39-45 Gray's Inn Road
London

INTERNAL BUILDING FABRIC
REPORT 20447/IBF1-RevB

For:

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31 October 2014

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INTERNAL BUILDING FABRIC
REPORT 20447/IBF1 Rev B

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Revision No.	Date	Description
A	23/09/2014	Minor Alterations
B	31/10/2014	Minor Alterations

1.0 INTRODUCTION

This report sets out the acoustic requirements for the internal building fabric of 39-45 Gray's Inn Road, London and provides acoustic advice to assist the design team. The advice presented herein has been formulated on the basis of achieving the minimum requirements of Building Regulations for conversion projects.

2.0 CRITERIA

39-45 Gray's Inn Road, London (referred to as "site" from here on) lies within the London Borough of Camden, who have issued the following Planning Condition:

Condition 6

"Prior to occupation of any relevant part of the development, details of sound insulation measures for the residential units shall be submitted to and approved in writing by the Local Planning Authority. The approved sound insulation measures shall be installed prior to occupation of any of the residential units and retained and maintained thereafter."

Building Regulations Approved Document E contains the following acoustic requirements:

2.1 ADE Requirement E1

Requirement E1 of ADE covers protection against sound from other parts of the building and adjoining buildings. Dwelling-houses, flats and rooms for residential purposes shall be designed and constructed in such a way that they provide reasonable resistance to sound from other parts of the same building and from adjoining buildings.

The normal way of satisfying Requirement E1 for conversion projects is to build separating walls and floors together with the associated flanking constructions, in such a way that they achieve the sound insulation values shown below.

	Airborne sound insulation $D_{nT,w}$ +C_{tr} dB (minimum values)	**Impact sound insulation $L'_{nT,w}$ dB (maximum values)**
Walls	43	-
Floors and stairs	43	64

In the case of walls or floors separating a dwelling from other parts of the same building, or adjoining building, that are used for communal or non-residential purposes, reasonable resistance to sound will require at least the standard of sound insulation shown above. This will include, for example, walls and floors separating dwellings from corridors, stair cores, lift shafts and plantrooms. However, although these walls must be constructed to the same standard, there is no requirement for pre-completion testing.

The performance of separating walls and floors, together with the associated flanking construction, must be verified by undertaking pre-completion testing as set out in ADE 2003.

2.2 ADE Requirement E2

Requirement E2 of ADE covers protection against sound within dwelling-houses, flats and rooms for residential purposes. Dwellings, houses, flats and rooms for residential purposes shall be designed and constructed in such a way that –

(a) internal walls between a bedroom or a room containing a water closet, and other rooms; and

(b) internal floors,

provide reasonable resistance to sound.

Requirement E2 does not apply to –

(a) an internal wall which contains a door;
(b) an internal wall which separates an en-suite toilet from the associated bedroom.

The normal way of satisfying Requirement E2 will be to use constructions for new walls and floors within a dwelling-house, flat or room for residential purposes that provide the laboratory sound insulation values set out in Table 2.

Table 2: Laboratory values for new internal walls and floors within: dwelling-houses, flats and rooms for residential purposes, whether purpose built or formed by material change of use.	
	Airborne Sound Insulation R_w dB (Minimum Values)
Walls	40
Floors	40

As these are laboratory values it is not appropriate to verify performance by pre-completion testing. There is therefore no requirement for an on-site performance figure or for pre-completion testing.

The ADE criterion of R_w40 dB is only the minimum required to meet Building Regulation standards, and is not onerous. A significantly higher standard of sound insulation may be considered appropriate for private or apartments. For example, between bedrooms and kitchens/bathrooms a staggered stud wall provides higher resistance to both airborne and structure borne sound.

2.3 ADE Requirement E3

Requirement E3 of ADE covers reverberation in common internal parts of buildings containing dwellings, but only applies to areas that give access to the dwellings. The common internal parts of buildings which contain dwellings shall be designed and constructed in such a way as to prevent more reverberation around the common parts than is reasonable.

The intention is to prevent excessive build up of sound in corridors, stairwells, hallways and entrance halls and in doing so reduce the noise transmitted to adjoining rooms.

The simplest method (Method A) of determining ADE compliance is to cover an area equal to or greater than 100% of the floor area of corridors and entrance halls with a Class C absorber or better.

For stairwells, an area equal to the combined area of the stair treads, the upper surface of the intermediate landings, the upper surface of the landings (excluding ground floor) and the ceiling area on the top floor should be covered with a Class D absorber, or an area equal to at least 50% of this area covered with a Class C absorber or better. The absorptive material should be equally distributed between all floor levels.

Alternatively the existing absorption provided by all surfaces can be determined and the extra absorption required calculated. In some cases, this method (Method B) may allow greater flexibility in meeting the requirements of E3 and require less additional absorption than the Method A. However, for this preliminary review we have only considered Method A.

2.4 Pre-completion Testing

Pre-completion testing is usually required to prove compliance with ADE Requirement E1 for new-build separating walls and floors. It is requested that 10% of the development is subject to pre-completion sound insulation testing.

It is the duty of the person carrying out the building work to ensure appropriate sound insulation testing is implemented according to the guidance set out in ADE. The locations for such tests are subject to selected by the Building Control body, with the measurements made by approved specialist acoustic organizations at the Developer's expense.

The sound insulation criteria have built in allowances for measurement uncertainty, so if any test does not achieve the criteria by any margin the test has failed. If a test fails the Developer will need to determine the cause. It will then be necessary for the Developer to undertake appropriate remedial treatment, to the satisfaction of Building Control. The rate of testing should be increased until Building Control is satisfied the problem has been solved.

Building Regulations require that sound insulation testing "be carried out by a test body with appropriate third party accreditation" and advise that "Test bodies conducting testing shall preferably have UKAS accreditation (or a European equivalent) for field measurements".

3.0 SEPARATING WALLS

3.1 Residential Separating Walls

We understand there are 3No. party wall types proposed for this project (Types IWS-201, IWS-202 and IWS-203) and are described below:

Type IWS-201

- 2No. 15mm layers of Soundbloc each side of
- Independent C studs
- 190mm void between linings with 150mm Isover insulation

Type IWS-202

- 1No. 15mm layers of Soundbloc
- 1No. layer of 15mm Duraline
- Independent C studs
- 190mm void between linings with 150mm Isover insulation
- 2No. 15mm layers Soundbloc

Type IWS-203

- 1No. 15mm layer of Soundbloc
- 1No. layer of 12mm plywood board
- Independent C studs
- 190mm void between linings with 100mm Isover insulation and 38mm Thermaline
- 2No. 15mm layers Soundbloc

In all cases partitions will need to be built slab to slab, through the screed.

All of the above constructions have the potential to achieve the requirements of ADE (for conversions projects), subject to flanking and workmanship.

For enhanced airborne sound insulation, the C studs could be substituted for I studs.

3.2 Walls Separating Apartments from Lift Shafts or Stairs

Lift Shafts

We understand the walls separating residential areas from lift shafts will be 200mm solid (cast in-situ) concrete. The only interactions between the lift shafts and the residential dwellings will be via en-suites and bathrooms. The proposed construction is Wall Type IWS-303 and comprises:

- 200mm solid (cast in-situ) concrete
- 60mm cavity
- 15mm wallboard connected via Gypframe GL1 inside the apartment

The above construction type is compliant with the requirements of Approved Document E however acoustically a better option would be for the 15mm wall board to be independent of the concrete shaft wall (i.e. no Gypframe GL1).

Stair Cores

We understand the walls separating residential areas from stair cores will be 200mm solid (cast in-situ) concrete. The interactions between the stair cores and the residential dwellings will be via bedrooms and bathrooms. The proposed construction is Wall Type IWS-301 and IWS-304 which comprises:

Bathrooms – IWS-304:

- 15mm wallboard
- Gypframe GL1 lining channels
- 60mm cavity
- 200mm solid (cast in-situ) concrete
- 70mm cavity with 50mm Isover insulation within
- 12mm plywood board
- 12.5mm glassroc H tilebacker
- 8mm glazed brick tiles with 2mm bonding

Bedrooms – IWS-301:

- 15mm wallboard
- Gypframe GL1 lining channels
- 60mm cavity
- 200mm solid (cast in-situ) concrete
- 75mm cavity with 50mm Isover insulation within
- 12.5mm wallboard on independent C studs

Both of the above construction types are compliant with the requirements of Approved Document E.

We would specifically advise against any plasterboard finish connected to the stair or lift shaft walls.

3.3 Service Risers

ADE states that pipes and ducts (excluding gas pipes) are required to be enclosed (full height) where they penetrate a floor separating habitable rooms.

ADE states that the enclosure should be constructed of material having a mass per unit area of at least 15kg/m^2 and that the enclosure should be lined or the duct or pipe should be wrapped within the enclosure with 25mm unfaced mineral wool.

However, the above measures will not ensure inaudibility within the habitable rooms. In order for noise from the pipes to be approaching inaudibility within the adjacent areas we would advise the following treatment:

- Cast iron or acoustic HDPE soil pipes are used throughout;
- Minimise the use of transitional sections;
- Wrap pipe in 25mm thick unfaced mineral wool throughout;
- Minimum gap of 10mm between pipes and wall/studs to be maintained throughout;
- Box in with double layer of 12.5mm Soundbloc (or equivalent) grade plasterboard;

- Any necessary penetrations required for services serving an apartment shall be finished in accordance with Sketches 20048/DP1 and 20048/MP1 enclosed.

Access to soil pipes can be provided by an access hatch comprising 2No. layers of plasterboard with compressible seals to maintain the integrity of the treatment.

Where service risers form the separating partition between apartments and common areas they should be constructed as follows (Wall Type IWS-202):

Reference: GypWall QUIET IWL, or acceptable equivalent.

- Acoustic rating: R_w 66dB ($R_w + C_{tr}$ 58dB).
- Thickness: 250mm.
- Framing: Gypframe 60I50 located in pairs at 600mm centres, and Gypframe 60S50 at abutments, openings and junctions.

Linings/ Facings:

- Two layers 15mm Gyproc SoundBloc, sheet width 1200mm, to apartment side offraming.
- One inner layer of 15mm Gyproc DuraLine (replaced with 15mm Class '0' plywood board when used in the riser locations) and one outer layer of 15mm Gyproc SoundBloc, sheet width 1200mm, to lobby/ riser side of framing.

Cavity insulation:

- Three layers of 50mm Isover Acoustic Partition Roll (APR 1200).

3.4 Internal Walls

Requirement E2 only applies to internal walls between a bedroom or a room containing a water closet, and other rooms and internal floors. It does not apply to an internal wall which separates an en-suite toilet from the associated bedroom or internal walls which contain a door.

The standard internal wall construction on this project is Wall Type IWS-204 which comprises:

- 2No. Layers 12.5mm wallboard mounted on C studs, each side of
- 70mm cavity with 25mm Isover insulation

The above construction has the potential to meet the requirements of Approved Document E.

There is no requirement for pre-completion testing to assess compliance.

3.5 Sound Flanking Control

3.5.1 Flank Wall Interfaces

Detail IWS-306 only occurs in partitions where the dwellings do not have any horizontal flank walls and as such the only concern with regards to airborne noise transfer is between flats above or below (vertical flanking). This detail shows the inner lining consists of 1No. layer of plasterboard (Kingspan K17/K18 Insulated plasterboard). From email correspondence we understand the slab edge will be sealed with a fire stopping material. This product will require minimum mass per unit area of at least 20kg/m^2 and the gap must be fully sealed (airtight).

From previous projects we know that for similar situations the following company has been able to provide a suitable solution:

Name & Address	**Telephone Number**	**Contact**
Siderise Insulation Limited Unit 15c Chessington Trading Estate Oakcroft Road Chessington Surrey KT9 1RH	0208 391 3650	Mike Carrick Steve Bond

Detail IWS-307 occurs on the new façade section of the building. We have reviewed this for horizontal and vertical flanking; the proposed build-up should be adequate to control the flanking noise between adjoining areas, assuming the steel beam is continuous and there is no air gap between the beam and the external wall (as shown on the drawing).

Detail IWS-308 occurs on the existing façade section of the building. We have reviewed this for both horizontal and vertical flanking. For vertical flanking the proposed build-up should be adequate to control the flanking noise between adjoining areas. For horizontal flanking (party walls between dwellings on the same floor), we have some concerns regarding the acoustic integrity of the build-up. We would suggest this is upgraded to incorporate 2 x 12.5mm layers of plasterboard (minimum) as there is a risk the current proposals will fall short of the requirements of ADE.

Where partitions abut external cladding, the external walls' internal lining should overlap the junction full-height on both sides of the wall. In no instances should linings to the external wall or columns run continuously between rooms.

From the drawings provided, the cavity of the external wall appears to be fully filled with mineral wool. In any areas where the external wall is not fully lined with mineral wool or polystyrene, the cavity of the external wall should be stopped with a flexible closer along each separating wall line.

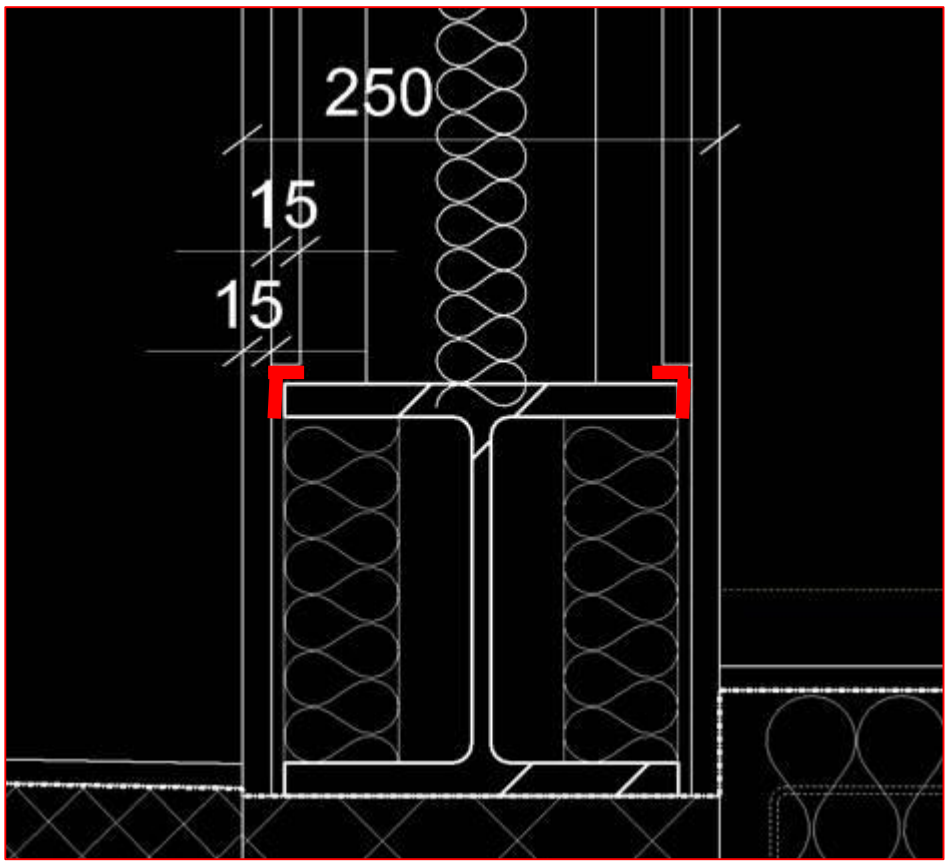
3.5.2 Head & Base Details

Separating walls must be built off the structural floors and not the 'floating' screeds. The wall must be built full height up to the underside of the slab or roof.

3.6 Steelwork

Generally, all steelwork (columns and beams) must be encased with plasterboard. A single layer of plasterboard should suffice where the steelwork runs through common parts of the building. In dwellings, the encasing should comprise 2 layers of 12.5mm (or thicker) plasterboard with mineral wool packing (10-45 kg/m^3). In all areas, the plasterboard must not be directly fixed to the steel.

We understand there are two instances where the steel column is only encased with1 layer of 15mm plasterboard. The inner layer of 15mm plasterboard runs from the side of the column and forms a party wall. See below:



We would suggest the area shown in red above are sealed with a non-setting mastic. This detail should be adequate to control the horizontal flanking between dwellings, so long as the external wall is double boarded as per the advice for Detail IWS-08 provided in Section 3.5.1.

4.0 SEPARATING FLOORS

4.1 Separating Floor Type

The drawing provided to us by RPP Architects (A_23_400) shows the separating floor will comprise of profiled metal deck concrete slabs (160mm max, 100mm min profile) with a floating floor above. A plasterboard ceiling will be hung below.

We have not been provided with detailed specifications for each material and as such the complete construction should achieve the specifications set out below, which when built to a good airtight standard with appropriate sound flanking control measures, should be capable of satisfying ADE.

Specification
Floating Floor Options Sand cement screed floating layer of 65mm or proprietary screed product of at least 80kg/m^2 with resilient layer of either minimum 25mm mineral wool (36kg/m^2) or an alternative type which meets both of the following: (i) maximum dynamic stiffness (measured according to BS EN 29052-1) of 15MN/m^3, and (ii) minimum thickness of 5mm under the load specified in the measurement procedure of BS EN 29052-1, 1.8kPa to 2.1k36Pa.
Base Profiled metal deck concrete slab (plus screed), minimum mass 300kg/m^2
Ceiling Plasterboard ceiling (10kg/m^2) on timber battens or plasterboard ceiling (10kg/m^2) on resilient channels plus 10kg/m^3 quilt.

We understand the current proposals for the resilient layer is to be 30mm Rockfloor Acoustic Insulation. If this is not implemented, please refer to the above specification.

Resilient flanking strips will be required to maintain the isolation of the floorboards/screed from the structure at perimeter walls.

4.2 Junction with External Walls

The separating floor slab must be built into the inner leaf of the external wall construction.

Please see Section 3.5.1 of this report for flanking detail reviews.

4.3 Steelwork

See Section 3.6.

4.4 Floors Separating Residential and Commercial Areas

The Basement and Ground Floor will be used for commercial use and provision is sought for retail use; Co-op are likely to be the tenant.

There is potential for noise transfer between the commercial areas on the Ground Floor and the residential areas on the First Floor.

The base-build floor build-up at First Floor should be as per Section 4.1 (above).

We understand the building will be let as a base build and it will be the responsibility of the tenant to fit it out according to their business needs.

When considering the fit-out, it will be necessary for noise levels in the commercial areas to be managed to an acceptable level in order to avoid excessive transmission into the residential areas. This may require additional sound insulation in the form of a suitable suspended or independent ceiling and/or limiting noise levels within the commercial space. We have enclosed a form of words for inclusion into the Tenants Handbook.

5.0 ROOF PLANT AREA

The mechanical plant which will serve the residential dwellings is to be located on the roof of the building in a purpose designed enclosure (mansard roof area) which will house all 16No. units.

We have previously calculated the plant noise levels from all 16No. items of plant. A summary of our calculations are presented below:

Plant	Sound Pressure Level (dB re $2x10^{-5}$ Pa) at 1 metre at Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1k	2k	4k	8k	
Cumulative Total for all Residential Plant	**74**	**66**	**66**	**64**	**60**	**53**	**46**	**34**	**65**

We have reviewed RPP Architect's Sketch (A_SK_141002). We would suggest the following is incorporated into the design in order to adequately control airborne noise from the plant area.

- All vertical partitions between external plant areas and internal areas should include additional mass in the form of 1No. 15mm layer of cement particle board.
- Above residential areas, the ceiling is suspended from steel beams and is shown as 1No. layer of plasterboard. We would suggest 2No. 12.5mm layers of SoundBloc (or similar) are laid on top of the steel beams with the insulation located within the void. The SoundBloc should not be penetrated.
- Our Acoustic Specification for Acoustic Roof Access Hatch is enclosed.

With the inclusion of the above advice, the build-up, which includes a 160mm concrete slab as the base should be adequate to control airborne noise from the plant area.

We would advise suitable anti-vibration measures are implemented in line with our previous advice.

6.0 DOORS

6.1 Apartment Front Doors

ADE contains the following advice with regard to minimising the reduction in acoustic performance of a separating wall construction containing a door:

"Ensure that any door has a good perimeter sealing (including the threshold where practical) and a minimum mass per unit area of 25kg/m^2 or a minimum sound reduction index of 29 dB R_w (measured according to BS 140-3 and rated according to BS 717-1).

Noisy parts of the building should preferably have a lobby, double door or high performance doorset to contain the noise. Where this is not possible, nearby flats should have similar protection."

The enclosed Acoustic Specification for Entrance Doors 20447/ED1 presents sound reduction requirements and guidance to achieve the above standard.

6.2 Internal Doors

Doors within single residential rooms should not require any acoustic rating. For quality apartment developments, we would recommend en-suite doors have a minimum superficial door density of 20 kg/m^2.

7.0 REVERBERATION IN COMMON PARTS

In terms of the potential noise impact from noise generated in common areas into apartments, the common areas can be divided into two categories; common areas that open directly into apartments (e.g. corridors); and common areas that do not open directly into apartments (e.g. fire escape stairs, areas separated from apartments by a lobby).

7.1 Common Areas that open directly into Apartments

For corridors and common areas that open directly into residential apartments it will normally be convenient to cover the entire ceiling area with the additional absorption in the form of a proprietary Absorption Class C acoustic ceiling; however, the absorptive material can be applied to any surface that faces into the space.

A Class C absorber is one which has an overall weighted absorption coefficient (α_w) of between 0.60 and 0.75. Typically British Gypsum's Gyptone (perforated plasterboard) systems fall into Class C depending on the pattern of perforation. Most acoustic suspended ceilings would fall into into Classes A to C.

Evidence that Requirement E3 has been satisfied should be presented, for example on a drawing or in a report, which should include:

1. A description of the enclosed space (entrance hall, corridor, stairwell etc);

2. The approach used to satisfy Requirement E3, in this instance Method A, stating the absorber class and the area to be covered.

7.2 Common Areas that do not open directly into Apartments

For common areas that do not open directly into residential apartments, such as Ground Floor entrance lobbies and fire escape stairs, we recommend than an agreement is sought from Building Control such that these areas are exempt from meeting requirement E3. HTA will be able to provide support in this respect, if required.

7.3 Alternative Solution to Sound Absorption

The intention of the E3 is to prevent excessive build up of sound in common parts. In doing so, noise transmitted into adjoining residential rooms with be reduced. Section 0.11 of ADE states:-

"In the Secretary of State's view the normal way of satisfying Requirement E3 will be to apply the sound absorption measures described in [a section] *of this Approved Document, or other measures of similar effectiveness."*

Should it be deemed unsuitable to satisfy Requirement E3 by applying additional sound absorption in common parts, as described in Section 6.1, it may be reasonable to assume 'other measures of similar effectiveness' could include enhancements of the separating wall/floor constructions between apartments and common parts.

In this Report, entrance doors to apartments are specified to achieve ADE (R_w 29 dB). We have calculated the difference in conversational noise levels within a corridor with and without the additional sound absorption described in Section 6.1 to be less than 6 dB.

We would therefore propose an alternative method of satisfy ADE E3 by enhancing the performance of apartment entrance doors by 6 dB from R_w 29 dB to R_w 35 dB (as per attached specification for uprated doors 20374/UD1).

This approach would require the approval of Building Control. However, if approved, it would mean corridor ceilings could be finished with plasterboard.

8.0 GENERAL CONSTRUCTION GUIDANCE

At this stage in the design we provide the following general construction guidance based on good acoustic practice.

- Partitions will need to be built full height (slab to slab).

- Where two layers of board are fixed to studs, they should be installed with staggered joints. All joints should be wet-plastered to form an airtight seal.

- A generous and continuous bead of mastic should be applied to all stud frames where they are fixed to the structure on all sides (soffit, floor slab, masonry wall/column).

- Where partitions/floors abut external cladding, the external walls' internal lining should overlap the junction full-height on both sides of the wall. In no instances should linings to the external wall or columns run continuously between rooms. Curtain walling mullions/transoms, if applicable, will need to achieve a sound flanking criterion depending on the room adjacencies. Double (rather than split) mullion/transom configurations will be required at interfaces with separating (i.e party) walls/floors.

- Room-to-room partitions should penetrate corridor partitions to eliminate flanking via a continuous corridor partition cavity or a continuous room side plasterboard leaf.

- Ideally sockets/switches should not be located within separating (i.e. party) wall constructions. Where absolutely necessary sockets should be separated with a minimum edge to edge stagger of 150mm and must not be located back to back. Where there is no blockwork core wall they should also be 'boxed-in' to the rear with a material having the same mass per unit area as that of the wall leaf in which they are inserted (i.e. no putty pads). Where there is a blockwork core wall boxing-in to the rear is not necessary. Similarly, boxing of sockets and switches is not necessary in internal walls.

- Where live ducts or pipes penetrate the building structure, it is essential to acoustically sleeve the penetrations to prevent transmission of noise and vibration. Sketches 20447/DP1 and 20447/MP1 enclosed illustrate how this may be achieved.

- Where wire trunking/baskets penetrate apartment walls above the front doors they should be finished in accordance with the relevant firestopping requirements.

- It is unacceptable for ductwork to run directly through separating (i.e party) walls/floors. Where this is unavoidable any instance must be bought to the attention of Hann Tucker and be considered on an individual basis.

- Crosstalk silencers may be required where ductwork is common to two or more dwellings/rooms.

- Soil and rainwater pipes shall be cast iron or acoustic HDPE not PVC.

- Soil and rainwater pipework routed through apartment ceiling voids shall be avoided wherever possible. Where this is not possible, the pipework shall be routed via an acoustic enclosure with acoustic access panels for any rodding eyes.

- Mechanical building services (including ducts and pipes) shall be supported off the structural load bearing walls and floors. No mechanical services shall be fixed to lightweight/drywall construction partitions.

- Wall hung WC pans and frames shall be located and supported so as to avoid structure borne noise transmission to adjacent apartments.

9.0 WORKMANSHIP

In most cases, the acoustic criteria are specified in terms of an on-site performance. Since the acoustic performance of on-site constructions depends on many factors, the effects of which cannot be anticipated or predicted to any great accuracy (such as buildability, flanking paths, build quality, sealing of junctions with other building elements and of service penetrations), it is not possible to provide indemnity.

The acoustic performance requirements for each building element, together with proposed forms of construction detailed in this Report, should (with appropriate avoidance of flanking paths, acoustic decoupling where appropriate and intimate site supervision) satisfy the acoustic performance requirements. It shall be the responsibility of the contractor, however, to comply with the requirements.

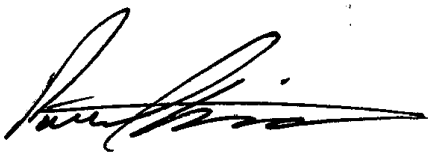
10.0 CONCLUSIONS

The report presents a review of the acoustic criteria applicable to this development as stipulated by Building Regulations Approved Document E: 2003 Edition.

Proposed constructions have been reviewed where possible and suitable constructions and finishes have been proposed to satisfy the acoustic requirements where no specific construction proposals have been made.

We have also provided some general acoustic design advice pertinent to the internal building fabric.

A copy of our Acoustic Specification for Lift Installations is attached.



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HT: 20447 **31 October 2014**

39-45 GRAY'S INN ROAD, LONDON

ACOUSTIC SPECIFICATION FOR RESILIENT LAYER UNDER FLOATING SCREED (FOR APPOVED DOCUMENT E FLOOR TYPE 2)

The resilient layer shall consist of either:

a) a layer of mineral wool of minimum thickness 25mm with density 36kg/m^3, paper faced on the upper side to prevent the screed entering the resilient layer, or

b) an alternative type of resilient layer meeting the following two requirements for the life of the building warranty (which precludes foams that are prone to "creep"):

(i) maximum dynamic stiffness (measured according to BS EN 29052-1:1992) of 15 MN/m^3, and

(ii) minimum thickness of 5mm under the load specified in the measurement procedure of BS EN 29052-1:1992, 1.8 kPa to 2.1 kPa.

The resilient layer shall be lapped up around the screed at the perimeter of the screed and under the skirtings. Care must be taken to prevent the screed bridging the resilient layer.

Suitable suppliers are:

Name & Address	Telephone Number	Contact	Product
Siderise Insulation Limited Unit 15c Chessington Trading Estate Oakcroft Road Chessington Surrey KT9 1RH	0208 391 3650	Mike Carrick Steve Bond	Regupol
CMS Danskin Acoustics Ltd Unit 8 Harding Way St Ives Cambridge PE27 3WR	01480 463750	Paul Absolon	Regupol
Thermal Economics Ltd Thermal House 8 Cardiff Road Luton Bedfordshire LU1 1PP	01582 450814	Ian Griffiths	Isorubber

The installation shall be in strict accordance with the supplier's instructions.
Any deviations from the above specification must be agreed by, and confirmed in writing to, Hann Tucker Associates.

39-45 GRAY'S INN ROAD, LONDON

ACOUSTIC SPECIFICATION FOR ENTRANCE DOORS (R_w 29 dB)

ACOUSTIC PERFORMANCE

Entrance doors to all apartments should achieve a minimum weighted sound reduction index of R_w 29 dB.

CONSTRUCTION GUIDANCE

Doors should comprise solid core hardwood having a minimum thickness of 44mm and a minimum superficial density of 20kg per square metre.

Door frames should be incorporated into openings into which they are fixed so as to maintain the standard of sound insulation. The opening should be accurately made to receive the door frame and any gaps around the perimeter packed with a soft material prior to application of a continuous, airtight seal on both sides.

Neoprene compression seals should be provided at the threshold, jambs and head of the frame. Their effectiveness relies on them being continuously and evenly compressed around the entire perimeter. Adequate door furniture, careful detailing and a high standard of workmanship are thus essential.

The centre meeting stiles of double leaf or leaf-and-a-half doors should be rebated and fitted with a compressible neoprene acoustic seal.

Suitable door seals and contact details are given below:

Head and Jamb Seals:	Sealmaster Type CA, ARH, RCX or RC2 (or equal approved)	
Threshold Seals:	Lorient Type IS8010 si or IS8040 si (or equal approved)	
Supplier	**Sealmaster Limited** Papisford Cambridge CB2 4HG	**Lorient Polyproducts Ltd** Fairfax Road Heathfield Industrial Estate Newton Abbott TQ12 6UD
Telephone:	01223 832851	01626 834252

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ACOUSTIC SPECIFICATION FOR

ACOUSTIC ROOF ACCESS HATCH

Performance

The roof access hatch shall provide the following octave band Sound Reduction Indices (SRI's) when tested in accordance with BS EN ISO 10140-2:2010:

Minimum Sound Reduction Indices (dB) at Octave Band Centre Frequency (Hz)						Mean SRI (dB) (100-3150 Hz)
125	250	500	1k	2k	4k	
27	35	40	42	46	47	40

The manufacturer or supplier of the acoustic roof access hatch shall guarantee the specified SRI, and ensure that the method of installation does not detract from the guaranteed performance. Any failure to meet the specification because of faulty design, manufacture or installation, will result in the manufacturer or supplier being held liable for remedial or replacement costs including consequential liability.

Construction

The acoustic roof access hatch shall be supplied complete with all the seals and frames, and with furniture as specified by the Architect.

The roof access hatch furniture should be designed and installed so as to ensure that the seals are acoustically effective over the whole periphery of the hatch.

It is recommended that the roof access hatch should be of steel construction with double neoprene/rubber compression.

Any deviations from the above specification must be agreed by, and confirmed in writing to, Hann Tucker Associates.

HT: 20447 **31 October 2014**

39-45 GRAY'S INN ROAD, LONDON

ACOUSTIC SPECIFICATION FOR

LIFT INSTALLATIONS

Lift ride quality and performance characteristics shall not exceed the following levels:

Noise in lift car [1]	55 $L_{Amax(fast)}$
Acceleration [1]	1.2m/sec^2
Jerk [1]	1.8m/sec^3
Horizontal peak to peak vibration [1]	0.12m/sec^2 (12mg)
Vertical peak to peak vibration [1]	0.15m/sec^2 (15mg)
Vertical vibration in occupied areas [2]	0.365 m/s $^{1.75}$ VDV
Noise in lift lobby [3]	55 $L_{Amax(fast)}$
Noise from in car announcement and arrival gongs [3]	65 $L_{Amax(fast)}$
Noise into offices through lift shaft walls [3]	35 $L_{Amax(fast)}$
Noise directly into offices without lift lobbies [3]	50 $L_{Amax(fast)}$
Noise into habitable rooms through lift shaft walls [3]	25 $L_{Amax(fast)}$

[1] Lift ride quality and performance characteristics shall be measured and presented in accordance with BS ISO 18738: 2003 'Lifts (elevators) – Measurements of lift ride quality'. N.B. The measurement parameter for vibration is peak to peak, not peak.

[2] Vibration levels shall be measured in terms of peak acceleration on the floor slabs in occupied areas based on the W_b weighting, as defined in Clause 3.3 of BS 6472-1:2008.

[3] Lifts shall be operated as per Section 6.4 of BS ISO 18738:2003. Noise levels shall be measured at 1m from the Lift Door or Shaft Wall, as appropriate, in accordance with the Association of Noise Consultants Guideline document ANC-9701-1997 titled "Noise Measurements in Buildings".

In order to meet the above criteria it is suggested that consideration be given to the following items.

(a) All lift equipment (including the lift motor, starter electrical cabinet, car controllers, reactors and motors generators) should be suitably vibration isolated as appropriate. All connections, such as electrical grounding, shall be formed from flexible cable/conduit.

(b) In the case of hydraulic lift installations, pipework shall be fitted with in-line silencers in order to effectively control noise transmission to areas outside the lift motor room via hydraulic fluid pipes.

(c) All support steelwork for the installation is to be selected to avoid any resonances forced by the lift motor and the natural frequencies of steelwork should therefore fall between the dominant system frequencies.

(d) The steelwork, in particular beams supporting diverter sheaves and pulleys, should be as stiff as possible and suitably vibration isolated from the main structural building elements. The mounting arrangements for the beams should be carefully considered to ensure that the beams are not less stiff than the proposed method of isolation. To this end, long span beams should be avoided and beams should terminate as closely as possible to columns rather than other horizontal beams. The stiffness of the beam support member should be at least 3 time greater than the stiffness of the beam.

(e) Rope hole penetrations shall be acoustically treated (if required) so as to ensure lift motor room noise breakout is controlled to ensure acceptable noise levels in the 'lift lobby' area as defined above.

(f) The car and counterweight guides shall be so joined and fixed to their brackets that they do not deflect by more than 1.0mm under normal operating conditions, and for all panoramic passenger and goods lifts the fixings shall be at floor level only.

39-45 GRAY'S INN ROAD, LONDON

X ACOUSTICS

All designs, works, materials, installations and tolerances are to be fully in accordance with the following:

- Building Regulations
- British Standard BS8233 "Sound insulation and noise reduction for buildings – Code of Practice".
- British Standard BS4142 "Method for rating industrial noise affecting mixed residential and industrial areas"
- CIBSE Guides issued by the Chartered Institution of Building Services Engineers.
- Planning Conditions and other requirements of the Local Authority.
- Statutory noise nuisance legislation.
- Manufacturer's installation instructions, particularly those relating to acoustic matters.
- Other relevant British Standards and Codes of Practice.

Where more than one standard is applicable, the more onerous shall be achieved.

Any relaxation of the acoustic criteria described herein must be agreed in writing by the Landlord or his Acoustic Consultant.

Tenants are warned that in some cases the acoustic criteria contained herein will be difficult to achieve. Tenants are advised to engage an acoustic consultant at an early stage to identify and address the implications of these acoustic criteria.

X.2 ATMOSPHERIC NOISE EMISSIONS

Tenants shall control noise from all of their sources (including mechanical services, amplified speech/music and activities) such that the total noise emissions from the development:

a) Do not cause a statutory noise nuisance.

b) Comply with the planning conditions and other requirements of the Local Authority.

c) When measured in terms of $L_{Aeq(5minutes)}$ they are at least the following amount below the prevailing background $L_{A90(15minutes)}$ noise level at any time:

		Criterion $L_{Aeq(5minutes)}$		
Location	Assessment Location	All Plant (i.e. combined)	Individual Tonal or Intermittent mechanical service, amplified speech/music and activities.	Emergency Plant Tested up to 1hour/week between 09:00 and 17:00 hours Monday to Friday or 09:00 to 13:00 Saturday
Residential	1m outside any openable noise sensitive window	L_{A90} -5dB	L_{A90} -10dB	As per statutory requirements. See above
Office	1m outside any openable noise sensitive window	52dB or L_{A90} -3dB, whichever is higher	50dB or L_{A90} -5dB, whichever is higher	60dB or L_{A90} +5dB, whichever is higher
Pavement	1m from façade, 1.8m above ground level	55dB or L_{A90} +5dB, whichever is higher		60dB or L_{A90} +10dB, whichever is higher

Note: Planning condition may be more onerous than above criteria.

All of the above criteria relate to the total noise levels from all sources within the development. Tenants shall therefore make appropriate allowances for contributing noise from all sources within the development. In the case of noise from amplified music and activities this shall be calculated according to the tenant's demise area relative to the total relevant tenant areas, unless otherwise agreed. In the case of mechanical services this shall be calculated on a pro-rata basis according to the tenant's plant/louvre area relative to the total plant/louvre area, unless otherwise agreed.

The tenant shall employ an acoustic consultant to assess their design and shall make a full submittal of the acoustic performance of the proposed installation for landlord approval prior to commencing installation.

X.3 NOISE AND VIBRATION TRANSFER TO INTERNAL AREAS

Tenants shall control noise and vibration transfer from all of their sources (including mechanical services, amplified speech/music and activities) to internal areas beyond their demise such that:

(a) It does not cause a nuisance, disturbance or annoyance.

(b) It does not exceed any acoustic criteria specifically agreed between the Landlord and other Tenants.

(c) It does not exceed the following Noise Rating (NR) levels.

Area	Criteria for Mechanical Services L_{eq}	Criteria for Music & Activities $L_{max(fast)}$
Residential	At least 5dB below the minimum L_{90} in each octave band across the audible frequency range.	
Offices/Management Suite	NR30	NR35
Retail Units, Restaurants, Bars, Circulation Areas, Landlord's Areas and Other Occupied Areas	NR35	NR40
Car Park ,service yards/Loading bays	NR50	NR55

NR refers to Noise Rating curves as defined in ISO R 1996.

(d) It does not give rise to audible tones or rattles.

(e) Vibration transfer from M&E services to internal occupied areas shall not exceed 0.01m.s^{-2} peak based on the W_b weighting as defined within BS 6472-1: 2008 "Guide to Evaluation of Human Exposure to Vibration in Buildings".

Criterion (a) is ultimately the overriding requirement. Provided (a) is complied with in full, some relaxation of (b) (c) (d) and (e) may be permissible, but only at the Landlord's discretion. Compliance with (b) (c) (d) and (e) would however, in most cases, be considered as evidence tending to demonstrate compliance with a).

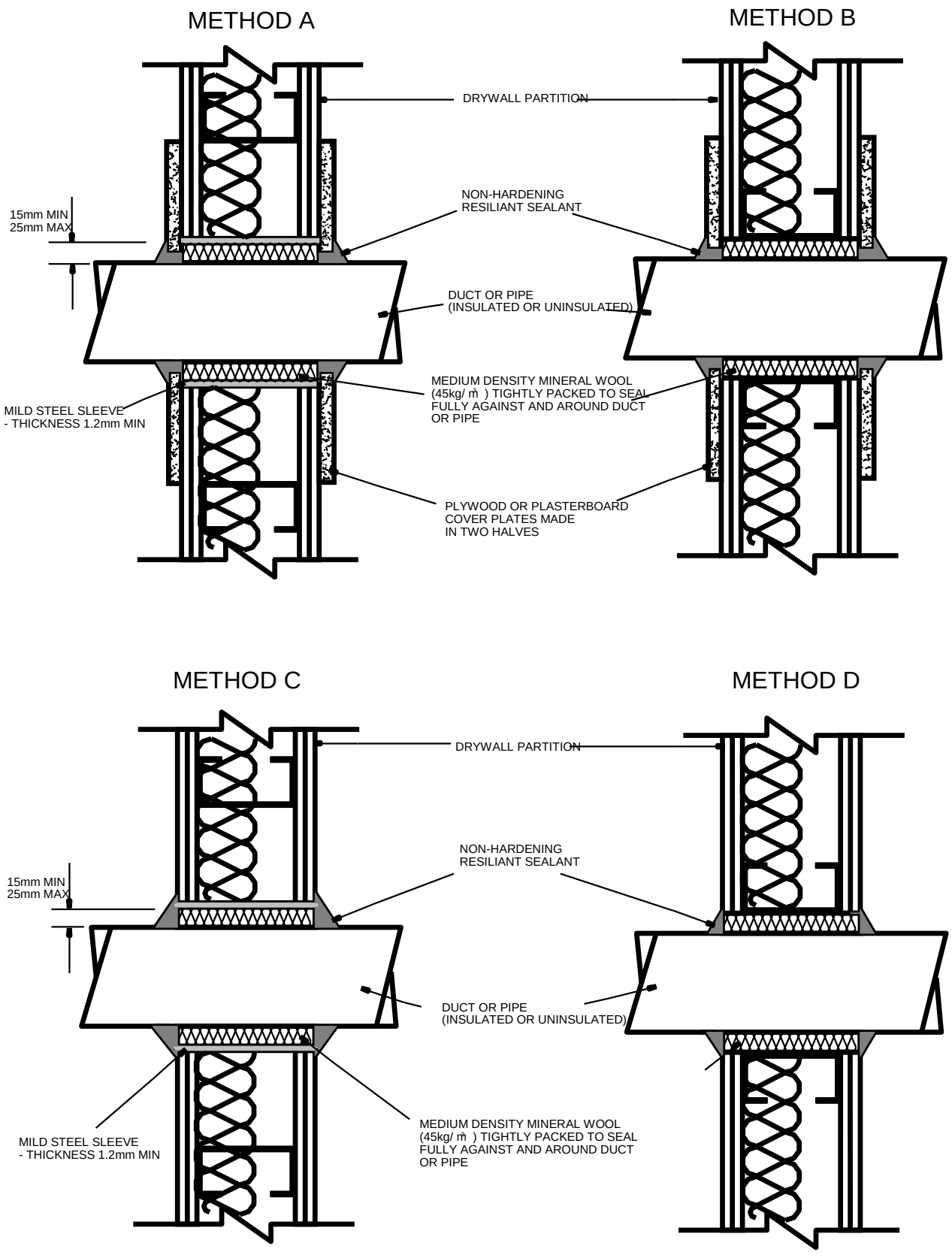
X.4 EMERGENCY PLANT

Relaxation of the above criteria may be permissible for emergency or standby plant, subject to agreement in writing with the Landlord or his Acoustic Consultant.

X.5 CONSTRUCTION NOISE & VIBRATION

Construction work shall not cause unacceptable nuisance to other occupants of the building or nearby buildings.

Construction work which is likely to cause nuisance to local residents should not take place outside Monday to Friday 08:00 to 18:00 hours except with the approval of the Local Authority and the Landlord.



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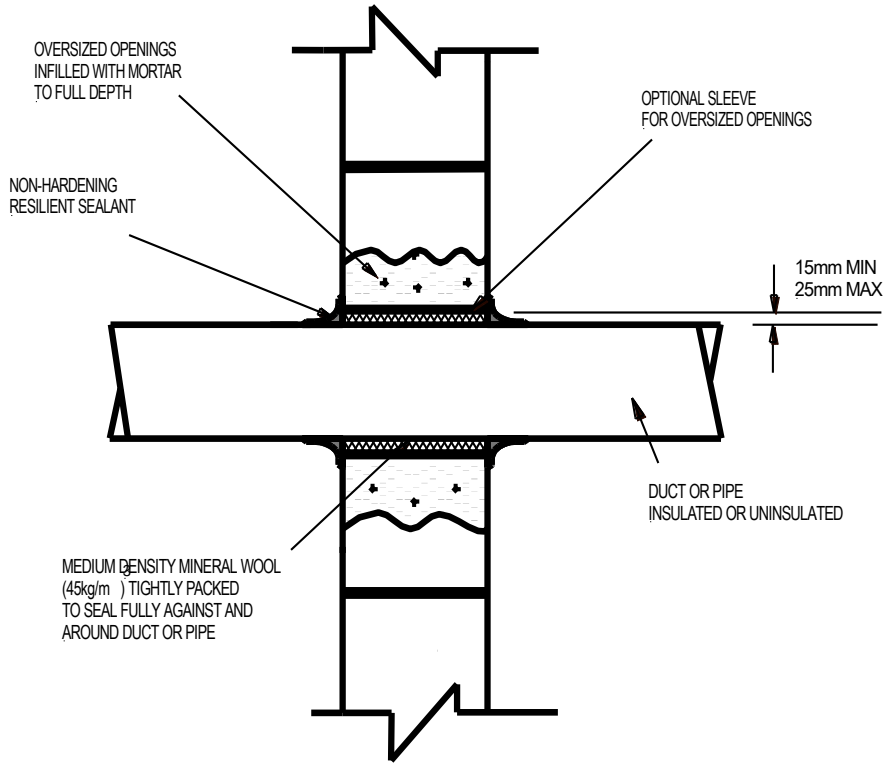
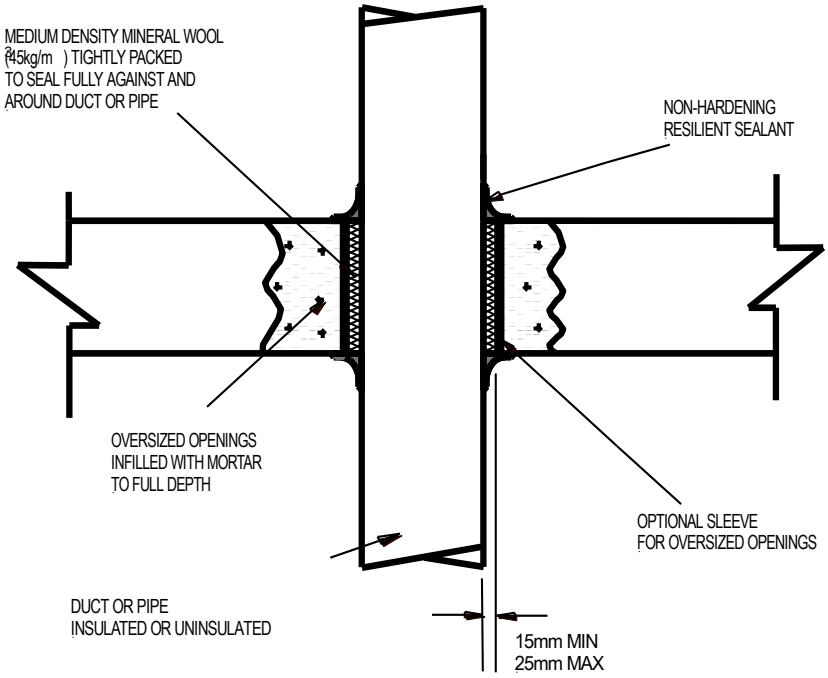
Title : Methods of Sealing Service Penetrations Through Drywall Partition

Project :	Day:	Figure :
39-45 Gray's Inn Road	03/09/14	20447/DP1
	Scale : N.T.S.	

WALL DETAIL



FLOOR DETAIL



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Title :

Method of Sealing Service Penetrations Through Masonry Constructions

Project :	Date :	Figure :
39-45 Gray's Inn Road	03/09/14	20447/MP1
	Scale : N.T.S.	