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ACOUSTIC CONSULTANTS

Acoustic Design Strategy

Proposed Student Development

Crown House, Huddersfield

REPORT REFERENCE NO. J005131-8042-CW-01

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1.0 SUMMARY

At the request of Abode Residences, PDA Ltd have produced an acoustic design report for the proposed student development at Crown House off Southgate in Huddersfield, HD1 1DE.

The proposal is to convert the former office building to form student accommodation with communal spaces including a gym and cafe on the ground floor.

The report reviews current legislation including Building Regulations Approved Document E, British Standards and Good Practice Guidance.

The report covers the following areas: sound insulation through the external building fabric, airborne sound insulation, impact sound insulation, internal doors, reverberation times in circulation spaces, building services noise within internal spaces and noise limits for building services atmospheric noise emissions.

2.0 DESIGN STANDARDS

2.1 Building Regulations Approved Document E – Resistance to the Passage of Sound

Approved Document E (2003 edition, amended 2004, 2010, 2013 and 2015) of the current Building Regulations (2010), states the following requirements for residential buildings.

Protection against sound from other parts of the building and adjoining buildings

E1. 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.

Protection against sound within a dwelling-house etc.

E2. Dwelling-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;
(c) existing walls and floors in a building which is subject to a material change of use.

Reverberation in the common internal parts of buildings containing flats or rooms for residential purposes

E3. The common internal parts of buildings which contain flats or rooms for residential purposes shall be designed and constructed in such a way as to prevent more reverberation around the common parts than is reasonable.

Requirement E3 only applies to corridors, stairwells, hallways and entrance halls which give access to the flat or room for residential purposes.

2.2 Approved Document E Design Criteria

Approved Document E "Resistance to the Passage of Sound" 2003 edition provides guidance to meeting the requirements of the Building Regulations 2010. The document provides specific values of sound insulation that are required in a number of situations. In the case of the airborne sound insulation of both separating walls and floors, the required sound insulation performance standards are quoted in terms of the $D_{nT,w}$ + C_{tr} values. In this case the C_{tr} value is a low frequency adaptation term.

The mixed use development will contain managed student homes comprising studio apartments with ground floor communal / amenity space including a café, gym and cinema.

In accordance with the requirements of ADE we would class the development as "Rooms for Residential Purposes formed by material change of use".

The required airborne and impact sound insulation values are as per the tables detailed below.

Table 1: ADE2003 required sound insulation for rooms for residential purposes formed by material change of use.

Rooms for Residential Purposes formed by material change of use	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

It should be noted that the values given in the table above are on-site values to be confirmed by testing upon project completion.

2.2.1 Internal Walls and Floors

New internal partitions and floors within dwellings are required to meet the following sound insulation criteria;

Table 2: Building Regulation ADE requirements – E2

Laboratory values for new internal walls and floors within purpose dwelling houses and flats	Airborne Sound Insulation R_w dB (minimum values)
Walls	≥ 40
Floors	≥ 40

It should be noted that the values given in the table above are laboratory tested values; laboratory test data will usually be provided by the manufacturer.

It is noted that E2 indicates that the above applied to the following areas:

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

(b) Internal floors

Requirement E2 does not apply to

(a) an internal wall which contains a door

(b) and internal wall which separates an en-suite toilet from the associated bedroom

(c) existing walls and floors in a building which is subject to a material change of use

2.2.2 Control of Reverberation Time in Common Internal Parts

Approved Document E states that reverberation time in common internal parts of buildings containing flats or rooms for residential purposes can be controlled to a reasonable level to fulfil the requirements of E3 by either:

Method A: Cover a specified area with an absorber of an appropriate class that has been rated according to BS EN ISO 11654:1997 *Acoustics. Sound absorbers for use in buildings. Rating of sound absorption*.

Method B: Determine the minimum amount of absorptive material using a calculation procedure in octave bands. Method B is intended only for corridors, hallways and entrance halls as it is not well suited to stairwells.

Requirement E3 only applies to corridors, stairwells, hallways and entrance halls which give access to the flat or room for residential purposes.

2.3 Planning Conditions

It is understood that the development has been granted planning permission subject to conditions. Conditions 14 and 15 relate to noise and stipulate the following:

Condition 14

"Prior to the hereby approved development being brought into use, a noise management plan shall be submitted to and approved in writing by the Local Planning Authority. The plan shall detail the control measures that will be taken to ensure that undue noise does not arise from the non-residential use of the development site and the control measures to ensure there will be no loss of amenity to the occupiers of neighbouring apartments. The approved noise management plan shall be implemented before use commences, reviewed periodically and retained thereafter."

Condition 15

"Prior to the occupation of any residential unit on the first or ninth floors, a report that demonstrates the internal noise criteria for both daytime and nighttime as set out within BS8233 has been achieved in all residential units on the first or ninth floors, shall be submitted to and approved in writing by the Local Planning Authority. Thereafter any noise mitigation measures so required shall be retained."

2.4 BS8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings

British Standard 8233:2014, *Guidance on Sound Insulation and noise reduction for buildings*, gives guidance on internal noise levels within dwellings, flats and rooms in residential use when unoccupied. The following criteria are for Living and Dining Rooms for daytime use and Bedrooms for night time.

Table 3: BS8233 Recommended Indoor Ambient Noise Levels

Activity	*Location*	*07:00 to 23:00*	*23:00 to 07:00*
Resting	Living room	35 $L_{Aeq,16hour}$	–
Dining	Dining room/area	40 $L_{Aeq,16hour}$	–
Sleeping (daytime resting)	Bedrooms	35 $L_{Aeq,16hour}$	30 $L_{Aeq,8hour}$

It should however be stressed that the above criterion relates to steady noise, in this case from road traffic etc., excluding unusual noise events departing from the typical noise character of the area.

Further to the above BS 8233 suggests, '*regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$, depending on the character and number of events per night. Sporadic noise events could require separate values'.*

In addition to the above, the WHO guidelines for Community Noise published in 1999 indicates that exceedances of 45 dB L_{Amax} for single sound events should be limited to no more than 10 – 15 times per night, when measured with a 'fast' time weighting.

With regard to gardens and external areas, BS 8233:2014 (Section 7.7.3.2) gives the following advice:

For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50dB $L_{Aeq,T,}$ with an upper guideline value of 55dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.

Ancillary Spaces

Further to the above, BS8233:2014 provides the following design criteria for non-residential uses:

Objective	Typical situations	Design range $L_{Aeq,T}$ dB
Typical noise levels for acoustic privacy in shared spaces	Restaurant	40 – 55
	Open plan office	45 – 50
	Night club, public house	40 – 45
	Ballroom, banqueting hall	35 – 40
	Living room	35 – 40

Activity	Location	Design range dB $L_{Aeq,T}$
Speech or telephone communications	Department store Cafeteria, canteen, kitchen	50 – 55
	Concourse Corridor, circulation space	45 – 55
Study and work requiring concentration	Library, gallery, museum	40 – 50
	Staff/meeting room, training room	35 – 45
	Executive office	35 – 40
Listening	Place of worship, counselling, meditation, relaxation	30 – 35

2.5 WHO Guidelines for Community Noise

In 1999, the WHO (World Health Organisation) published Guidelines for Community Noise, stating the following noise levels are applicable to residential dwellings.

Table 4: WHO Guidelines for Community Noise Criteria

Specific Environment	Critical Health Effect(s)	L_{Aeq} dB	Time Base (hours) *	L_{AFMAX} dB
Dwelling, indoors	Speech intelligibility & moderate annoyance, daytime & evening	35	16	-
Inside bedrooms	Sleep disturbance, night-time	30	8	45

* Typically taken to be daytime/evening - 07:00 – 23:00 hours and night time 23:00 – 07:00 hours.

The WHO guidelines state that, *"it is recommended that $L_{Aeq,T}$ be used to evaluate more-or-less continuous environmental noises. Where the noise is principally composed of a small number of discrete events, the additional use of L_{Amax} or SEL is recommended."* The guidelines recommend that for a good sleep, the indoor sound pressure levels should not exceed approximately 45dB L_{Amax} more than 10 – 15 times.

2.6 BS4142:2014+A1:2019 Method for Rating and Assessing Industrial and Commercial Sound

The effect of mechanical services plant noise emissions on the nearest noise sensitive residences can be assessed in accordance with BS4142:2014+A1:2019 – 'Methods for rating and assessing industrial and commercial sound'.

The standard describes a method of determining the level of a noise of commercial or industrial nature, together with procedures for assessing the impact of such a noise outside nearby noise sensitive areas.

The standard may be thought of as a procedure for comparing the noise from commercial sources with background noise levels in the absence of the commercial noise and determining the likely impact of the commercial noise on noise sensitive areas.

In accordance with BS 4142 the background noise level is the typical A-weighted sound pressure level at the assessment position that is exceeded for 90% of a given time interval (L_{A90}). The specific noise level is the equivalent continuous (L_{Aeq}) sound pressure level at the assessment position produced by the noise source over a given time interval.

Certain acoustic features can increase the impact over that expected from a simple comparison between the specific noise level and the background level. Where such features are present, these are taken into account by adding corrections to the specific noise level.

The corrections are applied based on whether the following features occur, or are expected to be present. The correction values can either be determined subjectively, or by various objective measurement procedures.

- Tonality – The noise contains a distinguishable, discrete, continuous tone (whine, hiss, screech, hum, etc.), 0 – 6 dB penalty.
- Impulsivity – The noise contains distinct impulses (bangs, clicks, clatters, or thumps), 0 – 9 dB penalty.
- Intermittency – The noise is irregular enough to attract attention, 0 – 3 dB penalty.
- Other – Where the specific sound does not fit the above, but is readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied.

From the addition of the above penalties where appropriate the rating level is established, this being the value that is compared with the background noise.

According to BS 4142 an initial estimate of the impact is given for a rating level of:

- Typically, the greater this difference, the greater the magnitude of the impact.
- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
- A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.

The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

BS4142 indicates that the noise source should be evaluated over the appropriate time interval which is as follows:

- 1 hour during the day (07:00 – 23:00 hours)
- 15 minutes during the night (23:00 – 07:00 hours)

The above initial assessment may then be modified depending on the context to take into account;

- The absolute level of the sound.
- The character and level of the residual sound compared to the character and level of the specific sound.
- The sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions, such as:
  1. Façade insulation treatment
  2. Ventilation and / or cooling that will reduce the need to have windows open so as to provide rapid or purge ventilation; and
  3. Acoustic screening

For this development, potential impacts have been identified as building services plant noise. It is assumed that building services will be running during the night and as such will be present during the most noise sensitive period.

3.0 INTERNAL NOISE LEVELS

In order to determine the existing ambient noise climate in the vicinity of the proposed development a noise survey was undertaken by PDA Ltd.

In addition, in accordance with the requirements of Planning Condition 6 potential future noise sources associated with the permitted development to the east of the site namely external plant and vehicle movements within the multi storey carpark have also been considered.

Full details of the survey and assessment can be found in PDA Report ‘J005131/8040/CW/01 – Ambient Noise and Building Envelope Assessment (Condition 6)’ dated 5th September 2024.

Based on the measured and predicted noise levels calculations have been undertaken to determine the likely noise ingress through the facade of the development. Recommendations for the glazing, ventilation and building façade elements that will be required to achieve the internal noise level requirements are provided in Section 3.1 below.

With the glazing and ventilation specifications provided within this report our calculations suggest that the noise criteria of BS8233:2014 and WHO Guidelines can be achieved within the dwellings.

The glazing and ventilation specification are provided in the following sections.

3.1 Glazing and Ventilation Specification

The dominant paths for noise transfer to the interior of buildings are generally the glazing and ventilation elements of the façade constructions. Based on this premise, to achieve the required internal noise levels as discussed in Section 2 the development would require the following glazing and ventilation specifications. Note that the following specification apply to habitable rooms only.

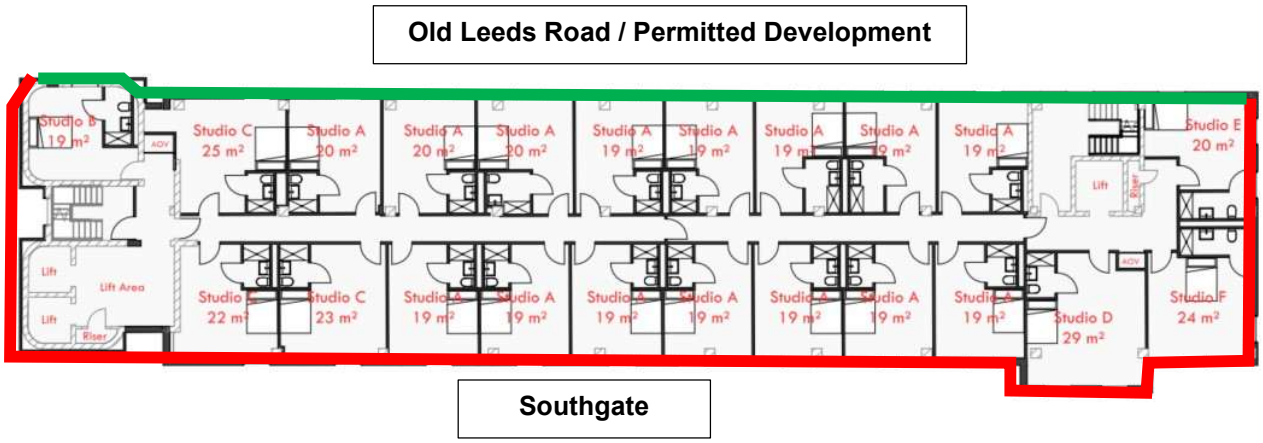


Figure 1 – Glazing and ventilation specification

Our calculations indicate that with the façade treatments specified in Table 5 the internal noise criterion given in Section 2 can be achieved within the habitable rooms of the proposed development.

Table 5: Glazing and Ventilation Schedule (with reference to Figure 1)

Facade	Room Type	Level	Minimum Glazing Rating R_w dB	Minimum combined Ventilator Rating $D_{n,e,w}$ dB	Calculated Highest Internal Noise Level dBA (Day/Night/Max)
Red	All	All	38	42	35/28/44
Green	All	All	33	33	32/30/41

3.2 Glazing Specification and Installation

For the glazing specification in Table 5 (above), all sound insulation values quoted above must be achieved by the overall combination of frame and glazing, and not just by the glazing alone. The frame should not reduce the performance of the system overall.

Glazing framing systems must be fully sealed with any gaps around the perimeter to be stuffed with dense mineral wool to full frame depth and sealed both sides with acoustic non-setting mastic, with weathering protection to be applied external to this. No gaps should be left unsealed.

The minimum performance requirements for the combination of glazing and framing recommended in the above tables are as follows:

Table 6: Required Minimum Sound Insulation of Combined Glazing and Framing

Typical Product	Minimum Sound Reduction Index R (dB) at Octave Band Centre Frequency (Hz)							R_w
	63	125	250	500	1000	2000	4000	
4/16/4mm	25	21	19	32	40	41	37	33
8/16/4mm	29	26	25	38	43	41	45	38

Note that the specifications are interchangeable provided the minimum sound reduction values are achieved e.g. if desired 38 dB R_w glazing could be used in place of 33 dB R_w.

For the glazing specifications in Table 5, all sound insulation values quoted must be achieved by the overall combination of frame and glazing, and not just by the glazing alone. It will need to be ensured that the frames and seals do not compromise the performance. It is recommended that acoustic test reports should be provided to PDA to ensure the performance complies with the recommendations specification detailed above.

3.2.1 Spandrel Panels

Where spandrel panels are proposed these should be designed to achieve a sound insulation performance approximately equivalent to the external wall (~53 dB R_w).

3.3 Ventilation

During periods when windows are open for purge ventilation internal noise levels will likely exceed the internal noise criteria given in Section 2 however, with regard to purge ventilation BS 8223:2014 states:

> *"The Building Regulations' supporting documents on ventilation recommend that habitable rooms in dwellings have background ventilation. Where openable windows cannot be relied upon for this ventilation, trickle ventilators can be used and sound attenuating types are available. However, windows may remain openable for rapid or purge ventilation, or at the occupant's choice.*

3.4 Ventilator Requirements

The ventilator inlets described in the following table are calculated to provide adequate sound insulation to maintain internal noise levels compliant with the guidance criteria when used in conjunction with the selected glazing. Selected ventilation inlets should provide equal or greater sound insulation performance across the frequency range to the values in Table 7; example products are noted below.

Table 7: Required Minimum Sound insulation of Ventilators

Example Product	***Minimum Normalised Element Level Difference $D_{n,e}$ (dB) at Octave Band Centre Frequency (Hz)***						***$D_{n,e,w}$***
	125	***250***	***500***	***1000***	***2000***	***4000***	
Simon Acoustic EMM	40	36	35	31	33	36	33
Greenwood 2500EA (1 acoustic module)	41	39	36	42	44	45	42

The acoustic specification relates to the combined performance of all ventilation elements. Where two or more ventilators are required to meet the ventilation requirement, the acoustic performance for a single ventilator must be selected so that the combined performance is as stated in the table below, e.g. **for 2 no. ventilators, the acoustic performance of each will need to be $D_{n,e,w}$ 45 dB to meet a combined $D_{n,e,w}$ 42 dB specification.**

It should be noted that inclusion of ventilators alone does not ensure compliance with Building Regulations or other regulatory requirements for ventilation. The ventilation strategy should be checked by others.

3.4.1 Mechanical Ventilation

If mechanical ventilation is desirable as an alternative to trickle ventilators this will be acceptable in terms of attenuating noise ingress from external sources. However, it will need to be ensure that self-generated

noise from the mechanical system does not give rise to exceedances of the internal noise criteria detailed Section 2.

Where this is the case, it is recommended that details are submitted to PDA for approval.

3.5 Walls

We are informed that the existing external wall construction is as follows; brick cladding (~100mm), nominal 25 – 50mm cavity, concrete panel (assumed 100mm). It is assumed that the external wall will be internally lined with 2 no. layers of 12.5mm plasterboard. From acoustic test data for similar constructions, it is assumed that the build-up has an acoustic performance of at least 53 dB R_W.

Lightweight constructions are also considered to be acceptable however, it should be ensured that the build-up achieves a minimum of 53 dB R_w e.g. typical cladding outer leaf, with a metsec structural liner forming the inner leaf consisting of cement board, 100mm metsec frame filled with mineral wool (minimum density 10kg/m^3) and internally lined with 2 no. layers of 12.5mm plasterboard.

Please note that the external façade should have no unsealed penetrations, and any openings for ventilation should meet the specifications for ventilators as discussed below.

3.6 Non-residential Spaces

BS8233:2014 gives the following internal noise levels thought to be applicable to uses of the ground floor communal and non-residential spaces. Where exact guidance is not available in BS8233:2014, it has been inferred from other guidance documents such as the previous issue of BS8233:1999 and CIBSE Guide A – Environmental Design.

Table 8: BS8233:2014 guidance on internal noise levels for ancillary spaces

Typical situations	Design Range $L_{Aeq,T}$ dB
Cafe	40 – 50
Open plan area (Cinema/Games/Lounge/Study Area)	40 – 50
Reception area	35 – 45
Gymnasium	40 – 50

The internal noise levels for all spaces above are due to the sum of external noise break-in from external sources and any internal noise sources, e.g. mechanical services plant.

It should be noted that Cibse guidance gives internal noise levels as Noise Rating NR whilst BS8233 gives levels as dB L_{Aeq}. NR (noise rating) is a single figure value applied to a noise spectrum when it is compared with a set of reference curves. It is typically used to denote mechanical services noise. Whilst there is no direct relationship between dBA and NR values, as a conservative rule of thumb for broadband noise, NR values are approximately 5 dB lower than the dBA values, where the noise spectrum is broadband, i.e. not dominated by any particular frequency, and therefore 5dB may be subtracted from the values above to give the target NR values for internal mechanical services noise.

The results of our noise survey suggest that façade noise level at the amenity/communal spaces is unlikely to exceed 66 dB $L_{Aeq.}$ On this basis we have calculated that standard double glazing (≥33 dB R_w) and mechanical ventilation will likely provide sufficient attenuation to achieve internal noise levels of between 35 – 50 dB.

4.0 INTERNAL SOUND INSULATION

To meet Building Regulations Approved Document E requirements, all separating party walls within the residential aspects of the development will need to achieve a minimum airborne sound insulation value of 43 dB $D_{nT,w} + C_{tr}$.

Please note that sound insulation in terms of dB $D_{nT,w} + C_{tr}$ (as required by the Building Regulations ADE) is an on-site tested parameter that depends upon the separating wall performance, flanking sound transmission and room characteristics. The dB $R_w + C_{tr}$ parameter represents a laboratory tested value of sound insulation, for the separating element alone. Therefore on-site a partition or floor rated at a certain $R_w + C_{tr}$ is unlikely to achieve the same value when tested and assessed in terms of dB $D_{nT,w} + C_{tr}$; in most cases the on-site tested value will be less than the laboratory $R_w + C_{tr}$ value.

4.1 Separating Walls

All separating party walls within residential aspects of the development will need to achieve a minimum airborne sound insulation performance of 43 dB $D_{nT,w} + C_{tr}$ this applies to the following adjacencies:

- Studio-Studio
- Studio-Corridors
- Studio-Communal Space
- Studio-Stairwell

It is understood that lightweight single stud partitions are to be used throughout the development with existing masonry elements retained in some areas.

The proposed wall types are reviewed in the following sections and are based on the following drawings provided to us by NC Architects:

- P-1021-101 Wall Types Internal Floors 1 – 9 dated 08/09/2025
- P-1026-101 Internal Wall Types Details – dated 08/09/2025

4.1.1 Separating Wall Between Studios (ref: PAR-A)

The drawings indicate that Partition Type A is proposed as the main separating wall type between studio apartments. It is understood that the proposed construction is as follows:

- *2 layers of 12.5mm SoundBloc plasterboard either side of a Gypframe 70 S 50 'C' Stud with an RB1 resilient bar to one side and 50mm mineral wool insulation in the cavity.*

Manufacturers test data indicates that the above wall construction is capable of achieving 53 dB $R_w + C_{tr}$ and is therefore, suitable to meet the acoustic criteria of Building Regulations Approved Document E, providing flanking noise transmission is adequately controlled.

Please note that PDA have been involved in the previous schemes where a similar construction between dwellings have been utilised. Though on commissioning the performance requirements of ADE2003 had been achieved, the results were very marginal. Very close care and attention to build quality is therefore essential in ensuring the performance is maintained particularly with respect to the fixing of boards to resilient bars.

Notes on fixing of Resilient Bars

The most common area that causes failure on site is the installation of the resilient bars. Should the resilient bar be bridged for any reason we would expect the wall performance to be in the region of 42dB $D_{ntw} + C_{tr}$, which would not be acceptable for the requirements of ADE2003.

The idea of the resilient bar is to separate one plasterboard lining from the studs. The following points should also be noted:

- It is of particular importance to ensure that resilient bars are fixed in line with manufacturers specifications.
- It is of paramount importance to ensure that the plasterboard is only attached to the free lip of the resilient bar, and that the other lip of the resilient bar is only attached to the stud.
- It cannot be stressed enough in ensuring that screws are not overlong, as screws should not screw from the plasterboard directly through to the stud. Should this happen the wall will fail to meet the requirements of ADE2003. Screws lengths should be as specified by the manufacturer. Applying plasterboard fixing screws at mid-bay positions as an extra precaution would also be recommended to off-set these from studs.
- As a further safeguard it must be ensured that the screws are not in line with the framing.

In addition to the above specific care and attention is required if it is proposed to install patressing behind the plasterboard lining as this could also compromise the wall construction.

Correct patressing detailing is critical and should be as per the following sketch to ensure that the patressing ply does not bridge between the plasterboards and the studs:

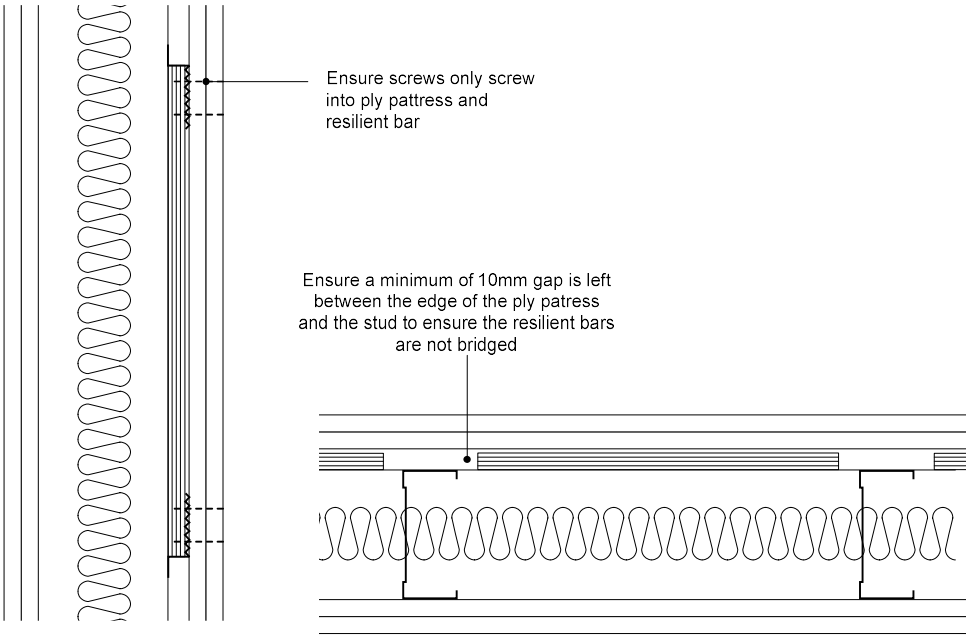


Figure 2 – Detail of pattress within resilient bar wall

4.1.2 Separating Wall Between Studios and Corridor (PAR-A)

With regards to corridor walls, Building Regulations ADE requires that the sound insulation requirements are met between any flat and other parts of the same building. ADE states, '*separating walls … should be used between corridors and rooms in flats, in order to control flanking transmission and to provide the required sound insulation. However, it is likely that the sound insulation will be reduced by the presence of the door.*'

The drawings indicate that Partition Type A is proposed as the separating wall type between studio apartments and the corridor. It is understood that the proposed construction is as follows:

- *2 layers of 12.5mm SoundBloc plasterboard either side of a Gypframe 70 S 50 'C' Stud with an RB1 resilient bar to one side and 50mm mineral wool insulation in the cavity.*

We would consider this construction to be acceptable.

4.2 Existing Masonry Walls

Where the existing wall is minimum 225mm masonry construction it is unlikely that the wall will need further upgrading to achieve the required sound insulation. Where this is the case a wet plaster finsh or a 12.5mm plasterboard on dabs will be sufficient.

However, if any of the masonry walls within the development are found to be <225mm then these will need to be upgraded. This may be achieved by plastering both sides of the wall and applying an additional lightweight wall lining to the apartment side of the wall as described below.

- Treat apartment side of the wall by adding two layers of 12.5mm sound resistant plasterboard on metal channel wall lining system (such as British Gypsum Gyplyner system or equivalent) with a minimum 35mm gap between the board and the face of the wall and 25mm mineral wool insulation of minimum density 10kg/m^3 fitted in the gap.

This additional lining will be required to separating walls to upgrade the sound insulation through the wall, and **also to any external flanking walls** less than 225mm solid masonry, which travel across separating walls and floors from one occupancy to another (vertically or horizontally).

The following lining is identified as 'Lin-A' on the drawings:

- *2 no. layers of 12.5mm siniat dB board on I studs with 25mm mineral wool insulation in the cavity.*

The above lining is consdiered to be acceptable.

Points to Note – Masonry Walls

- It should be ensured that there are no missing blocks/bricks within the existing walls and any gaps in the motar should be made good.
- We would note that there can be issues with dot and dab plasterboard which can cause resonances due to the small cavity between the plasterboard and blockwork. We would recommend dabs should be at no more than 450mm centres. This will reduce vibration of the plasterboard under sound excitation.

4.2.1 Separating Wall Between Bedrooms and Stair Core

Drawings indicate that the separating wall between the stair core and the apartments is as follows:

- *Min 140mm solid masonry lining to apartment side with 2 no. layers of 12.5mm siniat dB board on I studs with 25mm mineral wool insulation in the cavity.*

We have used Insul sound prediction software to predict the sound insulation performance of the above construction assuming minimum 1800 kg/m^3 dense concrete block. Our calculations suggest that the wall is likely to have a performance of 54 dB $R_w + C_{tr}$ and is therefore, suitable to meet the acoustic criteria of Building Regulations Approved Document E.

We note that in some instances Partition Type E is proposed to form the separating wall between apartments and the stair core. This is effectively a variation of Partition Type A with Fireline / duraline boards used in place of the sound resistant boards. Drawings indicate that the construction is as follows:

- *1 layers of 15mm Fireline and 1 layer of 15mm Duraline plasterboard to either side of a Gypframe 70 S 50 'C' Stud with an RB1 resilient bar to one side and 50mm mineral wool insulation in the cavity.*

Manufacturers test data indicates that the above wall construction is capable of achieving 53 dB $R_w + C_{tr}$ and is therefore, suitable to meet the acoustic criteria of Building Regulations Approved Document E, providing flanking noise transmission is adequately controlled.

4.2.2 Bathrooms

Although pre-completion testing is not normally undertaken between non-habitable rooms such as bathrooms, the separating wall between adjacent bathrooms should be constructed to meet the sound insulation requirements of the Building Regulations.

Where bathroom pods are proposed it would be recommended that pods be contained within the envelope of the apartment themselves and they should not form part of the separating wall construction.

The drawings indicate that the separating wall is continued between the bathroom pods and through to the corridor wall. This is considered to be acceptable.

4.3 SEPARATING FLOOR CONSTRUCTION

To meet Building Regulations Approved Document E requirements, all separating party floors will need to achieve a minimum airborne sound insulation value of 43 dB $D_{nT,w} + C_{tr}$ and a maximum impact sound insulation of 64 dB $L'_{nT,w}$.

It is understood that the existing floor construction comprises the following:

- 265mm hollow pot concrete (assumed minimum mass of 186 kg/m^2) with vinyl finish to the surface and a suspended ceiling consisting of 1 no. layer of 12.5mm wallboard to the underside (minimum 200mm cavity) and Cellecta Screed Board 30 to top of the slab.

We would consider that the floor construction above will be suitable to achieve the minimum sound insulation requirements of the Building Regulations providing flanking noise transmission is adequately controlled.

We note that the drawings also indicate a JCW 4.5mm Acoustic Impacta Mat 4551 is proposed to the top of the Screed Board. **If desired this may be omitted from the build-up.** The Cellecta Screed Board 30 is a high density acoustic overlay board with a mass of 27 kg/m^2 and an integral resilient layer. Based on manufacturers data for the screed board tested on comparable sub floors we would consider it to be suitable to control both impact sound through the floor and horizontal flanking transmission via the slab.

It should be borne in mind that floating floor treatments with a mass of less than 27 kg/m^2 may be detrimental to the airborne sound insulation performance of the separating wall/floor due the resonances created in the lower / mid frequency range. Therefore, if alternative products are proposed it is recommended that details are submitted to PDA for review.

Points to note

The Screed board should be installed in accordance with the manufacturers instruction. A proprietary isolating edge strip will be required to ensure no contact between the floating floor and surrounding walls. **It is imperative that the resilient layer forms a continuous barrier in all areas where the space below is part of an apartment**. Care needs to be taken at screed edges to maintain perimeter isolation, especially around doorways and columns.

Care must be taken to ensure that any isolating edge strip protrudes far enough to allow folding under the wall linings and skirting board; excess edge strip may be trimmed after linings and skirting are installed.

Bathrooms

Although testing will not normally be carried out from bathrooms, the bathroom floors will be required to meet the impact requirements of Building Regulations ADE. Where the bathroom is provided as a pre-fabricated pod, the pod floor will require a resilient layer within the build-up, located either under the floor finish, or between the pod frame and the structural floor. Where located under the pod frame, the layer should be appropriate to the loading of the pod. The resilient layer should meet the minimum weighted reduction in impact sound transmission ΔL_w 17 dB when measured in accordance with BS EN ISO 140-8:1998.

4.4 Internal Walls

Building Regulations ADE requires that internal walls and floors within dwellings between a bedroom or a room containing a water closet, and other rooms, should be selected to have a minimum laboratory sound insulation of 40 dB R_w. This requirement does not apply where the partition includes a door, or for a wall separating a bedroom from its associated en-suite.

We note that the development comprises studio apartments each with en-suite bathroom pods and therefore, internal walls are not subject to this requirement.

4.5 Corridor Walls

With regards to corridor walls, Building Regulations ADE requires that the sound insulation requirements are met between any flat and other parts of the same building.

ADE states, '*separating walls … should be used between corridors and rooms in flats, in order to control flanking transmission and to provide the required sound insulation. However, it is likely that the sound insulation will be reduced by the presence of the door.*'

Recommendations for the corridor wall construction are provided in Section 4.1.2 of this report.

4.6 Corridor Doors

Building Regulations ADE recommends that corridor doors are selected to have a minimum mass per unit area of 25kg/m^2, with full perimeter sealing (including the threshold where practical). Alternatively the door set may be selected to achieve a minimum sound reduction index of 29 dB R_w (measured in accordance with BS EN ISO 140-3:1995 and rated in accordance with BS EN ISO 717-1:1997 (amended 2006).

To achieve this it is recommended that good quality solid-core door sets be used with good perimeter neoprene sealing.

4.7 Internal Doors

It is recommended that good quality well fitted door sets be used with good perimeter sealing.

4.8 Roof

It is understood that the roof construction comprises; 300mm hollow pot construction with roof finish and celling to apartments below comprising 360mm void and a single layer of 12.5mm plasterboard. It is considered that the roof construction is suitable to control flanking noise for the top floor apartments and noise ingress from rain noise impact and aircraft, etc.

4.9 Plant Rooms/Refuse Store

It is important to control the noise generated by any internal plant within the development, i.e. lift operating equipment, ventilation plant etc., and also other mechanical items which may cause significant levels of sound and vibration.

Where a plant room is located immediately adjacent to a flat, the separating wall or floor in Section 4.1 – 4.2 should be used as a minimum. The construction will likely be sufficient for reasonable plant noise levels (e.g. up to approximately 70 dBA). PDA Ltd should be informed of expected noise levels in excess of the above.

All plant containing moving parts should be mounted on heavy framework or floor slab and be supported by manufacturer proprietary anti-vibration mounts or resilient pads to suppress vibration energy transfer to the structure. Flexible connections should be employed between plant and non-isolated components. These connections should allow unrestricted movement of the plant item.

4.10 Other Walls

There are no specific acoustic requirements between non-residential and communal areas of the development. For these walls, standard single stud partitions or blockwork may be considered sufficient.

4.11 Lifts

ADE contains no guidance or targets for the protection of dwellings from noise generated by lifts. However, where the lift shaft wall faces into an apartment, we would recommend that the lift wall construction should have an independent lining where adjoined to apartments.

Mitigation

Install an independent lining within the apartment. The lining should consist of a minimum of 2 no. layers of 12.5mm sound resistant plasterboard (minimum total mass per unit area 20kg/m^2) mounted on an independent framework (metal or timber) held off the party wall with a minimum clear cavity of 10mm. The cavity between the lining and wall should be a minimum 60mm (which will allow an independent stud of up to 50mm depth) filled with 50mm mineral wool quilt (minimum density 10kg/m^3).

To suppress flanking noise breakout from the lift shaft the lift shaft walls should be carried continuously to the underside of the roof slab.

The lift shaft can be a substantial source of structure borne noise and the basic philosophy is to mechanically ‘disconnect’ it from the rest of the building; thus closing all structural transmission paths. Lifts should be mounted on proprietary anti-vibration mounts to the manufacturer’s specification.

4.12 Enclosure of Services and Detailing of Penetrations

If any pipes internal to habitable rooms, e.g. soil pipes, water pipes, rainwater pipes etc. are to be run in risers or horizontal service ducts between rooms in separate apartments, then these need to be boxed out with material of at least 15kg/m^2, e.g. two layers of 12.5mm plasterboard. The boxed out enclosure

is to be mechanically independent of the pipes. The pipes either need to be wrapped in 25mm unfaced mineral-fibre or the enclosure should be lined with 25mm unfaced mineral-fibre.

Penetrations across partitions e.g. party floors or walls, whether boxed out or not, should be slightly oversized around the penetrating member (e.g. pipe or other) utilizing approximately 5-10mm gap around the perimeter to suppress structure-borne noise transmission across the partition. The remaining gap should then be well-sealed on both sides of the partition with minimum 10mm depth acoustic non-setting mastic utilising mineral wool or soft foam backing (if required). Alternatively acoustically acceptable firestopping collars can be used as long as they do not rigidly connect the penetrating member to the partition structure.

Penetration holes through the slab, whether in risers, non-habitable or habitable areas, should be slightly oversized with resulting perimeter gap filled to full floor slab depth with dense mineral wool and sealed both sides with non-setting mastic.

All pipe enclosure detailing would need to be checked to ensure the integrity of party structures is maintained, and would need checking with Building Control, who may want to see risers treated as a separating wall.

Ducts that serve adjacent apartments and have openings within both apartments may require crosstalk attenuators to be installed on the line of the separating partition, or alternative acoustic treatments, e.g. internally lined ductwork or acoustic flexible ductwork to the termination, to ensure the sound insulation of the separating walls is maintained.

4.13 Electrical Services and Sockets

Wall sockets, or other fixing penetrations (e.g. aerials, light-switches etc), in plasterboard walls or linings should be staggered on either side of partitions to ensure they are not back to back. Building Regulations ADE would suggest that a minimum edge to edge stagger of 150mm may be used. In addition the penetrations should be treated either with proprietary acoustic back boxes, e.g. Hilti CP617 Putty Pad, or sealed plasterboard backing to an equivalent specification to the wall lining.

Where sealed plasterboard backing to sockets is used it would be recommended that once the backing boards are screwed on, mineral wool be stuffed into the gaps all around the perimeter of the backing board leaving 10mm depth around the perimeter to be filled with non-setting mastic. It cannot be too strongly stated that total sealing of all gaps in the socket back-boards will be paramount to maintain performance on-site.

4.14 Curtain Walling

Curtain walling should not be continuous between apartments as it can be a significant source of flanking sound between rooms. Where curtain walling is installed we would recommend that the mullions are broken on the line of the floor slab with a movement joint; the upper and lower mullion may be connected by a profile insert and the internal hollow of the mullion should be closed with a suitable closer, e.g. Siderise mullion inserts MI5/MI6.

The cavity at the edge of the slab should be closed with a cavity stop, and board material with a minimum mass per unit area of 20kg/m^2. The same type of treatment would be recommended for transoms in continuous horizontal curtain walling between apartments and between apartments and other spaces.

4.15 Ground Floor Amenity Space

The drawings provided to us indicate that there are a number of non-residential areas on the ground floor of the development. These uses include a gym, communal cinema area, study lounge, cafe and administration area on the ground floor.

With regards to the student amenity space on the ground floor of the development Clause 0.8 of Approved Document E would suggest that;

'the performance standards set out in Tables 1a and 1b (of the document) are appropriate for walls, floors and stairs that separate spaces used for normal domestic purposes. A higher standard of sound insulation may be required between spaces used for normal domestic purposes and communal or non-domestic purposes. In these situations the appropriate level of sound insulation will depend on the noise generated in the communal or non-domestic space. Specialist advice may be needed to establish if a higher standard of sound insulation is required and, if so, to determine the appropriate level.'

It is assumed that the floor construction will be as per Section 4.2 and will therefore be sufficient to achieve the minimum requirements of the Building Regulations ADE.

It is likely that low noise uses e.g. the study area, café and student lounge, will not require any specific acoustic works. However where the use is likely to generate greater noise than that experienced in normal domestic uses then uprating works to the building structure may be required using enhanced ceilings or improved wall constructions/linings, etc.

General Guidelines

However, we would recommend typical measures to limit potential noise impacts as follows:

- Curfews are introduced such that shared areas can only be used in the daytime e.g. 07:00-23:00 hours.
- Any sound amplifying equipment to be set to limits approved on installation and any loudspeakers / televisions etc. to be resiliently mounted from the building structure.
- Setting of noise limits in shared spaces typically as below:

  75 dBA – day (07:00-23:00)

- Note that these limits are just for guidance and assume that the separating floor achieves the minimum airborne sound insulation requirement of the Building Regulations Approved Document E 2003 (ADE). Where the performance of the floor is designed to exceed the requirements of ADE, higher limits may be suitable.

4.16 Impact Noise Due to Gym Equipment

Free Weights

Untreated gym equipment is liable to introduce impact noise into floors onto which the equipment is rigidly connected or into floors where weights are dropped.

In the case of weights being dropped these are very difficult to remediate in terms of impact noise and we would not recommend that 'free weights' are used in gyms within mixed used developments unless these are on an independent ground-bearing slab on the ground floor. Hence, for the Gym within the development considered here, we would recommend that the use of free weights is avoided.

If a free weights area is desired, it will need to be ensured that some form of impact resistant floating floor be utilised to minimise the amount of vibration entering the structure.

It should be noted however that due to the complex nature of the vibration transfer between the Gym and the residential use below it is not possible to accurately predict the impact, and mitigation may not be possible with simple gym flooring solutions. Should it be desired to utilise free weights in the gym further impact sound transmission investigation will be required on the completed scheme to establish if and what type of system could be used to minimise structural sound transfer. This may include testing of weights dropping on sample resilient floor materials to find the combination of products that will achieve sufficient isolation.

A specialist supplier should be consulted to determine suitable finishes for the proposed gym. Typical products are available from Pliteq, TVS Acoustics or CMS Danskin.

Aerobic Exercise Machines

Exercise machines using bodyweight only such as running machines / treadmills / step machines etc should be isolated using either vibration pads or proprietary fixings between the machine and the floor. Typical products are Custom Audio Designs Treadmill Vibration Pads or equivalent, or Anti Vibration mounts such as available from AV Industrial Products. Mounts for isolation of the whole machine should be selected to provide isolation down to low frequencies with a relatively large static deflection (e.g. spring mounts or similar).

Weight Machines

Machines which use a stack of weights and pulleys in order to provide resistance when exercising will need treatment to the weight stack to ensure that impacts due to the weights dropping back into the resting position on the machine are not transmitted to the floor slab. Typically this requires a resilient 'Impact Washer' to be inserted below the stack of weights to prevent impacts when the weights drop back into position. Typical products are available from TVS Acoustics or CMS Danskin.

Loudspeakers / AV / HVAC Equipment

Any suspended loudspeakers, AV Equipment or HVAC equipment / ductwork must be suspended using proprietary anti-vibration hangers such as those available from AV Industrial Products or Christie & Grey or similar. Note that the selection and spacing of the hangers is dependent on the weight of the equipment and manufacturer's advice should be followed to ensure that the hangers are correctly loaded to give optimum vibration isolation.

In addition to the structure-borne sound transmission, we have assumed that noise levels will not be excessive within the Gym. As such any music noise or other entertainment noise should not be greater than typical noise levels would be in a domestic setting (~75 dBA).

5.0 ACOUSTIC DETAILING

It must be ensured that all partitions are installed in accordance with manufacturer recommendations. Correct acoustic detailing is essential for the separating element(s) to maintain its acoustic performance when installed in-situ.

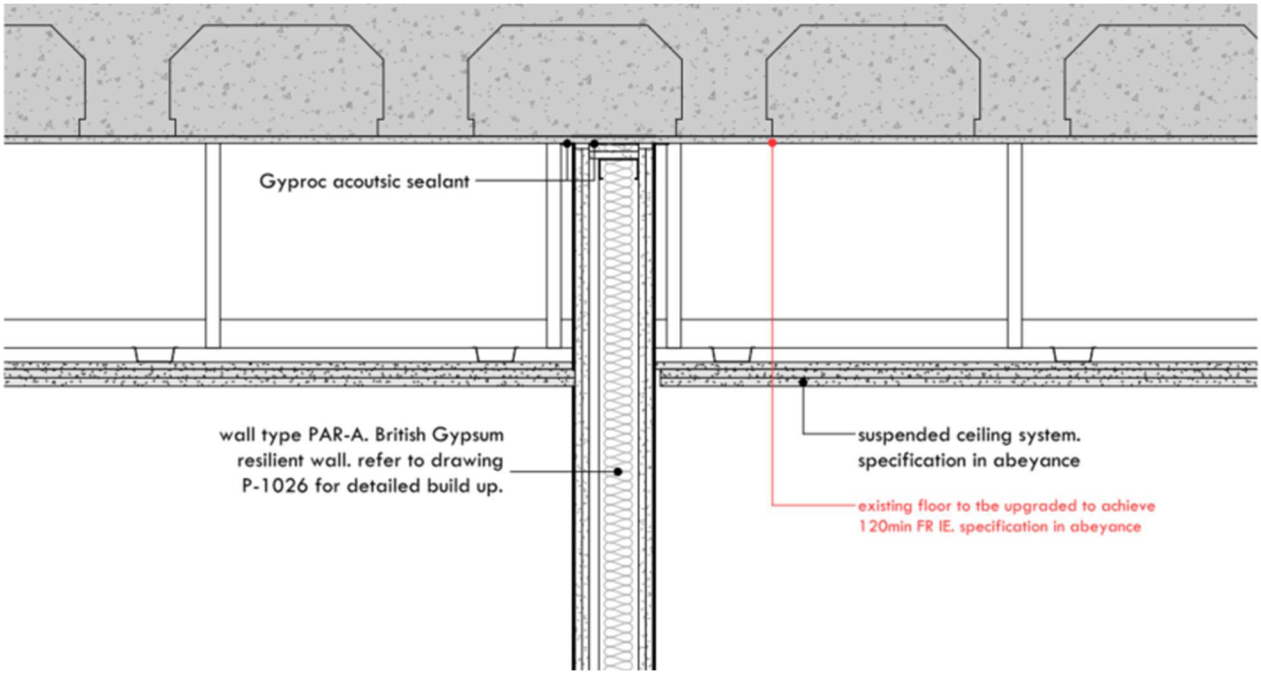
We have reviewed the junction details provided to us and recommendations are provided as required in the following sections.

5.1 Wall Head Junction

- All separating/corridor walls should be built full height from the floor slab to the underside of the soffit/roof.
- Where a separating partition meets the underside of the soffit/roof, care must be taken to ensure a good junction to maintain acoustic performance, particularly where a deflection head is employed.
- The head plate may be timber blocking or layers of core plasterboard and should extend down far enough to create a reasonable overlap with the board linings. Separate head plates are required for each stud track.
- The gap between the top of the plasterboard linings and slab should be loosely packed with mineral wool and sealed with a continuous ribbon of flexible mastic sealant (or steel angles if required); deflection heads should be in accordance with manufacturer instructions.
- The ceiling should not be continuous across the separating wall system i.e. the separating walls should be continuous to the soffit. Wall should be sealed up to plasterboard plank at soffit using deflection head

Drawings indicate the following detail is proposed which we would consider to be acceptable.

Figure 3 – Wall Head Detail

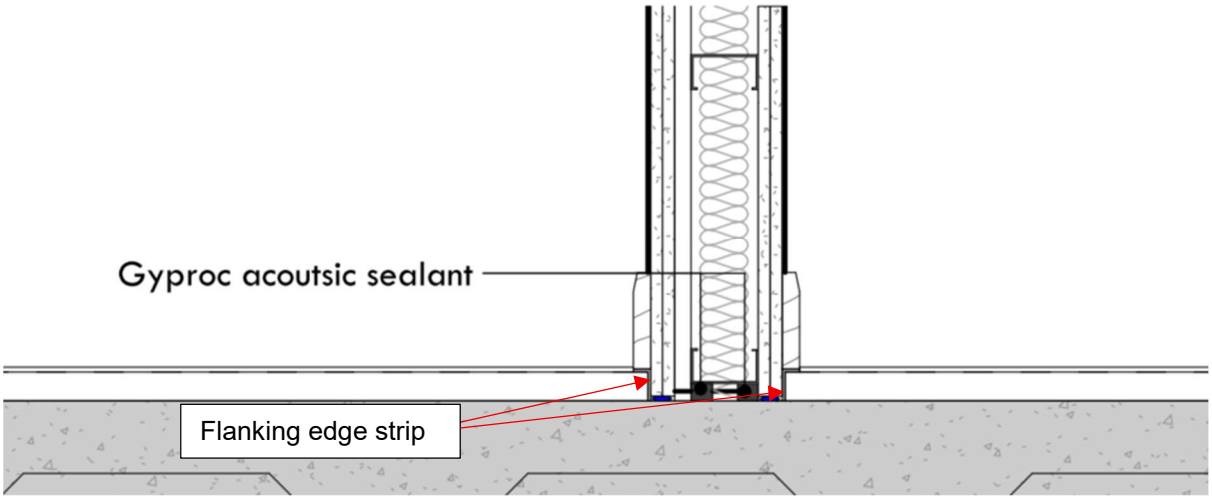


5.2 Wall Base Detail

- Partitions should not be built directly off floating floor.
- Partitions should be built from off the base slab, or off of a timber sole plate to provide discontinuity in the screed between rooms.
- A resilient edge strip should be used to isolate the screed from the partition/sole plate and also external walls and columns.

Drawings indicate the following detail is proposed which we would consider to be acceptable.

Figure 4 – Junction of Separating Wall with Separating Floor

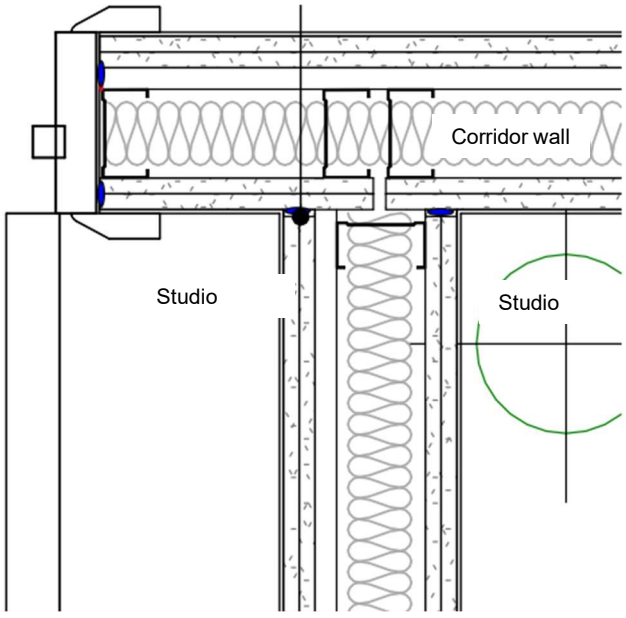


5.3 Junction of Separating Wall with External / Corridor Wall

- Where a separating wall meets a corridor wall the separating wall should dominate the junction. The corridor wall linings (bedroom side) should not be continuous across a separating party wall.

It is understood that the following detail is proposed which is considered to be acceptable.

Figure 5 – Junction of Separating Wall with Corridor Wall

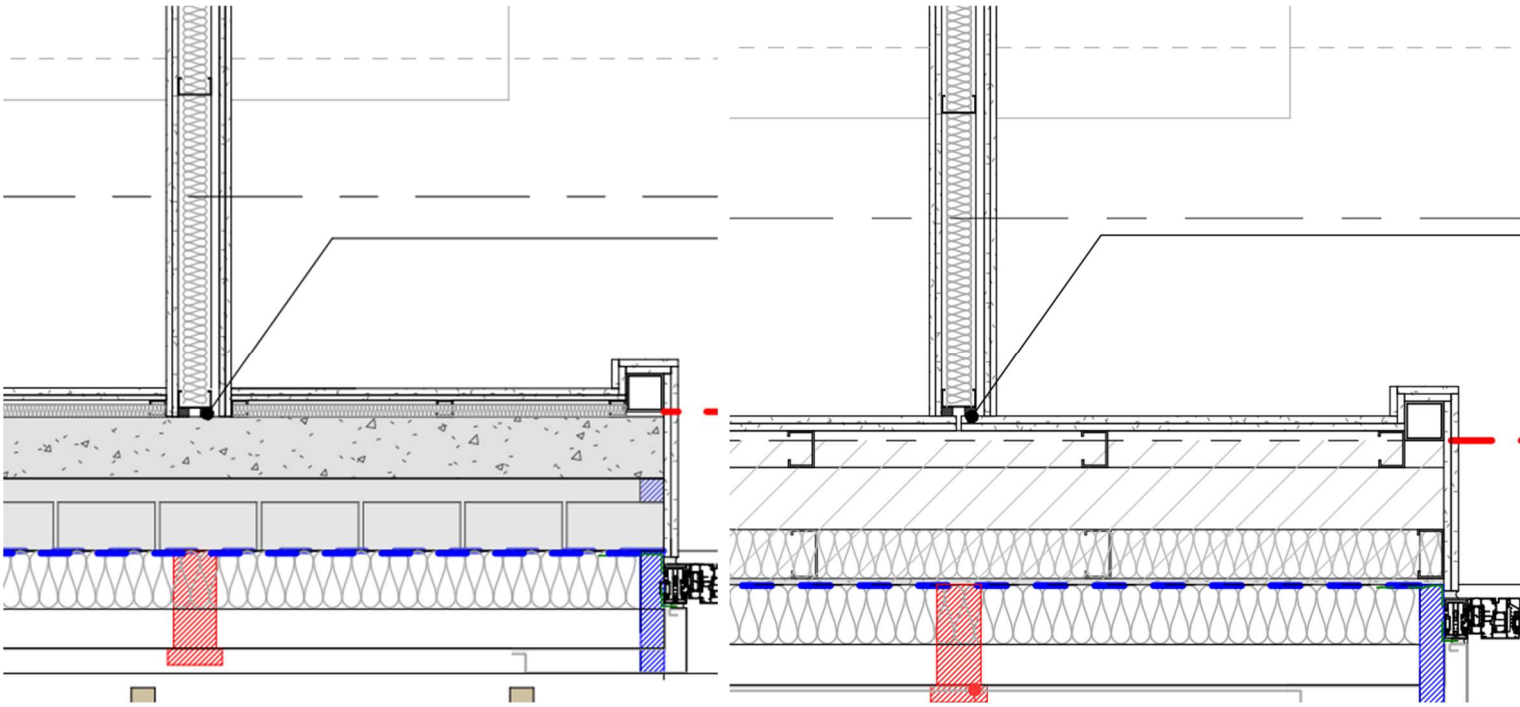


Note that a similar principle applies where the separating partitions meets the external wall.

- Where a separating partition meets an external wall any lightweight wall linings or dry-lining must be broken in line with the separating partition to prevent flanking sound transmission through the lightweight flanking lining.
- A cavity stop should be used to fill the cavity in external walls along the lines of all separating walls.

It is understood that the following detail is proposed where the separating wall interfaces with the external;

Figure 6 – Junction of Separating Wall with External Wall



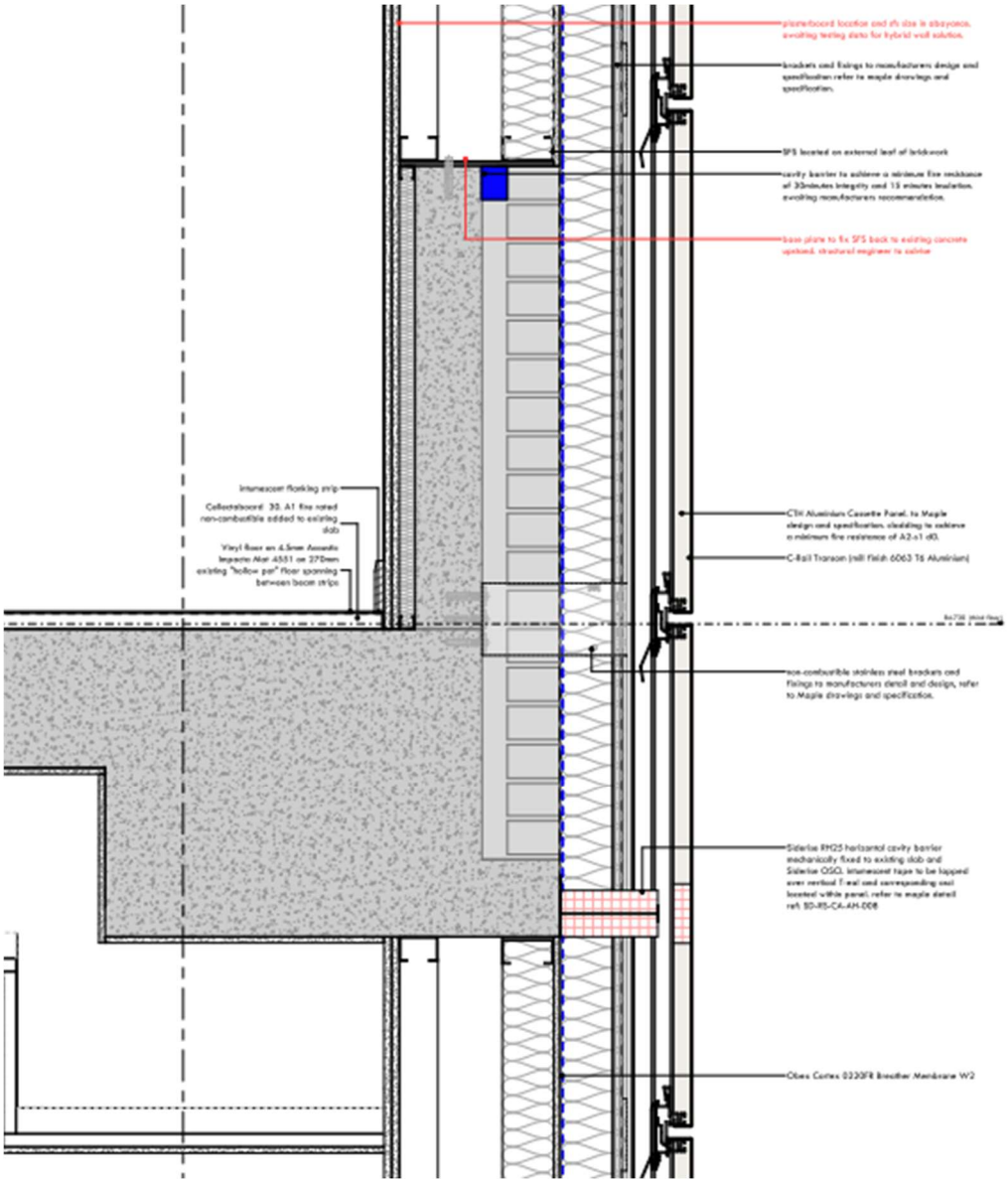
We would consider the detail above to be acceptable.

5.4 Junction of Separating Floor with External Wall

- The structural floor slab should be built into the inner leaf of the external wall to ensure no continuous inner leaf between floor levels. A cavity stop should be used to fill the cavity in external walls along the lines of all separating floors as shown in the detail above.

It is understood that the following detail is proposed which we would consider to be acceptable:

Figure 7 – Junction of Separating Floor with External Wall

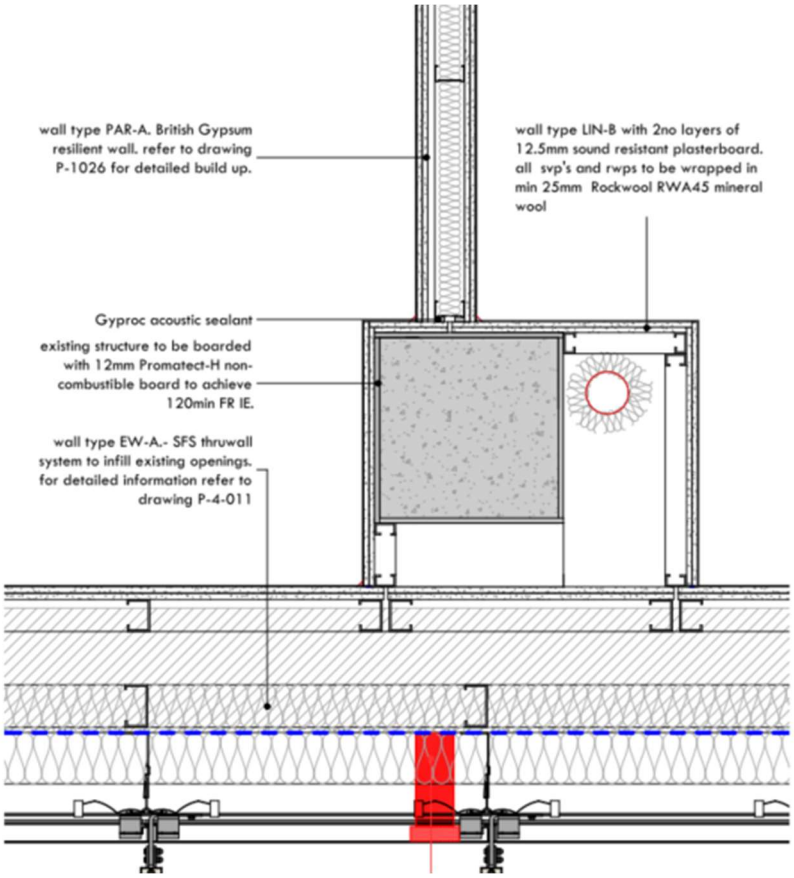


The external wall detail proposed above is generally considered to be acceptable however, we would recommend that **the internal lining is upgraded using a gypliner system** as per the advice in Section 4.1.3 of this report.

5.5 Junction of Separating Wall and Concrete Column

It is understood that the following detail is proposed where the separating wall meets the concrete columns;

Figure 8 – Junction of Separating Wall with Column/Window Infill



The above detail is considered to be acceptable. Note that for variations of the above detail is should be ensured that the internal plasterboard lining on the external wall / column should not be continuous across the separating partition.

6.0 GENERAL RECOMMENDATIONS

6.1 Toilets, Bathrooms and Kitchens

Metal pipe-work or soil pipes etc. should not be rigidly fixed to any wall, floor or riser internal wall and resilient fixings should always be used. Where flexible plastic water-pipes etc. are used then normal fixings may be used.

Basins, toilets, baths or showers (including shower mixers) should not be rigidly fixed to masonry walls, and should be mounted either on separate stud walls off the masonry or mounted using resilient fixings. Pipes or ductwork in the risers or partitions should not be rigidly fixed to any wall that is common to a habitable room.

6.2 Radiators

Where radiators are installed back to back on either side of separating partition, ideally separate flow and return lines should be used. If it is proposed to connect both radiators using a 'T' connection from a single overhead pipe, pliable plastic water-pipes should be used to reduce sound transmission through the system. Any pipe penetrations through the separating walls should be sealed as described in Section 4.11 above.

6.3 Substations

The separating walls and floors of the substation room should as a minimum meet the Building Regulations requirements given in Section 2.1 above. If the substation is not enclosed within its own acoustic enclosure within the room additional linings may be required to the walls and particularly the ceiling which separates the substation from the bedroom above. Details of the substation noise levels and enclosure details should be passed to PDA for review.

7.0 REVERBERATION TIMES

7.1 Sound absorption in corridors and stairwells

The criteria of Approved Document E of the Building Regulations to specify the absorption required in circulation spaces are detailed below. Absorption requirements are addressed using one of two methods A) or B);

A) For entrance halls, corridors or hallways, cover an area equal to or greater than the floor area, with a Class C absorber or better.

For stairwells or a stair enclosure, calculate the combined area of the stair treads, the upper surface of the intermediate landings, the upper surface of the landings (excluding the ground floor) and the ceiling area on the top floor. Either cover at least an area equal to this with a Class D absorber, or cover and area equal to 50% of this area with a Class C absorber or better.

B) For entrance halls provide a minimum of 0.20 m^2 total absorption area per cubic metre of the volume.

For corridors or hallways, provide a minimum of 0.25 m^2 total absorption area per cubic metre of the volume.

Method A

For corridors and any entrance halls that lead directly onto a bedroom/studio, the requirements may be achieved using Method A, by having an area of minimum Class C absorber which is equivalent to the floor area, such as an absorbent ceiling.

It is assumed that an MF ceiling is the preferred option, therefore examples of Class C absorbers are perforated plasterboard products such as British Gypsum Quattro 41 perforated plasterboard which has a single figure absorption rating αw of 0.65, Absorption Class C (Absorption Class C has a single figure weighted absorption coefficient αw of greater than or equal to 0.6). Other perforated plasterboard products are available including the British Gypsum Gyptone and Rigitone ranges, Knauf Akustikpanel and Siniat Creason. Other manufacturers are available.

Stairwells

We would note that where studio apartments open directly into the stairwell the requirements of Method A need to be achieved. The most convenient method to comply with this requirement is to install a Class C absorbent ceiling tile to the underside of all landings and intermediate landings and the ceiling area of the top floor.

Note that where the stairwells are lobbied and do not open directly onto any apartment. Therefore these spaces are not necessarily subject to requirement E3.

Carpeting would be recommended in all cases to control reverberant impact noise in the stairwells and corridors.

Method B

As an alternative a Method B calculation may be undertaken which takes into account the absorption provided by all surfaces and room dimensions. It our experience the specification of a suitable Class D absorbent carpet used throughout corridor spaces can greatly reduce the required area of an absorbent ceiling.

We have undertaken an assessment in accordance with Method B in the following sections.

7.2 Assessment of Surface Finishes

It is assumed that the surface finishes will be as follows:

- Ceiling: 12.5mm Plasterboard with a skimmed finish.
- Walls: Plasterboard separating walls / Timber door sets
- Floor: Carpet tiles (Forbo ‘Tessera Diffusion’ or similar)

Acoustic test data for the products used in the calculations are taken from Approved Document E, or manufacturer’s laboratory test data. Note that Forbo have provided the single figure absorption coefficient for their product, but not the frequency spectrum. We have therefore assumed a frequency spectrum from a similar carpet tile.

Table 9: Absorption coefficients of products used in the calculations

Product	***Single figure Absorption α_w***	***Absorption coefficient α_p, Octave band Hz***				
		250	***500***	***1k***	***2k***	***4k***
Carpet Forbo Tessera Diffusion	0.15 Class E	0.02	0.05	0.15	0.30	0.40
Plasterboard ceiling with large airspace	0.10 (unrated)	0.15	0.10	0.05	0.05	0.05
Plasterboard walls on frame, cavity with mineral wool	0.10 (unrated)	0.12	0.08	0.06	0.06	0.05
Solid Timber Door	0.10 (unrated)	0.10	0.08	0.08	0.08	0.08

7.3 Method B Calculation

Calculations have been undertaken for corridor areas based on the absorption coefficients given in Table 9. Room and surface dimensions are taken from GA drawings provided to us by the client. The results of the calculations are as follows:

Table 10: Calculated absorption area per cubic meter of volume.

*Reference**	*Level*	*Volume, m^3*	*ADE Required absorption area, m^2 (volume × 0.25)*	*Calculated absorption area, m^2, Octave band centre frequency Hz*					*Area of Class C absorber m^2 required*
				250	500	1k	2k	4k	
Lobby	1st – 9th	22	5.4	5.2	3.8	3.8	5.1	5.8	3
Corridor	1st – 9th	102	25.5	17.0	13.3	14.3	20.7	24.4	18

It can be seen above that when all finishes are taken into account as per the Method B calculation, additional acoustic absorption is required to the room surfaces as follows:

- 18m² additional Class C absorption to corridor
- 3m² additional Class C absorption to the lobby space

The additional absorption may be provided through the provision of acoustic finishes/panels to the walls or ceiling. In the table above we have given the area required of Class C absorbent ceiling/wall panels to meet the requirement.

This may be fulfilled by changing part of the plasterboard ceiling. Examples of Class C absorbers are perforated plasterboard products such as British Gypsum Quattro 41 perforated plasterboard which has a single figure absorption rating αw of 0.65, Absorption Class C (Absorption Class C has a single figure weighted absorption coefficient αw of greater than or equal to 0.6). Other perforated plasterboard products are available including the British Gypsum Gyptone and Rigitone ranges, Knauf Akustikpanel and Siniat Creason. See Figure below with reference to Table 10:

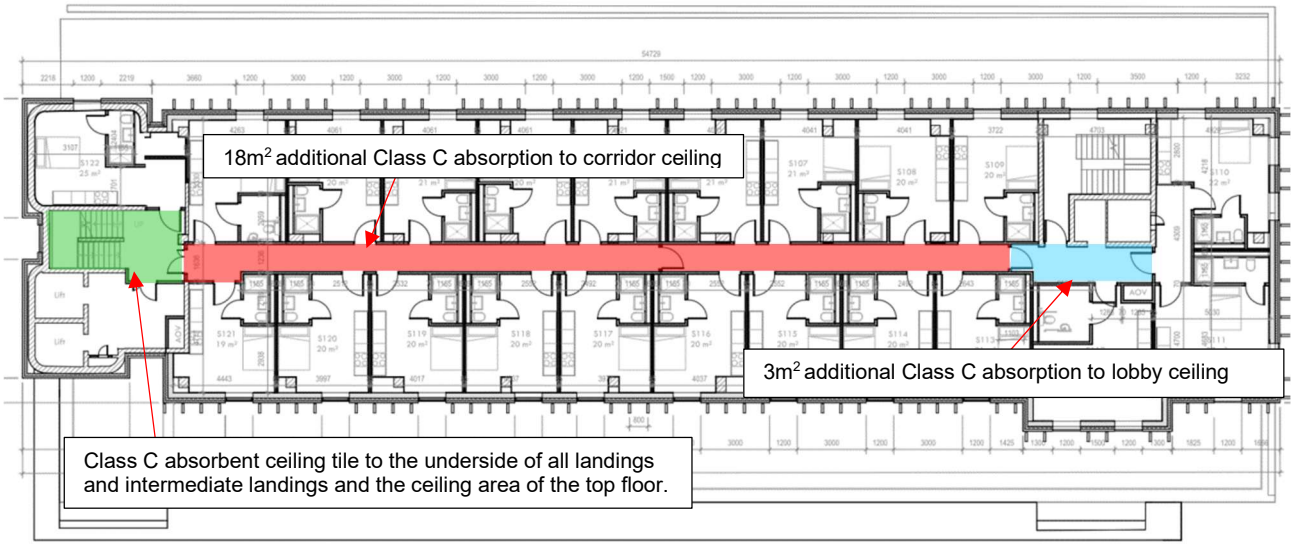


Figure 9 – Additional absorption required in corridor and lobby spaces (1st – 9th floor)

Note that the additional absorption should be spread evenly throughout each space.

8.0 BUILDING SERVICES NOISE

8.1 Internal Building Services Noise

Noise levels from internal building services should meet the internal noise levels within spaces defined in Section 2.5.

The internal noise levels above are to be due to the sum of external noise break-in from external sources and any internal noise sources, e.g. mechanical services plant.

It is recommend that details are provided to PDA for review.

8.2 External Building Services Noise

The measured noise levels on-site are considered to be representative of typical background noise levels at the nearest noise sensitive properties. Therefore, in accordance with the criteria of BS4142 we would recommend the following plant noise limits:

Table 11: External plant noise limits at the façade of the closest residential receivers

Daytime Noise Level (07:00 – 23:00 hours) L_{eq} dBA	***Night time noise Level (23:00 – 07:00 hours) L_{eq} dBA***
50	39

It is recommend that details of any external plant items are provided to PDA for review.

The verification of the noise emissions from the proposed external plant items to meet the noise limits above will be undertaken in a separate stand alone report.

APPENDIX A – NOTES FOR QUALITY CONTROL

1. Blockwork

All blockwork is to be mortared to an almost fair faced standard both horizontally and vertically. Only perfect blocks may be used with no pitting or cracks. The blockwork must seal effectively to the underside of the soffit.

Where blockwork walls form a cavity wall, care should be taken to avoid rubble and snots from bridging the cavity. This is especially important where one or more of the leaves is floating.

2. Plasterboard

All plasterboard joints are to be butted tight. The rule of thumb is that the joint should be tight enough over its entire length to prevent a normal business card from being inserted. Multiple layers should be fitted with staggered joints.

Base details and deflection heads are to be as per the British Gypsum White Book unless otherwise stated, and copious amounts of mastic to be used when fitting to the walls, floor and ceiling respectively.

3. Mineral Fibre

Mineral fibre slabs are to be butted tightly together and to boundary structures, to form a homogeneous layer.

4. Windows

All window frames are to be a good tight fit into the building structure with any gaps to be filled both internally and externally with a non-setting mastic in addition to the usual weather proofing seal to the exterior. Any gaps between the frame and building that are greater than 5 mm are to packed with a dense mineral fibre prior to mastic sealing.

5. Electrical Sockets

Electrical sockets must not be fitted back to back and removed areas of blockwork and plasterboard should be kept to an absolute minimum.

6. Water Pipes

All water pipes (and any other pipework) are to be resiliently mounted to avoid “water hammer”. This is particularly important for plasterboard walls.

7. Penetrations

Penetrations are to be dealt with as described in this report. Details for specific services penetrations may be supplied upon request.

8. Approved Samples and Inspections

Samples of each individual acoustic element should be provided for inspection at the beginning of its installation. Once approved, the Clerk of Works must ensure that the same level of quality continues throughout construction.

APPENDIX B – DEFINITION OF ACOUSTIC TERMS

The decibel

This is the basic unit of noise, denoted dB.

A Weighting

This is a weighting process which simulates the human ear's different sensitivity at different frequencies. A weighting can be shown two typical ways, 50 dB(A) L_{eq} or 50 dB $L_{Aeq.}$ Both mean the same thing. (See below for a definition of L_{eq}). The dB(A) level can be regarded as the overall level perceived by human beings.

L_{eq} and $L_{eq(s)}$

This is the equivalent continuous noise level which contains the same acoustic energy as the actual time-varying sound. In other words it is a kind of average noise level. It is denoted dB L_{eq} or, for A-weighted figures dB(A) L_{eq} or dB L_{Aeq}. It can also be expressed in terms of frequency analysis (see later). $L_{eq(s)}$ is the sample L_{eq} level.

L_n

This is the level exceeded for n% of the time. It is denoted dB L_n or, for A-weighted figures dB(A) L_n or dB $L_{An.}$ It can be expressed in terms of frequency analysis (see later). L_{90} is the level exceeded for 90% of the time and is a measure of the lowest level typically reached. L_{10} is the level exceeded for 10% of the time and is the highest level typically reached. L_{50} is the level exceeded for 50% of the time and, mathematically, it is the median.

L_{max}

This is the maximum level reached during a measurement period. The "time constant", or the ability of the equipment to respond to impulses is usually expressed along with it, e.g. "Fast", "Slow", etc. It is denoted dB L_{max} or, for A-weighted figures dB(A) $L_{max,}$ dB $L_{Amax,}$ etc. It can also be expressed in terms of frequency analysis.

Frequency Analysis

Whereas dB(A) gives a very useful overall figure, it has its limitations in that it cannot be used to model or predict the effect of noise control and mitigation as this nearly always has radically different performance at different frequencies.

Frequency analysis expresses an overall noise level at each frequency or band of frequencies in the audible range. Octave band analysis divides the audible range into 10 bands from 31.5 Hz to 16 kHz and the noise level in each band can be expressed in any form e.g. L_{eq}, L_{90}, L_{max} etc. One third octave band analysis uses 30 bands.

Narrow band analysis takes the process to resolutions of less than 1 Hz. This is useful for identifying the existence of tones (whines, hums, etc.) and in pin-pointing the sources.