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SOUND INSULATION INVESTIGATION REPORT

Report 15703.SI.01

Prepared on 14 March 2017

For:

Cape Construction

30 Gratton Terrace

London

NW2 6QE

Site Address	Test Date	Tested by
7 Warwick Court, London WC1R 5DJ	06/03/2017	George Hadjilambri AMIOA

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1.0 INTRODUCTION

KP Acoustics Ltd., Britannia House, 11 Glenthorne Road, London, W6 0LH has been commissioned by Cape Construction 30 Gratton Terrace, London, NW2 6QE to undertake a sound insulation investigation at 7 Warwick Court, London WC1R 5DJ under the provisions of Approved Document E of the Building Regulations 2010

This report records the results of the sound insulation tests and details the procedures used throughout the measurement and post-processing phases.

The sound insulation tests detailed in this report were undertaken by George Hadjilambri AMIOA in full accordance with BS EN ISO 140-4: 1998 *"Field measurements of airborne sound insulation between rooms"*, BS EN ISO 140-7: 1998 *"Field measurements of impact sound insulation between rooms"* and the procedures described in Annex B of the Approved Document.

The results are for indicative purposes and for the purpose of providing advice on improvement works as deemed necessary.

2.0 METHODOLOGY

2.1 Airborne Tests

High volume "pink" noise was generated from one loudspeaker in the source room, positioned to obtain a diffuse sound field. A spatial average of the resulting one-third octave band noise levels between 100 Hz and 3150 Hz was obtained by using a moving microphone technique over a minimum period of 30 seconds. The same measurement procedure was used in the receiver room. The procedure was then repeated for a second loudspeaker position within the source room, as required by the Standard.

The results of the tests were rated in accordance with BS EN ISO 717-1: 1997 "Rating of sound insulation in buildings and of building elements. Part 1 Airborne sound insulation".

2.2 Impact Tests

A tapping machine complying with Annex A of BS EN ISO 140-7 was placed in four different positions in the source room. The resulting one-third octave band noise levels between 100 Hz and 3150 Hz were measured at eight evenly distributed positions, for a minimum of five seconds at each position. Two receiver measurements were conducted for two source positions.

The results of the tests were rated in accordance with BS EN ISO 717-2: 1997 "Rating of sound insulation in buildings and of building elements. Part 2 Impact sound insulation".

2.3 Reverberation Time

Reverberation time measurements were taken following the procedure described below in order to correct the receiver levels for room characteristics.

The source was moved to the receiver room and "white noise" was generated and stopped instantaneously in order to measure the reverberation time in each of the one-third octave bands between 100 Hz and 3150 Hz. The internal programme of the meter was used to measure the decay time of the sound in the room. This was repeated nine times in each room in order to obtain an average result.

2.4 Background Noise

The background noise levels in the receiver rooms were measured during the tests and the receiving room levels corrected in accordance with BS EN ISO 140 Part 4.

The dominant source of background noise observed during the tests was road traffic noise from adjacent roads.

3.0 INSTRUMENTATION

The instrumentation used during testing is shown in Table 3.1 below.

Instrument	Manufacturer and Type	Serial Number
Precision integrating sound level meter & analyser	NTi XL2-TA Calibration No: 02464/4 Calibration Date 19th January 2016	A2A-09611-E0
Active Loudspeaker	RCF ART 310A	HAX20864
Pink Noise Source	NTi Audio Minirator MR-PRO	G2P-RABTR-F2
Calibrator	B&K Type 4231 Calibration No: 02464/7 Calibration Date 30th March 2016	1897774
Tapping machine	Sound Solutions Series 2 Calibration No: 01244/1 Calibration Date 23rd March 2015	TP02059

Table 3.1 - Instrumentation used during testing

4.0 REQUIREMENTS

It is understood that the property is a listed building. It should be noted that, as per Approved Document E, in the case of some historic buildings undergoing a material change of use, it may not be practical to improve to the standards set out in Table 1.a and 1.b of Approved Document E. The need to conserve the special characteristics of such historic buildings needs to be recognised, and in such work, the aim should be to improve sound insulation to the extent that it is practically possible, always provided that the work does not prejudice the character of the historic building, or increase the risk of long-term deterioration to the building fabric or fitting.

Table 4.1 summarises the internal sound insulation criteria for the apartments. In order to achieve the project aspirations while adhering to the above guidance for listed buildings, all separating wall and floor constructions are to provide sound insulation which would exceed the minimum requirements of Approved Document E 2003 (ADE) of the Building Regulations 2010 for new-build dwellings, as a minimum.

Element	Airborne Sound Insulation Performance	Impact Sound Insulation Performance
Separating walls	$D_{nT,w} + C_{tr} \geq 45dB$	-
Separating Floors	$D_{nT,w} + C_{tr} \geq 45dB$	$L'_{nTw} \leq 62dB$
Apartment Entrance Doors	R_w 30dB	-
Internal Walls	R_w 40dB	-

Table 4.1 Internal Sound Insulation – Apartments

5.0 TEST ROOMS

Details of the room tested is shown in Table 5.1 below. All the rooms tested were in a finished state, with doors fitted, walls painted and all sockets installed.

Test Element	Room 1	Room 2	Construction
Wall	Flat 5 Living Room	Flat 4 Living Room	• Existing floorboards • Timber joists • Pugging in between the joists (100mm deep) • Lath & plaster ceiling to underside of joists
Floor	Flat 5 Living Room	Flat 3 Living Room	

Table 5.1 - Room details

All the procedures described in Annex B of Approved Document E 2003 of the Building Regulations 2010 have been followed.

6.0 RESULTS

The results of testing are summarised in the tables below. For airborne tests, the higher the value, the better the performance. For impact tests, the lower the value, the better the performance.

6.1 Airborne Tests

The summarised results of the airborne tests are shown in Table 6.1.

Test Element	Source	Receiver	Test Result
Wall	Flat 5 Living Room	Flat 4 Living Room	$D_{nT,w} + C_{tr}$ 40dB
Floor	Flat 5 Living Room	Flat 3 Living Room	$D_{nT,w} + C_{tr}$ 42dB

Table 6.1 - Airborne Test Results

6.2 Impact Tests

The summarised results of the impact tests are shown in Table 6.2.

Test Element	Source	Receiver	Test Result
Floor	Flat 5 Living Room	Flat 3 Living Room	$L'_{nT,w}$ 57dB

Table 6.2 - Impact Test Results

7.0 DISCUSSION

The two main parameters used throughout this document to express airborne and impact sound insulation of separating constructions are $D_{nT,w + Ctr}$ and $L'_{nT,w}$, respectively. All specifications in this report will therefore be given with respect to those two descriptors.

7.1 Party Walls

Constructions typically capable of achieving the above requirements are shown below in Table 7.1, where options for a studwork system are provided. Partition type A would provide a nominal sound insulation performance of 40-45 dB, partition Type C would provide a higher degree of sound insulation, greater than 50dB. Partition Type B would cater for a more moderate performance.

Partition Type	Studwork Construction	Blockwork Construction
A	2x12.5mm SoundBloc / 48mm stud / 2x12.5mm SoundBloc, 25mm Isowool	140mm lightweight block, plastered/rendered 12mm on each side
B	70mm C-studs / 2x12.5mm SoundBloc on RB1 resilient bars on each side, 50mm mineral wool insulation (RWA45, or similar)	140mm high-density block (1300-1650kg/m^3) laid flat plastered/rendered 12mm on each side
C	Staggered 60I72 studs / 2x15mm SoundBloc on each side, 50mm mineral wool insulation (RWA45, or similar) or 92mm C-studs / RB1 resilient bars on each side / 2x15mm SoundBloc on each side / 75mm RWA45 mineral wool insulation	High-density (1850-2300kg/m^3) double-leaf 100mm blockwork , plastered/rendered

Table 7.1: Sound insulation performance for different partition types

All party walls between different apartments within the proposed development should fall within Type B, or C should a higher level of airborne sound insulation be required. All internal walls should fall within Type A. We would also recommend a Type C wall between common spaces and habitable spaces.

All new party walls must be built off isolating strips in order to minimise the horizontal flanking to adjacent, noise-sensitive spaces. The latter are resilient strips which are adhesively fixed onto the sub-decking (concrete floor), therefore allowing the wall leaf to be built off them.

Where party walls abut onto external (flanking) walls, vertical isolation strips must be incorporated and the junction sealed with a backer rod and non-setting mastic. Please incorporate strips of Regupol 3912 (studwork walls).

7.2 Party Floors

It is understood that the proposed construction details of the floors are comprised of the following elements:

- Timber engineered board
- WBP Plywood
- Timoleon UFH board
- Resilient Layer
- WBP Plywood
- Sound Insulation
- Existing Ceiling
- Sound Block Plaster board
- Fire Panel

In order to optimise the above design in terms of acoustic performance, we would recommend the following:

- 2x12.5mm SoundBloc boards as the main ceiling linings, fixed under RB1 resilient bars. Any fixings from the plasterboard ceiling to the resilient bars should not penetrate the joists, as this would significantly reduce the performance of the floor.
- Installation of dense mineral wool (thickness between 100mm and 150mm, density 45kg/m^3) between the joists, not tightly packed as this would form an acoustic bridge.
- Installation of a clip-on UFH system within the joists (Nu-Heat, or similar)
- Adhesive installation of strips of Regupol 6010SH (15mm) on the timber joists
- Floating installation, i.e. not mechanically fixed, of a cementitious t&g board on the resilient strips, which would act as the main decking. We would recommend Versapanel (18mm), or Lamaphon (19mm).
- Adhesive installation of a distributed, resilient layer on the plywood layer. We would recommend Regupol 3912 (6mm), or similar. Provided that the timber floor is sufficiently heavy, the resilient layer could accommodate its direct, adhesive installation.

(For tiles/vinyl/carpet, we would recommend the installation of Regupol 4515 in-lieu of Regupol 3912)

8.0 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 UKAS 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.

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 65dB.

It is anticipated 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 $2m^2$ 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 45mm solid core door panel and custom-built frame, fitted with acoustic compression seals to the head and jambs and an automatic drop seal at the threshold. 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. Automatic drop seals would also be required to achieve this objective.

Fan Coil Unit Cupboard Doors

Doors to the FCU cupboards should be acoustically rated to R_w30 dB and should consist of a minimum 40mm thick solid-core timber door with acoustic compression seals all round.

Hydraulic Systems

Hydraulic systems shall be designed and installed to minimise audibility of water/waste noise within the residential areas of the apartments.

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 residential 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/m^3).

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:

- 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.
- For both airborne and impact sound insulation, special attention should be given to workmanship regarding the proper sealing of junctions. It should be also noted that Yelofon flanking strips or strips of Technics 5 Duralay should be installed around the perimeter of the floor to isolate the floor from walls and skirtings. The strip should be turned up so that the skirting boards rest on them and any excess cut away.

9.0 CONCLUSIONS

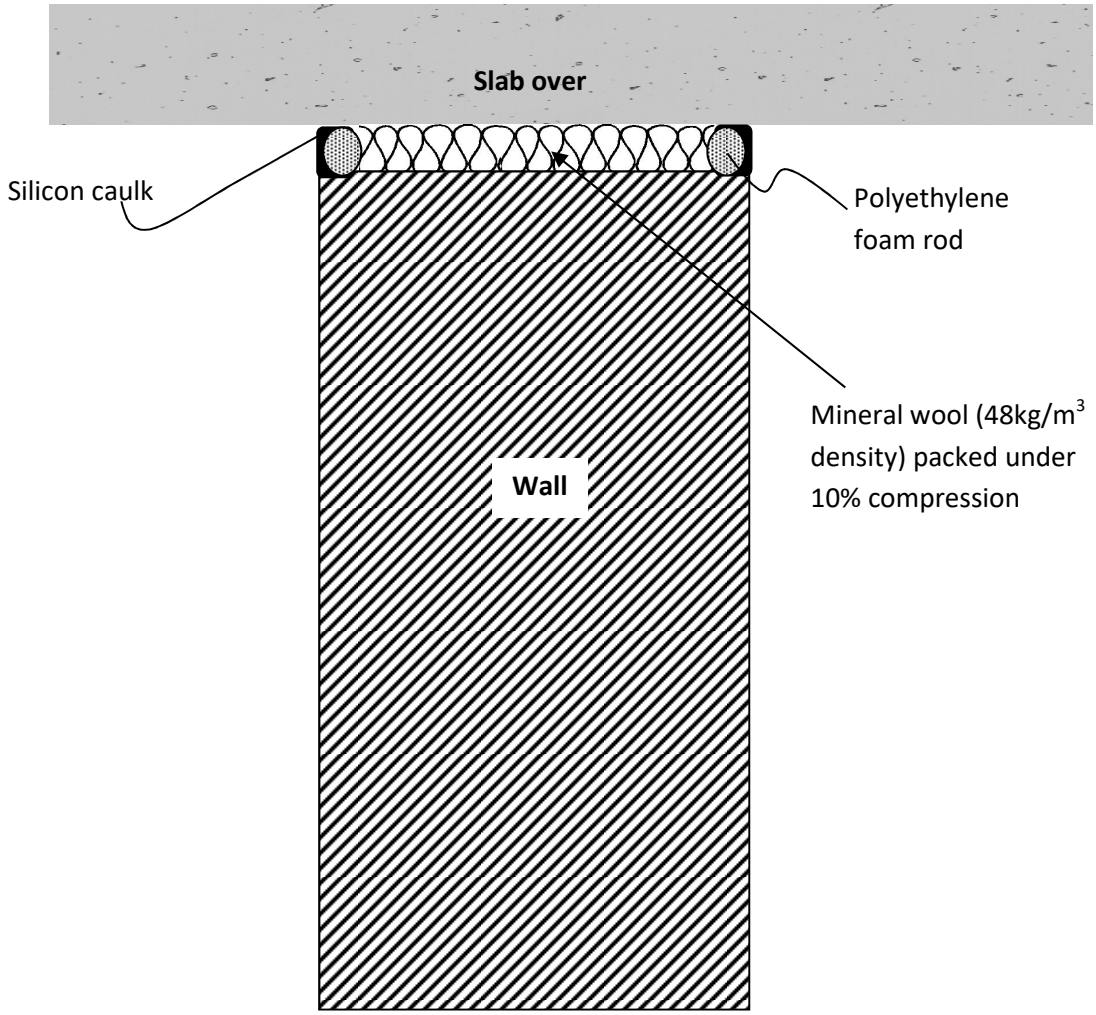
Sound Insulation tests were undertaken at 7 Warwick Court, London WC1R 5DJ under the under the requirement of Building Regulations 2010 Approved Document E (2003 Edition).

Rating of the airborne sound insulation of the floor tested has been calculated in accordance with the measurement and rating procedures defined in BS EN ISO 140 Part 4 and BS EN ISO 717 Part 1, respectively.

Rating of the impact sound insulation of the floor has been derived in accordance with the measurement and rating procedures defined in BS EN ISO 140 Part 7 and BS EN ISO 717 Part 2, respectively.

Guidelines for the improvement of the floor's sound insulation performance have been proposed which, should they be followed, would provide a pragmatic benefit for the tenants of 7 Warwick Court, London WC1R 5DJ by means of a measurable reduction in airborne and impact noise transmission, therefore fully satisfying the requirements shown in Section 4.

Report by	Checked by
George Hadjilambri AMIOA	**Kyriakos Papanagiotou MIOA**
KP Acoustics Ltd	**KP Acoustics Ltd**

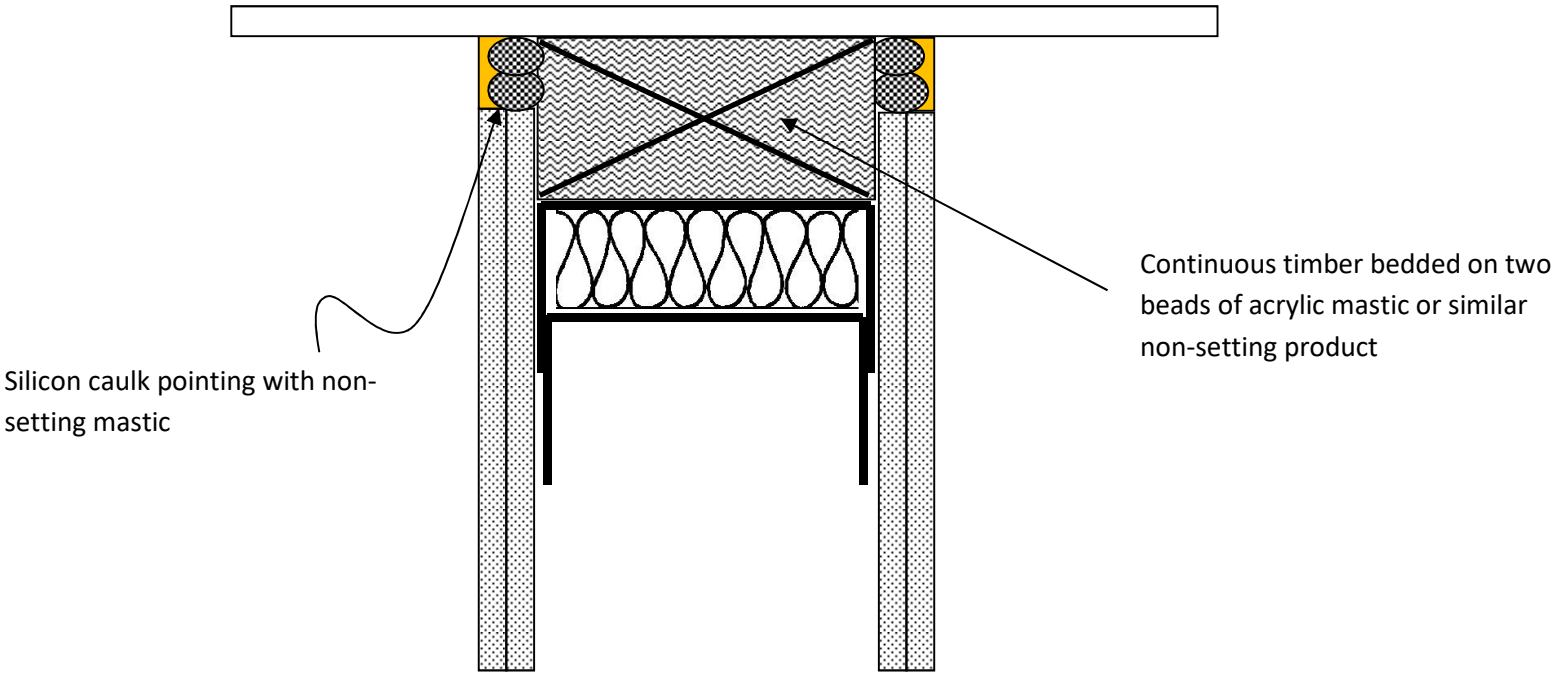


Title:
Wall head acoustic detail

Date: 07 March 2017

FIGURE 15703.DWG1

KP acoustics



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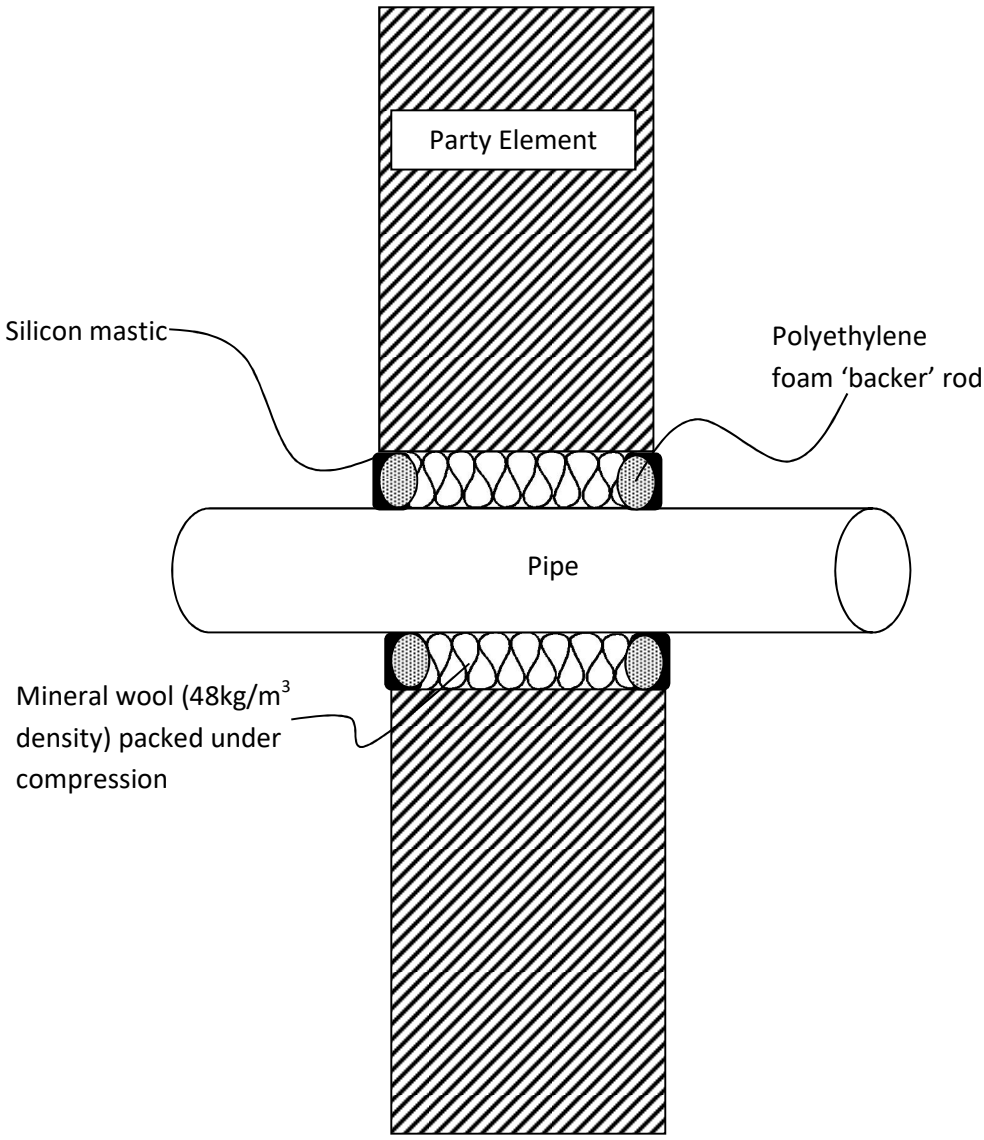
Deflection Head Detail

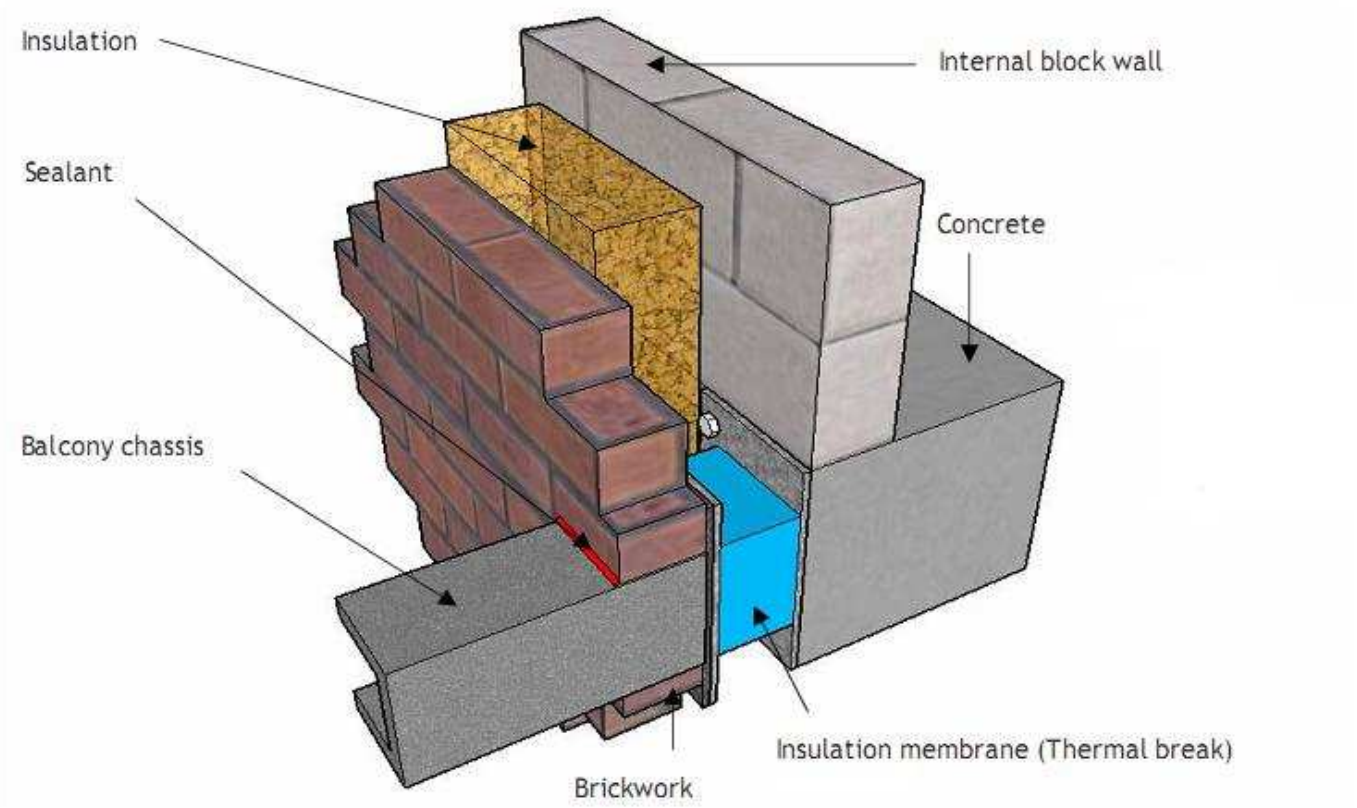
Date: 07 March 2017

FIGURE 15703.DWG2

KP acoustics



Title: Penetration Detail	**Date:** 07 March 2017	KP acoustics
	FIGURE 15703.DWG3	



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Concrete Floor – Sound Insulation of External Structural Elements

Date: 07 March 2017

FIGURE 15703.DWG4

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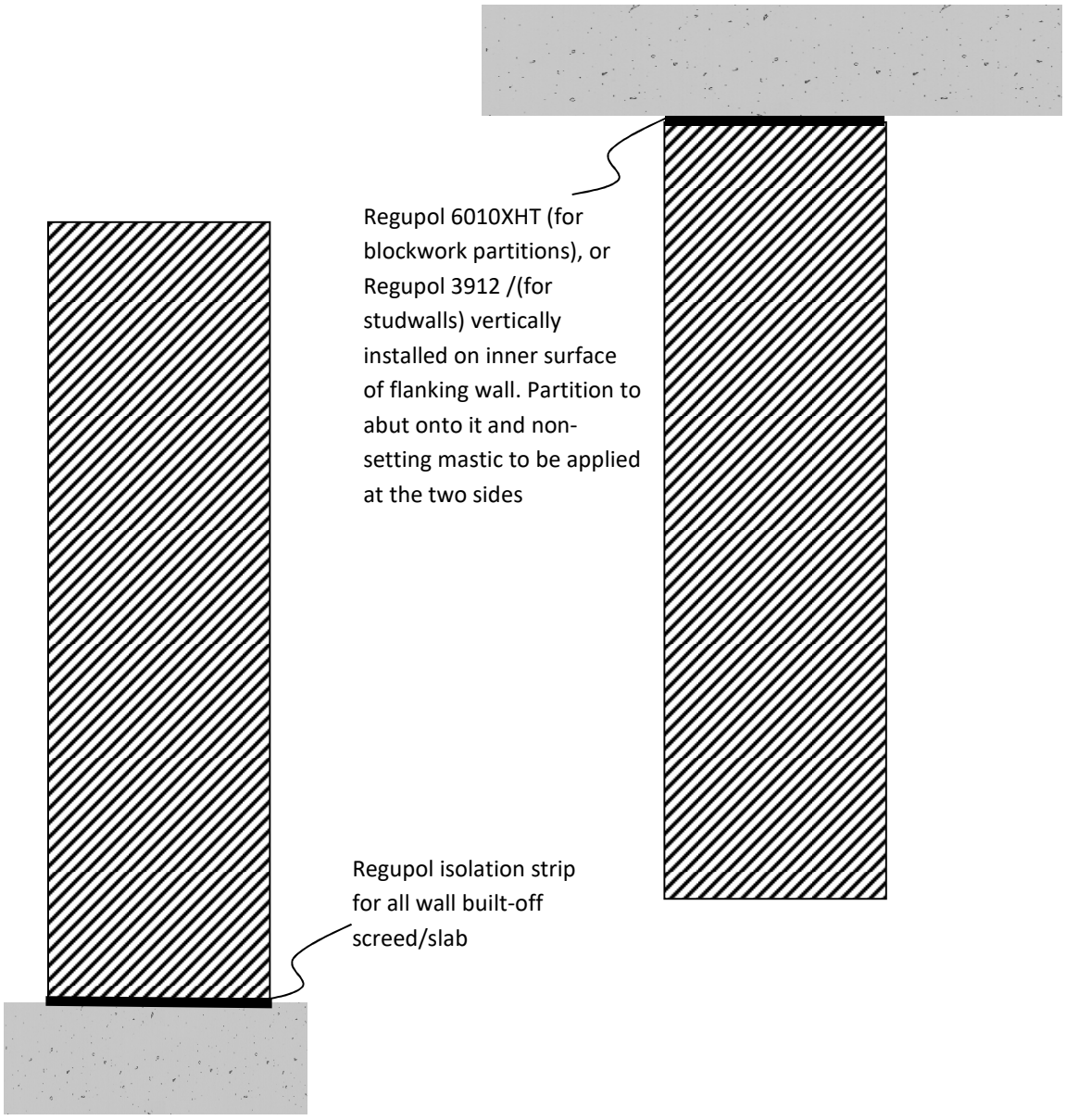

Title: Wall isolation detail	**Date:** 07 March 2017	KP acoustics
	FIGURE 15703.DWG5	