Northern Central
Manchester

Acoustic Design Report

21196/ADR1

20 February 2018

For:

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Hann Tucker Associates

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Document Control

Issue	Date	Comment	Prepared by	Authorised by
-	28/02/17	Draft for comment	-	-
			Andrew Jameson Director BSc(Hons), MIOA, MAES	-
0	20/02/18	No changes since draft.		-
			Andrew Jameson Director BSc(Hons), MIOA, MIET	-

This report has been prepared by Hann Tucker Associates Limited (HTA) with all reasonable skill, care and diligence in accordance with generally accepted acoustic consultancy principles and the purposes and terms agreed between HTA and our Client. Any information provided by third parties and referred to herein may not have been checked or verified by HTA unless expressly stated otherwise. This document contains confidential and commercially sensitive information and shall not be disclosed to third parties. Any third party relies upon this document at their own risk.

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Acoustic Design Report
23973/ADR1

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1.0 Introduction

This report sets out the acoustic requirements for the new-build private residential development referenced Northern Central, on Angel Street in Manchester and provides acoustic design advice to assist the design team. The advice presented herein has been formulated on the basis of achieving the requirements of Building Regulations, local planning requirements and other relevant British Standards/good practice design guides.

2.0 Acoustic Terminology

Appendix A contains a description of the acoustic terminology used herein.

3.0 General Requirements

3.1 Relevant Standards & Legislation

All design, works, materials, installations and tolerances are to be fully in accordance with the following key documents, amongst other relevant standards/guidelines:-

- Building Regulations' Approved Document E: 2003 Edition (with 2004, 2010, 2013 & 2015 amendments).
- National & local planning requirements (NPPF, EPU & relevant Planning Conditions).
- Statutory noise nuisance legislation.
- British Standard BS 8233: 2014 'Guidance on sound insulation and noise reduction for buildings'.
- British Standard BS 4142: 2014 'Methods for rating and assessing industrial and commercial sound'.
- CIBSE Guides issued by the Chartered Institution of Building Services Engineers.
- Manufacturer's installation instructions.
- Hann Tucker Associates' General Specification for Acoustic and Vibration Isolation Materials and Products.

The key standards and legislation documents are reviewed and discussed in Appendix B.

3.2 Employer's Brief

No specific acoustic design brief has been received by the developer and we understand the development is not being assessed to any environmental assessment methods.

3.3 General Specification for Acoustic & Vibration Isolation Material & Products

All acoustically rated products and materials specified on this scheme shall be in accordance with the Hann Tucker Associates' General Specification for Acoustic & Vibration Isolation Material & Products (copy available upon request).

3.4 Pre-completion Acoustic Testing

Pre-completion testing will be required to prove compliance with the requirements of ADE Requirement E1. 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 across separating walls and floors. The locations for such tests will be selected by the Building Control Body, with the measurements made by an approved specialist organization, such as Hann Tucker Associates.

Building Control should stipulate at least one set of tests for every ten "dwellings" (10%), assuming no test fails. 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 Contractor will need to determine the cause. It will then be necessary for the Contractor 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.

4.0 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.

5.0 Environmental Noise & Vibration Survey

A detailed environmental noise and vibration survey of the site have been undertaken by Hann Tucker Associates. The survey methodology and results are presented in our Noise & Vibration Impact Assessment Report referenced 21196/NVIA1revA dated 17 September 2015.

The noise climate is noted to be dominated by road traffic, particularly on Angel Street. Vibration levels were measured and predicted to fall below BS 6472 limits within new dwellings.

6.0 Acoustic Design Criteria

6.1 External Building Fabric

External noise intrusion into internal areas of the development shall be controlled to achieve the following ambient noise level criteria.

Area	Location	Daytime (07:00-23:00)	Night time (23:00-07:00)
Residential	Living Room	35 dB $L_{Aeq,16hr}$	-
	Bedroom	35 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,8hr}$ 45 dB* L_{Amax}
Common Parts	Corridor, Entrance Hall	NR 40 L_{eq}	
Commercial	Retail	NR 45 L_{eq}	

*not regularly exceeded.

6.2 Internal Building Fabric

6.2.1 Sound Insulation

The following table proposes the acoustic requirements for the residential internal building fabric elements, with the aim of satisfying ADE.

Location	Element	Sound Insulation Criterion	
		Airborne (Minimum Value)	Impact (Maximum Value)
Apartment to any other part of building	Party Wall	45 dB $D_{nT,w} + C_{tr}$	N/A
	Party Floor	45 dB $D_{nT,w} + C_{tr}$	62 dB $L'_{nT,w}$
Within Apartments	Internal Partition	40 dB* $R_{w\,(lab)}$	N/A

* only applicable for internal walls stipulated in ADE (E2) – see Appendix B.

6.2.2 Commercial to Residential Floor

See Section 6.5

6.2.2 Finishes in Common Parts

Sound absorbent finishes will be required to control reverberation in corridors that provide direct access to apartments. Ceilings should be sound absorptive to a suitable rating depending on the quantity of treatment, see Section 8.7. Floors should ideally be carpeted.

Subject to Building Control approval, it may be possible to seek an alternative approach to applying sound absorption to common parts. The purpose of the sound absorption is to reduce reverberant noise build-up and the subject transfer of this noise into apartments. The same benefit could therefore be achieved by uprating the sound insulation performance of the elements separating apartments from common parts (namely, the entrance doors). This option is discussed further in Section 8.7.

6.3 Internal Building Services Noise/Vibration

Noise and vibration transfer from mechanical services plant shall be controlled such that:

- Noise transfer to other areas does not exceed the following Noise Rating (NR) levels when measured with a precision grade sound level meter set to “fast” response.

Area	MEP Noise to Internal Areas		
	A/C or ventilation systems serving actual area	All other systems within area	All other systems
Bedroom	Set back night duty NR25	NR20	NR15
	Normal day duty NR 30		
	Boost duty NR 35		
Living Room / Kitchen	Normal duty NR30	NR 25	NR 20
	Boost duty NR 40 *(Cooker hood: Low-High NR45-55)*		
En-suite/main bathroom	Normal duty NR35	NR35	NR30
	Design/Boost duty NR45		
Common Parts	NR40		
Commercial Unit	NR45		
BOH Servicing, Car Park	NR50		
Plant room	to suit adjacent occupied areas*		

“NR” refers to Noise Rating curves as defined in ISO R 1996.
* Contractor’s acoustician to review plant room constructions once plant selections have been made.

- No noise source to give rise to audible tones or rattles.
- Vibration transfer from M&E services to internal occupied areas shall not exceed 0.01 m/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”.

The above levels are specified as the $L_{Aeq,30s}$ at 1.2 m above the floor level at a position no closer than 1 m from a wall in the absence of activity noise and noise ingress. Cooker hood limits apply at any location 1 m from the hood grille.

Smoke extract systems shall be designed so as not to exceed NR 55 in any internal area to ensure emergency announcements are clearly audible.

6.4 External Plant Noise

As stipulated in our Report 21196/NVIA1revA, the following cumulative plant noise emission limits have been specified for plant to be achieved at 1 m from residential windows (including those associated with the development itself).

Noise shall be assessed in accordance with BS 4142: 2014, with corrections applied for any plant emitting noise of a tonal or irregular quality, to achieve the below rating levels.

Period	BS 4142 Plant Noise Rating Limit (dBA)
Daytime (07:00-23:00)	43
Night-time (23:00-07:00)	38

6.5 Commercial Tenant Requirements

The floor between the commercial unit and the first floor dwellings shall be designed to satisfy ADE (as per Section 6.2) and not less than $D_{nT,w}$ 60 dB. This should be suitable for the majority of retail tenants.

However, a suitable form of words should be included in the tenant's handbook to ensure the tenant is made responsible for controlling noise from their activities and plant to suitable levels, internally and externally. A draft form of words is enclosed in Appendix C for your consideration.

7.0 External Building Fabric

7.1 Overview

The development consists of basement car parking, a ground floor commercial unit with back of house areas and a residential entrance plus 8-storeys of residential apartments. At ground floor, the external building fabric shall comprise masonry walls with curtain walling to the commercial unit. For the upper floor dwellings, facades will comprise SFS walls and punched in windows with small elements of curtain walling.

All apartments are to be ventilated with mechanical ventilation heat recovery units (MVHR) to provide background trickle ventilation. These units will have a boost, which should be manually operable to help mitigate the need for occupants to open window to prevent overheating. Purge ventilation will be provided by openable windows.

Based on the results of our noise survey, the following table presents the highest daytime $L_{Aeq,16hr}$ and night-time $L_{Aeq,8hr}$ (and L_{Amax}) free-field incident noise levels on each elevation of the development. Note: Noise levels will reduce marginally with height up the building (not by an amount that should influence façade specifications).

Facade	Free-field Incident Noise Level (dB)	
	Daytime $L_{Aeq,16hr}$	Night-time $L_{Aeq,8hr}$ (L_{Amax})
Angel Street	68	63 (78)
Dyche Street & Simpson Street	65	59 (75)
Ludgate Street	62	56 (71)

In our assessment of the acoustic performance of façade elements, we have assumed bedrooms and living areas will have typical furnishings including beds, sofas, chairs etc. Room and window dimensions have been taken from the latest architectural drawings (at time of writing). If these change, the acoustic specifications would also be subject to change.

7.2 External Walls

The external walls will be formed from load-bearing SFS as below:-

- External cladding finish;
- 12 mm cementitious board;
- 100 mm deep Metsec frame (600 mm centres) fully filled within mineral wool quilt;
- 2 x 15 mm dense plasterboard (min. 12.5 kg/m^2).

The above construction is considered sufficient to be capable of satisfying the internal noise limits (from external noise intrusion).

The linings should not pass continuously across party wall or floor line. However, the load-bearing Metsec frame itself will still introduce a sound flanking across party floors/walls. This could be treated by installing the external wall linings on resilient bars within habitable rooms, or by introducing a resilient pad/fixing arrangement in the frame at party wall/floor lines. Guidance should be sought from the prospective framing contractor to determine the most appropriate form of treatment (if any).

If external cladding finish is masonry, flexible cavity closers will be required at all party wall and floor interfaces. These should extend the full depth of the party wall/floor, compress fitted to form a continuous airtight seal.

At ground floor, cavity masonry external walls are proposed comprising outer brick, insulated cavity and medium density blockwork. This construction should be sufficient for controlling external noise intrusion. For sound flanking control, the inner blockwork must provide a minimum mass per unit area of 140 kg/m^2 (e.g. 100 mm block at min. density 1,400 kg/m^3).

Where mineral wool is specified, it should provide a density of between 10-45 kg/m^3.

7.3 Glazing / Cladding

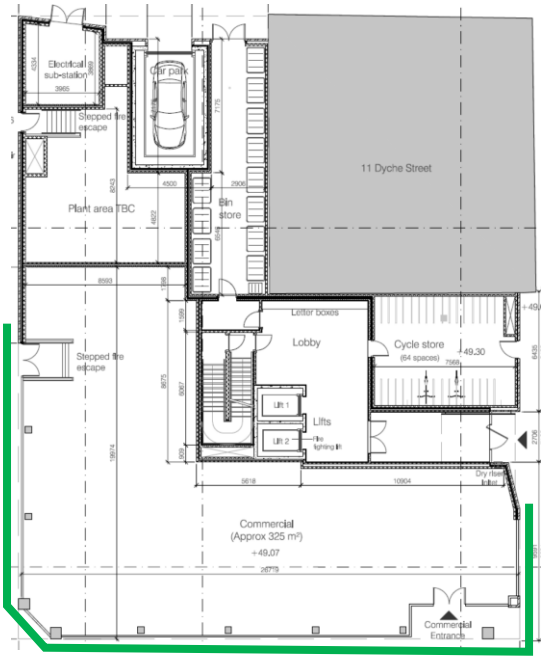
Sound Reduction

The following specification for glazing/cladding details our recommended minimum octave band sound reduction indices. In all cases, it is essential that the system is tested in accordance with BS EN ISO 10140-2 and that the quoted minimum sound reduction specifications are met by the system as a whole (not just the glass). Indicative overall weighted sound reduction values, $R_w + C_{tr}$, are provided for guidance purposes only.

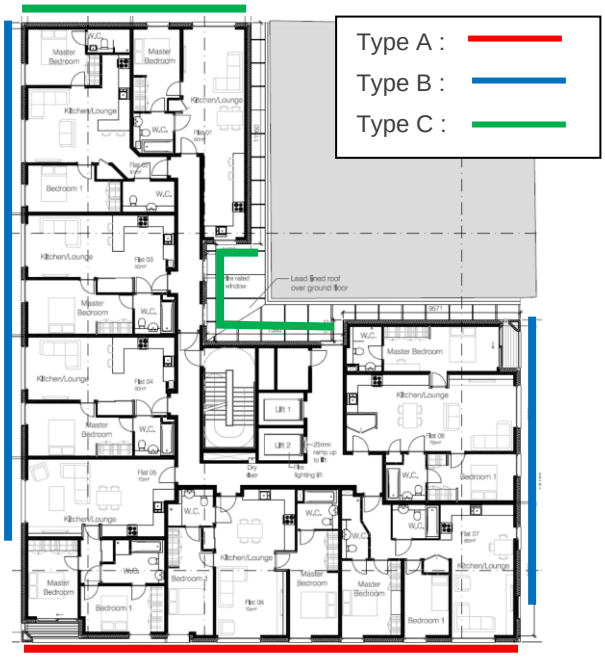
Where structural glass or non-vision spandrel panels are proposed, they should provide sound reduction performance at least equal to that required of the glazing/cladding in order to maintain the acoustic integrity of the building envelope.

Type	Façade	Minimum Sound Reduction, R (dB) at Octave Band Centre Frequency (Hz)						Indicative Overall, (dB) $R_w + C_{tr}$
		125	250	500	1k	2k	4k	
A	Red	26	31	38	42	42	42	36
B	Blue	24	28	34	37	38	38	33
C	Green	22	26	29	33	34	34	30

The following sketch illustrates the extent of the above Glazing/Cladding Type zones.



Ground Floor



Upper Floors

It is essential that prospective cladding system suppliers can demonstrate compliance with the acoustic performance detailed in our specification rather than simply offering a generic glazing configuration. However, we would suggest that the following configurations could typically be expected to provide the required levels of sound insulation.

Type	Façade	Example Glazing Configuration
A	Red	10 mm / (20 mm argon) / 8.8 mm lam.
B	Blue	10 mm / (16 mm argon) / 6.4 mm
C	Green	10 mm / (16 mm argon) / 6 mm

Sound Flanking

Where curtain walling (or similar lightweight cladding) spans continuously across party floor lines, the cladding system shall incorporate suitable elements against which the floor can be sealed to control sound flanking.

The complete curtain walling system shall be tested for flanking transmission at a junction with party floors and it shall provide the following minimum weighted normalised flanking level difference when tested in a laboratory in general accordance with BS EN ISO 10848-2:2006 and rated in accordance with BS EN ISO 717-1:2013.

Location	Minimum Sound Flanking Specification, $D_{nf,w} + C_{tr}$ (dB)
Junctions with Party Floors	50

The supplier must demonstrate through developed design details that vulnerable areas subjected to the passage of unwanted sound i.e. flanking transmission have been so developed along with trades immediately adjoining the cladding to satisfy the above.

N.B. To adequately control flanking transmission, we would suggest provisions are made for:-

- The party floors to be sealed to 2No. separate transoms (slab and ceiling interfaces);
- The gap between the slab edge and curtain walling system is sealed full height with a cavity closer.
- A continuous steel angle is used to fix and fully seal the curtain walling system to the top of the slab.
- Continuous mullions are broken at the slab edge with acoustic foam inserts applied, as required, depending on the system-type.

For further guidance and suitable products, please see below the details for a suitable supplier.

Name & Address	Telephone Number	Contacts
Siderise Insulation Ltd Unit 9.2 Typhoon Business Centre Chessington, Surrey, KT9 1RH	0208 391 3650	Stephen Bond Mike Carrick

7.4 MVHR Ventilators

All apartments will be ventilated with MVHR units providing the minimum background ventilation rates to satisfy Building Regulations' Part F. Units should be selected to achieve the NR limits presented in Section 6.3, and consideration should be given to the control of noise intrusion to satisfy noise limits in Section 6.1.

In order to maintain "reasonable" acoustic conditions during periods of summer cooling (to avoid overheating), we would suggest MVHR units are provided with a manually operable boost setting that can mitigate the periods in which windows need to be opened. This may not fully omit reliance on openable windows for the very hottest days, but it should allow the occupant to significantly *reduce* the need to open windows to avoid overheating over the course of a year.

With MVHR ventilation provided, natural trickle ventilators should be omitted.

7.5 Roof Systems

The roofing over apartments will be 160 mm composite deck concrete (80 mm trapezoidal profile depths, min. 2,300 kg/m^3) with ceilings and external insulation, which should comfortably control traffic noise intrusion when built to a good airtight standard.

8.0 Internal Building Fabric

8.1 Party Floors

The proposed party floors shall be constructed as below:-

- Floor finish (varies);
- Acoustic resilient layer;
- 160 mm composite concrete deck (TR80+ trapezoidal profiles, concrete ca. 2,300 kg/m^3);
- 200 mm (minimum) metal framed ceiling void containing 25 mm mineral wool quilt;
- 1 x 12.5 mm plasterboard ceiling.

Airborne Performance

The above floor construction is expected to be capable of satisfying the *airborne* sound insulation requirements of ADE with good workmanship and flanking control.

At external wall and internal load-bearing wall junctions, the floor will be supported on a continuous Metsec frame by angled supports. In all instances, load-bearing frames will be boarded with 2x15 mm SoundBloc and it is imperative these linings do not run continuously past the floor slab. The load-bearing Metsec frame may require additional treatment to prevent sound flanking, e.g. with boards fixed to resilient bars within habitable rooms or by introducing a resilient pad/fixing arrangement in the frame at party wall/floor lines. However, guidance should be sought from the prospective framing contractor to determine the most appropriate form of treatment (if any).

Where mineral wool is specified, including in the ceiling void, it should provide a density of between 10-45 kg/m^3.

Impact Performance

In order to make this floor capable of satisfying the ADE *impact* sound insulation requirements, a resilient floor covering is required which shall comprise a resilient material, or a material with a resilient base, with an overall uncompressed thickness of at least 4.5 mm and achieve a weighted reduction in impact sound pressure level (ΔL_w) of not less than **17 dB** when measured in accordance with BS EN ISO 140-8 and calculated in accordance with BS EN ISO 717-2.

The resilient floor covering should be bonded to the floor slab, unless otherwise agreed with Building Control.

The above can be achieved with 4.5 mm Regupol 4515, or equivalent and equally approved, bonded to the floor with the final floor finish laid on top. A list of suitable suppliers of resilient floor coverings is attached.

8.2 Commercial to Residential Party Floor

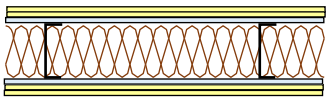
The ground floor accommodation shall be formed from a concrete frame with a transfer slab to the basement below and the first floor dwellings above. The transfer deck shall be formed from a minimum 300 mm thick concrete (ca. 2,300 kg/m^3) which is expected to be capable of satisfying the minimum airborne sound insulation requirements of ADE and 60 dB $D_{nT,w}$.

It is advisable to bond an acoustic resilient layer (meeting the same specification detailed in Section 8.1) to the slab within first floor apartments to control impact noise transfer between apartments on the same floor.

To control sound flanking, note the inner leaf of blockwork to the ground floor external wall should provide a minimum mass per unit area of 140 kg/m^2 (e.g. 100 mm medium block, min. 1,400 kg/m^3).

8.3 Party Walls

All party walls shall be load-bearing and will be formed from a single stud Metsec with resilient bars to both sides as per the below specification.

Element	Sketch	Specification
Party Wall		• 2 x 15 mm dense plasterboard (min. 12.5 kg/m^2 each); • 100 mm Metsec, 600 mm centres, with resilient bar both sides; • 100 mm mineral wool quilt (10-45 kg/m^3); • 2 x 15 mm dense plasterboard (min. 12.5 kg/m^2 each). *Width = ca.180 mm*

This build up is expected to be capable of achieving the required on-site airborne sound insulation target provided there is a good standard of workmanship and detailing, particularly with services penetrations (e.g. sockets/switches). All party walls must be built full height.

At external wall interfaces, the stud party walls must penetrate the external wall plasterboard linings to ensure linings do not fly continuously past party walls between apartments. A similar approach is required where party walls between apartments meet the corridor wall.

The need to isolate the continuous Metsec frame at party wall interfaces with the external wall needs to be reviewed with the specialist framing contractor.

8.4 Internal Walls

Within dwellings, internal non-load bearing walls shall achieve a minimum rating of R_w 40 dB. There are numerous partition types capable of meeting this minimum rating, such as 1 x 15 mm SoundBloc each side of 70 mm metal C stud. These walls could be built full height or slab-to-ceiling.

In some instances it may be prudent to enhance this specification (e.g. for a bedroom adjacent to a kitchen), which can be achieved easily by the inclusion of a mineral wool quilt and building full height slab to slab.

For load-bearing structural walls, internal walls shall comprise 2 x 15 mm SoundBloc each side of 100 mm Metsec frame (600 mm centres), fully filled with mineral wool insulation. Whilst this construction is easily capable of achieving R_w 40 dB (min.), consideration must also be given to sound flanking, as the Metsec frame will run continuously between apartments floor to floor. The need to isolate the frame at the party floor line will need to be reviewed with the specialist framing contractor.

8.5 Lift Shaft Linings

Lift shaft walls shall be constructed from a twin-stud Metsec frame, with appropriately specified fire-proof boarding and mineral wool cavity insulation. In no instances do lift shafts pass adjacent to habitable rooms. Nevertheless, it is important that the frame supporting the lift installation is sufficiently independent of the main structural frame to prevent the transmission of structure-borne vibration/noise. An acoustic specification of lift installations is provided in Appendix C, outlining the requirements for the lift contractor.

8.6 Residential Entrance Doors

Building Regulations' ADE contains the following guidance with regard to entrance doors to apartments:-

"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."

We would therefore suggest entrance doors are either rated at R_w 29 dB (minimum) or comprise:-

- solid core hardwood having a minimum thickness of 44 mm and a minimum superficial density of 20 kg per square metre;
- neoprene compression seals provided at the jambs and head of the frame (and threshold where practical). 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.

Suitable door seals are given below:

Head and Jamb Seals: Sealmaster Type CA, "Deluge" SEM/000, "Hurricane" SFS/016, "Hurricane" SFS/018, RC2 (or equal approved) Lorient Type IS7120 (or equal approved)

Threshold Seals: Lorient Type IS8010 si or IS8040 si (or equal approved)

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.

8.7 Finishes in Common Parts

All floors to corridors that are providing direct access to apartments should ideally be carpeted. If they are, the requirements of ADE could be achieved with the further inclusion of a sound absorbent ceiling covering at least 65% of the total ceiling area (evenly distributed) and achieving Absorption Class A, B or C. If corridors are finished with a hard floor (e.g. vinyl), the % of coverage required would increase to 100%.

Entrance halls and stair wells do not provide direct access to dwellings and should not, therefore, require any acoustic consideration on finishes.

If there is a preference to avoid applying sound absorption to corridors that do provide direct access to dwellings (in favour of a solid MF plasterboard ceiling), alternative approach to satisfy ADE would be to uprated entrance doors to R_w 35 dB, subject to Building Control approval. We would be pleased to assist and advise further upon request.

8.8 General Construction Guidance

We provide the following general points to promote good acoustic practice.

- Party walls must be built full height (slab to slab).
- Internal non-load bearing walls can be built up to the ceiling if desired.
- Where two layers of board are fixed to studs, they should be installed with staggered joints. All joints should be wet-plastered (e.g. taped and skimmed or wall fully skimmed 3mm) 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).
- In no instances should linings to the external wall run continuously from one apartment to another.
- Similarly, the apartment-side plasterboard lining to corridor wall must not run continuous between apartments.

9.0 Building Services Acoustics

9.1 Apartment MVHR Units

See Section 7.4.

9.2 Lift Installations

Noise and vibration levels due to the lift installations in residential and office buildings should not exceed the relevant limits stated in the Acoustic Specification for Lift Installations enclosed. It should be the responsibility of the lift contractor to meet the vibration and noise criteria presented in this specification.

9.3 Services Risers

Pipes (e.g. SVPs) and ducts (excluding gas pipes) are required to be enclosed (full height) where they penetrate a floor separating habitable rooms. In line with Building Regulations' ADE, the penetrations should be sealed at slabs with fire collars and be enclosed with 2 layers of plasterboard providing 15 kg/m^2 (min) and include 25mm unfaced mineral wool pipe lagging or riser lining.

Where there is a desire to minimise the audibility of noise from the pipes within the adjacent areas, we would recommend the following treatment, although this is not required for Building Regulations compliance:-

- 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;
- Box in with double layer of 15 mm dense plasterboard (min. 25 kg/m^2).

The above does not guarantee inaudibility, but would assist in approaching inaudibility where desired. Access to risers can be provided by an access hatch where the mass of the hatch matches that of the enclosure, with compressible seals to all four sides, or with proprietary doors achieving R_w 30 dB (corridor side) or R_w 35 dB (apartment side).

Pipework shall be supported in a manner which prevents structure borne noise transmission to walls and floors. This shall be achieved by:

- Supporting via unistrut off concrete slabs which is fully independent of lightweight walls (minimum 10mm clearance).
- Using oversized brackets containing neoprene inserts.
- Incorporating acoustic dampeners where pipework is suspended from floor slabs.
- Using rubber lined pipe brackets.

Drainage pipework traversing in ceiling voids must lagged within 25mm mineral wool and be boxed in with 2 layers of 15 mm dense plasterboard, including within the commercial unit.

9.4 Service Penetrations

All penetrations of wall/floor constructions by ducts, pipework, electrical cables, etc. should be adequately sealed acoustically. Where live ducts or pipes penetrate the building structure, it is essential to acoustically sleeve the penetrations to prevent transmission of noise and vibration.

This should be done by sleeving penetrations with a 25 mm thickness of mineral wool having a density of at least 45 kg/m^3. Care should be taken to seal any gaps by means of heavy grout, and the whole should be finished with a liberal application of dense, soft, non-hardening mastic. Sketches 21196/DP1 and 21196/MP1 enclosed illustrate how this may be achieved.

9.5 Socket/Switches

Penetrations within party walls for electrical sockets will inevitable increase the risk of failures and must be avoided where possible (e.g. located within internal walls, located within a sacrificial plasterboard lining or boxed in). Party walls must not include large penetrations, e.g. for recessed AV boxes, TV's speakers etc.

Sockets must not be back-to-back in any instance, and thus mirrored apartment service layouts must consider staggered services with the inclusion of backing boxes (to maintain acoustic integrity) where necessary and a minimum back-to-back stagger of 300 mm.

Appendix A

Acoustic Terminology

dB - Decibel - Used as a measurement of sound pressure level. It is the logarithmic ratio of the noise being assessed to a standard reference level.

dB(A) - The human ear is more susceptible to mid-frequency noise than the high and low frequencies. To take account of this when measuring noise, the 'A' weighting scale is used so that the measured noise corresponds roughly to the overall level of noise that is discerned by the average human. It is also possible to calculate the 'A' weighted noise level by applying certain corrections to an un-weighted spectrum. The measured or calculated 'A' weighted noise level is known as the dB(A) level.

Because of being a logarithmic scale noise levels in dB(A) do not have a linear relationship to each other. For similar noises, a change in noise level of 10dB(A) represents a doubling or halving of subjective loudness. A change of 3dB(A) is just perceptible.

L_{Aeq} **-** The concept of L_{Aeq} (equivalent continuous sound level) has up to recently been primarily used in assessing noise in industry but seems now to be finding use in defining many other types of noise, such as aircraft noise, environmental noise and construction noise.

L_{Aeq} is defined as the (A-weighted) notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the actual, fluctuating sound measured over that period (30 minutes).

$D_{nT,w}$ - **Weighted Level Difference (dB)**

A single number quantity characterising the on site airborne sound insulation performance of a construction, including transmission of sound via flanking paths (e.g. adjoining floors/walls).

The higher the $D_{nT,w}$ of a construction, the better its airborne sound insulation performance; the higher the $D_{nT,w}$ requirement, the more stringent the criteria.

R_w - **Weighted Sound Reduction Index (dB)**

A single number quantity characterising the laboratory based airborne sound insulation performance of a construction, independent of transmission of sound via flanking paths.

As with $D_{nT,w}$, the higher the R_w, the better the sound insulation performance; the higher the R_w requirement, the more stringent the criterion.

Since the level of reverberation in a "receive" room affects the difference in sound level across a wall or floor on site, $D_{nT,w}$ and $L'_{nT,w}$ include a correction for the "receive" room reverberation time (allowing comparison of values measured in various conditions).

RT, RT_{60}, T or T_{60} **Reverberation Time (secs)**

The time, in seconds, for a sound to decay by 60dB.

Appendix B

Relevant Acoustic Standards & Legislation

B.1 Building Regulations' Approved Document E

B.1.1 Party Walls & Floors

Requirement E1 of Approved Document E: 2003 Edition (ADE) covers protection against sound from other parts of the building and adjoining buildings. In this development, apartments 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 is to build separating walls and floors together with the associated flanking constructions, in such a way that they achieve the on-site sound insulation values shown below.

Development Type	Element	Airborne Sound Insulation $D_{nT,w} + C_{tr}$	Impact Sound Insulation $L'_{nT,w}$
Purpose built dwelling-houses and flats	Separating Walls	$\geq$ 45 dB	-
	Separating Floors	$\geq$ 45 dB	$\leq$ 62 dB
Purpose built rooms for residential purpose	Separating Walls	$\geq$ 43 dB	-
	Separating Floors	$\geq$ 45 dB	$\leq$ 62 dB

In the case of walls or floors separating an apartment from communal or non-residential spaces, 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, retail/commercial units, plantrooms, etc.

The performance of separating walls and floors between apartments would usually be verified by undertaking pre-completion testing, as discussed in the Report.

B.1.2 Internal Walls & Floors (within Apartments)

Requirement E2 of ADE covers protection against sound *within* apartment, so that internal walls and floors between a bedroom, or a room containing a water closet, and other rooms provide reasonable resistance to sound.

This requirement does not apply to internal walls which contain a door or walls separating an en-suite toilet from the associated bedroom.

The normal way of satisfying Requirement E2 will be to use constructions for new internal walls and floors that provide the laboratory sound insulation values set out in the table below.

Element	Airborne Sound Insulation R_w
Internal Walls	40
Internal Floors	40

As these are laboratory values there is no requirement for an on-site performance or pre-completion testing.

B.1.3 Control of Reverberation in Common Parts

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.

It is our understanding that the ADE requirement does not apply to areas that do not give direct access to rooms for residential purpose. The requirements for this development should be clarified with Building Control as it will depend upon their interpretation.

The simplest method (Method A) of determining ADE compliance is to cover 100% of the ceiling area of corridors and entrance halls with a Class C absorber.

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.

B.2 National Planning Policy Framework

The National Planning Policy Framework (NPPF, March 2012) sets out the Government's planning policies for England and how these are expected to be applied. It sets out the Government's requirements for the planning system only to the extent that it is relevant, proportionate and necessary to do so. It provides a framework within which local people and their accountable councils can produce their own distinctive local and neighbourhood plans, which reflect the needs and priorities of their communities.

B.3 BS 8233

British Standard 8233:2014 "Sound insulation and noise reduction for buildings" recommends design criteria for internal ambient noise levels for dwellings. It states that it is desirable that internal ambient noise levels do not exceed the following guidelines:

Room Type	07:00-23:00 hrs	23:00-07:00 hrs
Living Rooms	35 dB $L_{Aeq,16hr}$	-
Bedrooms	35 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,8hr}$

The document goes on to state that the above target levels may be relaxed by 5 dB and reasonable internal conditions would still be achieved. This relaxation could be applied where there is a need for housing in a noisy area.

For outdoor living spaces, an upper guideline value of 55 dB $L_{Aeq,T}$ is quoted.

B.4 BS 4142

BS 4142: 2014 describes methods for rating and assessing the effects of outdoor sound levels, of an industrial and/or a commercial nature, "*on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident*".

The impact of a specific sound is indicated by subtracting the existing background noise level from the rating level (i.e. noise level from the proposed items of plant/machinery/etc plus any acoustic feature corrections).

The noise from the new development is expressed in terms of a rating level and given as a $L_{Aeq,\,T}$ noise level. The existing background noise level is expressed in terms of a $L_{A90,\,T}$ noise level.

APPENDIX C

SPECIFICATIONS & OTHER ATTACHMENTS

HT: 21196

NORTHERN CENTRAL, MANCHESTER

DRAFT FORM OF WORDS FOR INCLUSION IN TENANT'S HANDBOOK REGARDING ACOUSTICS

X.0 ACOUSTICS

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

- Building Regulations
- British Standard BS 8233: 2014.
- British Standard BS 4142: 2014.
- CIBSE Guides by Chartered Institution of Building Services Engineers.
- Planning Conditions and other requirements of the Local Authority.
- Statutory noise nuisance legislation.
- Manufacturer's installation instructions on 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.1 Atmospheric Noise Emissions

Tenants shall control noise from all of their sources (including mechanical services, amplified speech/music and activities) such that the total atmospheric 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 $L_{Aeq,5min}$ they are at least the following amount below the prevailing background $L_{A90,15min}$ noise level at any time:

Location	**Assessment Location**	**Criterion $L_{Aeq,5min}$**		
		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} – 5 dB	L_{A90} – 10 dB	Seek LPA Guidance.
Pavement	1m from façade, 1.8m above ground level	55 dB or L_{A90} + 5 dB (whichever is higher)		60 dB or L_{A90} + 10 dB (whichever is higher)

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.

No other equipment shall be installed without the Landlords consent.

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.2 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 5 dB below the minimum L_{90} in each octave band across the audible frequency range.	
Circulation Areas, Landlord's Areas and Other Occupied Areas	NR35	NR40

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).

SUITABLE SUPPLIERS

of

RESILIENT FLOOR COVERINGS

Name & Address	Telephone Number	Contact
Sound Reduction Systems Ltd Adam Street Off Lever Street Bolton BL3 2AP	01204 380074	Roger Manifold
CMS Danskin Acoustics Ltd Unit 2 Lynecastle Road Appleton Thorn Trading Estate Warrington WA4 4SN	01925 577711	Paul Absolon
Tiflex Limited Tiflex House Liskeard Cornwall PL14 4NB	01579 320808	Mike Hargreaves
Thermal Economics Ltd Thermal House 8 Cardiff Road Luton Bedfordshire LU1 1PP	01582 450814	Ian Griffiths

HT: 21196

NORTHERN CENTRAL, MANCHESTER

ACOUSTIC SPECIFICATION FOR LIFT INSTALLATIONS

The ride quality of passenger lifts is to be measured using approved* precision grade vibration and sound recording equipment, fitted with the latest software.

A series of measurements are to be made following the methodology of BS ISO 18738: 2003 over different journeys in both directions of travel, including a full height run; a run over approximately half travel and a number of single floor journeys. All measurements are to be taken over a full lift cycle defined as a single journey starting when the lift doors commence closing on one floor to the point when they are fully open on the destination floor.

To ensure accurate assessment of the noise from door equipment, all measurements are to be made with the voice module, landing gongs and other audible signals muted. Measurements shall also clearly identify the direction of travel and the journey details.

The results of the noise and vibration measurements shall demonstrate compliance with the following:

Maximum Noise Level in Lift Car	55 $L_{Amax(fast)}$
Maximum Noise Level in Lift Lobby	55 $L_{Amax(fast)}$
Maximum Noise into Residential Areas through Lift Shaft Walls	30 $L_{Amax(fast)}$
Maximum Noise in Top Floor Apartment through Lift Door	40 $L_{Amax(fast)}$
Maximum Noise from In Car Announcement and Arrival Gongs	65 $L_{Amax(fast)}$

N.B. The maximum noise values specified above shall be measured with any in-car mechanical ventilation devices both switched "on" and switched "off". Noise levels shall be measured at 1m from the Lift Door or Shaft Wall as appropriate.

Maximum Acceleration	1.2m/sec^2
Maximum Jerk	1.8m/sec^3
Maximum Horizontal Vibration	0.12m/sec^2 (12mg)
Maximum Vertical Vibration	0.15m/sec^2 (15mg)

N.B. The maximum vibration values specified above are the peak-to-peak levels using the ISO ride quality filter.

The maximum vibration levels measured on the floor slabs in occupied areas shall not exceed the following Vibration Dose Value (VDV), as defined in BS 6472-1 : 2008.

Night-time 8 hours	0.1m/sec$^{1.75}$
Daytime 16 hours	0.2m/sec$^{1.75}$

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.

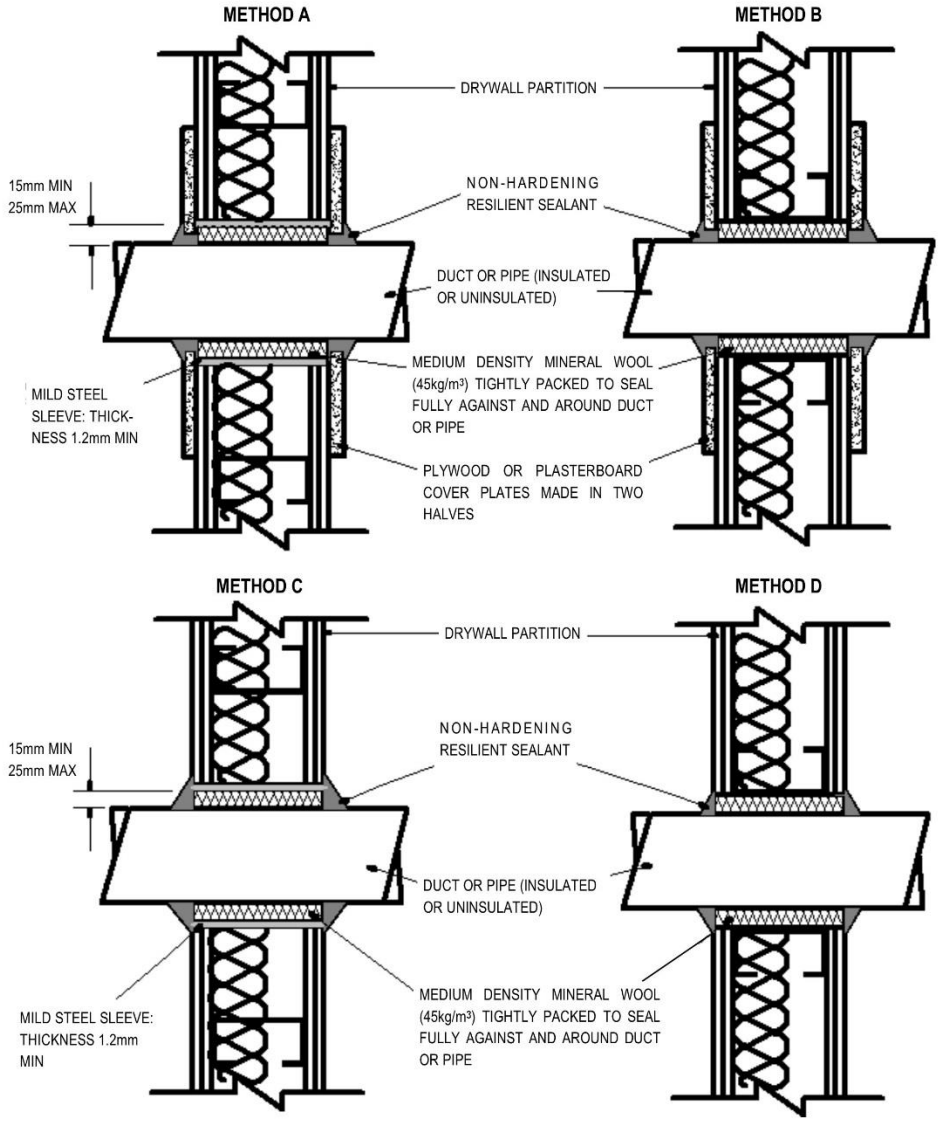
(d) The steelwork, in particular beams supporting diverter sheaves and pulleys, should be as stiff as possible and suitably vibration isolated from the main structural building elements. The mounting arrangements for the beams should be carefully considered to ensure that the beams are not less stiff 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.

* A typical approved lift vibration and sound recording device would be a Precision Measurement Technologies EVA625, coupled with an ETCH01 tachometer module for escalator measurements, all fitted with the latest software upgrades.

Method of Sealing Service Penetrations Through Drywall Constructions

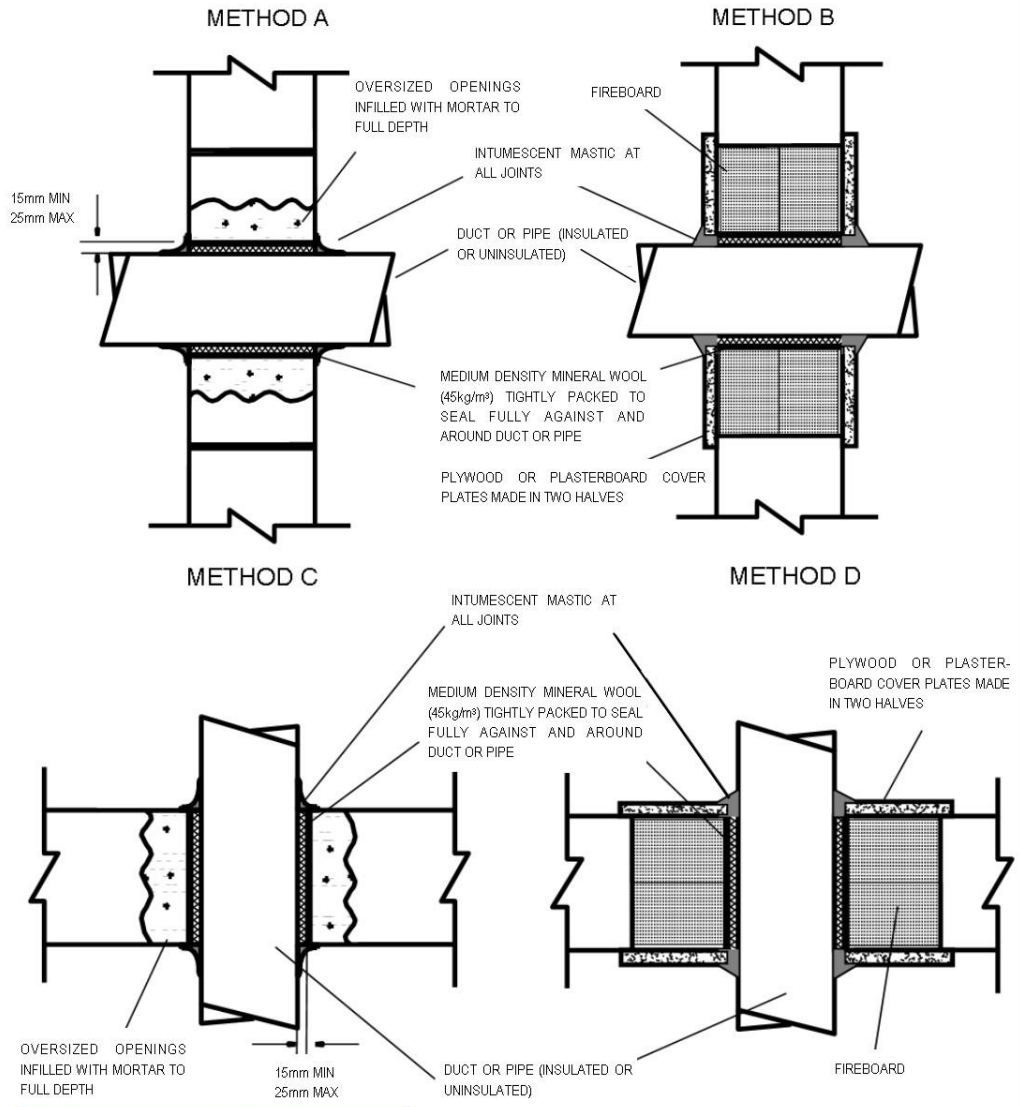


Sketch Information		
Project	:	Northern Central
Sketch Ref	:	21196/DP1
Date	:	02.17
Scale	:	N.T.S.

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Methods of Sealing Service Penetrations Through Masonry Constructions



Sketch Information		
Project	:	Northern Central
Sketch Ref	:	21196/MP1
Date	:	02.17
Scale	:	N.T.S.

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