7TH WAVE ACOUSTICS

Acoustic Report

Kingston Wharf, Shoreham-by-Sea
Noise & Vibration Impact Assessment

Final Report
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Project **Kingston Wharf, Shoreham-by-Sea**
Noise & Vibration Impact Assessment

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1 INTRODUCTION

7th Wave Acoustics (7wa) has been appointed by PMC Construction Ltd, to prepare a noise and vibration assessment to support the discharge of Conditions 37 and 47 attached to the planning consent (Ref: AWDM/0204/20) [1] for the new mixed-use development at Kingston Wharf, Shoreham-by-Sea.

The existing site and proposed development are described in the following section of this report, whilst the noise related planning conditions are included within Section 3. A description of acoustic terms is presented in Section 4. The noise assessments of the substation and lift, to support the discharge of Condition 37, are presented in Sections 5 and 6, respectively. The desktop review of the proposed building design in regard to sound insulation, to support the discharge of Condition 47, is presented in Section 7. The conclusions of this study are summarised in Section 8. Figures referred to in the report are presented in Appendix A.

The report has been produced by Jamie Pearson (MIOA) and reviewed by Neil Anderson (MIOA). Jamie has over 10 year's experience in the production of noise impact assessments and has produced a significant number of noise assessments in consultancy roles. Neil is an acoustic expert with 30 year's experience providing noise and vibration advice in the design and construction of major infrastructure projects.

The findings are reported herein.

2 SITE AND DEVELOPMENT DESCRIPTION

The site is located in Shoreham-by-Sea, positioned between the A259 Brighton Road to the north and the River Adur to the south.

The site is situated in a predominantly commercial area, with warehouses and builders merchants to the north and a metal recycling yard to the west of the site. A railway line runs behind the commercial businesses to the north, while beyond the River Adur to the south are existing residential developments.

The proposed development will comprise 255 no. new dwellings within three buildings, with a separate commercial building to provide B1 office space, B8 storage space and A3 café use.

A location plan and proposed site layout is provided in Figure A1 of Appendix A.

The ambient noise environment in the area is dominated by road traffic on the A259, with noise from the metal recycling yard also audible, particularly towards the western end of the site. Train passes on the railway line does not appear to influence the ambient noise levels at the development site.

3 ASSESSMENT CRITERIA

3.1 Local Authority Requirements

The development site is located within the area of Adur & Worthing Councils.

Planning conditions 37 and 47, attached to decision notice AWDM/0204/20, which are pertinent to this assessment, are as follows:

Noise & Vibration - Lift and Substation

37. With the exception of Enabling Works, no other phase of residential development shall take place until an Acoustic Assessment of the impact of noise and vibration from the lift shafts, including the lift machinery and from the substation, on the adjacent residential units, has been submitted to and approved in writing by the Local Planning Authority. The Assessment shall include details of a Mitigation Scheme for protecting the residential units. The Scheme shall be designed to achieve a level within the residential units of no greater than 30dB $L_{Aeq,\ 1\ hour}$. All works which form part of the Scheme shall be completed in accordance with the approved details before any of the residential units are occupied and permanently maintained thereafter.

Reason: To protect residents from noise and vibration in accordance with Policies 34 of the Adur Local Plan and SH7 of the Shoreham Harbour Joint Area Action Plan 2019.

Approved Document -E- Resistance to Sound.

47. Details for compliance with ADE are to be submitted. You will also need to consider how sound reverberation will be negated within the common parts of the building. Ideally an Acoustic Report should be prepared, including details of the sound testing regime if registration with Robust Details is not to be adopted.

4 NOISE UNITS

There is a million to one ratio between the threshold of hearing and the highest tolerable sound pressure. Noise is therefore measured using a logarithmic scale, to account for this wide range, called the decibel (dB). Noise is defined as unwanted sound and the range of audible sound varies from around 0 dB to 140 dB.

The human ear is capable of detecting sound over a range of frequencies from around 20 Hz to 20 kHz; however, its response varies depending on the frequency and is most sensitive to sounds in the mid frequency range of 1 kHz to 5 kHz. Instrumentation used to measure noise is, therefore, weighted across the frequency bands to represent the sensitivity of the ear. This is called 'A weighting' and is represented as dB(A).

It is generally accepted that a change in noise level of 1 dB is not perceptible by the normal ear under normal conditions, a 3 dB change is just perceptible, whilst a change of 10 dB is perceived as a doubling or halving of the noise level.

An indication of the range of noise levels commonly found in the environment is given below in Table 4.1.

Table 4.1: Typical Noise Levels

Typical Noise Level dB(A)	Example
0	Threshold of hearing
30	Rural area at night
40	Residential area at night
60	Conversation
80	Inside general factory premises
100	Near to pneumatic hammer
120	Near to speaker at rock concert
140	Threshold of pain

A number of different indices are used to describe the fluctuations in noise level over certain time periods. The main indices include:

$L_{A90,T}$ This is the noise level exceeded for 90% of the measurement period and provides a measurement of the quieter 'lull' periods in between noise events. It is often referred to as the background noise level.

$L_{Aeq,T}$ This is the equivalent continuous A-weighted sound pressure level and is the level of a notional steady sound which has the same acoustic energy as the fluctuating sound over a specified time period, T. It is often used for measuring all sources of noise in the environment, which can be referred to as the ambient noise.

$L_{Amax,F}$ This is the maximum sound pressure level measured in a given time period with the sound level meter set to 'fast' response.

5 SUBSTATION NOISE ASSESSMENT – CONDITION 37

5.1 Overview

Substations are used on housing developments as an easier and safer way to deliver electricity to homes, with the size of a substation varying depending on the size of the development.

The plant associated with the substations at the Kingston Wharf development include electrical transformers.

The proposed locations of the substations are highlighted in Figure A1 of Appendix A. For the purposes of this assessment, the substations are referred to as substations 1 and 2.

5.2 Closest Noise Sensitive Receptors

The closest noise sensitive receptors to the proposed substations are identified in Figures A2, A3 and A4 of Appendix A as R1, R2 and R3. These are all residential dwellings yet to be built at the development site.

R1 represents residential dwellings at Block A, located c. 3m to the west of substation 1 and R2 represents residential dwellings at Block B, located c. 12m to the east of substation 1. R3 represents residential dwellings at Block c. 9m to the west of substation 2.

5.3 Substation Design

It is understood that 2no. 1000KvA electrical transformers are to be located in substation 1 and 1 no. 1000KvA transformer is to be located in substation 2.

Substation 1 Construction

The construction of substation 1 consists of a brick outer face, a 50mm cavity and block inner face. The roof construction will consist of 1no. layer of 12mm Supalux sheet fixed in staggered roof joists. It is understood the floor will be constructed of concrete. A blockwork partition will split the substation building into two, housing 1 no. transformer in each.

There are 2 no. louvred access doors located on the north façade of the substation building. 2. no. ventilation louvres are also located on the east and west facades of the substation (1 no. on each), as shown in Figure A5 of Appendix A. The louvred openings are considered the weakest part of the construction in terms of sound insulation.

Substation 2 Construction

The transformer at substation 2 will be housed within a GRP enclosure.

There are 6. no. ventilation louvres also located on the east, south and west facades of the substation (2 no. on each), as shown in Figure A6 of Appendix A. Again, the louvred openings are considered the weakest part of the construction in terms of sound insulation.

5.4 Plant Specific Noise Levels

Each of the transformers (3 no. in total) will have a 1000kVa power rating. The sound power level of the selected transformers, provided by the suppliers of the transformer, have a sound power level of 59 dB (A).
The test data can be seen in Figure A7 of Appendix A.

5.5 Calculation of Noise Levels

A computer model has been constructed using SoundPLAN version 5.1. This commercial software package implements complex calculations using acoustical ray-tracing techniques, taking into account the acoustically reflective and absorptive properties of the building elements. The environmental noise propagation from source to receiver position is calculated in accordance with the procedures defined in ISO 9613-2:1996 Attenuation of Sound during propagation outdoors, part 2: General method of calculation[2], using the following acoustic algorithm:

$$L_{fT}(DW) = Lw + Dc - A$$

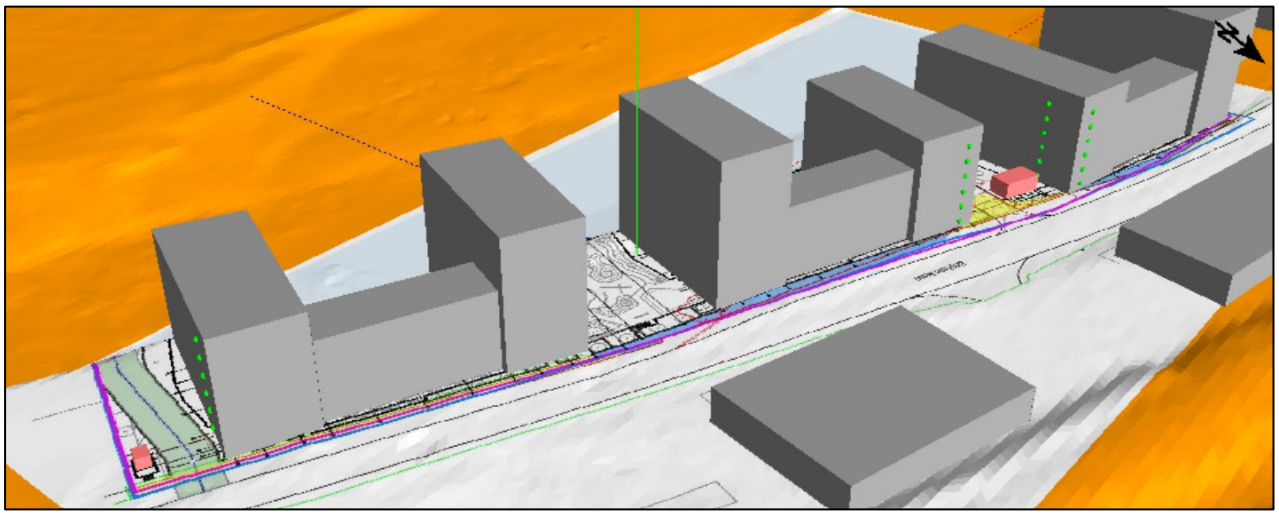
Where

Lft(DW)	=	equivalent continuous downwind octave-band sound pressure level at a receiver location
Lw	=	sound power level of the noise source
Dc	=	directivity correction
A	=	attenuation that occurs during propagation from the point sound source to the receiver. A = Adiv + Aatm + Agr + Abar +Amisc
Adiv	=	attenuation due to geometrical divergence
Aatm	=	attenuation due to atmospheric absorption
Agr	=	attenuation due to the ground effect
Abar	=	attenuation due to a barrier
Amisc	=	attenuation due to miscellaneous other effects

The following assumptions have been made in the noise modelling exercise:

- 100% on-time assumed for all 3 no. transformers;
- Ground absorption modelled as hard ground;
- Residential buildings modelled at height of 20m;
- Receptor calculation points modelled at height of 1.5m to represent ground floor assessment level, with 3.0m repeats per floor. The floor with the highest calculated level is presented for assessment purposes;
- Topographical data has been incorporated into the model;
- Each substation façade has been modelled as an area source. Details of the adopted sound power levels are summarised in the following sub section of the report; and
- A screenshot of the noise model is presented below in Figure 5.1.

Figure 5.1: Screenshot of Noise Model



5.6 Assessment of Internal Noise Levels

To represent the noise breakout from the transformers within the substation buildings, the building facades were modelled as area sources. The following process was used to estimate the breakout noise level and calibrate the area sources in the noise model:

Internal Reverberant Noise Levels

- Internal reverberant noise levels were calculated using the following equation:

  $SPL_R = SWL - 10\log R_c + 6dB$

  Where:

  SWL is the sound power level of the internal noise sources
  R_c is the room constant

- The following building materials have been used to determine the room constant:

<u>Substation 1</u>

  - Floor and internal wall lining consist of rough finished concrete; and
  - Roof lining assumed to perform similar to plywood.

<u>Substation 2</u>

  - Floor lining consist of rough finished concrete; and
  - The sound absorption coefficients of glass reinforced plastic (GRP) kiosks was not available in octave bands. As such, it has been assumed that walls and roof linings perform similar to smooth plastic wall tiles.

- Louvred doors and louvred openings for each buildings assumed to provide no acoustic attenuation;
- The sound power spectrum used for the calculations, calculated from the supplied manufacturers data, is presented overleaf in Table 5.1.

Table 5.1: Transformer Sound Power Levels

Supplier	Model	Sound Power Level L_W dB, by Octave Band Frequency (Hz)								L_{WA} dB
		63	125	250	500	1k	2k	4k	8k	
Schneider Electric	1000 kVa Transformer	53	48	57	46	36	28	26	25	59

Internal to External Noise

The internal noise was then used to determine the noise level, L_{out}, just outside the facades, arising from the sound transmission through the façade, given the reverberant noise level inside the building, L_{in}, and the sound reduction index, R, of the façade elements.

$$L_{out} = L_{in} – R - 6$$

The sound reductions for the wall and roof elements for substation 1 have been modelled in a proprietary sound insulation modelling software INSUL V9. The INSUL calculations are shown in Figures A8 and A9 of Appendix A.

For substation 2, manufacturers of the GRP kiosks have indicated that the kiosks provide a sound reduction of c. 24 dB. However, the sound reduction index of glass reinforced plastic kiosks was not available in octave bands. As such, the octave band reduction for a 6mm smooth fibre board has been assumed for calculation purposes and is summarised below in Table 5.2. The assumption also provides a sound reduction ($R_w + C_{tr}$) of 24 dB.

Table 5.2: Assumed Sound Reduction of GRP Kiosk

Model	Sound Reduction (R), dB								$R_w + C_{tr}$
	63	125	250	500	1k	2k	4k	8k	
6mm Fibre Board[1]	11	15	19	24	29	33	32	32[2]	24

Notes:
[1] Assumption obtained from INSUL V9; and
[2] derived for assessment purposes.

Finally, the external noise level was used to calculate the sound power level L_w of the facades, using the following equation:

$$L_w = Lout + 10Log\ S$$

Where S = surface area of the façade.

The derived façade sound power levels were incorporated into the computer noise model as area sources for each façade of the buildings.

The results of the site noise levels at the closest receptors are discussed in the following sub-section.

5.7 Plant Specific Sound Levels

The specific sound pressure level at R1, R2 and R3 are estimated to be 24 dB(A), 19 dB(A) and 39 dB (A). Allowing for a loss of approximately 13dB through a window partially open for ventilation, as specified in the Acoustics Ventilation and Overheating (AVO) Residential Design Guide, this would result in an internal level of 11 dB (A), 6 dB(A) and 26 dB (A) at R1, R2 and R3, respectively.

The results of the assessment indicate that noise from the sub-stations would achieve the internal noise criteria level of 30 dB $L_{Aeq,1hour}$ specified in Planning Condition 37.

6 LIFT SYSTEM NOISE ASSESSMENT – CONDITION 37

6.1 Overview

The elevator is a necessary facility providing access and vertical mobility for visitors and residents in buildings with numerous floors. When used in residential buildings, the noise and vibration of elevator operations can potentially intrude on residences adjacent to the equipment.

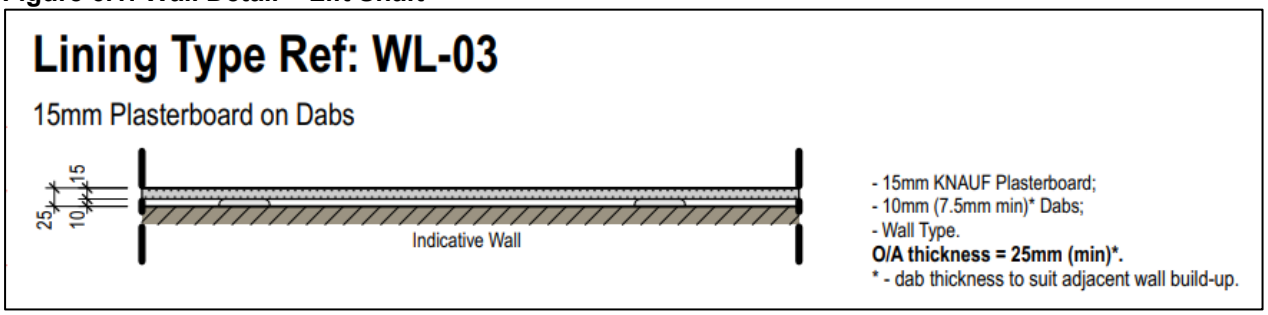
In apartment Blocks A, B and C, the lift shaft adjoins communal areas or hallways and habitable rooms inside the flats.

6.2 Lift Shaft Design

The lift shaft design proposal presented below in Figure 6.1 (**Drawing no. Wall Types Sheet 1a Rev T2**) indicates the following lift shaft wall build-up:

- 225mm concrete;
- 10mm dabs; and
- 15mm KNAUF Plasterboard.

Figure 6.1: Wall Detail – Lift Shaft

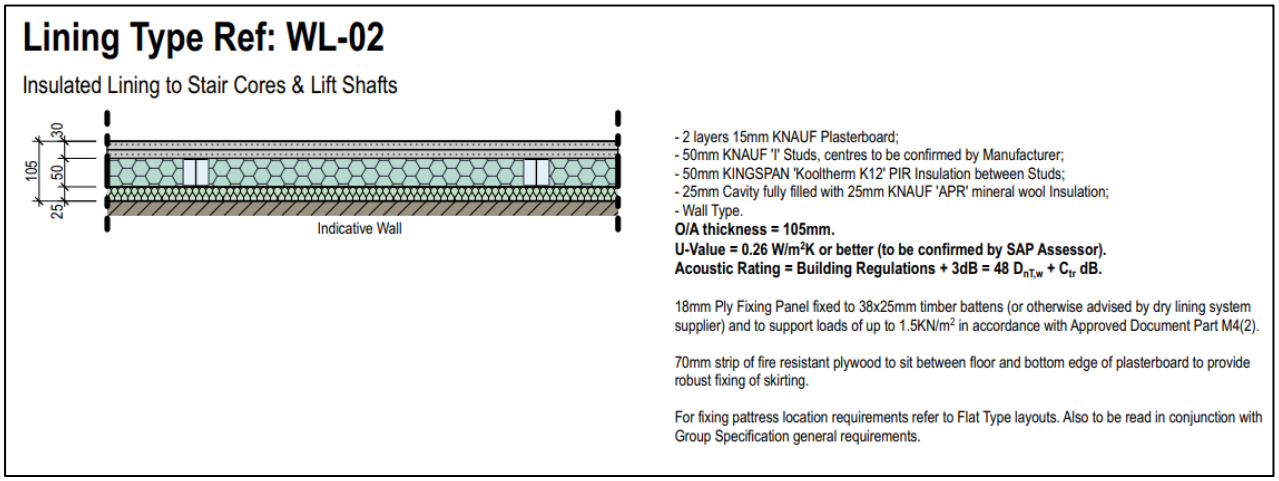


Note: Wall type is 225mm concrete.

In order to limit the transmission of noise and vibration where the lift shaft is adjacent to habitable rooms (bedrooms, living rooms, kitchen diners, dining rooms etc.), the following wall lining will also be adopted, as shown in Figure 6.2 (**Drawing no. Wall Types Sheet 1a Rev T2**):

- 2 layers 15mm KNAUF Plasterboard;
- 50mm KNAUF 'I' Studs;
- 50mm KINGSPAN 'Kooltherm K12' PIR Insulation between Studs;
- 25mm Cavity fully filled with 25mm KNAUF 'APR' mineral wool Insulation; and
- Wall type (as above).

Figure 6.2: Wall Detail – Lift Shaft Lining to Habitable Rooms



Note: Wall type is 225mm concrete, 7.5mm min dabs; and 15mm KNAUF Plasterboard..

To provide an indication of the likely sound insulation performance that can be expected from the wall system between the lift shaft and habitable rooms on site, the wall system has been modelled using INSUL V9. The calculation predicts R_w+C_{tr} 72=dB (+/- 3dB) (R_w 84dB, C_{tr} -12dB). The INSUL calculation is shown in Figure A10 of Appendix A.

Based on the estimated sound insulation of the proposed wall partition, and allowing for a reduction in the sound insulation performance by -10dB due to flanking transmission, in order to comply with the noise criteria of 30 dB $L_{Aeq,1hour}$ set out in Planning Condition 37, the noise levels within the lift shaft should not exceed 92 dB (A).

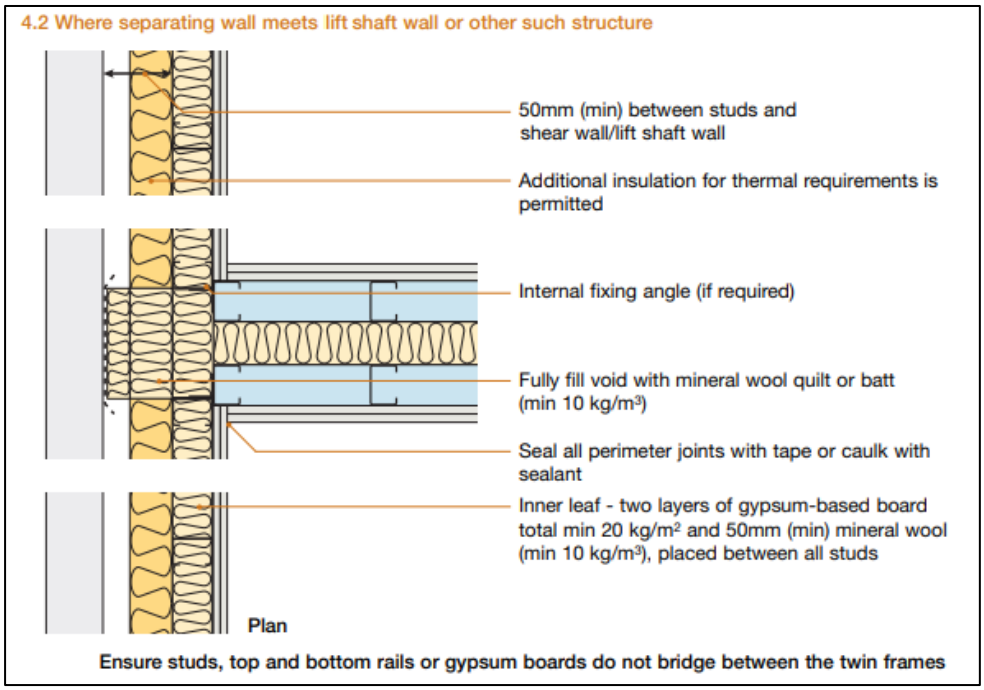
No noise data from the supplier is available for noise within the proposed lift shaft. However, research [3] indicates that typical noise levels in lift plant rooms/shafts for modern machines range from 75-80dB(A). These noise levels fall below the maximum noise level of 92 dB (A).

The proposed design of the lift shaft walls, and wall lining, is considered to be a suitable construction for achieving the criteria of 30 dB $L_{Aeq,1hour}$ set out in Planning Condition 37.

Robust Details

Robust details also provide guidance where separating walls meet lift shaft walls, which has been reproduced overleaf in Figure 6.3.

Figure 6.3: Robust Details Example Where Separating Wall Meets Lift Shaft Wall



The robust detail presented above indicates that the wall lining should have two layers of wallboard and a minimum of 50mm of mineral wool placed between studs, a minimum of 50mm between studs and shaft wall and additional insulation for thermal requirements.

The current proposal is not entirely in line with the guidance provided within Robust Details as the proposed cavity is only 25mm wide.

Notwithstanding any comparison with the details above, it has been shown that the proposal is suitable for controlling noise transfer from the lift shaft into adjoining habitable rooms, however, it is recommended that consideration is given to increasing the cavity to 50mm to match the guidance within Robust Details, should there be sufficient space to do so.

6.3 Vibration Considerations

The inclusion of the cavity within the additional wall lining is also important for creating isolation between the lift shaft and the rooms, to minimise structural transfer of vibration into the rooms.

The lift motor and associated equipment should also be installed on suitable anti-vibration mountings to prevent the transmission of excessive vibration and/or structure-borne noise to any parts of the living accommodation.

Interaction of rails and lift car guides are also a potential source of vibration and subsequent noise. It is therefore recommended that the rails should be fastened to the building at the edge of the floor slab. The floor slab edges are inherently stiffer than the shaft walls and will limit the transmission of the rail/guide interactions from generating structure borne noise in adjacent spaces. It is acknowledged however that it is fundamental to ensure that the cars run smoothly up and down the rails.

It is seen to be the responsibility of the lift manufacturer/contractor to ensure that lifts are installed and isolated correctly.

7 REVIEW OF PROPOSED CONSTRUCTIONS – CONDITION 47

7.1 Sound Insulation of Separating Walls and Floors

In order to comply with the building regulations, the separating walls and floors must meet the minimum performance standards from Approved Document E 2003 [4] (ADE2003) under a pre-completion testing regime.

The new building has been identified as purpose-built dwellings. Therefore, the separating floors and walls have to achieve the values in Table 0.1a of ADE2003. The requirements have been reproduced below in Table 7.1.

Table 7.1: Minimum Sound Insulation Performance Standards for Dwelling Houses and Flats from ADE2003

Dwelling-houses and flats – performance standards for separating walls, separating floors, and stairs that have a separating function		
Purpose built dwelling-houses and flats	**Airborne Sound Insulation $D_{nT,W} + C_{tr}$ dB (minimum values)**	**Airborne Sound Insulation $L'_{nT,W}$ dB (Maximum values)**
Walls **Floors and Stairs**	45 45	- 62

The performance standards set out in Table 0.1a from ADE2003 are appropriate for walls, floors and stairs that separate spaces used for normal domestic purposes.

In some cases, a higher performance is required, for example to gain credits under and assessment route such as Code for Sustainable Homes or as a client requirement for improved performance. However, It is understood that the ADE requirements provided in Table 7.1 are the design targets for this development.

7.2 Sound Insulation of Internal Walls and Floors

In order to comply with the internal sound insulation requirements of ADE2003, constructions used within a dwelling-house or flat should achieve the minimum laboratory sound insulation performance requirements from Table 2 of ADE2003. This table is reproduced in below Table 7.2.

Table 7.2: Minimum Sound Insulation Performance for Internal Walls and Floors from ADE2003

Laboratory values for new internal walls and floors within dwelling-house, flats and rooms for residential purposes, whether purpose built or formed by material change of use	
Purpose built dwelling-houses and flats	**Airborne Sound Insulation R_W dB (minimum values)**
Walls, Floors and stairs	40 40

ADE2003 provides a series of example constructions that would satisfy the requirements of Table 7.2; however, the suggested constructions are not exhaustive, and it is open to the developer to use alternative details provided the laboratory performance has been demonstrated in an appropriately accredited laboratory.

It should be noted that the performance standards only apply to internal walls that do not contain a door. Where an internal wall separates a bedroom from an en-suite, the performance standards do not apply.

7.3 Reverberation Control in Common Area

ADE2003 requires that reverberation should be controlled in common areas, such as stairwells and corridors. ADE2003 prescribes two methods for demonstrating this:

- **Method A:** Cover a specified area with an absorber of an appropriate class that has been rated according to BS EN ISO 11654:1997[5].

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

7.4 Review of Proposed Constructions Separating Walls - Requirement E1

When selecting suitable partitions to achieve the sound insulation requirements, the manufacturers of partitioning systems will often provide laboratory test data stated in the form of the sound reduction index (R_w or R_w+C_{tr}). There is no straightforward relationship between the laboratory rating (R_w+C_{tr}) and the on-site rating ($D_{nT,w}+C_{tr}$). The difference will depend on many factors including workmanship, the partition area and the junction details. However, it is useful to note that to achieve the standard E1 requirements, a minimum laboratory test requirement of 49 dB R_w+C_{tr} is advised by British Gypsum to achieve the 45 dB $D_{nT,w}+C_{tr}$ with a recommended solution of 54 dB R_w+C_{tr}. This of course requires a reasonable standard of workmanship and junction details commensurate with the sound insulation standards.

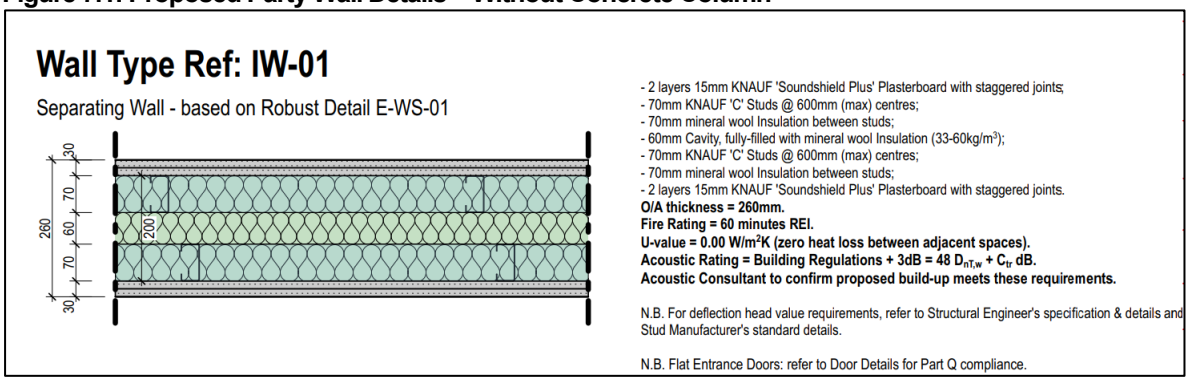
A selection of the key proposed partitions for the project, provided by HGP Architects, have been reviewed, with the findings set out below.

<u>Separating Party Walls Between Apartments</u>

Current design proposals presented below in Figure 7.1 (**Drawing no. Wall Types Sheet 1 Rev T1**) indicate the following intermediate wall build-up between apartments:

- 2x 15mm KNAUF ‘Soundshield Plus’ Plasterboard, on either side;
- 70mm KNAUF ‘C’ studs @ 60mm (max) centers, on either side;
- 70mm mineral wool insulation between studs, on either side; and
- 60mm cavity, fully filled with mineral wool insulation, on either side.

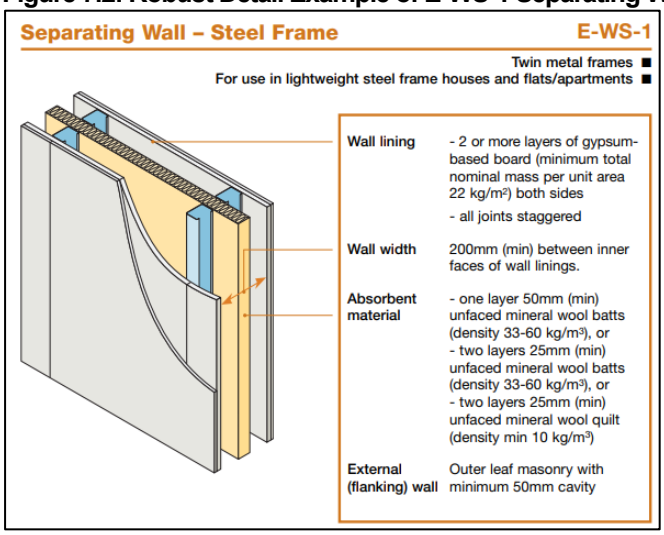
Figure 7.1: Proposed Party Wall Details – Without Concrete Column



This build-up is based on the Robust Details E-WS-1 separating wall design for the use in lightweight steel frame houses and flats/apartments and is a suitable construction type to achieve the required levels of sound insulation. The E-WS-1 separating wall design is presented below in Figure 7.2.

It should be noted that the resistance to airborne sound depends on the mass per unit area of the leaves, the isolation of the frames and the absorption in the cavity between the frames.

Figure 7.2: Robust Detail Example of E-WS-1 Separating Wall Detail



In order to provide an indication of the likely sound insulation performance that can be expected on site, the wall system has been modelled using INSUL V9. The calculation predicts R_w+C_{tr} 61=dB (+/- 3dB) (R_w 67dB, C_{tr} -6dB) which would indicate meeting the standard E1 requirement between apartment party walls The INSUL calculation is shown in Figure A11 of Appendix A.

The following points should be considered:

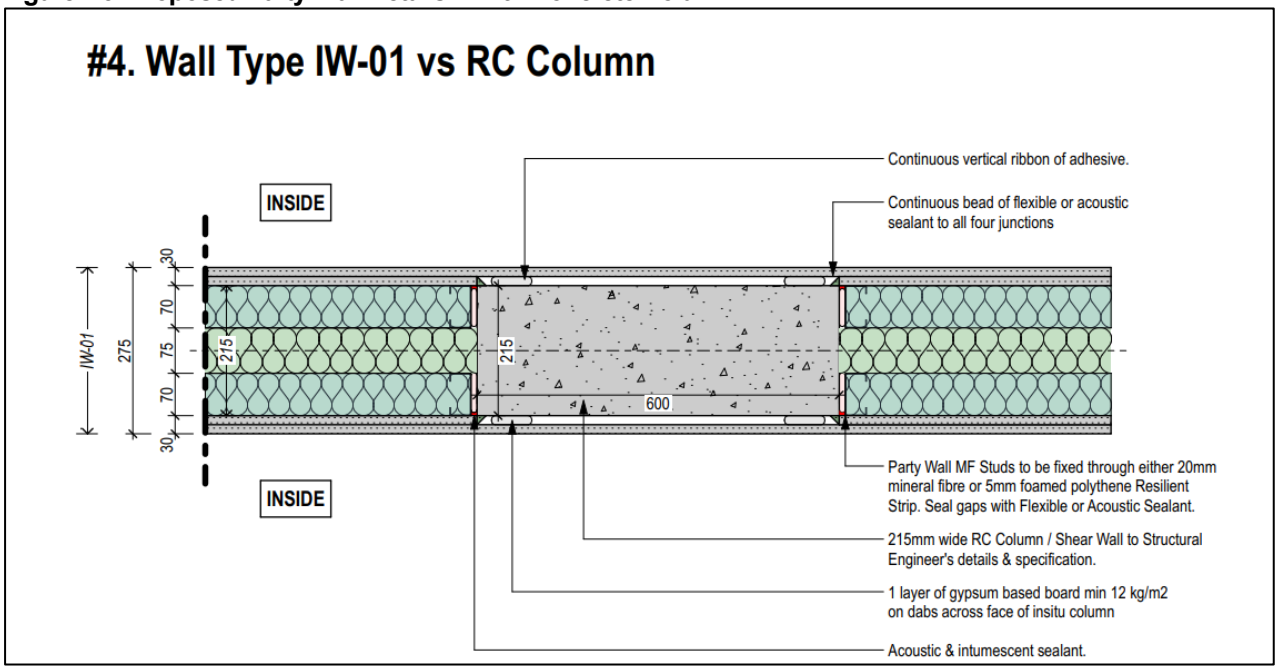
- Keep wall linings at least 200mm apart;
- Ensure the batts or quilt cover the whole wall area and are fitted together tightly;
- Make sure batts or quilt are not tightly compressed by the twin frames;
- Ensure that all cavity stops/closers are flexible or are fixed to one frame only;
- Make sure there is no connection between the two leaves except where ties are necessary for structural reasons;
- Stagger joints in wall linings to avoid air paths and seal all joints in outer layer with tape or caulk with sealant; and
- Seal all joints in outer layer with tape or caulk with sealant.

It should be noted that the sound insulation requirements from corridor to flats is the same as the separating walls. In practice, they are often limited by the presence of a door to the flat, which reduces the overall practical sound insulation significantly. Review of the block plans indicate that some areas of the corridor walls are against a habitable room i.e. the room that is more sensitive such as bedrooms and living areas.

In order to mitigate this, any door to the stairwell should have good perimeter sealing (including the threshold where practicable) and a minimum mass per unit area of 25kg/m^2 or a minimum sound reduction index of 29dB R_w (measured according to BS EN ISO 140-3:1995 and rated according to BS EN ISO 717-1:1997) [6].

Drawings detailing the party walls with concrete column (**Drawing no. Wall Types Sheet 2 Rev T2**) is displayed below in Figure 7.3.

Figure 7.3: Proposed Party Wall Details – With Concrete Column



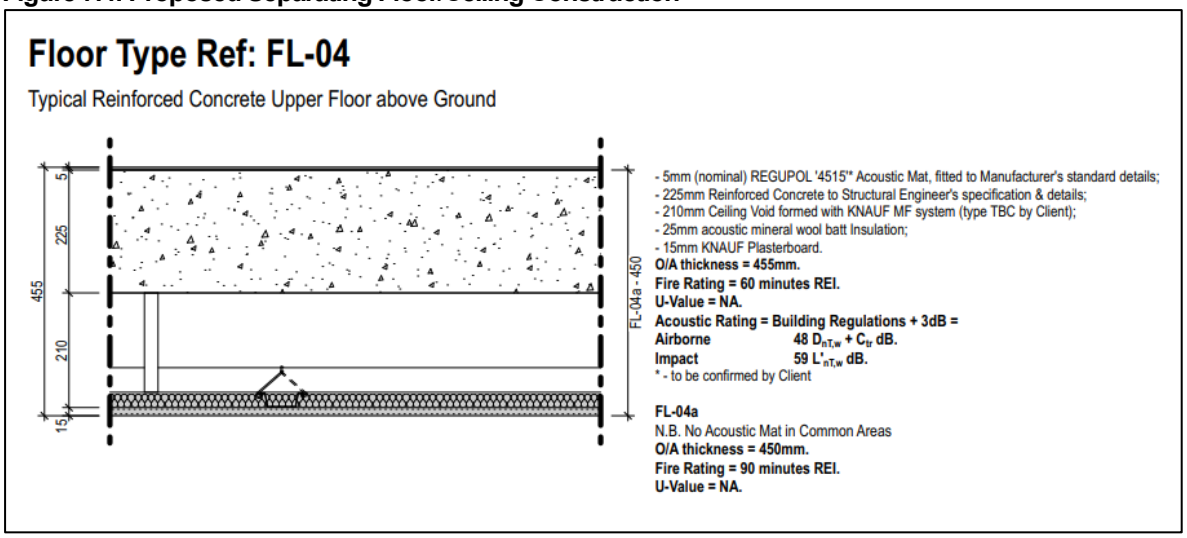
The concrete column itself should provide adequate sound insulation. However, based on experience of similar constructions, a resonant dip in the sound insulation can often be seen at around 63 Hz, which is normally due to small cavities either side of the concrete column, as shown in Figure 7.3. It is recommended that the partition is slightly off-set such that the small gap on one side of the column were removed completely, by running the boards on one side flush against the concrete column (and increasing the cavity on the other side). If the walls cannot be built to such tolerances, it is recommended that to mitigate flanking sound, the small cavity is sufficiently filled with insulation.

7.5 Review of Proposed Constructions - Separating Floor/Ceiling

The design proposals (**Drawing Floor Types Sheet 1 Rev T1**) for the floor/ceiling build-up between apartments are summarised below and shown in Figure 7.4:

- 5mm REGUPOL 4515 Acoustic Mat;
- 225mm reinforced concrete;
- 210mm ceiling void formed with KNAUF MF systems;
- 25mm mineral wool; and
- 15mm KNAUF plasterboard.

Figure 7.4: Proposed Separating Floor/Ceiling Construction

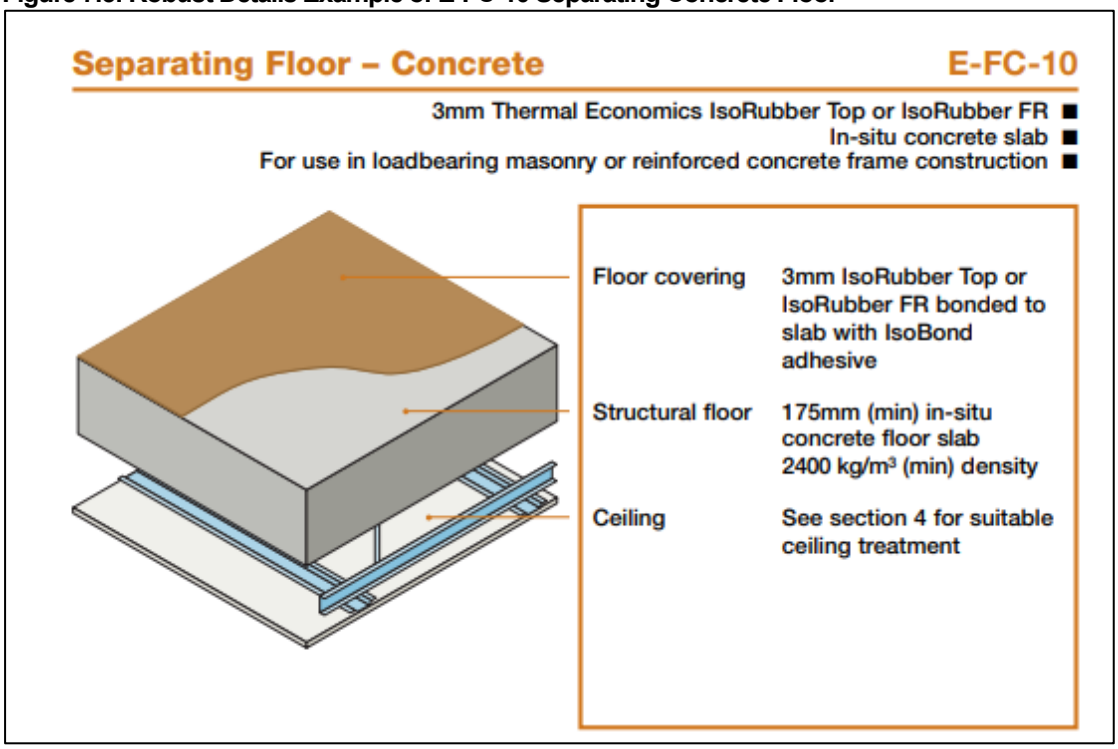


The above build-up is based around the ADE2003 Floor Type 1 system with a concrete base with ceiling and soft floor covering and is similar to the robust detail [7] E-FC-10 presented below in Figure 7.5.

Robust details recommend a minimum ceiling void of 150mm and a minimum of 25mm acoustic mineral wool. The proposal is for 210mm void and 25mm mineral wool. The proposed detail is therefore considered suitable.

The Robust detail requires a 3mm Thermal Economics IsoRubber Top or IsoTubber FR floor covering, however, the selected product (Regupol 4515 acoustic mat) is deemed to be sufficient.

Figure 7.5: Robust Details Example of E-FC-10 Separating Concrete Floor



An INSUL calculation of the proposed system predicts R_w+C_{tr} 67dB (+/-3dB) (R_w 73dB, Ctr -6dB) for airborne sound insulation, which would indicate achieving the standard E1 requirement between apartment party walls .

INSUL modelling indicates an impact noise level of 41dB $L_{nT,W.}$ This would comply with the performance standard specified in ADE.

The INSUL calculations are shown in Figure A12 and A13 of Appendix A.

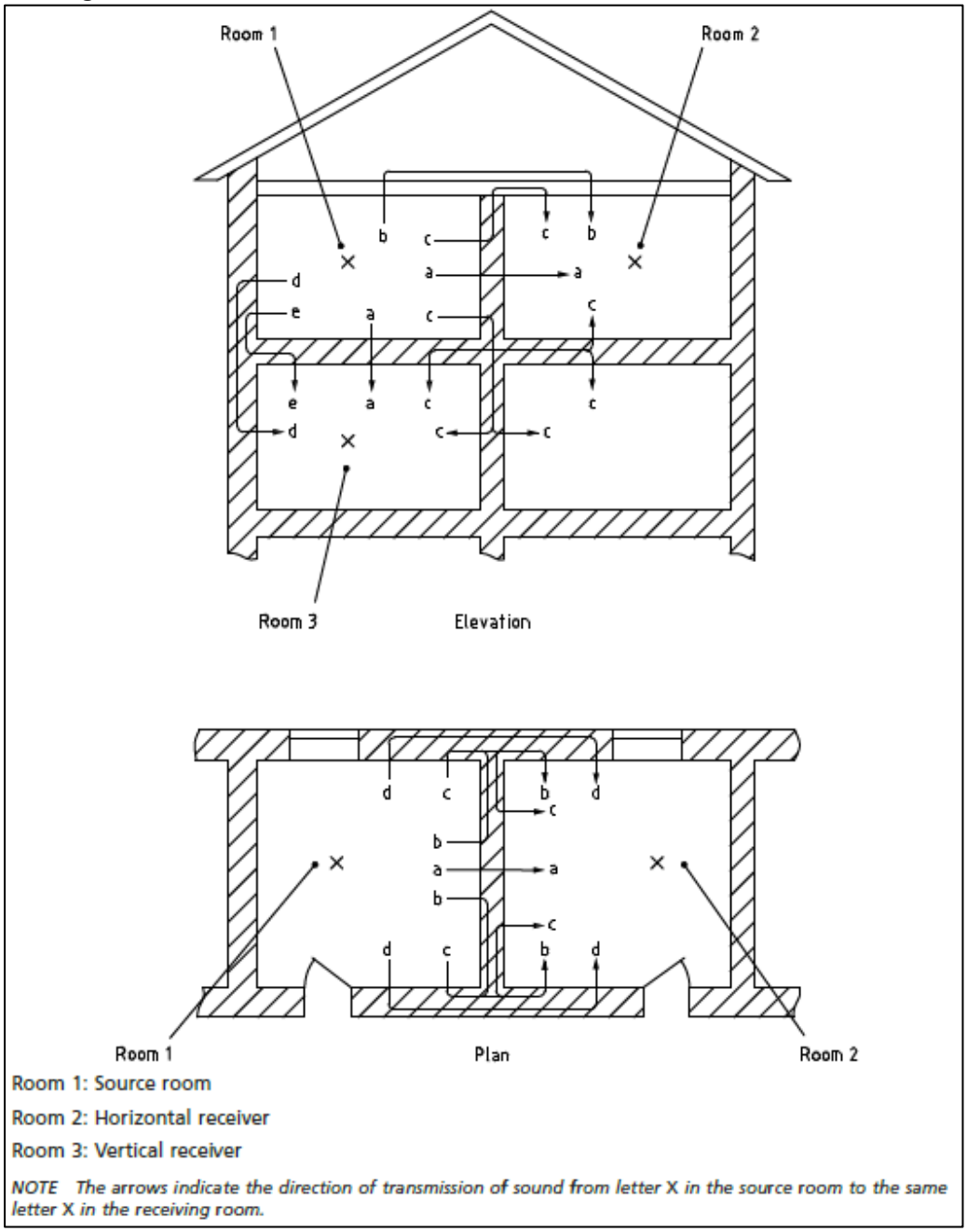
The following points should be considered:

- the floor slab density should be 2200kg/m^3;
- all voids between walls and floors should be filled;
- ensure the Acoustic Mat is fully bonded to the slab with adhesive;
- ensure the Acoustic Mat fully covers the floor surface;
- ensure the ceiling void is a minimum of 150mm and ceiling treatment is installed to manufacturer's instructions;
- ensure that floor slab breaks the vertical continuity of flanking walls;
- ensure that concrete does not enter the cavity and bridge between the two leaves; and
- flanking strips should be installed around the perimeter of the flooring board to isolate floor from walls and skirtings. Flanking strips should be installed to manufacturers instructions.

7.6 Flanking Transmission

Sound can travel not only through the partition that separates two rooms but also via other elements in the building. When sound travels through these other building elements it is referred to as flanking transmission. Figure 7.6 [8] overleaf illustrates how flanking sound can detract from the level of sound insulation between spaces.

Figure 7.6: Illustrating the Difference Between Sound Transmitted Directly (A- A) Through A Common Area and Flanking Transmission



Room 1: Source room

Room 2: Horizontal receiver

Room 3: Vertical receiver

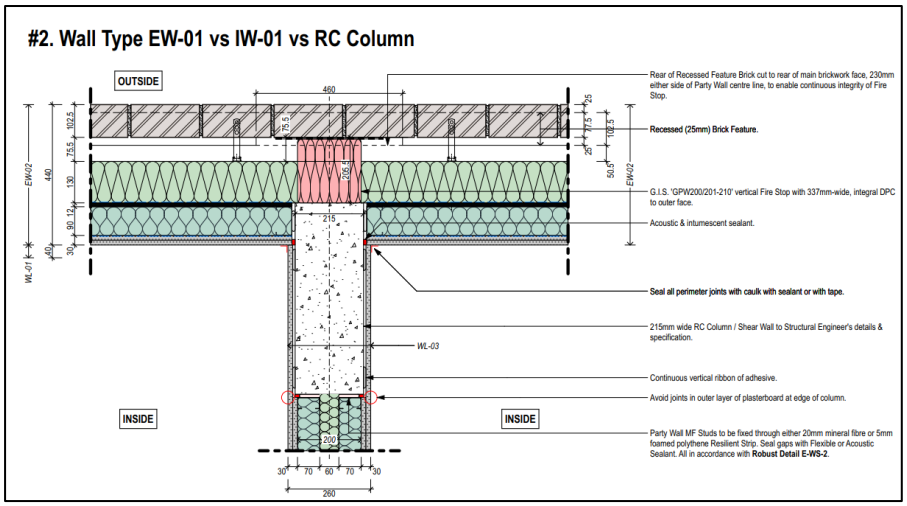
NOTE The arrows indicate the direction of transmission of sound from letter X in the source room to the same letter X in the receiving room.

Flanking transmission allows sound to enter the adjacent room even if the separating surface itself is heavily engineered.

Care should be taken to correctly detail the junctions between the separating walls and other elements, such as floors, roofs, external walls and internal walls.

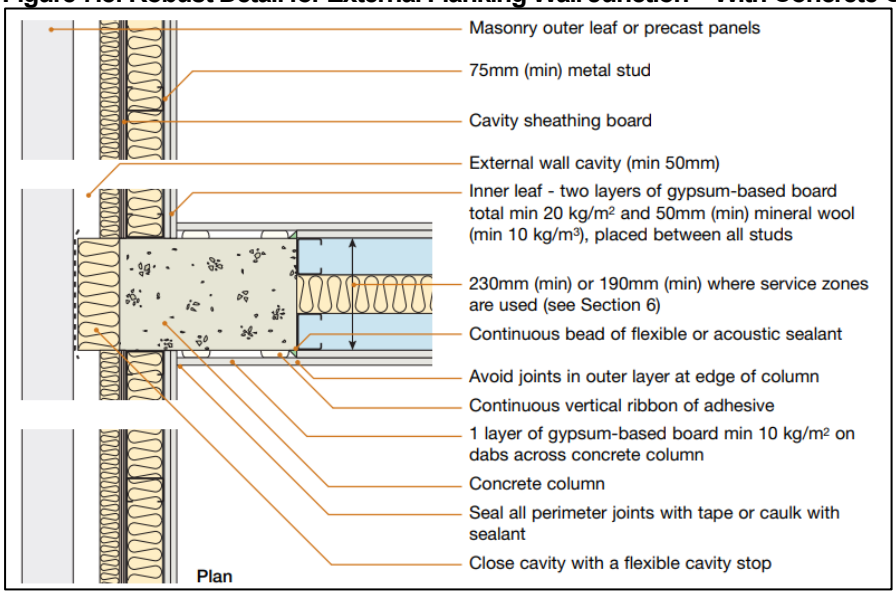
7.7 Separating Wall - External Wall Junction

The separating wall junction with the external wall is a key junction that should be suitably detailed. The current detail for the external wall **(Drawing no. Wall Types Sheet 2 Rev T2)** and separating wall junction is illustrated in Figure 7.7 below.**Figure 7.7: Proposed External Flanking Wall Junction – With Concrete Column**



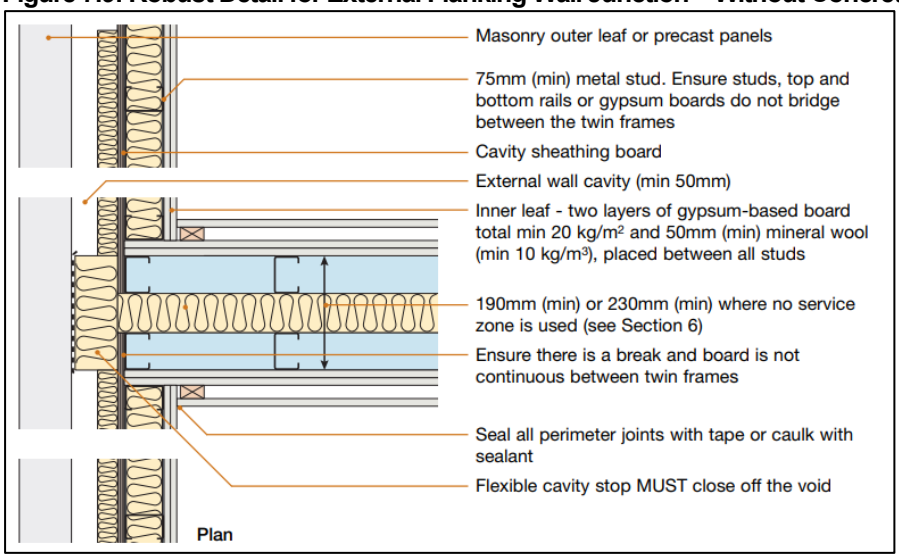
The flanking control considerations above appear to follow the Robust Details (Figure 7.8 below). Based on this, the above details are noted to be suitable from an acoustic design standpoint.

Figure 7.8: Robust Detail for External Flanking Wall Junction – With Concrete Column



Where there is an external wall junction without concrete column, key elements of the detail include the inner leaf (of the external wall) and rigid insulation are discontinuous at the junction with the separating wall. All joints between the plasterboard linings should be caulked with flexible mastic sealant. Additional mineral wool should be placed within the external wall in the junction zone (if not already part of the wall build-up), as shown below in Figure 7.9.

Figure 7.9: Robust Detail for External Flanking Wall Junction – Without Concrete Column



7.8 Separating Floor – External Wall Junction

The current detail **(Drawing no. Window Reveals Sheet 1 Rev T2)** for the external wall and separating floor junction is illustrated in Figure 7.10 below:

Figure 7.10: Proposed External Wall to Floor Junction Detail

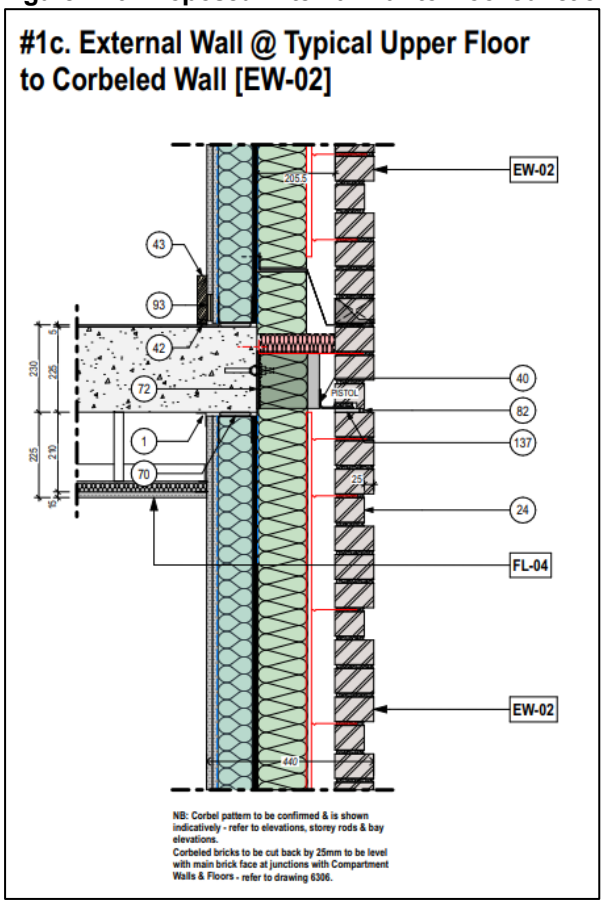
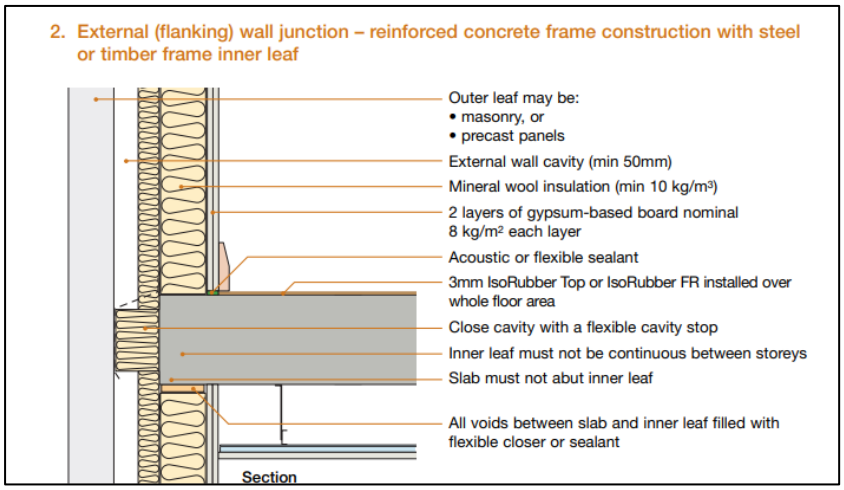


Figure 7.11 below shows an example of an external wall to floor junction.

Figure 7.11: Robust Details Example of External (Flanking) Wall junction

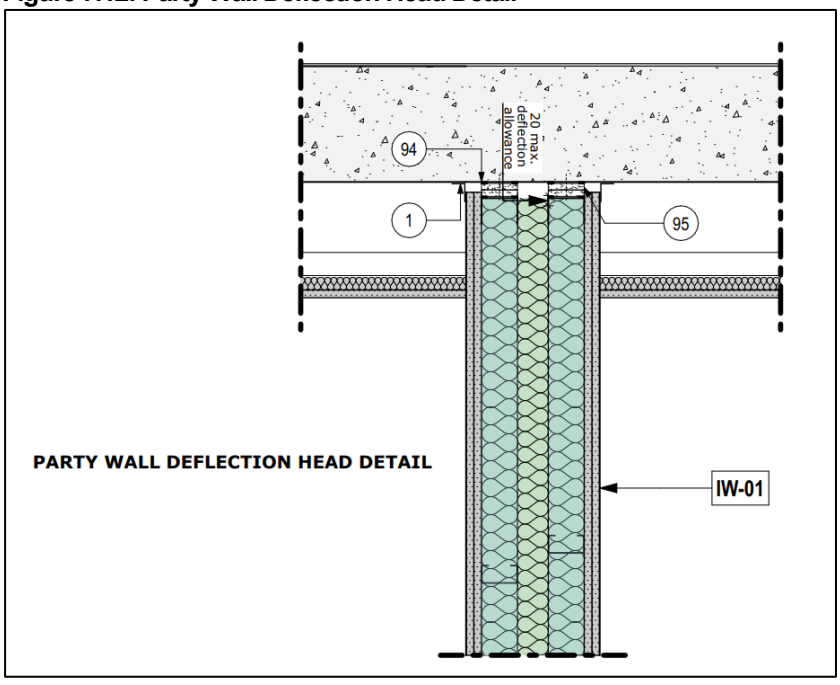


The flanking control considerations above appear to follow most of the Robust Details and includes the use of a flexible cavity stop. However, the proposed detail includes a masonry support bracket, which is understood to take the external masonry load and apply it back to the structure of the supporting building. This product could potentially create a flanking path for noise and care should be taken during installation. As a precaution, it is recommended that the face of the bracket which comes into contact with the floor slab, is wrapped with an isolation material, such as YELOfon screed underlay. It is also important that manufacturers installation details for the masonry support brackets are followed correctly.

7.9 Separating Wall and Separating Floor

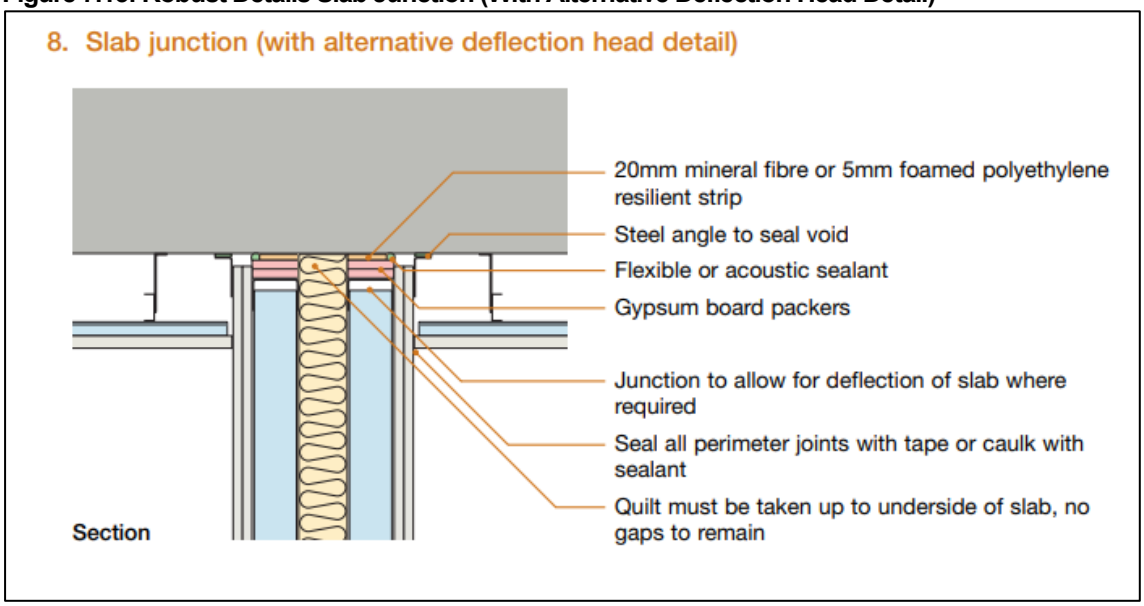
The deflection head detail **(Drawing no. Deflection Head Detail Rev T1)** has been provided for the separating wall and floor junction detail and is illustrated in Figure 7.12 below:

Figure 7.12: Party Wall Deflection Head Detail



A typical detail setting out the design intent for the separating wall and floor junction is set out below in Figure 7.13.

Figure 7.13: Robust Details Slab Junction (With Alternative Deflection Head Detail)



The proposed details appear to be in line with the Robust Details provided above. The use of steel angles and the acoustic sealant are evident.

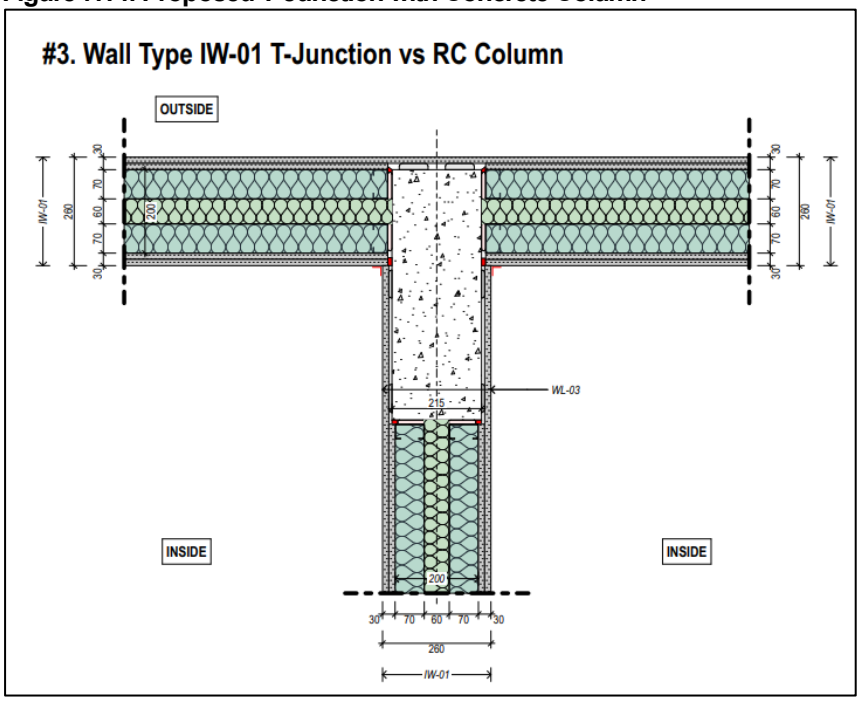
A detail for the upper side of the floor has not been received. However, all the comments made in section 7.5 will still apply. The key is to ensure the partition is built off the slab.

Edge strips should be included around the skirting and final floor finish.

7.10 Separating Wall Internal Junctions

The junction between separating wall and corridor wall should be detailed appropriately to ensure flanking transmission is minimised across the junction. The proposed detail **(Drawing no. Wall Types Sheet 2 Rev T2)** is illustrated in Figure 7.14 below. This detail shows where the separating wall meets an RC column.

Figure 7.14: Proposed T-Junction with Concrete Column

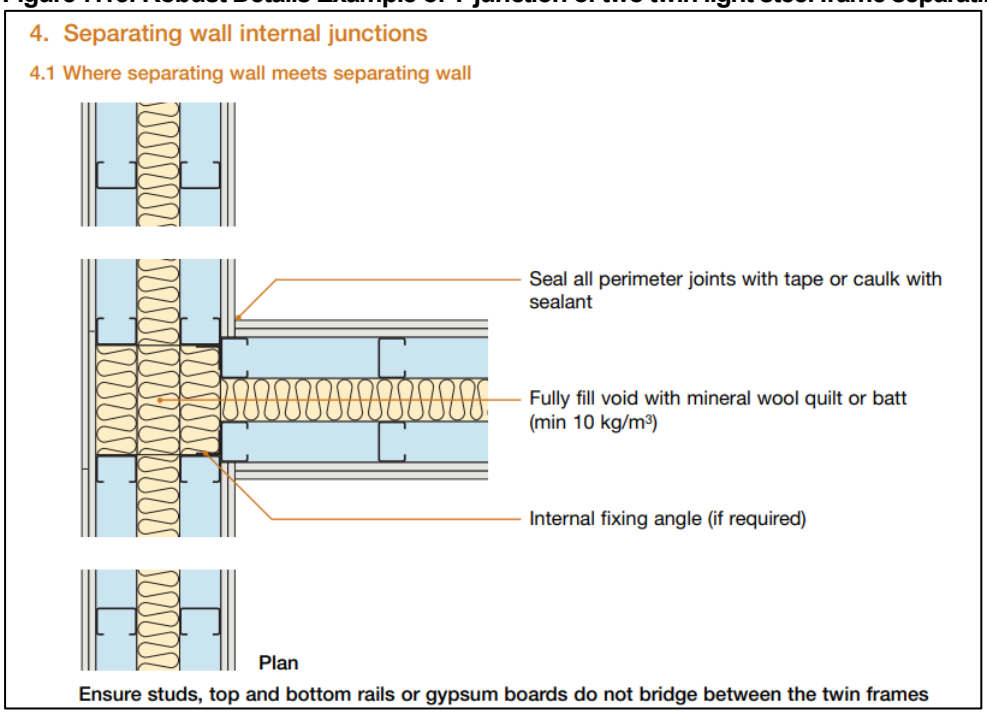


Robust details advises that all joints should be sealed with tape or caulked with sealant and a minimum of 50mm mineral wool is placed between studs for the first 600mm. This is evident in the proposed detail.

Robust details also recommends that steel or timber battens should be positioned around the concrete column to separate the column from the inner or outer partitions. The recommendations provided in Section 7.4 regarding offsetting the concrete column should be followed, if practicable to do so.

Where there is a T-junction without a concrete column, the key is to ensure the inner lining of the flank wall (e.g. corridor wall) is not continuous across the separating wall. All joints should be sealed with tape or caulk with sealant and the voids should be fully filled with mineral wool. The design should ensure that studs, top and bottom rails or gypsum boards do not bridge between the twin frames. An example of a separating internal wall junction is shown below in Figure 7.15.

Figure 7.15: Robust Details Example of T-junction of two twin light steel frame separating walls



Again, the key is to ensure the inner lining of the flank wall (e.g. corridor wall) is not continuous across the separating wall. You should ensure that studs, top and bottom rails or gypsum boards do not bridge between the twin frames.

7.11 Service Penetrations and Steel Beams

It is expected that service penetrations will be required throughout the building.

Pipes and ducts that penetrate a floor separating two habitable rooms in different flats should be enclosed to their full height in each flat.

The enclosure should be constructed of a material having a mass per unit area of at least 15kg/m^2.

Either line the enclosure, or wrap the duct/pipe within the enclosure, with 25mm of unfaced mineral wool.

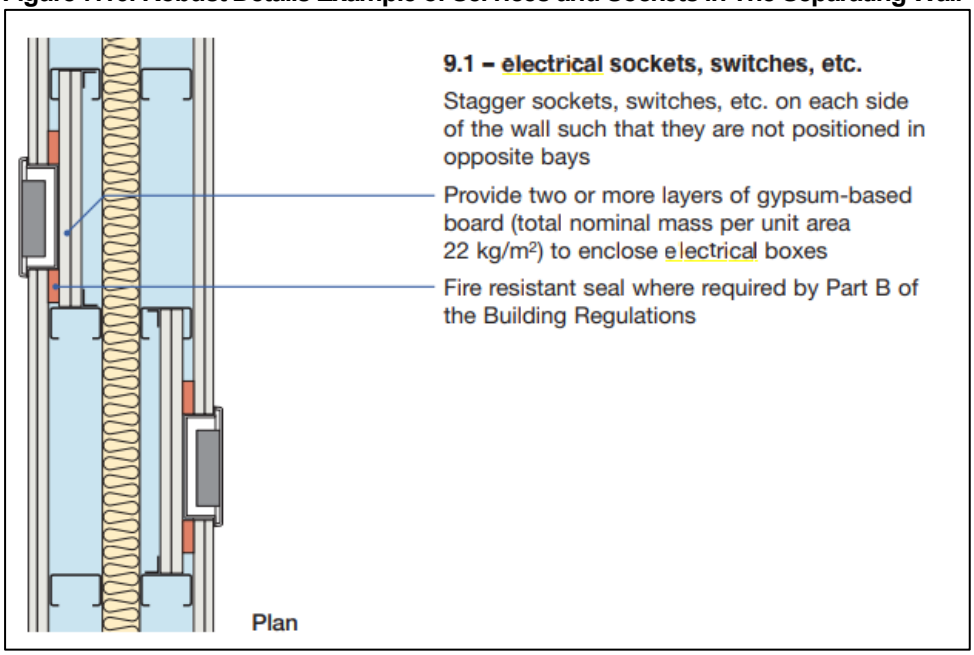
The requirement for SVPs as identified in the Building Regulations for acoustics is pretty minimal (single layer OR double layer of plasterboard min mass 15Kg/m^2 and mineral fibre wrap around the pipe). However, noise from water flow through the pipe is a known issue especially if there are a crossover of zones (i.e. bathroom to bedroom or living rooms).

Where there are offsets or horizontal runs across habitable spaces (bedrooms, living rooms etc.), it is recommended that acoustically treated pipes are used (e.g. db12 pipework) wrapped in muftilag, we would recommend that the horizontal sections of pipes are boxed out with 2 layers of 12.5mm standard plasterboard.

Although this does not imply 100% inaudibility of the water noise or that there will be no complaints relating to this issue, the design would avoid significant water noise issues and will have demonstrated a standard that goes beyond the Building Regulations.

Sound penetrating through gaps in walls such as electrical sockets will reduce its insulation of airborne sound. To ensure the sound insulation is not reduced with the installation of electrical sockets or switches, the Robust Details Handbook provides the guidance specified, as shown in Figure 7.16.

Figure 7.16: Robust Details Example of Services and Sockets in The Separating Wall



7.12 Ceiling Downlighters and Recessed Lighting

To enable downlighters and recessed lighting to be installed in the ceiling, the ceiling void must be at least 150mm and they need to be installed;

- At no more than one light per $2m^2$ of ceiling area in each room;
- At centers of not less than 0.75m; and
- Into openings not exceeding 100mm diameter or 100mm x 100mm.

7.13 Internal Walls

Most internal wall constructions within individual flats need to be designed to provide 40 dB R_w for compliance with Requirement E2 of the Building Regulations.

It is understood that the proposed construction will be single leaf metal stud walls as follows:

- 15mm KNAUF Plasterboard;
- 70mm KNAUF 'C' studs at 600mm centers;
- 25mm acoustic insulation where habitable rooms meet; and
- 15mm KNAUF Plasterboard.

An INSUL calculation of the proposed system predicts R_w 43dB. The configuration can be considered to achieve the E2 requirements.

Where there is a door in the partition, the mineral wool may be omitted.

7.14 Reverberation time requirements

The reverberation in common areas, such as the stairwell, should be controlled. This will help reduce the noise at source in the stairwell, reducing the likelihood that it will cause disturbance to the proposed flats. At this stage, if the precise material selections are not yet known, we would recommend adopting Method A.

Method A

For entrance halls, corridors and hallways, an area equal to the floor area should be fitted with a class C absorber or better.

For stairwells, the combined area of the stair treads, the upper surface of the intermediate landings, the upper surface of the landings (excluding ground floor) and the ceiling area on the top floor should be calculated. An area equal to at least 50% of this calculated area should be fitted with a Class C absorber or better or 100% with a Class D absorber[9].

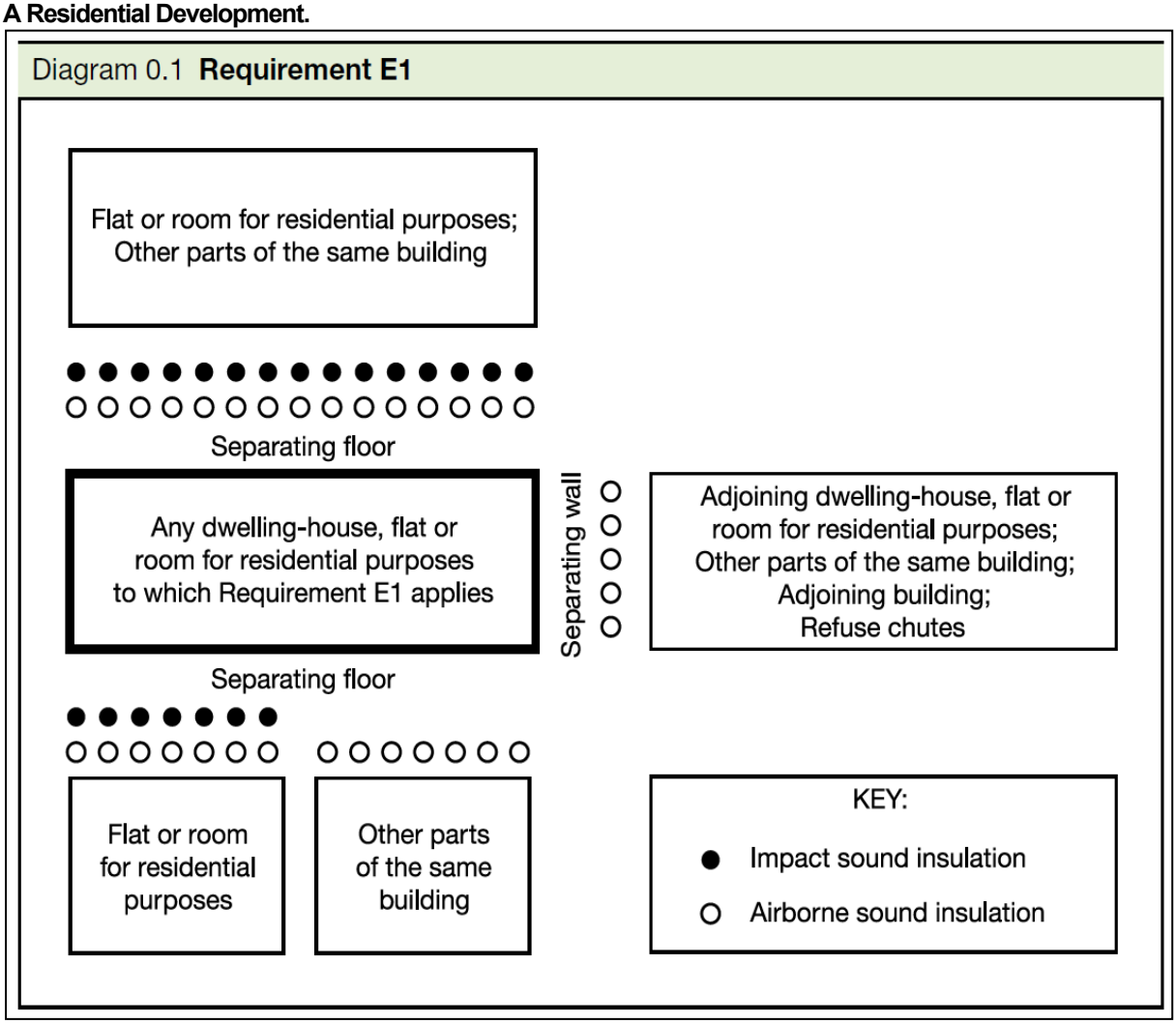
The absorptive material should be equally distributed between all floor levels. It will normally be convenient to cover the underside of intermediate landings, the underside of the other landings, and the ceiling area on the top floor.

Several proprietary products are available on the market and provided the manufacturer can provide valid test results to substantiate any performance claims, acoustic requirements are expected to be met.

7.15 Testing Requirements

One set of tests is conducted for every ten properties in a group or sub-group. A group is defined by the type of property and a sub-group is defined by the construction methods that have been used. Normally, one set of tests in a group of flats should comprise six individual sound insulation tests (two airborne wall tests, two airborne floor tests and two floor impact tests). The number of required tests is summarised in Figure 7.17.

Figure 7.17: Diagram 0.1 From ADE 2003 Illustrating Where Sound Insulation Testing Should Be Carried Out in A Residential Development.



Ideally, testing would be carried out when the development is essentially complete but prior to decoration.

8 SUMMARY AND CONCLUSIONS

7th Wave Acoustics (7wa) has been appointed by PMC Construction Ltd, to prepare a noise and vibration assessment to support the discharge of Conditions 37 and 47 attached to the planning consent (Ref: AWDM/0511/21) for the new mixed-use development at Kingston Wharf, Shoreham-by-Sea.

To support the discharge of Condition 37, a review of the proposed lift shaft construction, including the proposed wall lining construction where the lift shaft is adjacent to habitable rooms, has been undertaken.

The proposal for the lift shaft construction is considered suitable for controlling noise transfer from the lift shaft into adjoining habitable rooms and would provide a level of sound insulation that would enable sound from the lift shaft to not exceed 30dB $L_{Aeq,\ 1\ hour}$ within residential units.

Recommendations to prevent the transmission of excessive vibration and/or structure-borne noise to any parts of the living accommodation has been provided.

An assessment of noise from the proposed substations has also been undertaken. The assessment indicates that the substation noise levels inside the closest noise sensitive receptors, with windows open, would fall 3 dB or more below the 30dB $L_{Aeq,\ 1\ hour}$ criteria specified in planning Condition 37.

To support the discharge of Condition 47, a desktop assessment of the proposed new separating wall and floor constructions has been undertaken.

Key recommendations for proposed wall and floor constructions, and junction detailing to avoid flanking transmission, have been put forward based on the guidance contained in ADE2003 and other manufacturer's literature.

The recommendations also consider how reverberation within the common parts of the building and includes details of the sound testing requirements.

9 REFERENCES

1. Adur District Council. Planning Permission. Ref: AWDM/0204/20.
2. International Organisation for Standardisation. ISO 9613-2:1996. Acoustic - Attenuation of sound during propagation outdoors: Part 2: General method for calculation. 1996.
3. Study of Noise Produced by Elevators Inside Buildings. Dr. Mihaela Picu. 2007.
4. Approved Document E 2003 (2015 Amendments) “Resistance to the passage of sound”.
5. BS EN ISO 11654:1997 “Acoustics: Sound absorbers for use in buildings. Rating of sound absorption”
6. Approved Document E 2003 (2015 Amendments), Paragraph 2.26.
7. Robust Details Handbook. Part E. 4th Edition.
8. BS8233:2014 ‘Guidance on sound insulation and noise reduction for buildings’ Figure E1; Pg 54.
9. Approved Document E 2003 (2015 Amendments), Paragraph 7.10

APPENDIX A: FIGURES

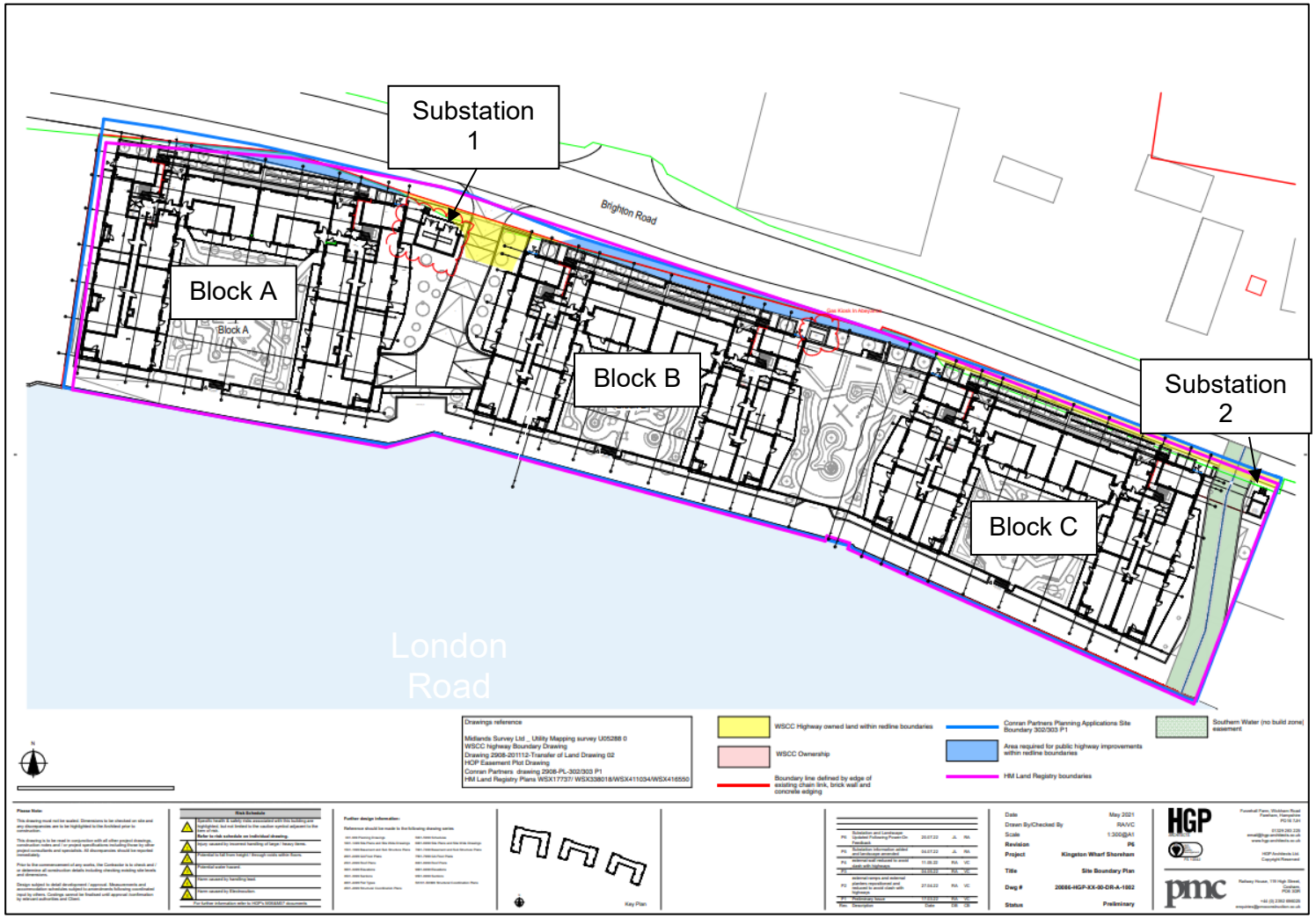


Figure A1: Site Location Plan Highlighting Location of Substations

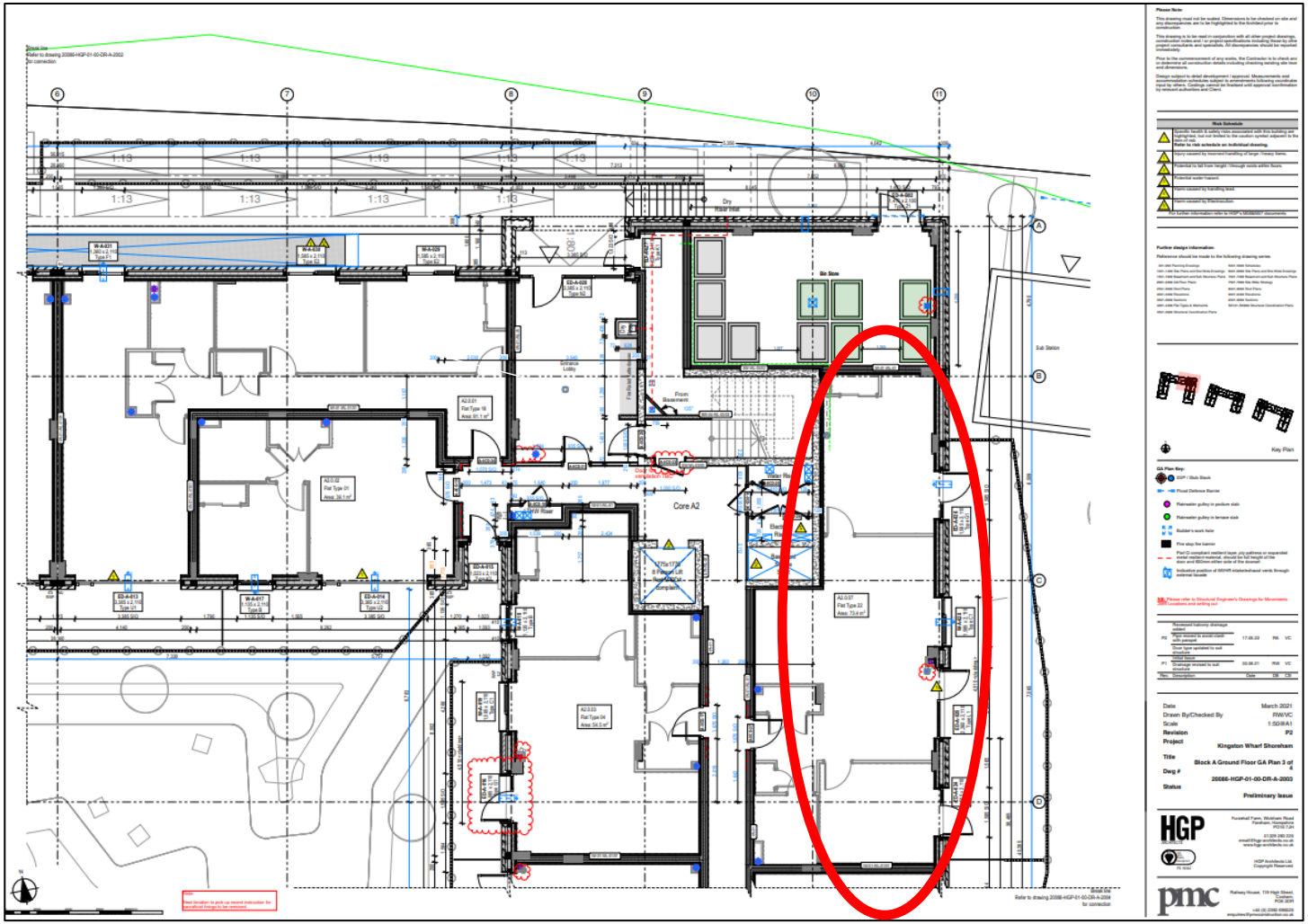


Figure A2: Noise Sensitive Receptor R1

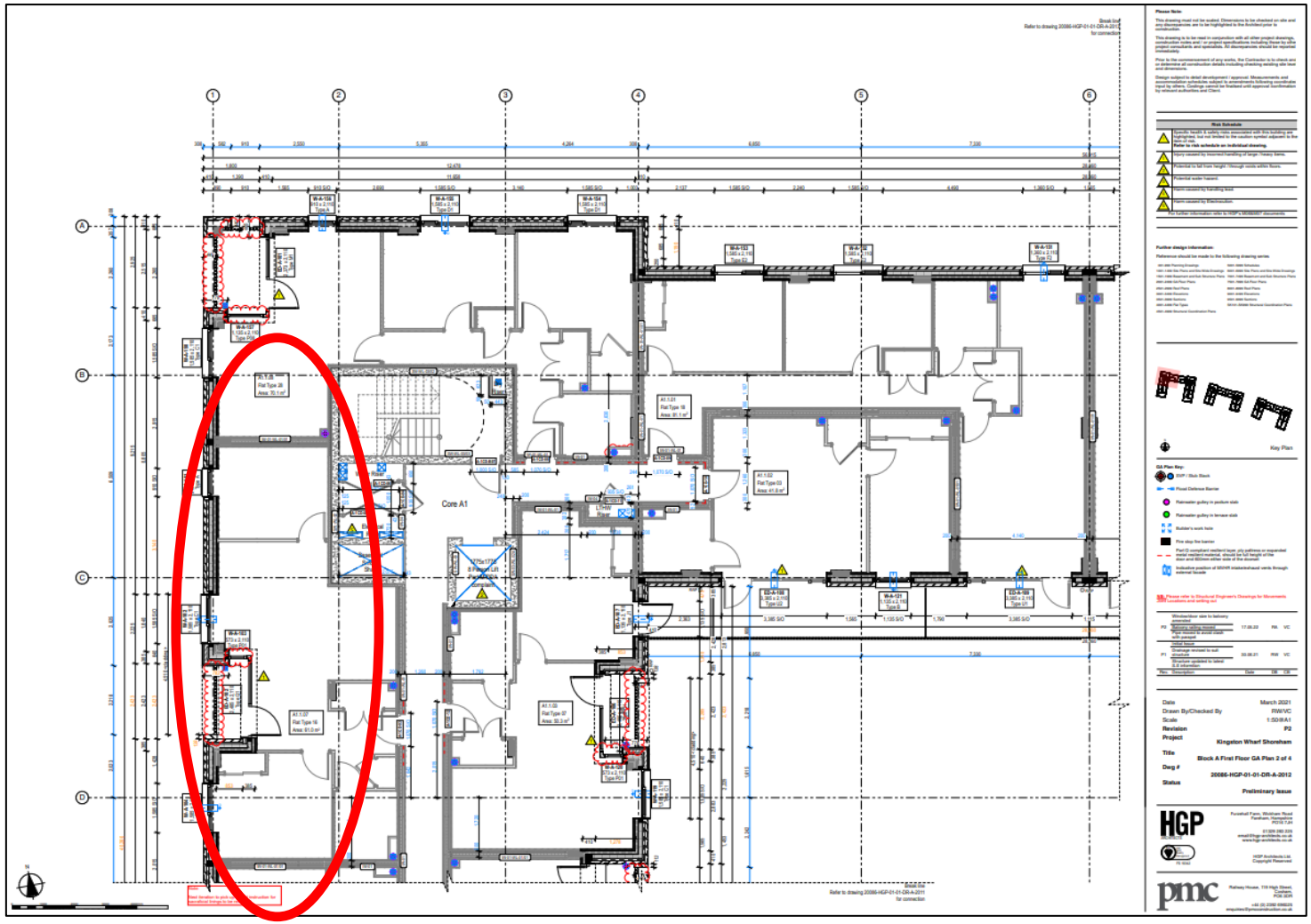


Figure A3: Noise Sensitive Receptor R2

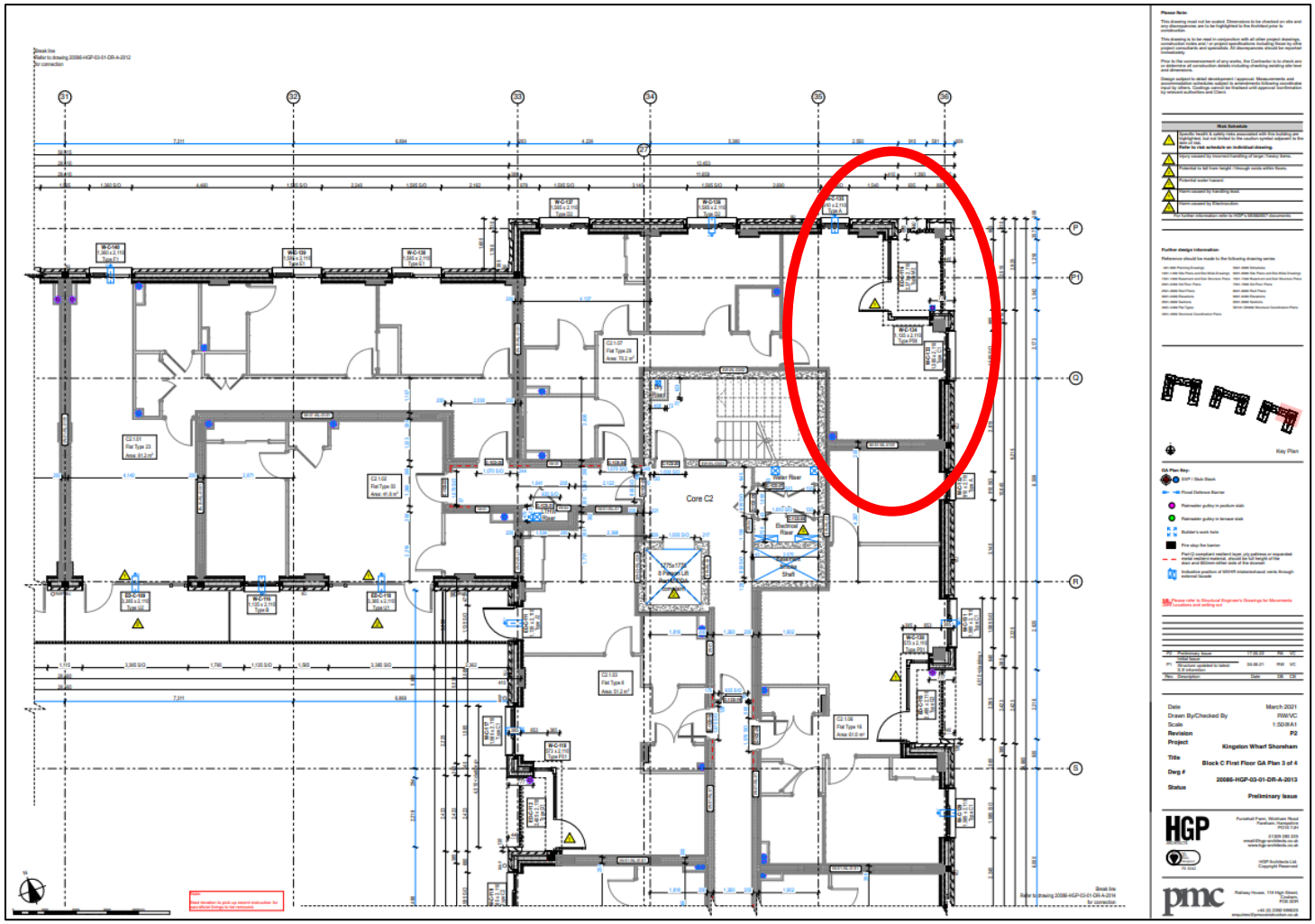


Figure A4: Noise Sensitive Receptor R3

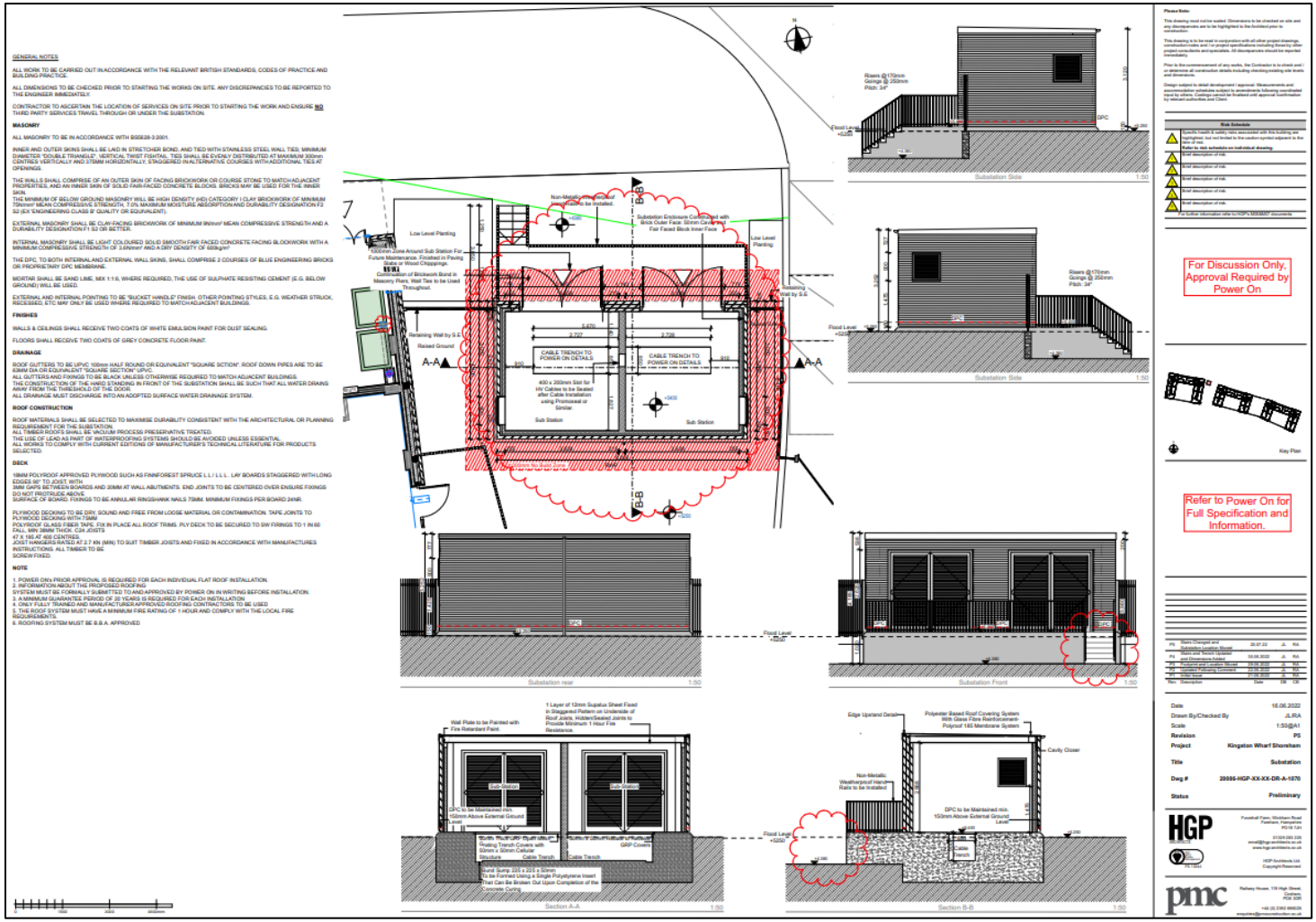


Figure A5: Substation 1 Design

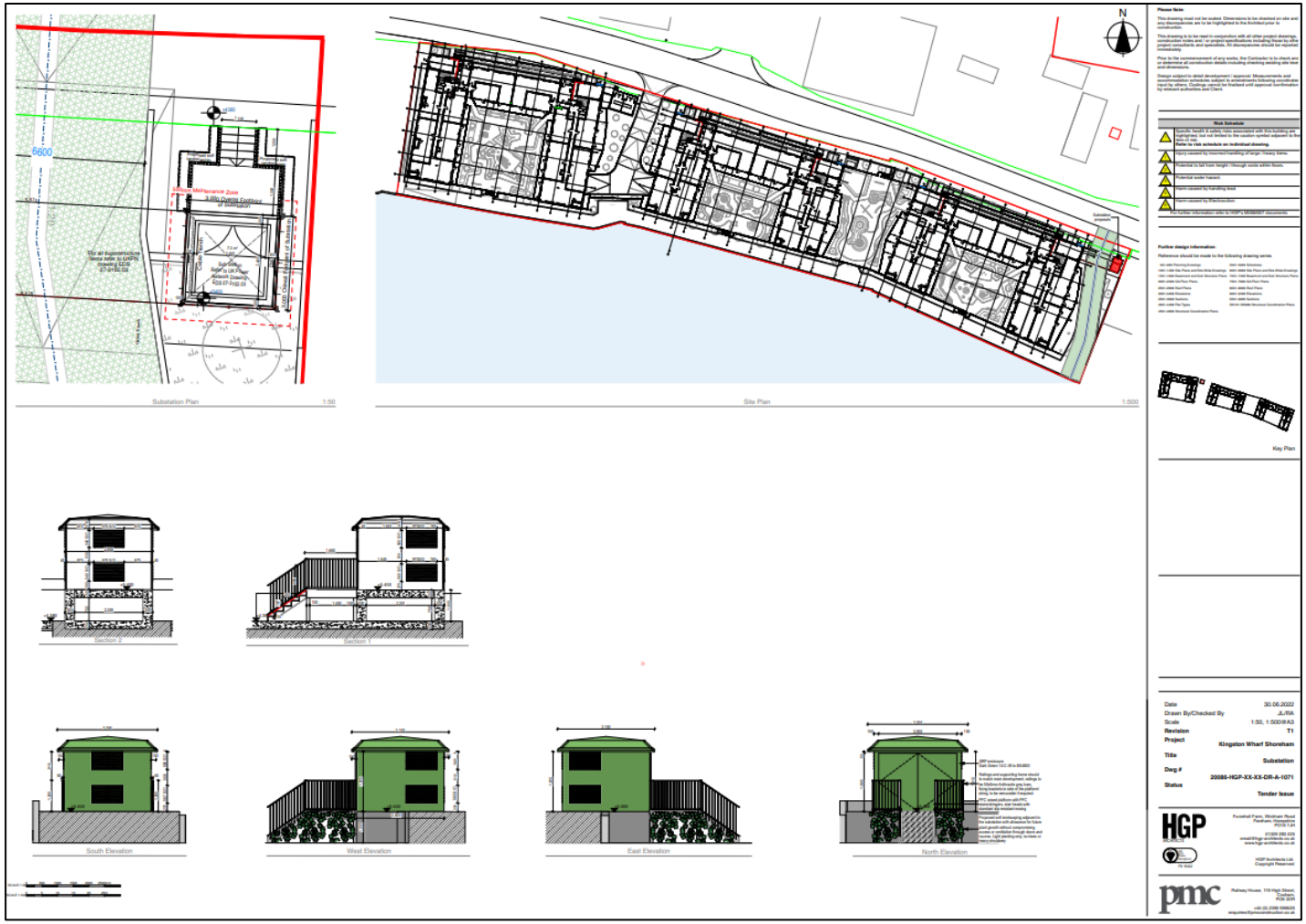
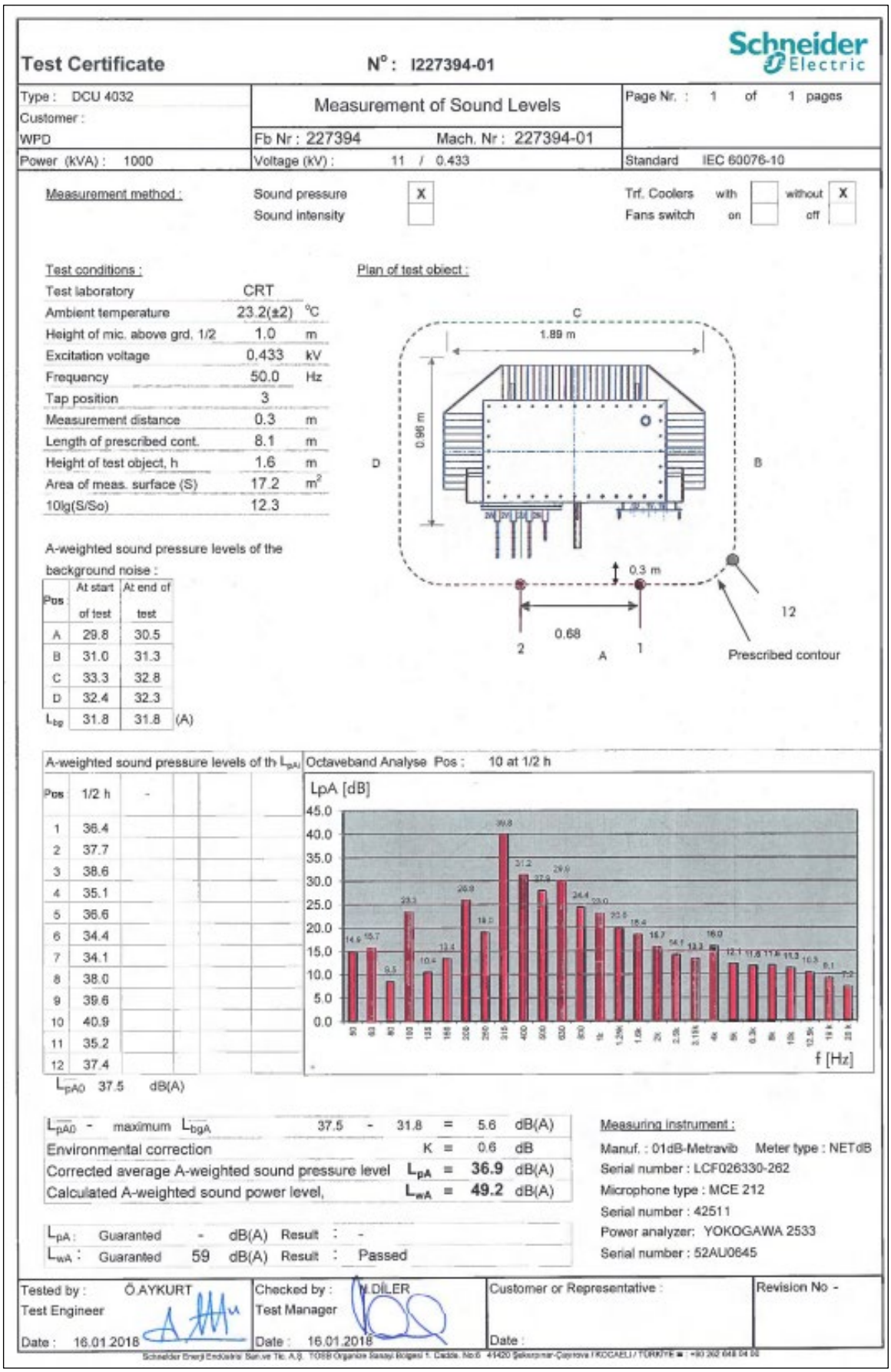


Figure A6: Substation 2 Design



Test Certificate N°: I227394-01 — Schneider Electric

Type: DCU 4032	Measurement of Sound Levels	Page Nr.: 1 of 1 pages
Customer: WPD	Fb Nr: 227394 Mach. Nr: 227394-01	
Power (KVA): 1000	Voltage (kV): 11 / 0.433	Standard IEC 60076-10

Measurement method: Sound pressure [X] Sound intensity [ ] — Trf. Coolers with [ ] without [X] Fans switch on [ ] off [ ]

Test conditions:

Test laboratory	CRT	
Ambient temperature	23.2(±2)	°C
Height of mic. above grd. 1/2	1.0	m
Excitation voltage	0.433	kV
Frequency	50.0	Hz
Tap position	3	
Measurement distance	0.3	m
Length of prescribed cont.	8.1	m
Height of test object, h	1.6	m
Area of meas. surface (S)	17.2	m^2
10lg(S/So)	12.3	

Plan of test object:

A-weighted sound pressure levels of the background noise:

Pos	At start of test	At end of test	
A	29.8	30.5	
B	31.0	31.3	
C	33.3	32.8	
D	32.4	32.3	
L_{bg}	31.8	31.8	(A)

A-weighted sound pressure levels of th L_{pA}

Pos	1/2 h
1	36.4
2	37.7
3	38.6
4	35.1
5	36.6
6	34.4
7	34.1
8	38.0
9	39.6
10	40.9
11	35.2
12	37.4

L_{pA0} 37.5 dB(A)

Octaveband Analyse Pos: 10 at 1/2 h

L_{pA0} - maximum L_{bgA}	37.5	- 31.8	=	5.6	dB(A)
Environmental correction			K =	0.6	dB
Corrected average A-weighted sound pressure level			L_{pA} =	**36.9**	dB(A)
Calculated A-weighted sound power level,			L_{wA} =	**49.2**	dB(A)

L_{pA}: Guaranteed	-	dB(A)	Result:	-
L_{wA}: Guaranteed	59	dB(A)	Result:	Passed

Measuring instrument:
Manuf.: 01dB-Metravib Meter type: NETdB
Serial number: LCF026330-262
Microphone type: MCE 212
Serial number: 42511
Power analyzer: YOKOGAWA 2533
Serial number: 52AU0645

Tested by: Ö.AYKURT Test Engineer Date: 16.01.2018	Checked by: N.DİLER Test Manager Date: 16.01.2018	Customer or Representative: Date:	Revision No -

Schneider Enerji Endüstrisi Satış ve Tic. A.Ş. TOSB Organize Sanayi Bölgesi 1. Cadde. No:6 41420 Şekerpınar-Çayırova / KOCAELİ / TÜRKİYE ■ : +90 262 648 04 00

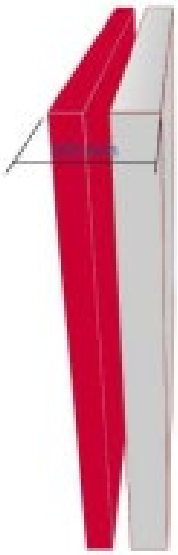
Figure A7: Transformer Noise Data

Sound Insulation Prediction (v9.0.23)

INSUL

Program copyright Marshall Day Acoustics 2017
Margin of error is generally within Rw ± 3 dB
Key No. 5531
Job Name:
Job No.:
Initials Jamie Pearson
Date 09/11/2022
File Name:

Notes



Rw 61 dB
C -1 dB
Ctr -7 dB

Mass-air-mass resonant frequency = 42 Hz
Panel Size = 2.7 m x 4.0 m
Partition surface mass = 170 kg/m²

System description

Panel 1 : 1 x 72 mm Brick

Frame: None (no connectors) (TE2 mm x 45 mm); Stud spacing 600 mm ; Cavity Width 50 mm
Panel 2 : 1 x 100 mm Aerated Concrete Block

freq.(Hz)	R(dB)	R(dB)
50	16	
63	26	20
80	32	
100	38	
125	42	41
160	46	
200	50	
250	52	51
315	52	
400	50	
500	67	55
630	70	
800	74	
1000	78	71
1250	67	
1600	73	
2000	77	76
2500	82	
3150	86	
4000	90	89
5000	93	

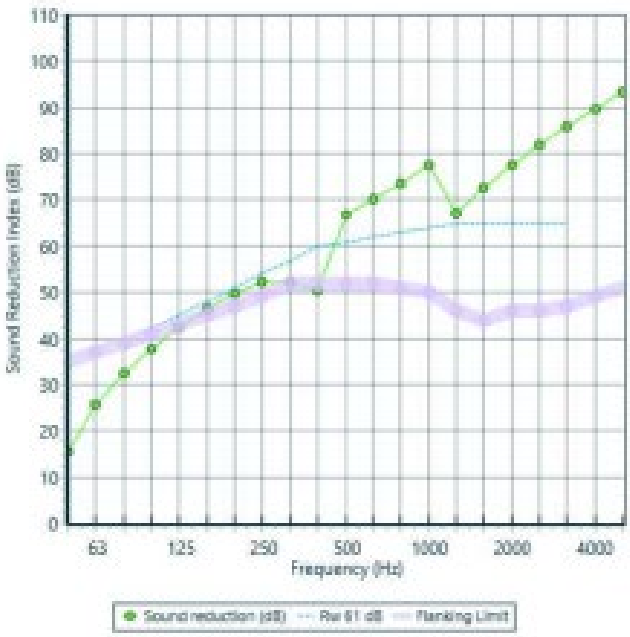


Figure A8: INSUL Calculation of Substation 1 - Walls

Sound Insulation Prediction (v9.0.23)

INSUL

Program copyright Marshall Day Acoustics 2017
Margin of error is generally within Rw ±3 dB
- Key No. 5531
Job Name:
Job No.: Initials:Jamie Pearson
Date:09/11/2022
File Name:

Notes:



Rw 31 dB
C -1 dB
Ctr -3 dB

Panel Size = 2.7 m x 4.0 m
Partition surface mass = 14.4 kg/m²

System description

Panel 1 : 1 x 12 mm NuClad

Frame: Solid Joist (162 mm x 45 mm), Stud spacing: 600 mm

freq.(Hz)	R(dB)	R(dB)
50	14	
63	15	15
80	16	
100	18	
125	19	19
160	20	
200	22	
250	24	23
315	25	
400	27	
500	28	28
630	30	
800	31	
1000	33	33
1250	34	
1600	35	
2000	35	33
2500	31	
3150	28	
4000	32	31
5000	35	

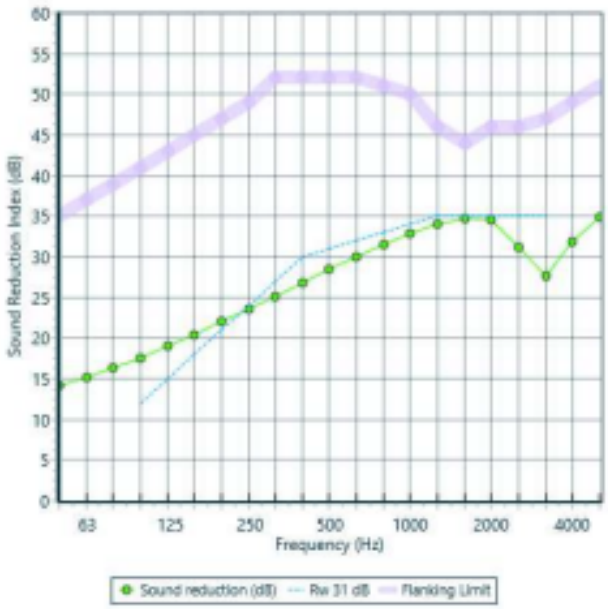


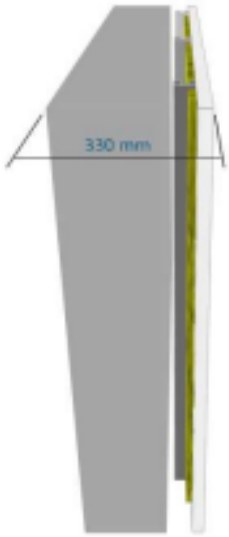
Figure A9: INSUL Calculation of Substation 1 - Roof

Sound Insulation Prediction (v9.0.8)

INSUL

Program copyright Marshall Day Acoustics 2017
margin of error is generally within Rw +/- 3 dB
- Key No. 5531
Job Name:
Job No.: Insulcircha
Date: 07/11/2022
File Name:

Notes:



Rw 84 dB
C -4 dB
Ctr -12 dB

Mass-air-mass resonant frequency = 44 Hz
Panel Size = 2.7 m x 4.0 m
Partition surface mass = 546 kg/m²

System description

Panel 1 : 1 x 225 mm Concrete

Frame: Right steel stud + air gap. Cavity Width 75 mm ,Stud spacing 600 mm , 1 x Fibreglass (10kg/m3) Thickness 25 mm
Panel 2 + 2 x 15 mm Gyproc Wallboard 15mm

Floor Cover Thickness 0.02 mm

freq.(Hz)	TL(dB)	TL(dB)
50	35	
63	43	39
80	50	
100	55	
125	58	58
160	66	
200	71	
250	76	74
315	80	
400	85	
500	89	88
630	93	
800	98	
1000	101	100
1250	104	
1600	106	
2000	108	108
2500	109	
3150	104	
4000	109	107
5000	113	

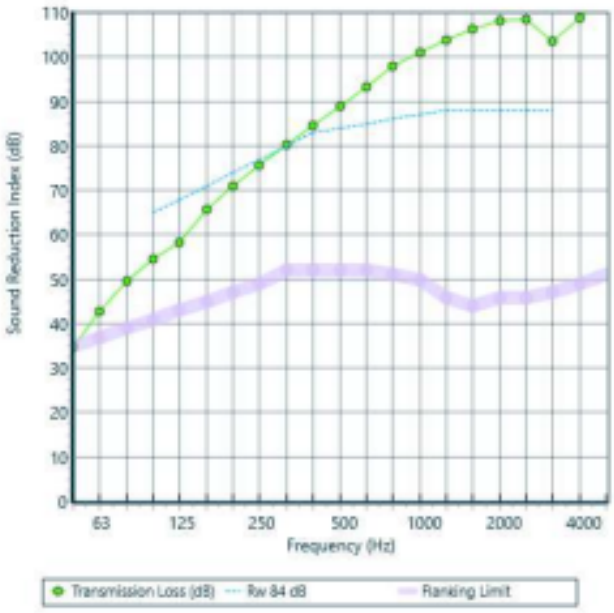


Figure A10: INSUL Calculation of Separating Lift Wall Construction with Lining

Sound Insulation Prediction (v9.0.23)

INSUL

Program copyright Marshall Day Acoustics 2017
Margin of error is generally within Rw ±3 dB
- Key No. 5531
Job Name:
Job No.: Initials:Jamie Pearson
Date:11/11/2022
File Name:

Notes:



Rw 67 dB
C -3 dB
Ctr -6 dB

Mass-air-mass resonant frequency = ~31 Hz
Panel Size = 2.7 m x 4.0 m
Partition surface mass = 57.2 kg/m²

System description

Panel 1 : 2 x 15 mm Knauf SoundShield™ 15mm

Frame: Staggered Steel Stud (70 mm x 35 mm); Stud spacing 600 mm ; Cavity Width 200 mm ; 1 x Fibreglass (10kg/m3) Thickness 200 mm
Panel 2 : 2 x 15 mm Knauf SoundShield™ 15mm

freq.(Hz)	R(dB)	R(dB)
50	26	
63	33	30
80	39	
100	45	
125	49	48
160	53	
200	57	
250	60	59
315	63	
400	65	
500	67	67
630	69	
800	71	
1000	72	72
1250	73	
1600	73	
2000	70	64
2500	60	
3150	63	
4000	67	65
5000	70	

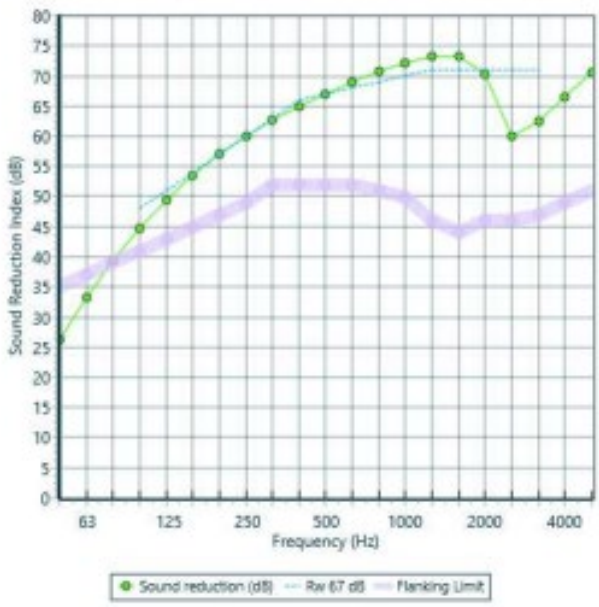


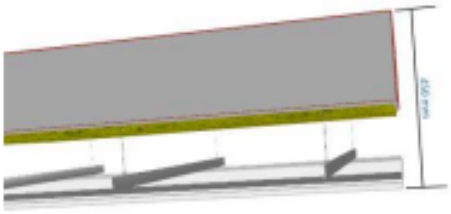
Figure A11: INSUL Calculation of Separating Wall Construction

Sound Insulation Prediction (v9.0.23)

INSUL

Program copyright Marshall Day Acoustics 2017
Margin of error is generally within Rw ±3 dB
- Key No. 5531
Job Name:
Job No.: Initials:Jamie Pearson
Date:09/11/2022
File Name:

Notes:



Rw 73 dB
C -2 dB
Ctr -6 dB

Mass-air-mass resonant frequency = ~35 Hz
Panel Size = 2.7 m x 4.0 m
Partition surface mass = 537 kg/m²

System description

Panel 1 : 1 x 225 mm Concrete

Frame: Suspended Light Steel Grid (2.1E2 mm x 45 mm); Stud spacing 600 mm ; Cavity Width 210 mm ; 1 x Fibreglass (10kg/m3) Thickness 25 mm ...
Panel 2 : 1 x 15 mm Knauf Wallboard 15mm

freq.(Hz)	R(dB)	R(dB)
50	41	
63	48	45
80	53	
100	57	
125	58	57
160	56	
200	59	
250	62	61
315	64	
400	67	
500	69	69
630	72	
800	74	
1000	76	76
1250	78	
1600	80	
2000	80	81
2500	83	
3150	94	
4000	98	97
5000	102	

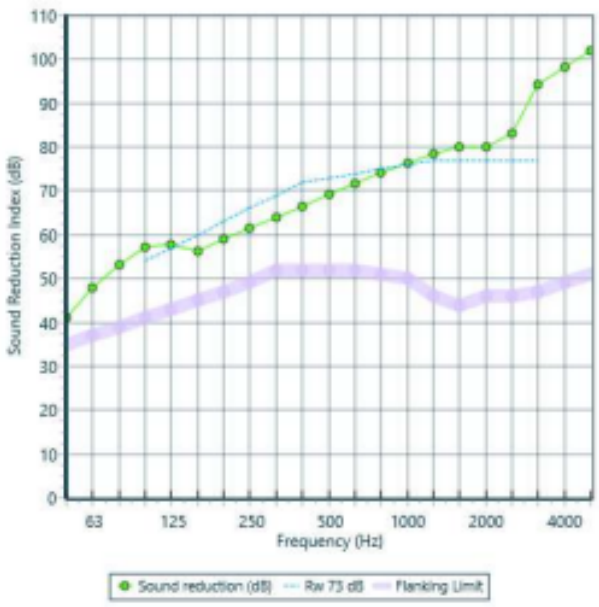


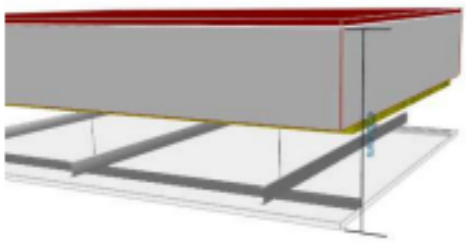
Figure A12: INSUL Calculation of Separating Floor Construction - Airborne

Sound Insulation Prediction (v9.0.23)

INSUL

Program copyright Marshall Day Acoustics 2017
Margin of error is generally within Ln,w ±5 dB
- Key No. 5531
Job Name:
Job No.: Initials:Jamie Pearson
Date:09/11/2022
File Name:

Notes:



Ln,w 41 dB

Mass-air-mass resonant frequency = 41 Hz
Panel Size = 2.4 m x 2.4 m
Partition surface mass = 537 kg/m²

System description

Panel 1 : 1 x 225 mm Concrete

Frame: Suspended Light Steel Grid (2.1E2 mm x 45 mm); Stud spacing 600 mm ; Cavity Width 210 mm ; 1 x Fibreglass (10kg/m3) Thickness 25 mm ...
Panel 2 : 1 x 15 mm Knauf Wallboard 15mm

Floor Cover: Regupol 4515 (4.5mm) under Timber (14mm) Glued Thickness 14 mm

freq.(Hz)	Ln(dB)	Ln(dB)
50	50	
63	43	52
80	44	
100	47	
125	46	51
160	45	
200	49	
250	48	54
315	50	
400	46	
500	37	47
630	31	
800	27	
1000	20	28
1250	12	
1600	8	
2000	5	11
2500	4	
3150	-4	
4000	-9	-3
5000	-13	

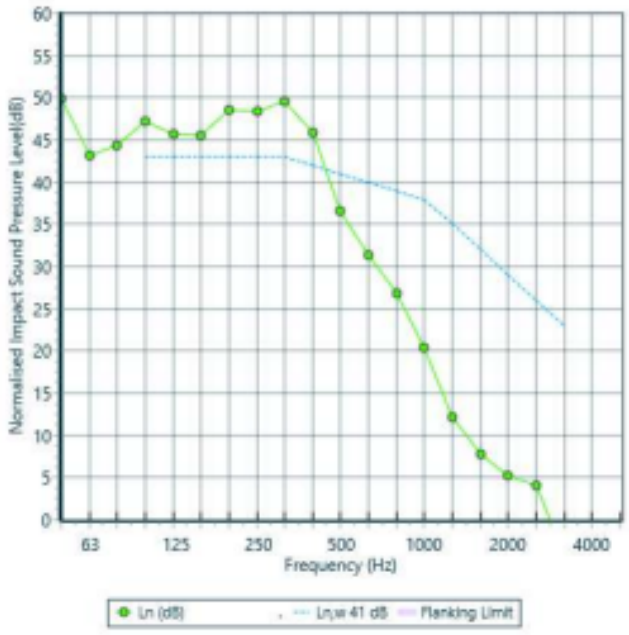


Figure A13: INSUL Calculation of Separating Floor Construction - Impact