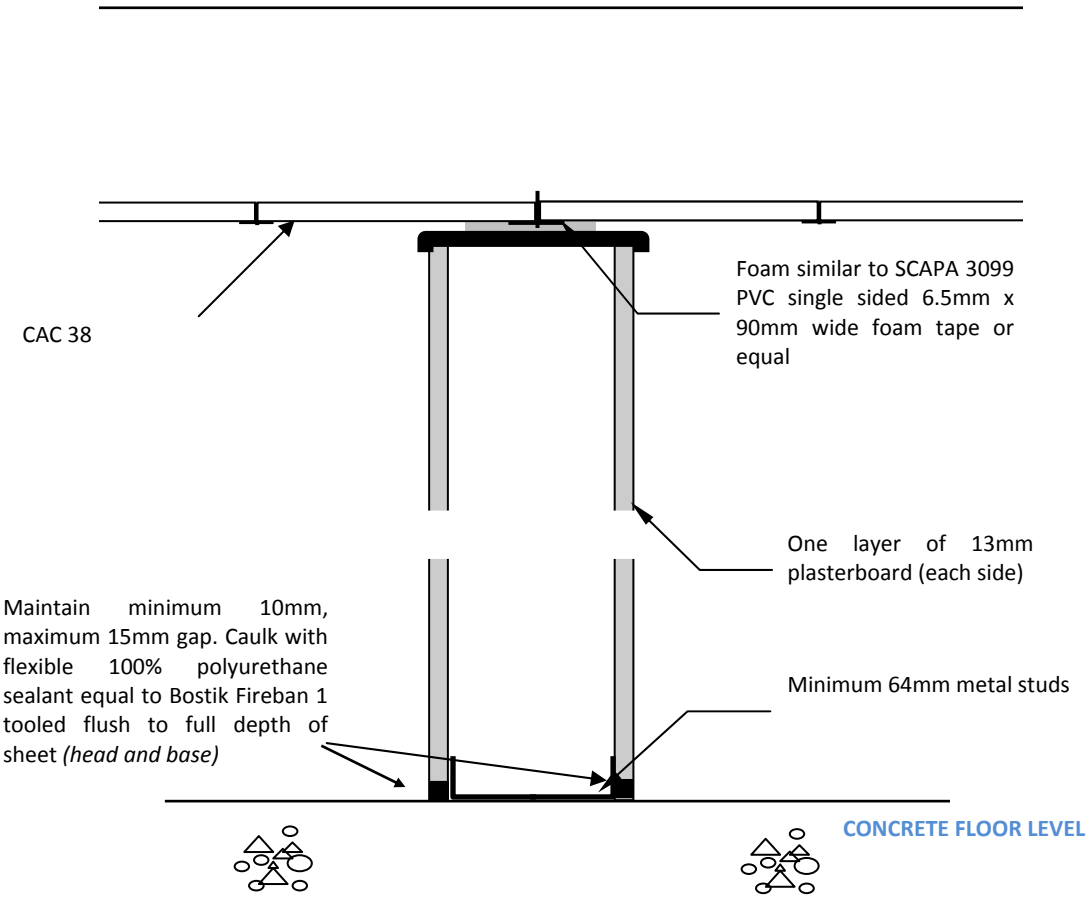

SECTION ELEVATION

NOTE: ENSURE THAT ALL PENETRATIONS IN WALLS AND CEILINGS ARE ACOUSTICALLY SEALED

SECTION ELEVATION **STC/R_w 35 Wall System** **Ceiling Tile**	**Acoustic Logic Consultancy Pty Ltd** **9 Sarah Street Mascot, 2020** **GRAYTHWAITE REHABILITATION CENTRE**

Date:	**Drawn:**	**Checked:**	**Project No:**	**Drawing No:**
June 2011	JS	BW	20110406	AC004a
Issue	**Scale:**	**Approved**		
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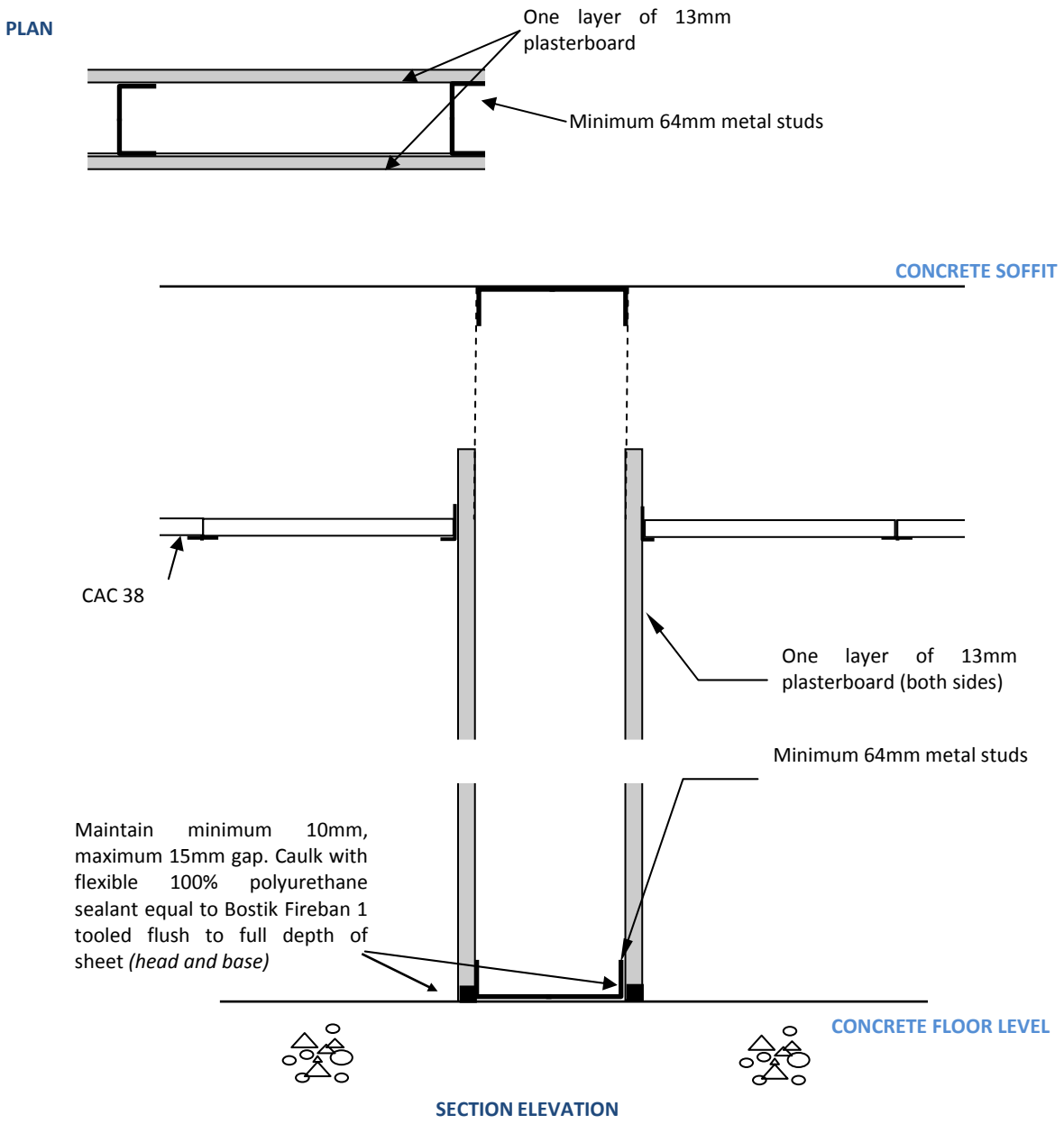

NOTE: ENSURE THAT ALL PENETRATIONS IN WALLS AND CEILINGS ARE ACOUSTICALLY SEALED

SECTION ELEVATION **STC/R_w 35 Wall System** **Non Full Height Walls**	**Acoustic Logic Consultancy Pty Ltd** **9 Sarah Street Mascot, 2020** **GRAYTHWAITE REHABILITATION CENTRE**

Date:	**Drawn:**	**Checked:**	**Project No:**	**Drawing No:**
June 2011	JS	BW	20110406	AC004b
Issue	**Scale:**	**Approved**		
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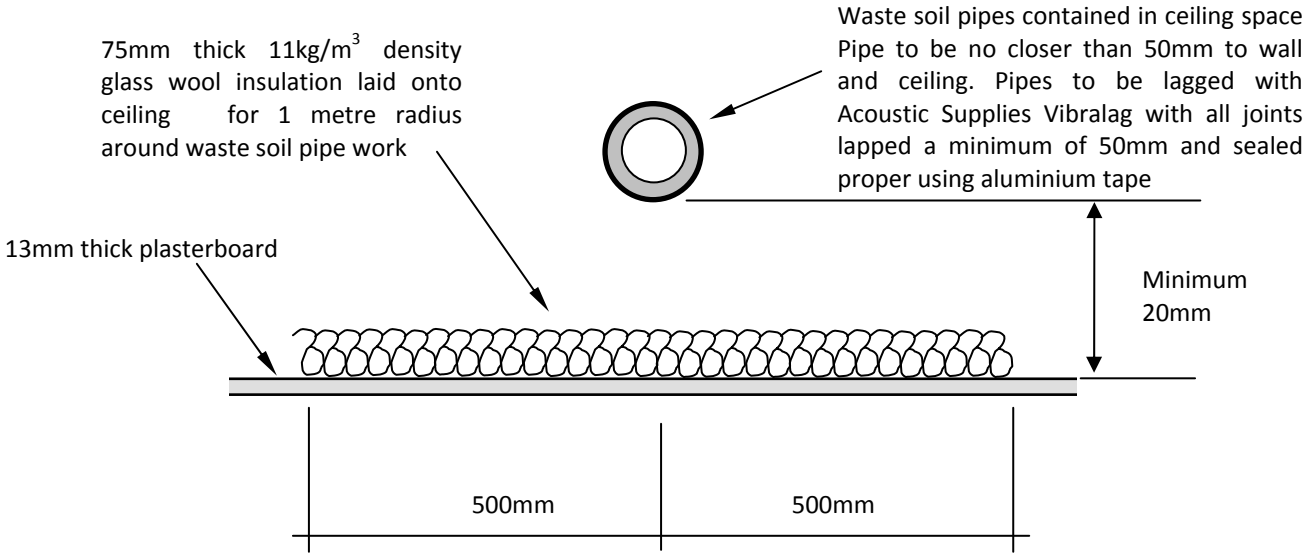

NON WET AREAS

CEILING SECTION

WASTE PIPE TREATMENT ABOVE NON WET AREAS			**Acoustic Logic Consultancy Pty Ltd 9 Sarah Street Mascot, 2020**	
			GRAYTHWAITE REHABILITATION CENTRE	
Date:	**Drawn:**	**Checked:**	**Project No:**	**Drawing No:**
June 2011	JS	BW	20110406	AC005
Issue	**Audited:**	**Approved**		
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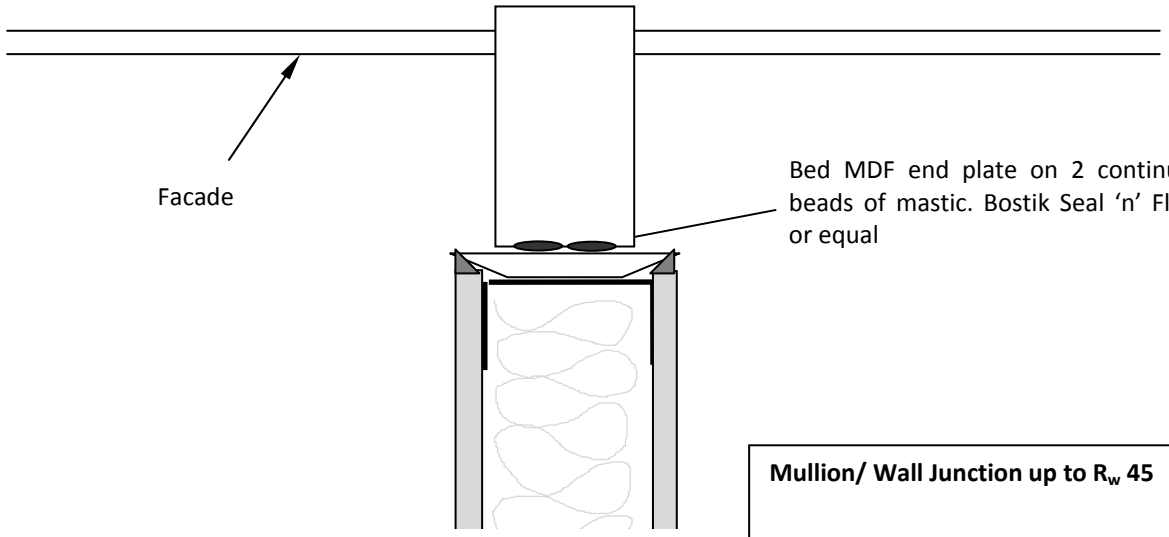

PLAN SECTION OF MULLION/FAÇADE JUNCTIONS			Acoustic Logic Consultancy Pty Ltd 9 Sarah Street Mascot, 2020	
			GRAYTHWAITE REHABILITATION CENTRE	
Date:	**Drawn:**	**Checked:**	**Project No:**	**Drawing No:**
June 2011	JS	BW	20110406	AC006
Issue	**Audited:**	**Approved**		
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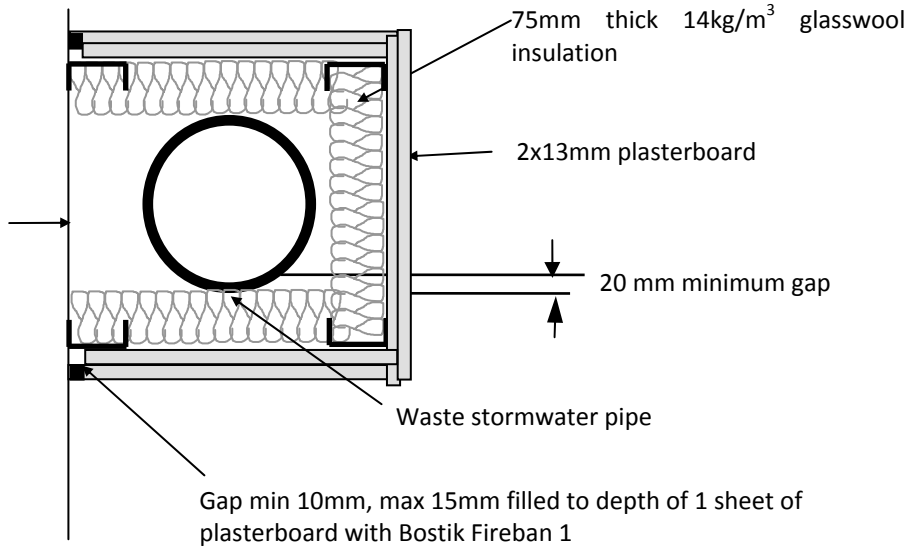
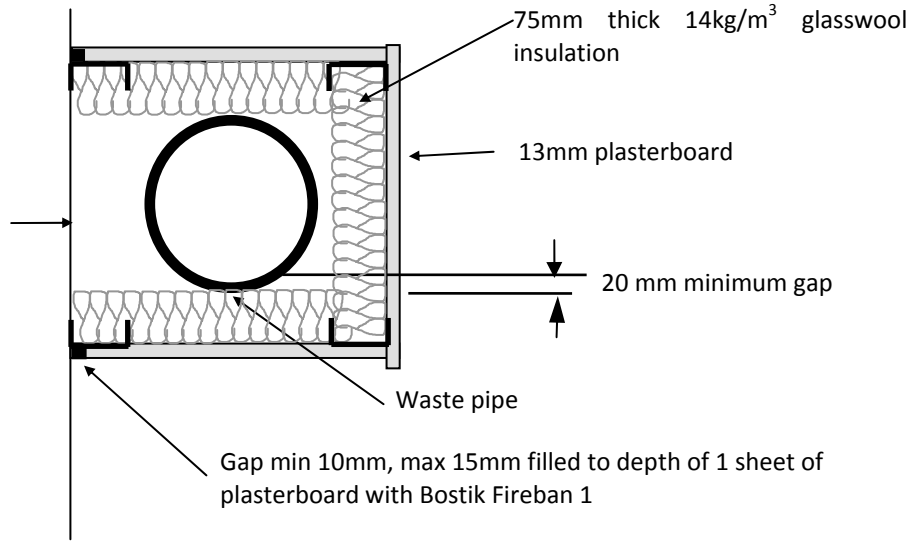


NON-FIRE RATED OPTION

RISER TREATMENT – RISER ADJACENT TO OFFICES, CONSULTING, TREATMENT, MEETING and WARD ROOMS			**Acoustic Logic Consultancy Pty Ltd** 9 Sarah Street, Mascot	
			GRAYTHWAITE REHABILITATION CENTRE	
Date:	**Drawn:**	**Checked:**	**Project No:**	**Drawing No:**
July 2011	BW		20110406	AC007
Issue	**Scale:**	**Approved**		
	NTS			



NON-FIRE RATED OPTION

WASTE / STORMWATER RISER TREATMENT **RISER TREATMENT FOR WET / UTILITIES AREAS / CORRIDORS**			**Acoustic Logic Consultancy Pty Ltd** 9 Sarah Street, Mascot **GRAYTHWAITE REHABILITATION CENTRE**	
Date:	**Drawn:**	**Checked:**	**Project No:**	**Drawing No:**
June 2011	BW		20110406	AC008
Issue	**Scale:**	**Approved**		
	NTS			