

The Charter, Gravesend



**Acoustic Design Review
Report 20764.ADR.01**

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20764.DWG1-5 Technical Drawings

1.0 INTRODUCTION

KP Acoustics (KPA) has been commissioned to provide a bespoke acoustic design review for the development of a mixed-use commercial and residential accommodation at 2A-2B Windmill Lane, Stratford.

The Client intends that the residential accommodation will be of high standard and that this requirement will also apply to internal noise levels and sound insulation. The main objective of this report is therefore to encapsulate all design issues in the form of a design specification.

This and the following sections of the document show the acoustic criteria that the contractor is to achieve. The following sections provide potential designs to assist the contractor in formulating their proposals. Alternative designs are acceptable, provided that they meet the employer's quality objectives and achieve the relevant project acoustic criteria.

2.0 NOISE CRITERIA

Noise Criteria

The acoustic design criteria for external noise intrusion are defined in Table 2.1. These have been derived following the guidance given in BS8233:2014 '*Sound insulation and noise reduction for buildings*'.

Room	Daytime	Night-time
Bedrooms	35	30
Living Rooms	40	-

Table 2.1: Internal Noise Criteria, L_{eq} – External Noise Intrusion

Table 2.2 lists the internal noise criteria to be achieved from building services within all habitable and commercial spaces.

Room	Minimum	Normal
Bedrooms	NR20	NR25
Living Room	NR25	NR30
Bathrooms	NR30	NR35
Kitchens	NR30	NR40
Commercial Spaces	NR38	

Table 2.2: Internal Noise Criteria - Building Services Noise

3.0 INTERNAL SOUND INSULATION

Table 3.1 summarises the internal sound insulation criteria for the apartments. In order to achieve the project aspirations, all separating wall and floor constructions are to provide sound insulation which would satisfy the minimum requirements of The Building Regulations 2010 (Approved Document E 2003).

Doors and internal walls to sensitive rooms within the apartments are to provide sound insulation above the values required by ADE.

Element	Airborne Sound Insulation Performance	Impact Sound Insulation Performance
Separating walls	$D_{nT,w} + C_{tr} \geq 48\text{dB}$	-
Separating Floors	$D_{nT,w} + C_{tr} \geq 50\text{dB}$	$L'_{nTw} \leq 56\text{dB}$
Apartment Entrance Doors	$R_w \geq 30\text{dB}$	-
Internal Walls separating bedrooms and bathrooms from adjacent spaces and living areas. Walls with no connecting doors	$R_w \geq 40\text{dB}$	-

Table 3.1 Internal Sound Insulation – Apartments

Party Walls between Apartments

Current proposals entail the following elements:

- 2x15mm SoundBloc boards
- Double frame comprising 60mm I-studs at 600mm centres
- 190mm void with 100mm mineral wool insulation (APR1200, or similar)
- 2x15mm SoundBloc boards

The above system has been modelled with proprietary simulation software (Insul™) and the results have revealed a performance of 51dB, $D_{nT,w} + C_{tr}$, therefore comfortably providing the design target for airborne sound insulation shown in Table 3.1 without any further changes. We would highly recommend that all party walls be built slab-to-slab, i.e. they should be ‘*embedded*’ within the proposed screed system, and reach the underside of the soffit above.

Internal Walls Within Apartments

In the case of internal walls, current proposals entail the following build-up:

- 1x12.5mm WallBoard and skim coat
- 70mm C-stud with 25mm mineral wool insulation (APR1200, or similar)
- 1x12.5mm WallBoard and skim coat

Other variants of this wall could entail the use of ply for the use of tiles, which is not anticipated to have any effect on the acoustic integrity of the internal walls.

No further changes would be required for the above system, as it would comfortably meet the design targets shown in Table 3.1.

Separating Walls between Apartments & Stair/Lift Core and Riser

Current proposals entail the following elements

- 15mm SoundBloc board on RB1 resilient bars, fixed onto a 60mm I-stud frame with 50mm mineral wool insulation within the formed void (APR1200, or similar)
- 200mm in-situ concrete wall

Our view is that the above system could be simplified by removing the RB1 resilient bars, while retaining only the I-stud frame. This minor amendment would be considered sufficient to control noise breaking into all habitable spaces. No further changes would therefore be required.

Party Floors

The required performance of the floors depends on the use of the spaces they separate and on their tolerance to noise created from the spaces above and below the construction in question.

The current party floor system between apartments is currently comprising the following build-up:

- 15mm floor finish
- Approx. 65mm concrete topping, or sand:cement screed
- 6mm IsoRubber (or similar) isolating resilient layer
- 225mm RC concrete slab
- MF-type ceiling system with 1x12.5mm WallBoard (or similar) as the ceiling soffit under approx. 175mm void

The above build-up would provide airborne and impact sound insulation values which would fully satisfy the design targets of Table 3.1 provided the following points are adopted into the design strategy:

- We would recommend that a rubber-based resilient isolating layer is installed between the screed and the concrete slab. This can be comprised of Regupol 7210C (5mm), or similar.
- Ensure that the mass per unit area of the screed is 80kg/m^2
- Ensure that the density of the concrete slab is 2400kg/m^3 (min.)
- Ensure that the screed does not come in contact with the floor slab, or perimeter walls. The resilient layer should therefore be turned up around the edges of the floor in order to ensure that it is decoupled from the main slab.

Noise Transfer between Ground Floors to First Floor Levels

It is proposed to incorporate a number of ancillary spaces within the Ground Floor of the development (plant rooms, cycle store, commercial areas, etc.). The design shows these spaces to be directly below habitable spaces. Noise intrusion into the apartments should therefore be minimised.

It is understood that the separating floor system would comprise a 200mm RC slab with a 50mm sand:cement screed. This would be considered sufficient to ensure a good degree of airborne sound insulation between the aforementioned areas and 1st Floor habitable areas.

4.0 ACOUSTIC PERFORMANCE – BUILDING ELEMENTS

The design and detailing of all constructions providing acoustic separation must be approved by the architect, the structural engineer and the acoustic consultant.

External Building Fabric

The acoustic performance specifications for the building envelope are given on the basis of all elements of the construction. It is not satisfactory for tenderers to base their proposals on comparisons of glass manufacturers' tested performance figures as these rarely take the adverse effects of framing, seals, building interfaces, etc. into account.

It will be necessary for window systems to be tested in an independent accredited laboratory, or approved equivalent, and for the test samples to be agreed with the acoustic consultant. Estimates of performance based on previous test data will not be accepted as

evidence of compliance except in non-critical situations, including ancillary areas and circulation spaces.

It is essential that all exterior opening glazing (doors and windows) should form an airtight seal with its frame when shut. Neoprene seals are to be specified, rather than brush seals. The frames are to be constructed to ensure there are no holes. It is equally important to ensure that the frame seals tightly into the surrounding opening. The opening should be accurately made to receive the window and the perimeter gap packed with an acoustically absorbent material, before the application of a continuous mastic seal on both sides.

Internal Sound Insulation

Separating (Party) Walls

In order to achieve the in-situ sound insulation requirement of Table 3.1, separating walls should achieve a sound reduction performance of R_w 60-62dB, when measured in accordance with BS EN ISO 140-3: 1995 '*Acoustics – Measurement of sound insulation in buildings and of building elements – Part 3: Laboratory measurement of airborne sound insulation of building elements*' and rated following the methodology given in BS EN ISO 717-1: 1997 '*Acoustics – Rating of sound insulation in buildings and of building elements - Part 1: Airborne sound insulation*'. .

All junctions between separating walls and other constructions shall be designed and built such that there is no compromise in airborne sound insulation.

Separating Floors

In order to achieve the in-situ sound insulation requirement of Table 3.1, separating floors should be capable of achieving a sound reduction performance of R_w 60-62dB.

It is understood that a metal-framed plasterboard ceiling would be the main underfloor soffit element. Where the ceiling is to incorporate lighting, etc., penetrations should be limited to not more than 5% of the ceiling area in order to maintain the sound insulation between floors. Penetration of the floor, e.g. for services, should be of the minimum dimension necessary. Openings should be packed with mineral fibre and closed-off with plasterboard pattresses, or similar, or filled with a cementitious compound following installation.

Provided that there is a minimum ceiling void of 75mm, downlighters, or recessed lighting may be installed at no more than one unit per 2m² of ceiling area, at centres not less than 0.75m and into openings not exceeding 100mm diameter.

Remaining gaps must be sealed with generous application of non-hardening mastic to provide a continuous seal.

Doors to Apartments

Doors to apartments shall be designed to achieve weighted sound reduction of R_w 30dB. This is likely to require a minimum 44mm solid core door panel and custom-built frame, fitted with acoustic compression seals to the head and jambs. Door furniture must be capable of maintaining the acoustic performance and should be fitted in accordance with the manufacturer's instructions.

The door assembly should be installed within a prepared opening, with all gaps packed with mineral fibre and sealed with a continuous bead of non-hardening builders mastic, using backing rods where necessary. Small gaps, i.e. less than 3 mm width, could be sealed with mastic only.

Some points which should be followed regarding the acoustic performance of doors are as follows.

- Non-hardening caulk should be used to seal joints airtight
- If hollow metal frames are used, they should be fibre or grout-filled
- Doors should be 'gasketed' around the entire perimeter to be airtight when closed
- Seals should be adjustable to compensate for wear, thermal movement, settlement of building structure and other factors that cause misalignment of the doors
- Quality hydraulic closers should be fitted on all doors likely to be subjected to heavy use

Internal Walls

Internal wall constructions shall achieve the weighted sound reduction index given in Table 3.1 when measured in accordance with BS EN ISO 140-3: 1995 '*Acoustics – Measurement of sound insulation in buildings and of building elements – Part 3: Laboratory measurement of airborne sound insulation of building elements*' and rated following the methodology given in BS EN ISO 717-1: 1997 '*Acoustics – Rating of sound insulation in buildings and of building elements - Part 1: Airborne sound insulation*'.

The walls must either extend full height or otherwise have an acoustic detail within the ceiling void to control flanking noise. Appropriate acoustic sealing with adjacent structures must also be achieved at all edges. Any penetrations must be acoustically sealed with a pattress and resilient sleeve detail, with joints finished with a continuous bead of non-hardening mastic.

Internal Doors (Hinged)

In order to meet the quality aspirations of the development, hinged internal doors should feature a solid core timber door panel within a close-fitting frame and shall be fitted with simple seals to the head and jambs. Doors to sensitive rooms should achieve the acoustic performance given in Table 3.1.

Air Velocities

Where passing through, or above habitable spaces, air velocities within ducts should be controlled to the values shown in Table 4.1, in parallel to the installation of a suitably selected silencer schedule, or via the installation of lagging.

NR Criterion	NR35	NR30
Main Branch	5	4
Grille	2.5	2
Diffuser	2	1.5
Return air stub duct in ceiling	3	2

Table 4.1: Maximum airflow velocity (m/s)

Fan Coil Unit Cupboard Doors

Doors to the FCU cupboards should be acoustically rated to R_w 30 dB and should consist of a minimum 40mm thick solid-core timber door with acoustic compression seals all round.

Control Panels

Where located within party walls, recessed control panels should be backed with two layers of 12.5mm SoundBloc plasterboard, or similar. The control panel should be fitted within the wall such that periphery gaps are minimal (less than 5mm width). The control panel fascia should incorporate a rubber gasket all round to ensure an effective acoustic seal with the plastered face of the wall. Control panels on either side of a wall should be offset by at least 500mm.

Acoustic Lagging

Where lagging may be required to achieve a degree of attenuation, we would recommend the following:

Normal duty lagging

- Rockwool RockLap H&V

Heavy duty lagging

- Techwrap 2, or Techtube from Rockwool

Control of Reverberation for Building Services Cupboards

Where reverberant noise due to noise within the FCU cupboards needs to be suppressed, we would recommend the following:

- Armasound RD from Armacell

Access Panels

Where access panels are required, a proprietary access panel solution would be suitable, such as the following:

- http://www.ceildoorproducts.co.uk/wp-content/uploads/2014/03/CTMP_dB.pdf
- <https://www.accesspanels.co.uk/access-panels/acoustic-rated>

Another option would be a hinged door with rebated meeting stile, with compression seals to the perimeter. This would likely need to be constructed from timber, such as 18mm MDF, of greater mass per unit area than 12.5mm SoundBloc (10.6kg/m²) and, when closed, the latch should be set to ensure that the door exerts positive pressure on the compression seals to maintain the acoustic integrity of the panel.

Hydraulic Systems

Hydraulic systems shall be designed and installed to minimise audibility of water/waste noise within the habitable spaces.

The following controls shall be adopted to minimise noise emissions from hydraulic systems.

- Avoid hard grouting and chasing of water pipes in walls, particularly where walls are common with noise sensitive areas.
- In noise sensitive areas, support pipes with clamps having a soft neoprene sleeve.

- Route all rainwater down pipes outside the building or, alternatively, via service cupboards or risers boxed-in by means of 2x12.5mm layers of FireLine. Avoid bends and T-junctions in ceiling spaces above noise sensitive areas.
- Do not support pipework from lightweight constructions

Where it is unavoidable that hydraulic systems pass through habitable spaces, they must be concealed. As a minimum, bulkheads shall consist of minimum two layers of 12.5mm plasterboard with staggered and sealed joints. When concealing waste systems, the bulkhead shall also be lined internally with 50 mm mineral fibre insulation (30 – 40 kg/m³).

General principles with regards to waste systems behind lightweight constructions within apartments are shown in Table 4.2.

Pipework Construction	Typical Door Construction
Cast iron pipework	No treatment necessary
Copper pipework	Wrapped in minimum 25mm thick acoustic insulation/foam and lag with 5kg/m ² loaded vinyl sound barrier material, or similar
Plastic pipework	Wrapped in minimum 50mm thick acoustic insulation/foam and lag with 5kg/m ² loaded vinyl sound barrier material, or similar
Plastic pipework to taps	No treatment necessary
Drainage systems	Wrapped in minimum 25mm thick acoustic insulation where concealed by lightweight constructions within habitable areas

Table 4.2 Acoustic specification of duct lagging

Where pipework passes through floors, penetrations shall ensure effective acoustic sealing around the pipes. This would be achieved by initially providing all pipework with a resilient sleeve detail. Large floor openings can be in-filled using a proprietary cementitious fire-stopping compound to the depth of the slab, whilst smaller openings can be loosely packed with mineral fibre insulation and closed-off with plasterboard pattresses above and below the slab. If using fire-stopping compound, it must be ensured that pipework holes in the formwork are cut oversize to prevent contact with the pipes. Any gaps remaining around pipework penetrations must be sealed with a continuous bead of non-hardening mastic.

General Considerations

The following shall be considered in the design and construction of the apartment:

- Where party walls abut onto external (flanking) walls, vertical isolation strips (Regupol 6010XHT for masonry, Regupol 3912 for stud walls) must be incorporated and the junction sealed with a backer rod and non-setting mastic.
- In the case of additional heavy fixtures or services, 150FC90 nogging channels could be employed without significantly affecting the sound insulation properties of the proposed walls.
- Masonry constructions should be built to a high standard and must feature fully-mortared joints.
- Plasterboard layers of drywall constructions must have overlapping joints which are taped and sealed.
- Back-to-back recesses/cut-outs, e.g. for wall sockets and light switches, shall be avoided in walls separating apartments or habitable spaces wherever possible. If unavoidable, acoustic detailing shall be agreed with the acoustic consultant, such that the sound insulation of the wall is maintained.
- Chasing of walls providing acoustic separation shall be offset on either side of the wall. The amount of chasing should be the minimum necessary and should be fully filled with plaster following installation of the services.
- Wall cavities shall remain clear of rubble and debris in order to maintain the acoustic separation of the leaves.
- Measures shall be adopted to ensure that resilient mounting systems do not become 'bridged' during construction.
- Services running through ceiling voids or under floor cavity could be lagged with 25-45mm thick Rockwool, Armaflex, Kingspan or any similar pipe insulation product.
- External elements should be attached to 'stubs' or brackets which in-turn are directly connected to the concrete floor. An isolating layer should be introduced to minimise cold bridging of the extended steelwork. This thermal and acoustic break would eliminate any transfer from the external element into the structure of the building.

5.0 REVERBERATION IN COMMON PARTS

Approved Document E of the Building Regulations states that for entrance halls, corridors, and hallways, an area equal to or greater than the floor area should be covered with a Class C absorber or better.

In this case, and based on the latest proposals shown in the shared Sketchbook issued by Leslie Jones Architecture, we would recommend the installation of a product that has the texture of a concrete soffit, so that the aesthetic identity of the space can be preserved. For this reason, we would suggest the direct fixing of panels throughout the majority of the underfloor concrete soffit within the communal residential corridors. The specific product to use would be the following:

- Troldekt Plus, from Troldekt (<https://www.troldekt.com/Product-range/Troldekt-Plus>)

The rationale behind the above product is the practicality of its installation, the uniformity in the control of reverberation, and the fact that the installation of Building Services would retain its acoustic properties largely intact.

6.0 LIFT NOISE/VIBRATION

Vibration measurements should be made at the centre of the car, on the floor, in three mutually perpendicular axes corresponding to vertical, front-to-back and side-to-side.

Measurements should be made of acceleration levels in each direction over two complete cycles, one from the bottom of the building to the top, and one from the top of the building to the bottom.

The measurement method is critical to the repeatability of results. It is, therefore, preferable to use a real time vibration analyser covering all frequency bands, as opposed to taking individual frequency band measurements over repeated lift runs.

A cycle is defined as the period from just before the door starts to close at one level, to just after the doors open at the final level.

Acceleration levels should be measured as rms values using a time constant of - 0.125 seconds "fast", and the maximum values recorded in each 1/3 octave band from 1Hz inclusive over each complete cycle.

The following limits will apply:

Horizontal Vibration

- 1 - 20 Hz inclusive: The maximum rms acceleration level should not exceed 0.1m/s^2
- 25 - 80Hz inclusive: The maximum rms acceleration level should not exceed 0.5m/s^2

The above limits apply to any time during a complete cycle, in any 1/3 octave band in the frequency range specified.

Vertical Vibration

At maximum speed, the maximum rms acceleration level in any 1/3 octave band should not exceed 0.08m/s^2 in the frequency range 1-80Hz.

During acceleration/deceleration and start/stop periods, the maximum rms in any 1/3 octave band should not exceed 0.15m/s^2 in the frequency range 1-80Hz.

The above limits apply to lifts with speed up to 4m/s. Lifts having speeds above this will be subject to increased vibration limits. For lift speeds in the range 4-7m/s, a multiplier of 1.5 may be used for all acceleration level limits.

In-Car Noise Levels

Door noise, when measured with a precision grade sound level meter set to "fast" meter response at 1.5m from the floor and 1m from the door face, should not exceed 50dB(A).

Noise levels in the car at the maximum car velocity in the cycle should not exceed the following when measured as described above:

Lift Speed	Maximum Level
0.5 - 2.0m/s	55dB(A)
2.0 - 7.0m/s	60dB(A)

In-car announcements should not exceed 65 dB(A) when measured as described above.

Lift Lobbies

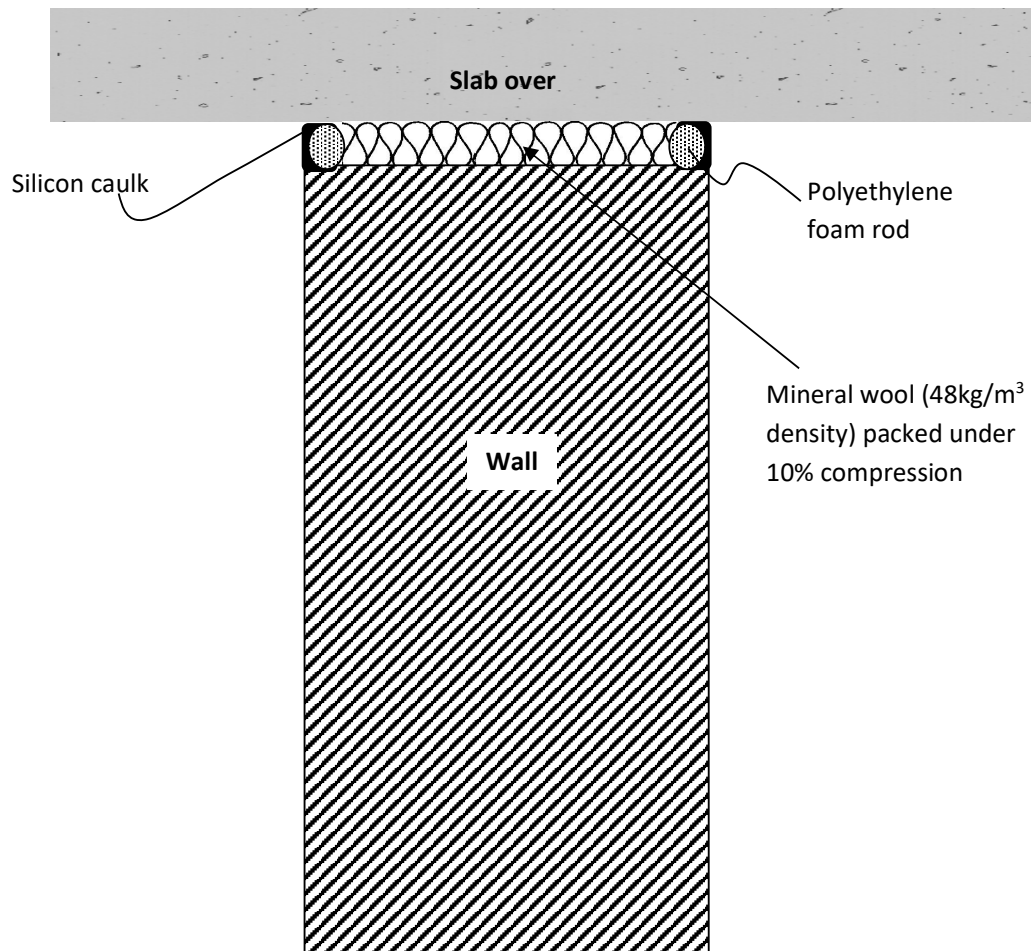
Lift noise, when measured with a precision grade sound level meter set to "fast" response at 1.5m from the floor and 1m from the door face, should generally not exceed 50dB(A) at any time during the lift cycle. This does not include lift arrival indication sounders, which should operate at a level generally below 65 dB(A).

It can be confirmed that the lift supplier for this scheme has confirmed the above points, so no issues would be anticipated.

7.0 CONCLUSION

The drawings for the proposed development at The Charter, Gravesend have been reviewed and suitable acoustic specifications have been determined.

A detailed acoustic design review has been undertaken based on the latest drawings provided by Leslie Jones Architecture. A pragmatic approach to the design has been adopted with a common denominator of optimising cost against on-site performance, while fully satisfying the project's set design targets.

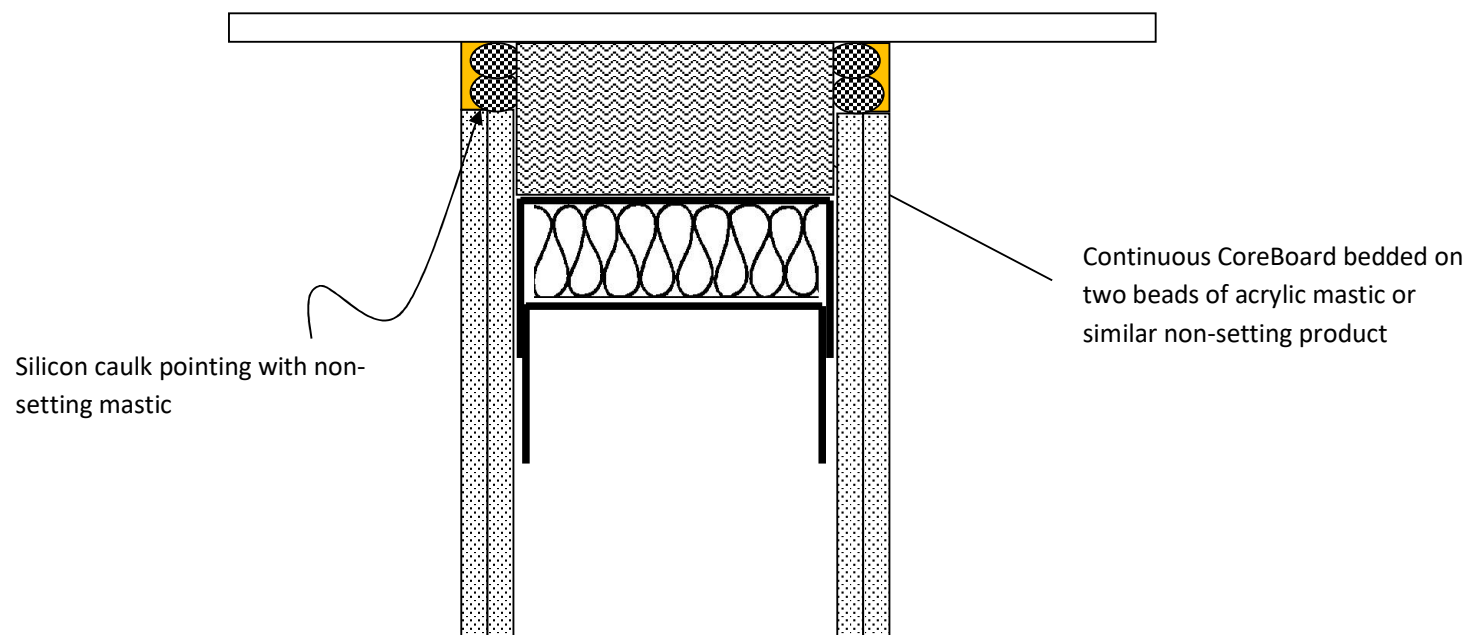


Title:
Wall head acoustic detail

Date: 05 May 2020
Revision:

FIGURE 20764.DWG1





Title:

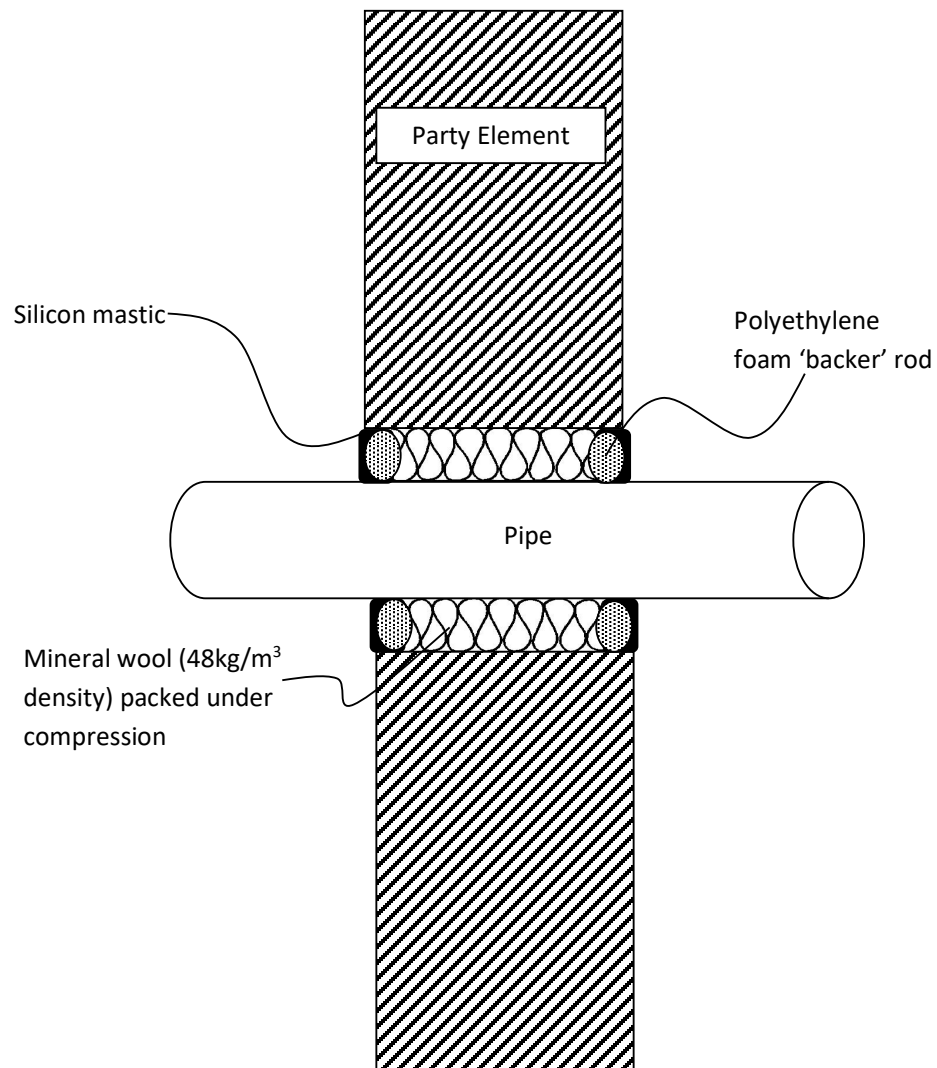
Deflection Head Detail

Date: 05 May 2020

Revision:

FIGURE 20764.DWG2



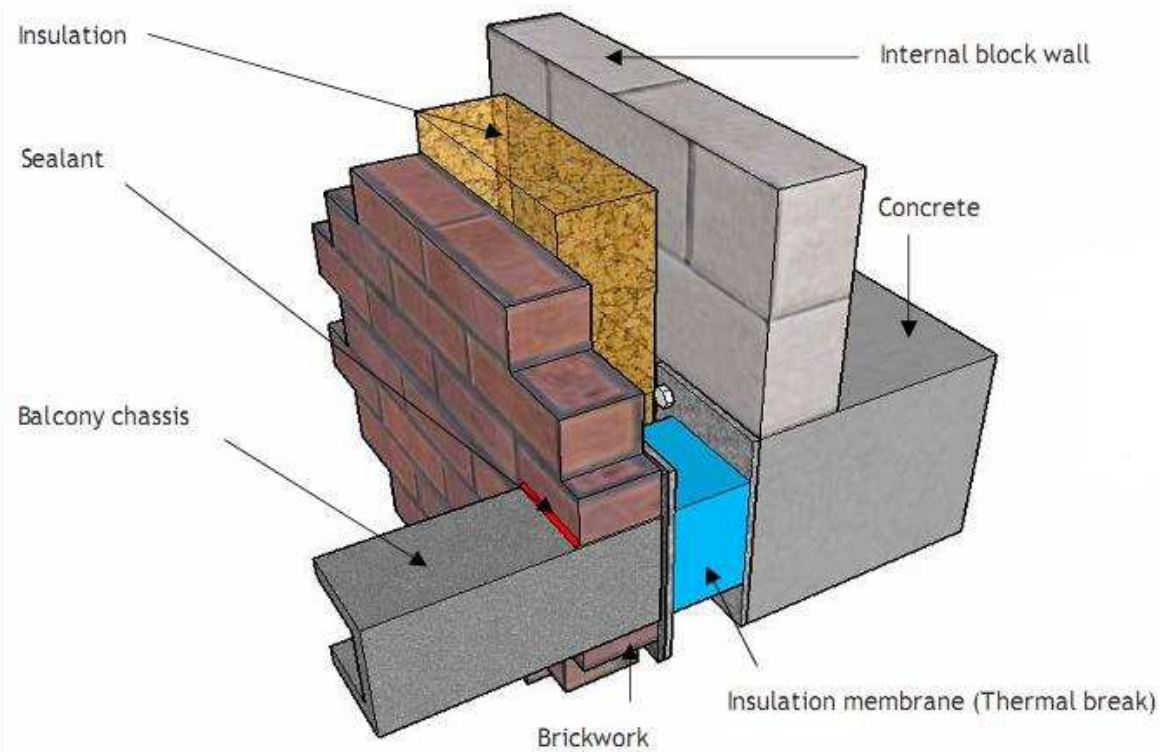


Title:
Penetration Detail

Date: 05 May 2020
Revision:

FIGURE 20764.DWG3





Title:

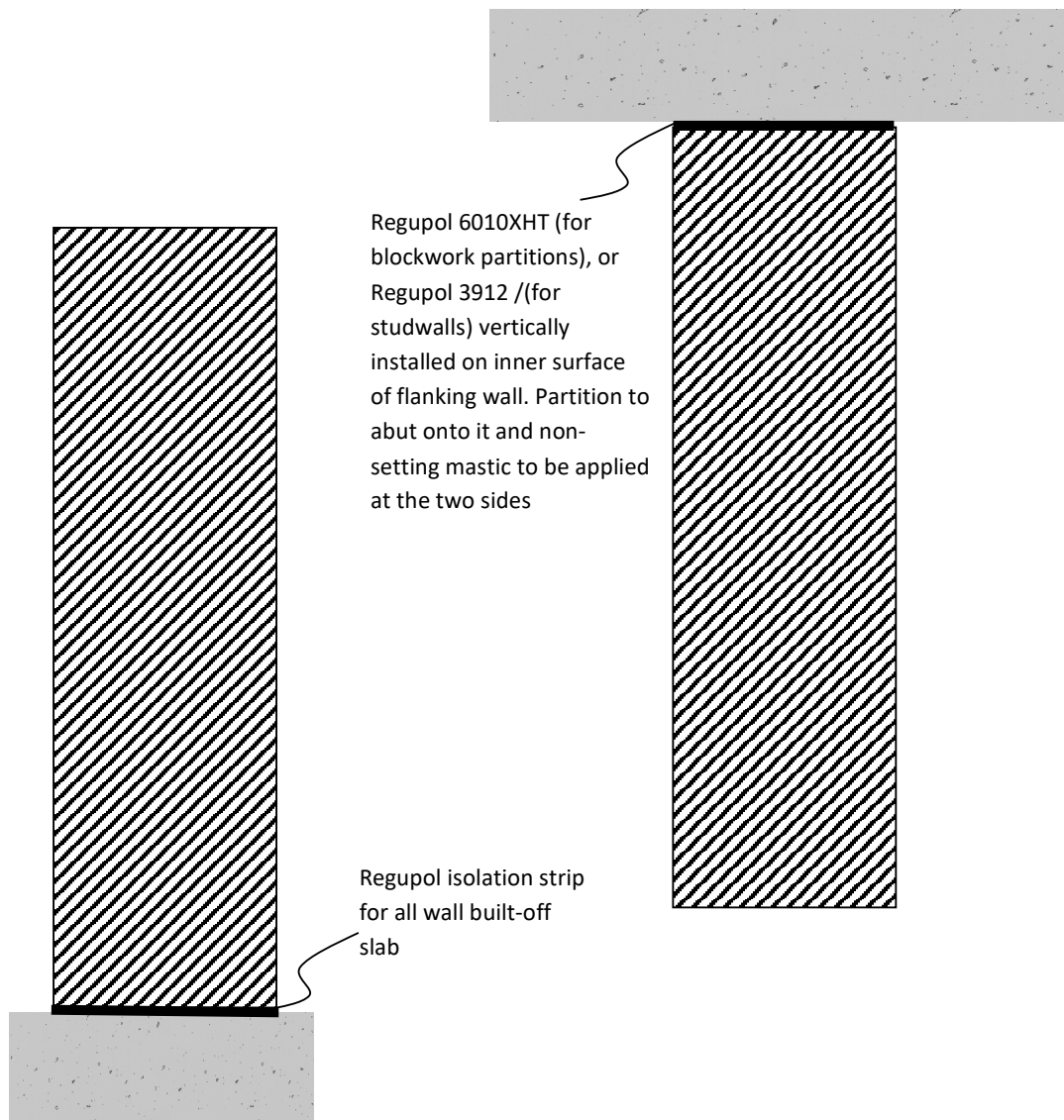
Concrete Floor – Sound Insulation of External Structural Elements

Date: 05 May 2020

Revision:

FIGURE 20764.DWG4





Title:
Wall isolation detail

Date: 05 May 2020
Revision:

FIGURE 20764.DWG5

