Residential & Commerical Development

11-12 Grenville St, London WC1N 1LZ

soundsolution CONSULTANTS

Acoustic Design Report

TECHNICAL REPORT

37195 R1

11-12 Grenville St - Residential Development

Acoustic Design Report

Prepared for: Bartek Cmiel, 11-12 Grenville St, London WC1N 1LZ

Site location: 11-12 Grenville St, London WC1N 1LZ

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1 INTRODUCTION

1.1 Sound Solution Consultants (SSC) have been appointed to provide acoustic design advice for the proposed development known as 11-12 Grenville St, London WC1N 1LZ. The Site has been granted planning permission by London Borough of Camden Council (LBCC) (ref. 21/00230/PFUL2 (PP-09431799)) subject to a number of planning conditions, some of which are related to noise and are discussed in Section 3.

1.2 As part of the appointment, an environmental sound survey has been undertaken and the results used to provide project acoustic requirements and present acoustic guidance to inform the current design. In addition to this, background sound levels have been used to provide indicative limiting noise levels for proposed plant items, which would need to be achieved upon the installation and commissioning of building services units.

1.3 The design guidance, for internal sound insulation, within this report is based upon acoustic performance criteria contained in Part E of the Building Regulations. With recommended improvements above these as required by LBCC. It will be necessary that guidance is taken from others, in confirming structural (Part A) and fire integrity (Part B) of the acoustically suitable proposals.

1.4 If at any stage the detail within the specification document is unclear, or subject to further discussion, then it should be resolved before installation is attempted.

1.5 Site inspections are recommended to check and verify installation details during various construction phases. Visits are suggested to be arranged by the contracting site manager during the installation of separating walls, ceilings and floating floors.

1.6 A Glossary of Acoustic Terms can be found in Appendix A that may assist with the terminology used within this report.

1.7 A glossary of building materials can be found in Appendix B that may assist with the material requirements for building.

1.8 The principle aims of the acoustic design are summarised below:

- Minimise the environmental noise ‘break-in’ to noise sensitive spaces to provide suitable internal ambient noise levels;
- Achieve internal ambient noise levels within the various proposed areas that are applicable to their use;
- Control reverberant noise build-up within residential common areas to provide a suitable internal acoustic environment;
- Provide sufficient levels of sound insulation between spaces to maintain suitable levels of privacy and avoid disturbance from adjacent spaces; and
- Provide limiting levels for external plant items at nearest noise-sensitive receptors and indicative guidance to achieve these levels.

2 SITE DESCRIPTION

LOCATION

2.1 The proposed development is situated 11-12 Grenville St, London WC1N 1LZ (hereinafter, "The Site"). to the north of Central London. The Site is bounded to the east by Grenville Street and by existing residential properties to all other elevations.

2.2 A plan highlighting the boundary of The Site has been provided in Appendix C

PROPOSED DEVELOPMENT

2.3 The Site development involves the conversion of a three-storey building containing office spaces and a ground floor restaurant (Class A3 use) into a three-storey building comprising flats and retention of the ground restaurant (Class A3 use) as follows:

- 6 no. standard flats, Including a basement flat to the rear (BF to 3F);
- 1 no. restaurant (GF);
- Rooftop plant area (4F).

2.4 Development proposal drawings are presented in Appendix D.

EXISTING NOISE SENSITIVE RECEPTORS

2.5 Existing noise sensitive receptors (NSRs) surrounding the site comprise:

- Downing Court (adjacent to north of the site)
- 13 Grenville Street (adjacent to the south of the site); and
- Dwellings at Chandler House (8m to the west of the site).

3 DESIGN CRITERIA

PROFESSIONAL PRACTICE GUIDANCE: PLANNING & NOISE

3.1 Professional Practice Guidance on Planning and Noise has been developed by a working group consisting of representatives of the Association of Noise Consultants (ANC), Institute of Acoustics (IOA), Chartered Institute of Environmental Health (CIEH) and practitioners from a planning and local authority background. The guidance was made effective in May 2017 to provide a recommended approach to the management of noise within the planning system in England. The document draws upon the legislation, guidance and standards available at the time of publication and reflects the Noise Policy Statement for England (NPSE), the National Planning Policy Framework (NPPF) and Planning Practice Guidance (such as PPG-Noise), as well as other authoritative sources of guidance.

3.2 The guidance is intended to offer advice for Local Planning Authorities and developers, and their respective professional advisers and promises to:

- advocate full consideration of the acoustic environment from the earliest possible stage of the development control process;
- encourage the process of good acoustic design in and around new residential developments;
- outline what should be taken into account in deciding planning applications for new noise-sensitive developments.
- improve understanding of how to determine the extent of potential noise impact and effect; and
- assist the delivery of sustainable development.

3.3 The scope of ProPG considers new residential development that will be exposed to, predominantly, airborne noise from transportation sources. The ProPG recommended approach is outlined below.

"The two sequential stages of the overall approach are:

- *Stage 1 – an initial noise risk assessment of the proposed development site; and*
- *Stage 2 – a systematic consideration of four key elements*

The four key elements to be undertaken in parallel during Stage 2 of the recommended approach are:

- *Element 1 – demonstrating a "Good Acoustic Design Process";*
- *Element 2 – observing internal "Noise Level Guidelines";*
- *Element 3 – undertaking an "External Amenity Area Noise Assessment"; and*
- *Element 4 – consideration of "Other Relevant Noise Issues".*

The approach is underpinned by the preparation and delivery of an "Acoustic Design Statement" (ADS). An ADS for a site assessed as high risk should be more detailed than for a site assessed as low risk. An ADS should not be necessary for a site assessed as negligible risk."

3.4 The initial noise risk assessment of the site without noise mitigation is summarised in Figure 1, where the indicative noise levels *"…should be interpreted with a degree of flexibility having regard to the locality, the project and the wider context."* Therefore, indicative levels should not strictly be used to determine the noise risk.

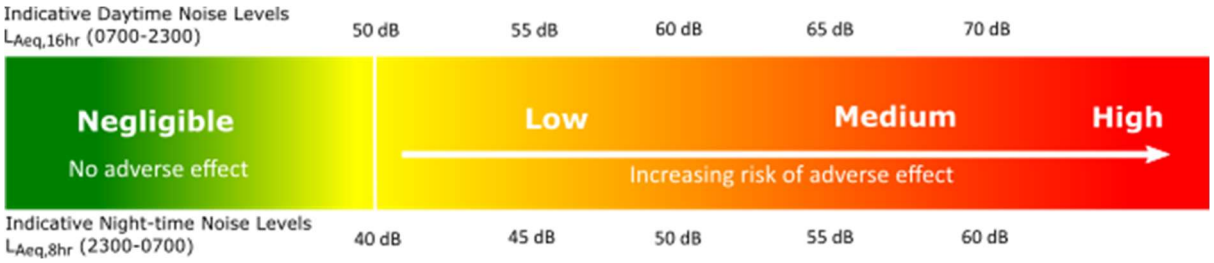


Figure 1 - Initial Site Noise Risk Assessment

3.5 ProPG also provides pre-planning application guidance based on the site noise risk, which relates proportionally to the importance of addressing noise issues through good acoustic design.

"[Noise levels considered to pose a negligible noise risk] indicate that the development site is likely to be acceptable from a noise perspective, and the application need not normally be delayed on noise grounds.

At low noise levels, the site is likely to be acceptable from a noise perspective provided that a good acoustic design process is followed and is demonstrated in the ADS which confirms how the adverse impacts of noise will be mitigated and minimised in the finished development.

As noise levels increase, the site is likely to be less suitable from a noise perspective and any subsequent application may be refused unless a good acoustic design process is followed and is demonstrated in an ADS which confirms how the adverse impacts of noise will be mitigated and minimised in the finished development.

High noise levels indicate that there is an increased risk that the development may be refused on noise grounds. This risk may be reduced by following a good acoustic design process that is demonstrated in a detailed ADS. Applicants are strongly advised to seek expert advice."

3.6 In cases where the site is exposed to noise of an industrial and/or commercial nature, the document provides guidance which should be considered at Stage 1 of the ProPG approach.

"In the case where industrial or commercial noise is present on the site but is "not dominant" (i.e. where the impact would be rated as lower than adverse (subject to context) if a BS4142:2014 assessment was to be carried out), its contribution may be included in the noise level used to establish the degree of risk (and if included, this should be clearly stated).

Where industrial or commercial noise is present on the site and is considered to be "dominant" (i.e. where the impact would be rated as adverse or greater (subject to context) if a BS4142:2014 assessment was to be carried out), then the risk assessment should not be applied to the industrial

or commercial noise component and regard should be had to the guidance in BS4142:2014. The judgement on whether or not to undertake a BS4142 assessment to determine the dominance should be proportionate to the level of risk. In low risk cases a subjective judgement of dominance, based on audibility, would normally be sufficient."

NATIONAL PLANNING POLICY FRAMEWORK (NPPF)

3.1 The Department for Communities and Local Government introduced the National Planning Policy Framework (NPPF) in March 2012. The Framework replaced most planning policy, circulars and guidance including Planning Policy Guidance 24: Planning and Noise (1994). The NPPF defines the Government's planning policy for England and sets out the framework, within which local authorities must prepare their local and neighbourhood plans, reflecting the needs and priorities of their communities. The Government's stated purpose in producing the NPPF is to streamline policy so the planning process is less restrictive and provide a more easily understood framework for delivering sustainable development.

3.2 With particular reference to noise, under the heading of "Conserving and Enhancing the Natural Environment", aims are detailed in Section 123 of the NPPF. It is stated that planning policies and decisions should aim to:

- Avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of the new development;
- Mitigate and reduce to a minimum, other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions;
- Recognise that development will often create some noise and existing business wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established, and
- Identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prised for their recreational and amenity value for this reason.

3.3 Further NPPF aims related to noise include:

Section 109: The planning system should contribute to and enhance the natural and local environment by: preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability;

Section 111: Planning policies and decisions should encourage the effective use of land by re-using land that has been previously developed (brownfield land), provided that it is not of high environmental value. To prevent unacceptable risks from pollution and land instability, planning policies and decisions should ensure that new development is appropriate for its location. The effects (including cumulative effects) of pollution on health, the natural environment or general amenity, and the potential sensitivity of the area or proposed development to adverse effects from pollution, should be taken into account...

3.4 The NPPF acknowledges that there is a host of existing sources of national and international guidance which can be used, in conjunction with the Framework, to inform the production of Local Plans and decision making.

NOISE POLICY STATEMENT FOR ENGLAND (NPSE)

3.5 The Noise Policy Statement for England (NPSE) was published in March 2010. It sets out the long-term vision of government noise policy, which is fundamentally to: "Promote good health and good quality of life through the effective management and control of noise within the context of Government policy on sustainable development". The vision is supported by three key aims:

- Avoid significant adverse impacts on health and quality of life;
- Mitigate and reduce to a minimum, other adverse impacts on health; and
- Where possible, contribute to the improvement of health and quality of life.

3.6 The NPSE should apply to all forms of noise including environmental noise, neighbour noise and neighbourhood noise but does not apply to noise in the workplace. The NPSE adopts the following concepts, to help consider whether noise is likely to have "significant adverse" or "adverse" effects on health and quality of life:

SOAEL – Significant Observed Adverse Effect Level.

This is the level above which significant adverse effects on health and quality of life occur.

LOAEL – Lowest Observed Adverse Effect Level.

This is the level above which adverse effects on health and quality of life can be detected.

NOEL – No Observed Effect Level.

This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.

3.7 The NPSE emphasises that:

"It is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times. It is acknowledged that further research is required to increase our understanding of what may constitute a significant adverse impact on health and quality of life from noise. However, not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available (Defra, 2010)."

NATIONAL PLANNING PRACTICE GUIDANCE (PPG-NOISE)

3.8 Revised Planning Practice Guidance was released in March 2014 to support the NPPF. The Guidance stipulates that Local Planning Authorities' plan making and decision making should take account of the acoustic environment and in doing so consider:

- Whether or not a significant adverse effect is occurring or likely to occur;
- Whether or not an adverse effect is occurring or likely to occur; and
- Whether or not a good standard of amenity can be achieved.

3.9 The table below is in the Guidance to assist recognising "when noise could be a concern".

Perception	Examples of Outcomes	Increasing Effect Level	Action
Unnoticeable	No Effect	NOEL	No specific measures required
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	
		LOAEL	
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for sleep disturbance. Affects acoustic character of the area and creates a perceived change in quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
		SOAEL	
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening, and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid

Perception	Examples of Outcomes	Increasing Effect Level	Action
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

Table 2 – Planning Practice Guidance to Support National Planning Policy Framework.

LOCAL PLANNING REQUIRMENTS

3.10 Planning permission for the development has been granted (ref. 2017/4551P) by LBCC subject to the following conditions and guidance relating to noise:

8 The external noise level emitted from plant, machinery or equipment at the development hereby approved shall be lower than the lowest existing background noise level by at least 10dBA as assessed according to BS4142:2014 at the nearest and/or most affected noise sensitive premises, with all machinery operating together at maximum capacity.

Reason: To safeguard the amenities of the adjoining premises and the area generally in accordance with the requirements of policies A1, A4, TC2 and TC4 of the London Borough of Camden Local Plan 2017.

9 Prior to commencement of the development, details shall be submitted to and approved in writing by the Council, of the sound insulation of the floor/ ceiling/ walls separating the commercial part(s) of the premises from noise sensitive premises. Details shall demonstrate that the sound insulation value DnT,w and L'nT,w is enhanced by at least 10dB above the Building Regulations value and, where necessary, additional mitigation measures are implemented to contain commercial noise within the commercial premises and to achieve the 'Good' criteria of BS8233:2014 within the noise sensitive premises. Approved details shall be implemented prior to occupation of the development and thereafter be permanently retained.

Reason: To safeguard the amenities of the proposed residential flats in accordance with the requirements of policies A1 and A4 of the London Borough of Camden Local Plan 2017.

19 Prior to use, plant or equipment and ducting at the development shall be mounted with proprietary anti-vibration isolators and fan motors shall be vibration isolated from the casing and adequately silenced and maintained as such.

Reason: To ensure that the amenity of occupiers of the development site and surrounding premises is not adversely affected by vibration

20 Prior to commencement of the development, details shall be submitted to and approved in writing by the Council, of an enhanced sound insulation value DnT,w and L'nT,w of at least 5dB above the Building Regulations value, for the floor/ceiling/wall structures separating different types of rooms/ uses in adjoining dwellings, namely [eg. living room and kitchen above bedroom of separate dwelling]. Approved details shall be implemented prior to occupation of the development and thereafter be permanently retained.

Reason: To safeguard the amenities of the proposed residential flats in accordance with the requirements of policies A1 and A4 of the London Borough of Camden Local Plan 2017.

21 The noise level in rooms at the development hereby approved shall meet the noise standard specified in BS8233:2014 for internal rooms and external amenity areas.

Reason: To safeguard the amenities of the proposed residential flats in accordance with the requirements of policies A1 and A4 of the London Borough of Camden Local Plan 2017.

APPROVED DOCUMENT E 2003 (ADE 2003) PERFORMANCE STANDARDS

3.11 Approved Document E (2003 Edition incorporating 2004, 2010, 2013 & 2015 amendments) deals with the following requirements of Part E of Schedule 1 to the Building Regulations 2010:

- E1 Protection against sound from other parts of the building and adjoining buildings.
- E2 Protection against sound within a dwelling-house etc.
- E3 Reverberation in the common internal parts of buildings containing flats or rooms for residential purposes.

3.12 The performance standards for walls, floors and stairs that have a separating function relevant to this project are summarised from ADE Table 0.1b. However, in line with LBCC – Planning Condition 20, the criteria include a 5dB improvement above building regulations between dwellings which shall be achieved throughout the development.

Build Description	Separating Element	Airborne Sound Insulation $D_{nT,w} + C_{tr}$ dB (Minimum values)	5dB improvement $D_{nT,W+Ctr}$ dB	Impact sound insulation $L'_{nT,w}$ dB (Maximum values)	5dB improvement $L'_{nT,w}$ dB
		Material Change of Use		Material Change of Use	
Dwelling-houses and flats	Walls	43	48	-	
	Floors and stairs	43	48	64	59

Table 3 – Performance standards: material change of use dwelling-houses and flats.

INTERNAL WALLS

3.13 In accordance with Table 0.2 of ADE, new internal walls within flats and rooms for residential purposes should have a minimum airborne sound insulation performance of R_w 40dB (Laboratory Rating).

REVERBERATION IN COMMON PARTS

3.14 Section 7 of ADE requires reverberant conditions to be controlled within internal common residential parts of buildings such as entrance halls, corridors and hallways that give direct access to flats by decreasing reverberant sound build-up. There are two methods of achieving this, either by covering a specified area with an absorber of an appropriate class that has been rated according to ISO 11654:1997, or by stipulating a minimum area of total absorption per cubic metre of the room volume as shown in Table 4:

Area	Minimum of total absorption area per cubic metre of the volume
Entrance halls	0.20m^2
Corridors and hallways	0.25m^2

Table 4 - ADE Reverberant Noise Control Criteria

3.15 In the case of historic buildings (e.g. listed buildings, those in conservation areas or of architectural and historical interest) undergoing material change of use, it may not be practical to improve the sound insulation to the performance standards set out in this section. The aim should be to improve sound insulation to the extent that is practically possible, balanced against the need to conserve the special characteristics of the historic building. In such cases it is reasonable to affix a notice in a conspicuous place inside the building, showing the sound insulation values obtained by testing in accordance with ADE Annex B.

SOUND INSLUATION BETWEEN COMMERCIAL AND RESIDENTIAL DWELLINGS

3.16 In accordance with the requirements of LBCC – Planning Condition 9, a higher standard of sound insulation is required between spaces used for normal domestic purposes and communal

or non-domestic purposes, when compared to those set out in this section. In this case criteria should achieve a 10 dB improvement. Accordingly, the upgraded design criteria are presented in Table 5.

Build Description	Separating Element	Airborne Sound Insulation $D_{nT,w} + C_{tr}$ dB (Minimum values)	10 dB improvement $D_{nT,W+Ctr}$ dB
		Material Change of Use	
Commercial use to material change of use dwelling-houses and flats.	Walls	43	53
	Floors	43	53

Table 5 – Performance standards: commercial use to material change of use dwelling-houses and flats.

BS8233:2014 GUIDANCE ON SOUND INSULATION AND NOISE REDUCTION FOR BUILDINGS

3.17 BS8233: 2014 provides guidance for internal noise levels within a number of different building types and uses, and for various activities within such buildings.

3.18 In accordance with LBCC – Planning Condition 21, Table 6 shows recommended internal noise levels for residential dwellings, as given in Table 4 of BS 8233:2014.

Area	Day Level (07:00 – 23:00) dB(A)	Night Level (23:00 – 07:00) dB(A)
Living Rooms	35	N/A
Dining Rooms	40	N/A
Bedrooms	N/A	30

Table 6 - Internal Noise Level Criteria for Dwellings

3.19 BS 8233:2014 also recommends that individual noise events at night can be disturbing to sleep patterns, and that a guideline level should be set in terms of SEL or $L_{AF,max}$.

3.20 BS 8233:2014 does not give a definitive level for internal noise events, or define an appropriate number of exceedances per night. However, the World Health Organisation's 'Guidelines for Community Noise' (1999) references a study by Vallet & Vernet, 1991, which concluded that "For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dB $L_{AF,max}$ more that 10-15 times per night."

THE WORLD HEALTH ORGANISATION – GUIDELINES FOR COMMUNITY NOISE

3.21 The scope of WHO Guidelines for Community Noise was to consolidate scientific knowledge on the health impacts of community noise, to provide guidance to environmental health authorities and professionals trying to protect people from the harmful effects of noise in non-

industrial environments. The health risk to human from exposure to environmental noise was evaluated and guidelines derived.

3.22 The WHO presents a measure to assess adverse health effects from steady-state 'anonymous' noises such as transportation sources.

"The effects of noise in dwellings, typically, are sleep disturbance, annoyance and speech interference. For bedrooms, the critical effect is sleep disturbance. Indoor guideline values for bedrooms are 30 dB LAeq for continuous noise.... At night-time, outside sound levels about 1 metre from facades of living spaces should not exceed 45 dB LAeq, so that people may sleep with bedroom windows open. This value was obtained by assuming that the noise reduction from outside to inside with the window open is 15 dB. To enable casual conversation indoors during daytime, the sound level of interfering noise should not exceed 35 dB LAeq."

"The capacity of a noise to induce annoyance depends upon its physical characteristics, including the sound pressure level, spectral characteristics and variations of these properties with time. During daytime, few people are highly annoyed at LAeq levels below 55 dB(A), and few are moderately annoyed at LAeq levels below 50 dB(A)."

BS 4142:2014+A1:2019 METHODS FOR RATING AND ASSESSING INDUSTRIAL AND COMMERCIAL SOUND

3.23 The British Standard BS 4142:2014 +A1:2019 "Methods for Rating and Assessing Industrial and Commercial Sound" describes methods for rating and assessing sound of an industrial or commercial nature. The scope of the standard includes relevant topics for commercial development, such as sound from fixed installations (mechanical and electrical plant and equipment). The standard is applicable to the determination of rating levels for sources of sound as well as ambient, background and residual levels. The Standard was amended in June 2019.

3.24 Certain acoustic features can increase the significance of impact that might be expected from a comparison of the specific sound level to the background sound level where these features are likely to affect perception and response. Where such features are present at the assessment location, a character correction (or penalty) to the specific sound level is made to obtain the rating level. This can be approached from subjective, objective and reference methods.

- Tonality: A correction of 0dB to +6dB for sound ranging from not tonal to prominently tonal.
- Impulsivity: A correction of up to +9dB can be applied for sound that is impulsive.
- Intermittency: A penalty of +3dB can be applied if on/off conditions are readily distinctive within the reference time interval over the period of the greatest amount of on-time.
- Other characteristics: A penalty of +3dB can be applied in the absence of all other defined characteristics, where the specific sound contains a distinctive feature in the residual acoustic environment.

3.25 Character corrections are normally added arithmetically where more than one feature is present, however, if any single feature is dominant to the exclusion of others, then it may be appropriate to reduce the correction or apply a zero correction for the minor characteristics. The rating sound level is equal to the specific sound level if there are no acoustic features present or expected to be present.

3.26 The significance of sound depends upon both the margin by which the rating level exceeds the background sound level and the context in which the sound occurs. An initial estimate of the impact of the specific sound is made by subtracting the measured background sound level from the rating level. The context of the development is important in assessing the impact.

- 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 significant adverse impact. Where the rating level does exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

3.27 The scope of the Standard recognises that human response to sound can be subjective and is affected by many factors, both acoustic and non-acoustic. The significance of its impact can depend on various factors such as the exceedance to the background level, its absolute level, time of day and change in environment, as well as local attitudes to the source of sound and character of the neighbourhood.

BUILDING SERVICES NOISE

3.28 This document uses indoor ambient noise level criteria in terms of dB $L_{Aeq,T}$ which includes external noise transmitted via the façade as well as internal noise such as that from mechanical ventilation systems.

3.29 Noise Rating (NR) curves are often used by building services consultants to predict internal noise levels due to mechanical ventilation systems. In the absence of strong low frequency noise, dB $L_{Aeq,T}$ can be approximated from the NR value using the following formula: dB $L_{Aeq,T} \approx$ NR + 6 dB. In the presence of mechanical noise with low frequency content, a difference of 10 dB has been viewed more relevant.

3.30 When appraising dB $L_{Aeq,T}$ criteria, for the noise transmitted via the façade must be combined with building services noise to provide total internal ambient noise level (IANL) in any space, being inclusive of both elements, where applicable. The resulting IANL design requirement provides a suitable value, or range of values, relevant to the reverberant conditions of the rooms.

Room Type	IANL Design Requirement dB $L_{Aeq,T}$ re. 20 µPa	Mechanical Services Noise Rating Curve*
Residential (day)	≤ 35	≤ NR29
Residential (night)	≤ 30	≤ NR24

** Assumes an absence of strong, low-frequency noise.*

Table 7 – Internal ambient noise level design requirements, including mechanical services.

Noise Rating Curve	Sound Pressure Level dB $L_{eq,T}$ per octave band centre frequency, Hz							
	63	125	250	500	1000	2000	4000	8000
NR24	54.4	42.9	34.3	27.7	24.0	20.9	18.5	16.7
NR29	58.3	47.2	39.0	32.6	29.0	25.9	23.6	21.9

Table 8 – Definition of relevant Noise Rating curves for mechanical services.

3.31 The design of mechanical services shall satisfy night-time internal ambient noise level requirement, being more stringent than daytime by 5 dB $L_{Aeq,T}$. This has been considered relevant to building ventilation conditions as per Approved Document F.

4 ENVIRONMENTAL SURVEY SUMMARY

4.1 An environmental survey was undertaken from Tuesday 14th to Wednesday 15th September 2021 to quantify sound levels at the development site. Appendix E provides the details of the study which has been summarised in this section.

4.2 Background sound pressure levels have been reported in this section in accordance with LBCC planning criteria in terms of the "minimum external background noise". In practice, there is no single level for background sound as this is a fluctuating parameter.

4.3 The following summary of dB $L_{A90,\ 15\ min}$ sound pressure levels have been summated from the measured data at both positions of the environmental survey. This has been established in accordance with the methodology of BS 4142.

Measurement Data			Background Sound Pressure Level, dB $L_{A90,\ 15\ min}$ re. 20µPa	
Position	Time HH:MM	Period Description	Range	Typical
1 (Front)	07:00 – 23:00	Day	49 - 61	55
	23:00 – 07:00	Night	46 - 53	47
2 (Rear)	07:00 – 23:00	Day	44 - 52	46
	23:00 – 07:00	Night	42 - 45	43

Table 9 – Background sound level dB $L_{A90,\ T}$ summary at development site.

4.4 Residual sound pressure levels have been summarised in this section in accordance with LBCC planning criteria whereby the "existing external ambient noise level" needs to be defined.

4.5 The following average equivalent sound pressure levels dB $L_{Aeq,\ T}$ have been established as representative without the proposed development in operation.

Measurement Data			Residual Sound Pressure Level, dB $L_{Aeq,\ T}$ re. 20µPa	
Position	Time HH:MM	Period Description	15-min Range	Average
1 (Front)	07:00 – 23:00	Day	56 - 69	64
	23:00 – 07:00	Night	50 - 63	55
2 (Rear)	07:00 – 23:00	Day	45 - 58	53
	23:00 – 07:00	Night	43 - 47	45

Table 10 – Residual sound level dB $L_{Aeq,\ T}$ summary at development site.

EXTERNAL PLANT NOISE LIMITS

4.6 External plant noise emissions have been stipulated by LBCC – Planning Condition 8 and should be designed to be 10 dB below the typical background sound level at the nearest noise-sensitive receptors.

4.7 Accordingly, a summary of the limiting rating levels is presented in Table 11.

Receptors	Limiting Rating Level in accordance with LBCC ($L_{Ar,Tr}$)	Limiting Rating Level in accordance with LBCC ($L_{Ar,Tr}$)
	Daytime	Night-time
13 Grenville street (Position1)	45 dB	37 dB
Chandler House (Position 2)	36 dB	33 dB

Table 11 – Limiting Rating Levels in accordance with the requirements of LBCC

5 EXTERNAL SOUND INSULATION

5.1 **Ambient sound levels at the front of the site significantly exceed the World Health Organisation Community Noise guidance limits of 55 dB $L_{Aeq,16h}$ day and limits of 45 dB $L_{Aeq,8h}$ and 60 dB $L_{Amax(F)}$ during the night; while ambient levels at the rear generally do not exceed these values. Therefore, commensurate acoustic provisions are required, where necessary, to achieve a suitable standard of residential accommodation.**

5.2 In accordance with the assessment guidance in Annex G of BS 8233:2014 and Professional Practice Guidance on Planning & Noise, the overall sound insulation performance of the building can be indicated by simple calculation from the free-field noise level.

CALCULATION	A	B	(A – B) + 5
Period	Highest Free-Field Ambient Noise Levels $L_{Aeq,T}$ dB	ProPG Internal Noise Level Guidelines $L_{Aeq,T}$ dB	Typical insulation Specification dB Rw
Day (07:00 – 23:00)	64	35	34
Night (23:00 – 07:00)	56	30	31
	77	45	37

Table 12 – Sound insulation estimate using the simple calculation method of BS 8233 and noise level measurements taken at Position 1.

CALCULATION	A	B	(A – B) + 5
Period	Highest Free-Field Ambient Noise Levels $L_{Aeq,T}$ dB	ProPG Internal Noise Level Guidelines $L_{Aeq,T}$ dB	Typical insulation Specification dB Rw
Day (07:00 – 23:00)	53	35	23
Night (23:00 – 07:00)	45	30	20
	62	45	22

Table 13 – Sound insulation estimate using the simple calculation method of BS 8233 and noise level measurements taken at Position 2.

5.3 The R_w values used in the above calculation are derived from pink noise, indicating that the actual insulation value provided against specific noise sources will be less. For example, road traffic noise will be more relative to an $R_w + C_{tr}$ value (re. BS EN ISO 717-1:2013). The above table demonstrates minimum insulation specifications where it is estimated that the required R_w value may be higher.

"…the R_w values suffice for a rough calculation, although it is likely to underestimate the level in the room by up to 5 dBA. Where the estimate is within 5 dBA of the target noise level, a more rigorous calculation needs to be carried out using octave bands."

5.4 The windows and any trickle ventilators are normally the weakest part of a residential façade. Table 7 of this report demonstrates that a high-performance sound insulation specification is required at the front of the property to achieve BS 8233:2014 internal noise criteria; therefore, detailed calculations of the building envelope have been performed to establish appropriate mitigation measures.

5.5 The detailed calculations have been performed in octave frequency bands in accordance with Section G2 of BS 8233:2014 and noise mitigation measures have been generated in accordance with the proposed plans. The octave band results are shown in Appendix F; however, a summary of the calculation is shown in the Table 14.

Room Name	Sound Insulation Scheme, dB				Criteria, dB(A)			Pass / Fail Design Vs Criteria
					35	30	45	
	Wall	Glazing	Façade Vent(s)	Roof	Day	Night	Max	
	Rw	Rw	Dne,w	Rw	dB(A)	dB(A)	dB(A)	
Unit 1 Living	57	30	34	-	26	20	37	PASS
Unit 1 Bed	57	30	34	57	26	19	36	PASS
Unit 2 Living	57	35	40	-	28	22	43	PASS
Unit 3 Living	57	35	40	-	30	24	45	PASS
Unit 3 Bed	57	30	34	-	26	19	36	PASS
Unit 4 Living	57	35	40	-	29	23	44	PASS
Unit 4 Bed	57	30	34	-	26	19	36	PASS
Unit 2 Bed (Front)	57	35	40	-	30	24	45	PASS
Unit 2 Bed (Rear)	57	30	34	-	27	21	38	PASS
Unit 5 Living	57	35	40	57	28	21	42	PASS
Unit 5 Bed	57	30	34	51	27	20	37	PASS
Unit 6 Living	57	35	40	-	29	22	43	PASS
Unit 6 Bed	57	35	40	-	30	24	45	PASS

Table 14 – Detailed calculation summary of noise levels inside proposed accommodation.

5.6 If residents choose to have their windows open for rapid ventilation, assuming a nominal 15dB attenuation this action would afford, then the internal levels experienced would be higher than those recommended by BS 8233:2014. It shall be noted that the British Standard clarifies that *"if relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation that does not compromise the façade insulation or the resulting noise level".* Adequate ventilation is described as building ventilation in accordance with this standard (e.g. trickle ventilation, which must be considered "open" for adequate assessment).

GLAZING SPECIFICATION

5.7 The calculations undertaken in this section assume that double glazing is installed to attenuate road traffic noise in accordance with BS 8233:2014 and World Health Organisation internal noise guidance criteria. The glazing specifications are based on achieving both the internal average and maximum criteria which require a suitable, accompanying ventilation strategy.

Glazing Location	Double Glazing Configuration (glass-gap-glass)	Sound Reduction Index, SRI dB						
		125Hz	250Hz	500Hz	1KHz	2KHz	4KHz	Rw
Front Elevation	*4-16-6 Standard glass & Standard glass*	23	23	33	39	39	38	35

Glazing Location	Double Glazing Configuration (glass-gap-glass)	Sound Reduction Index, SRI dB						
		125Hz	250Hz	500Hz	1KHz	2KHz	4KHz	Rw
All other Elevations	*4-20-4 Standard glass & Standard glass*	21	20	27	38	41	37	30

Table 15 – Glazing performance specifications.

5.8 Glazing insertion losses shown above are product performance data provided by Saint Gobain, test certificates can be made available on request.

5.9 Alternative glazing configurations and window manufacturers may be used, so long as the above specifications are met in relevant façade locations. Numerous alternative construction types exist to meet these performances. Any comparative products should be verified using laboratory test data, where further advice and assistance can be provided.

5.10 The glazing performance specification should be reviewed at the appropriate stage of the development to ensure that the glazing specification is commensurate to the proposed internal noise criteria.

5.11 It shall be noted that in the case of all rooms of the development, it can be shown that opening the windows will exceed desirable internal noise criteria. The information in this section is therefore based upon securing a suitable internal environment with closed windows.

VENTILATION STRATEGY

5.12 The ventilation strategy at the development is described with reference to Approved Document F (2010) as System 1: background ventilators and intermittent extract fans - to all flats.

5.13 Calculations to BS 8233:2014 in this assessment assume that the above ventilation type will be used as stated, to provide background ventilation for all habitable rooms.

5.14 Where System 1 is specified, it is assumed that extract ventilation systems to extract air from wet rooms of the development (i.e. kitchens and bathrooms) via ductwork in the ceiling void. A suitable unit should be selected whose noise level achieves suitable BS 8233 internal criteria for the spaces to which it feeds from. This equipment includes a trickle ventilation in normal operation and boost function for rapid ventilation.

5.15 It shall be noted that the BS 8233 limits for internal noise do not apply specifically to bathrooms but a level of 40dB $L_{Aeq,T}$ is applicable to dining areas. As a guide, an internal noise guidance limit of no greater than NR30 (63Hz to 8kHz) is recommended not to be exceeded from all extract ventilation systems installed in bathroom and kitchen areas. These values are roughly equivalent to 35dB(A) as specified by WHO / BS 8233 criteria for suitable standards of internal noise.

5.16 The make-up air from MEV ventilation is provided via a trickle vent in the façade. The Building Regulations Approved Document F details the minimum performance requirements for background ventilators in dwellings. When accompanied with a continuous mechanical extract

system in kitchens and bathrooms, a single trickle vent will be required in each habitable room within the non-assisted living flats to provide 2,500mm^2 equivalent free area.

Area Ref.	Building element	Element Normalised level difference, $D_{n,e}$ dB						
		125 Hz	250 Hz	500 Hz	1K Hz	2K Hz	4K Hz	$D_{n,e,w}$
Front Elevation	*Passivent AL-dB 40 Acoustic, through window trickle vent*	46	43	36	40	43	56	40
All Other Elevations	*Greenwood 4000L Acoustic, through window trickle vent*	39	36	34	31	34	38	34

Table 16 –Trickle ventilation performance specifications.

5.17 Acoustic ventilation level differences shown above are based on the use of Passivent and Greenwood ventilation products, test certificates can be made available on request.

5.18 Ventilation specifications are rated with trickle vents open and suitable alternatives are available from other manufacturers. Note that where ventilation specifications are used, they are rated with trickle vents open.

5.19 In the case of System 1 and System 2, where the total number of ventilators need to achieve a suitable Equivalent Area for the entire dwelling, each habitable room may need to contain more than one trickle vent. In this instance, the performance of the ventilator will need to increase (by a factor 10 x $\log_{10}$ [n], where n is the number of vents per room). For example:

Façade component	Quantity in Room Façade	Specification	Metric with Adaptation Term
Ventilators (per habitable room)	1	≥ 40	dB $D_{ne,w} + C_{tr}$
	2	≥ 43	
	3	≥ 45	
	4	≥ 46	
	5	≥ 47	
	6	≥ 48	

Table 1 – Minimum specifications for ventilators, where one or more are used per habitable room.

ACHIEVED NOISE CRITERIA

5.20 In accordance with the requirements of LBCC – Planning Condition 21, using measured data at the development site and proposed acoustic design, the following key guidance criteria is estimated to be achieved, beyond the limitations in this report.

- Resultant internal noise levels in bedrooms and living rooms achieve BS 8233:2014 and World Health Organisation criterion of 35dB $L_{Aeq,\ 16h}$ for steady noise levels during the day.
- Resultant internal noise levels in all bedrooms achieve BS 8233:2014 and World Health Organisation criterion of 30dB $L_{Aeq,\ 8h}$ for steady noise levels during the night-time.

- The World Health Organisation health limit of 45dB $L_{Amax(F)}$ is not expected to be exceeded on a regular basis in bedrooms during the night-time, when considering the highest 15 events that occur.

- Internal levels will be maintained where proposed mechanical systems are used to provide trickle or increased ventilation rates. The provision for rapid ventilation has been offered noting that adverse effects could occur if future occupants choose to open their windows.

6 DESIGN REVIEW

6.1 The following guidance is supplemented by acoustic markups provided in Appendix H.

INSTALLATION SEQUENCE

6.2 The following order shall be undertaken in the installation of all elements of this report to ensure that the correct junction of acoustic systems with flanking elements.

1. Separating walls or independent wall linings.
2. Treatment to flanking elements.
3. Internal walls.
4. Internal and acoustic ceilings.
5. Any thermal wall linings.
6. Floating floors.

REQUIREMENT E1: SEPARATING WALL CONSTRUCTIONS

6.3 It is not currently known whether any of the existing internal walls shall be retained within the development. Therefore, the client has requested that, at this design stage, both a masonry and timber wall construction be recommended

6.4 Based on the above and in accordance with the requirements of LBCC - Planning Condition 20, the following wall constructions are recommended to achieve a 5 dB improvement above building regulations.

MASONRY WALL CONSTRUCTION

- Gypsum based board (min mass per unit area 12.5kg/m2) on dot and dab
- Minimum 13mm render
- 215mm Block laid flat (min. density 1850 kg/m3)
- Minimum 13mm render 1
- Gypsum based board (min mass per unit area 12.5kg/m2) on dot and dab

The following points should be noted for this masonry wall construction:

- Keep cavity and wall ties (and insulation free from mortar droppings and debris
- Fully fill all blockwork joints with mortar
- Ensure that only solid blocks (i.e., not hollow, or cellular) are used in the construction of separating and flanking walls
- Keep any chases for services to a minimum and fill well with mortar.
- Stagger chases on each side of the wall to avoid them being back-to-back

TIMBER WALL CONSTRUCTION

- 2 layers of Gypsum based board (total nominal mass per unit area 22kg/m2)
- 95mm timber stud with 60mm APR insulation (minimum density (10kg/m3)
- 50mm gap between studs
- 95mm timber stud with 60mm APR insulation (minimum density (10kg/m3)
- 2 layers of Gypsum based board (total nominal mass per unit area 22kg/m2)

The following points should be noted for this timber wall construction:

- Keep inner facings of wall linings at least 240mm apart
- Ensure quilt or batts cover whole lining area, fitting tight between studs without sagging
- 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
- Seal all joints in outer layer with tape or caulk with sealant

6.5 Each of these constructions should achieve a minimum performance of 48dB $D_{nT,w} + C_{tr}$.

6.6 Subject to junction details and quality of workmanship on-site, the in-situ sound insulation is expected to be sufficient to comply with the minimum performance requirements of LBCC between dwellings, i.e. flat bedroom to flat bedroom.

DOORS

6.7 All doors to individual dwellings should provide a minimum, lab tested, sound insulation of 29 dB R_w.

6.8 A doorset providing 29 dB R_w would typically comprise a 44mm thick solid core timber door with a mass per unit area of at least 29 kg/m_2 with full perimeter acoustic seals to the head, jamb and an acoustic drop seal to the threshold.

REQUIREMENT E1: SEPARATING FLOOR CONSTRUCTIONS

6.9 It is not currently known whether any of the existing internal floors shall be retained within the development. Therefore, the client has requested that, at this design stage, both a masonry and timber floor construction be recommended

6.10 Based on the above and in accordance with the requirements of LBCC - Planning Condition 20, the following floor constructions are recommended to achieve a 5 dB improvement above building regulations.

MASONRY FLOOR CONSTRUCTION

- Minimum 65mm screed
- 6mm IsoRubber base with IsoEdge flanking strip
- 150mm precast concrete plank (min mass per unit area 300kg/m^3)
- 75mm void

- One layer of nominal 10kg/m^2 gypsum-based board.

The following points should be noted for this masonry floor construction:

- Butt planks tightly together
- Grout all joints between planks
- Fill all voids between walls and floor
- Ensure floating floor treatment is suitable and install in accordance with the manufacturer's instructions.
- Install flanking strips around the perimeter of the flooring board to isolate floor from walls and skirtings
- Make sure ceiling treatment is installed in accordance with the manufacturer's instructions (where applicable)
- Ensure that only the correct blocks are used in the construction of external (flanking) walls, all blocks should be assumed to be solid (i.e., not hollow, or cellular)

TIMBER FLOOR CONSTRUCTION

- Proprietary medium weight floating floor laid over existing floorboards, floating floor to comprise a dense continuous layer min mass 20kg/m2 rigid board with a 6-12mm thick continuous open-cell foam / felt backing, sealed about its room edge with a 5mm thick foam seal to give a water tight seal.
- 11mm timber floorboard (min density 600 kg/m^3) and 220mm timber joists at maximum 400mm centres
- 100mm mineral fibre insulation (≥45kg/m3) between joists
- Minimum 16mm Resilient Bars running counter to joists with 2 layers 15mm dense (blue) plasterboard (min 12.5kg/m^2 mass)

6.11 The following points should be noted for this timber floor construction:

- Lay quilt between joists ensuring no gaps remain
- Ensure floating floor treatment is suitable and is installed in accordance with the manufacturer's instructions
- Ensure sub-deck quilt is laid between and not under flooring battens
- Install flanking strips around the perimeter of the flooring board to isolate floor from walls and skirtings
- Ensure resilient ceiling bars are fixed at right angles to the joists
- Ensure timber floor ceiling treatment is fixed correctly
- Stagger joints in ceiling layers

6.12 The partition achieves high levels of sound insulation by virtue of the separation between the board and the stud framing afforded by the Resilient Bars. It is important that, when screw-fixing boards, the screws do not contact the stud framing (displayed in Figure 3, good on the left and bad on the right) and also that services, fixtures, etc, do not form a bridge between the lining boards on each side of the partition.

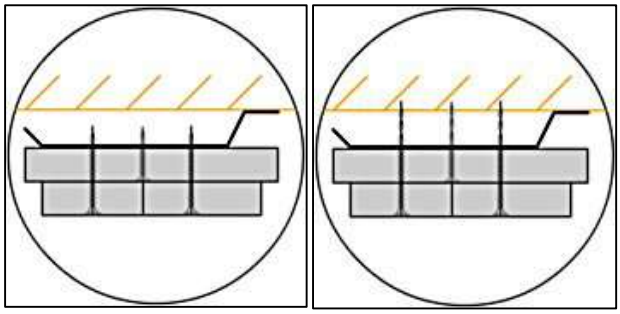


Figure 3 - Good (left) and Bad (right) Resilient Bar Mounting

6.13 Each of these constructions should achieve a minimum airborne sound performance of 48dB $D_{nT,w+Ctr}$ and a minimum impact sound insulation performance of 59dB $L_{nT,w}$

6.14 Subject to junction details and quality of workmanship on-site, the in-situ sound insulation is expected to be sufficient to comply with the minimum performance requirements of LBCC between dwellings, i.e. flat bedroom to flat bedroom.

SOUND INSULATION BETWEEN COMMERCIAL AREAS / PLANT ROOMS AND DWELLINGS

6.15 Within bin store areas there is a probability of activities contributing to high levels of noise (i.e., slamming bin lids, glass bottles breaking and refuse collection day), some of which could occur during daytime and night-time periods. Likewise, internal plant rooms typically contain equipment producing high levels of noise and vibration.

6.16 Based on the requirements of LBCC - Planning Condition 9 the following wall and floor constructions are recommended to achieve a 10 dB improvement above building regulations.

WALL CONSTRUCTION

6.17 In order to reduce structure-borne transfer through this wall construction the internal wall would need to be independent from the shaft wall, this could be achieved by the following recommended construction (see Figure 2):

- One layer plasterboard on dabs with 3mm skim coating
- 215mm Block laid flat
- 15mm Cavity
- Independent 60mm ‘C’ or ‘I’stud
- 25mm rock wool in cavity (min. density 18.3 kg/m3)
- two layers of 15mm plasterboard (min. density 12.6 kg/m2)

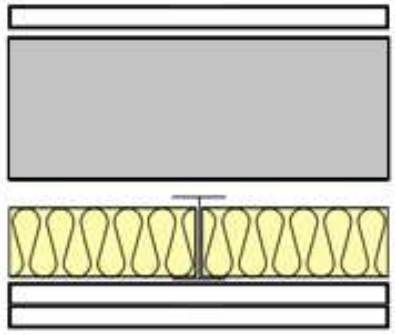


Figure 2 - Independent Wall Lining

6.18 The above floor constructions should achieve a minimum performance of 53 dB $D_{nT,w} + C_{tr}$.

6.19 Subject to junction details and quality of workmanship on-site, the in-situ sound insulation is expected to be sufficient to comply with the minimum performance requirements of LBCC between commercial units and dwellings, i.e. restaurant kitchen to Unit 1 media room and restaurant to Unit 1 living room.

FLOOR CONSTRUCTION

6.20 In order to achieve an adequate level of sound insulation, the following enhancements to the floor construction are recommended:

- Minimum 65mm screed
- 6mm IsoRubber base with IsoEdge flanking strip
- 150mm precast concrete plank (min mass per unit area 300kg/m^3)
- 200mm void;
- 150mm mineral wool in void;
- Metal hanger system incorporating Gypframe GAH1 Acoustic Hangers;
- Two Layers 15mm unperforated plasterboard ceiling (min. mass per unit area 12.6 kg/m2).

6.21 Should the spaces beneath residential dwellings require services to be suspended from the ceiling, these should be below the recommended construction detailed above, incorporate suitable anti-vibration hangers and, if required to be concealed, include an additional sacrificial ceiling below. Check loading of all proposed ceiling fixings.

6.22 The above floor constructions should achieve a minimum performance of 53 dB $D_{nT,w} + C_{tr}$.

6.23 Subject to junction details and quality of workmanship on-site, the in-situ sound insulation is expected to be sufficient to comply with the minimum performance requirements of LBCC between commercial units and dwellings, i.e. restaurant to flat bedroom.

REQUIREMENT E2: INTERNAL WALL CONSTRUCTIONS

6.24 The guidance in this section follows Approved Document E Requirement E2 and applies to internal wall; to achieve a minimum (laboratory) performance of 40 dB R_w. These walls are not subject to pre-completion testing and only occur between rooms of the same dwelling.

6.25 Internal walls shall be constructed as follows:

- 2.5mm skim
- 12.5mm WallBoard
- 70mm metal stud with 50mm APR insulation (minimum 10kg/m3)
- 12.5mm WallBoard
- 2.5mm skim

6.26 This construction should achieve a minimum performance of 40dB R_w.

6.27 Internal walls are not subject to in-situ sound insulation requirements. The lab tested performance of the proposed construction is compliant with the minimum ADE design requirements for internal walls.

REQUIREMENT E3: TREATMENT OF STAIRS AND COMMUNAL AREAS, INCLUDING REVERBERATION IN COMMON PARTS OF THE BUILDING

6.28 The guidance in this section follows Approved Document E Requirement E3 which states that 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.

6.29 The guidance only applies to corridors, stairwells, hallways, and entrance halls which give direct access to the flat or room for residential purposes i.e. directly outside of each flat. In communal areas it is recommended to have an ISO 11654 Class C ceiling system below the floor structure. Hard floor coverings (such as laminate flooring) are not advised to be used in stairwells.

6.30 An ISO 11654 Class C ceiling system is typically found in the form of a mineral tile ceiling, stick on acoustic panel or perforated plasterboard. Manufacturer's laboratory test data should be used to confirm the system absorption performance of any preferred scheme.

6.31 Details of Requirement E3 ceiling locations are illustrated in Appendix I.

6.32 By nature of the building stairwells being self-contained, there is no requirements to treat stairs for sound insulation as an access stair does not form a separating element between flats and common areas.

7 ADDITIONAL GUIDANCE

FLANKING WALLS

7.1 Flanking Transmission occurs when airborne sound and/or structure-borne vibration is transmitted from one area of a building to another, usually by structural components. In order to control flanking between noise sensitive spaces, careful acoustic detailing specifically at junctions between adjacent elements is required to maintain the specified acoustic performance of a separating wall or floor. Interfaces with other elements may include: Floors, Raised Access Floors, Slab Soffits, External Facades, Structural Steel Work, Partitions, Roofs and Door Sets.

JUNCTION GUIDANCE

7.2 Generally, partition walls between internal spaces should be built full height and sealed to the underside of the roof/floor structure above to ensure no air gaps. Particular attention is advised for head details to ensure all junctions and gaps are suitably filled with an acoustic sealant such that acoustic performance is not compromised. A typical head junction detail for acoustic requirements is shown below. Please note that use of steel angles is a requirement only if the junction is exposed to the room and is not required where the junction is obscured by a suspended ceiling.

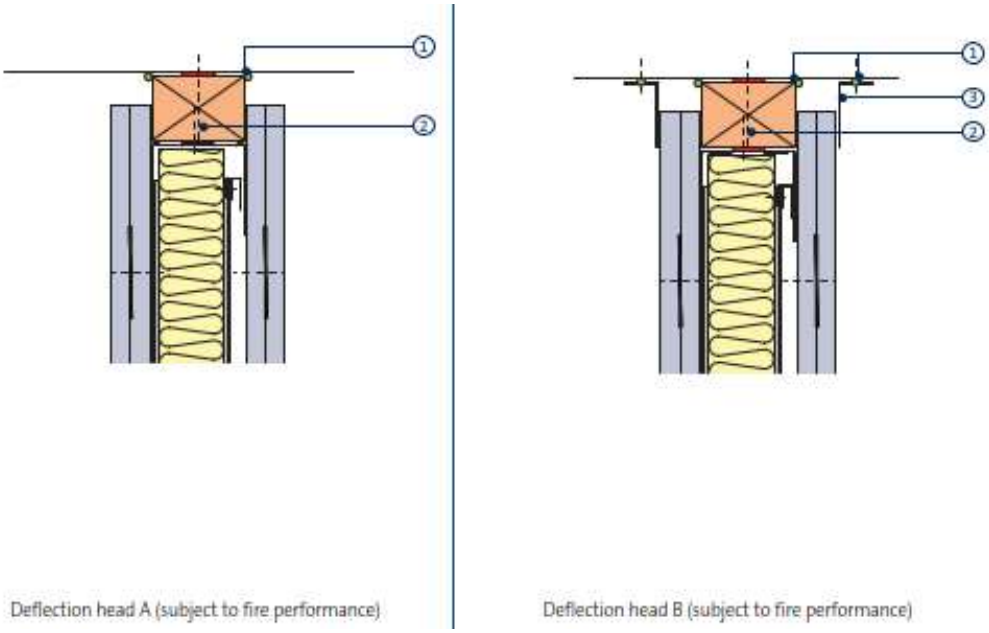


Figure 4 – Deflection Head Detail – BG White Book

7.3 It should be ensured that the acoustic integrity of separating walls and floors is maintained at junctions by breaking any flanking linings. The figure below shows typical flanking junctions between walls.

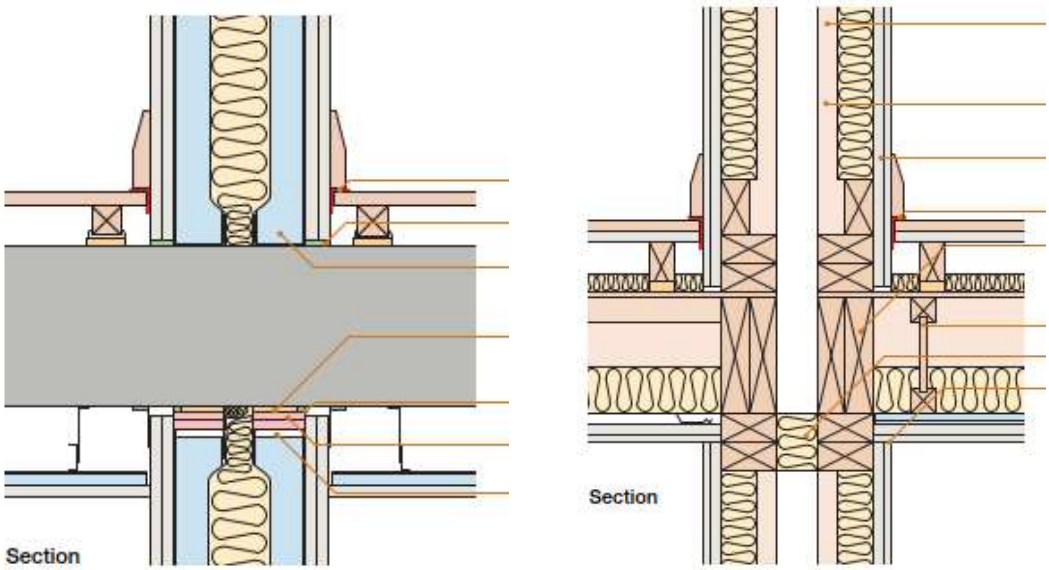


Figure 5 – Typical separating wall junctions

7.4 At junctions between lightweight partitions, the flanking partition should be split by the separating partition. Where this type of junction is not possible additional flanking wall linings may be required. For separating walls rated at ≥ 50 dB R_w it is recommended that the junction should be formed with 5-10mm gap between separating partition linings and corridor wall lining.

7.5 Plasterboard linings to external walls should not run common between rooms; they should be stopped either side of the wall or floor junction with any common cavity closed off on the line of the partition/floor. If the majority of the external wall linings are to consist of two layers of plasterboard lining on independent wall lining framework. To minimise flanking transmission via the linings, it is recommended the plasterboard have a minimum mass per unit area of 11kg/m2 per board. Where lightweight partitions abut masonry walls, it is critical that separating partition linings are taken tight up to the masonry, with joints fully sealed.

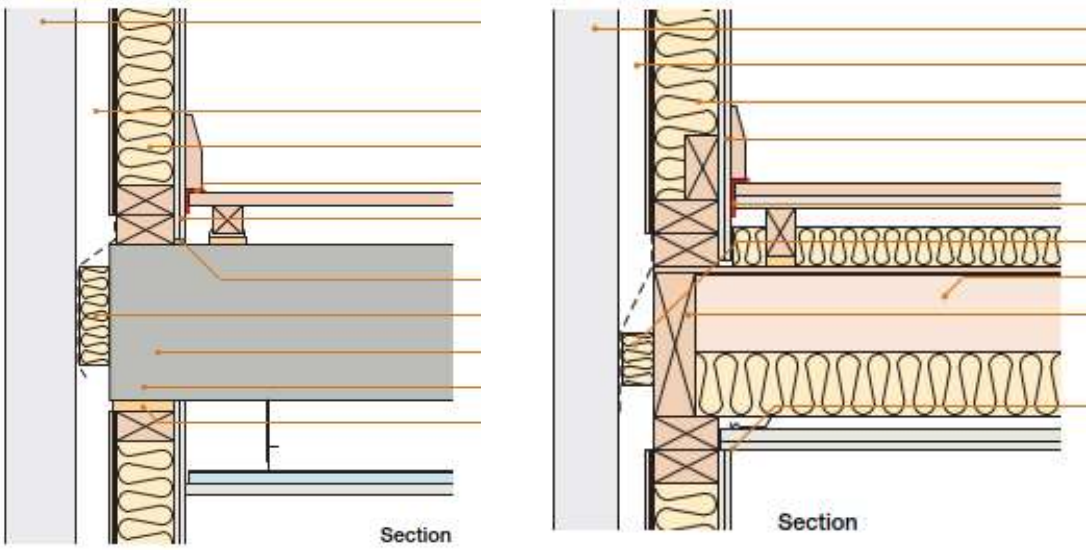


Figure 6 – External Wall Junction

ROOM-IN-ROOF CEILINGS

7.6 For any room formed in the roof space of the development, with a separating wall to an adjacent bedroom, the ceiling of that bedroom and adjacent bedroom shall be resilient. The ceiling shall be formed as per type SF1, with mineral wool, resilient bars.

INSTALLATION OF FLOATING FLOORS

7.7 The following guidance should be noted with the use of floating acoustic floors:

- Manufacturers' installation guidance shall always be followed with proprietary floating acoustic flooring systems.
- Floating floors must be installed up to the edge of any internal or separating wall and incorporate a manufacturers' (nominally 6 - 8 mm thick) perimeter flanking strip it.
- Do not bridge between the floating layer and the base of surrounding walls (i.e. with skirting board, or services that penetrate the resilient layer);

- Do not fix the floating boards or battens directly to the structural floor or walls;
- The floating floor shall not be continuous between dwellings and common areas or installed underneath a new lightweight separating or internal wall structure.

7.8 As part of the treatment to floors within residential flats, the height of the upper floors will increase by a nominal amount. A raised timber floor can be used here. If a floating floor is installed on the landing and lobby areas this is acceptable, but all floors must not be common; underneath the entrance doors and into each flat.

7.9 For bathroom areas, it is also acceptable that any floating floor system is modified to create a raised floor. Underneath the finish of the room (e.g. tiles) however must remain a resilient mat of nominal 4.5 mm thickness.

TREATMENT OF FLANKING PATHS

7.10 In conversion projects there are always flanking paths (for sound to travel around a separating element) which need treatment otherwise they will compromise the sound insulation of the separating structures and can lead to test failures. This includes service pipe work, steelwork or fireplaces that can bypass the separating floor or wall.

7.11 Any penetration through a separating element should be located within apertures that are sized to suit, or otherwise not too large as to create a significant acoustic weak point. The flanking element shall be fully enclosed in each room about the separating element. If chimney breasts are to be partially maintained in rooms of the development, then these must be fully treated.

7.12 For any services flanking element, create a nominal 50 mm timber or metal stud frame spaced at least 20 mm from flanking element to form independent wall lining. Wrap the flanking element using 25 mm thick quilt of density 12 – 24 kg/m^3 and provide two layers of 15 mm thick dense plasterboard, totalling ≥ 25 kg/m^2 mass per area; overlapped and fixed independently to each stud frame.

7.13 Any fireplace openings shall be fully covered and sealed using a masonry enclosure of dense aggregate block ≥ 1,850 kg/m^3 mass per area.

STEELWORK TREATMENT

7.14 Where steelwork runs across acoustically rated separating walls, the partition will need to be formed around the penetration. Small gaps, e.g. 10-15mm, should be packed with mineral wool and sealed with non-setting mastic. Larger gaps should be filled and sealed with two layers of 50mm dense fire batt (or equivalent). Direct contact between the partition wall linings and the steel should be avoided to prevent bridging of the wall cavity.

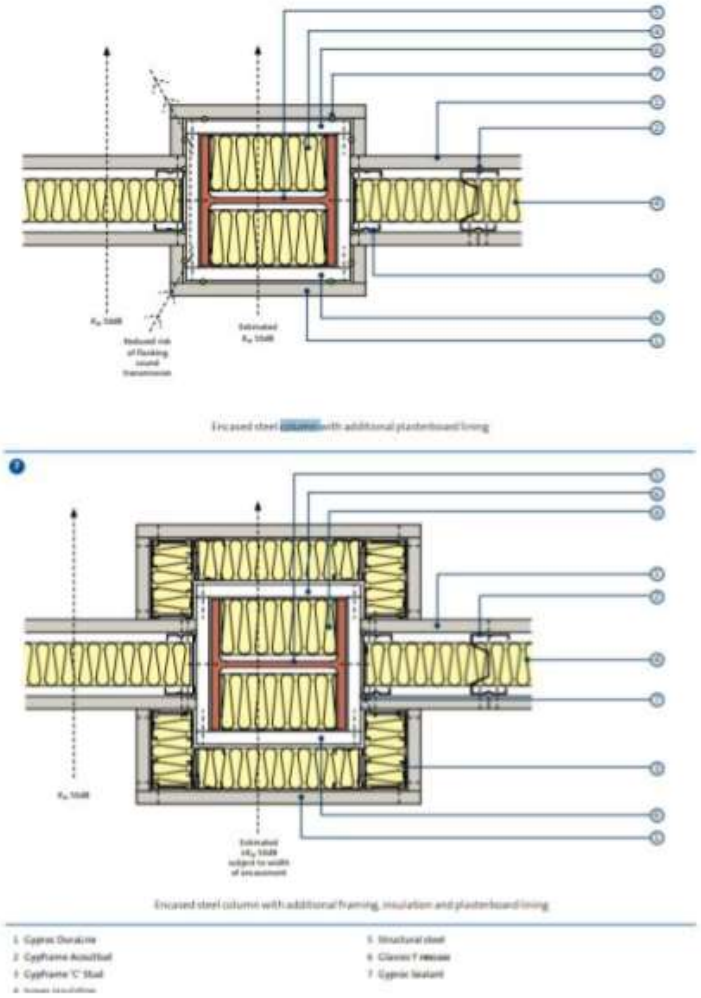


Figure 7 – Example Steelwork Junctions

7.15 Beams within sound insulating ceilings/bulkheads will be protected as long as the beams are completely above the ceiling and that there is no mechanical connection between the beam and the suspended ceiling. All other steelwork is to be lined with mineral wool insulation and encased with two layers of plasterboard having staggered joints and fully sealed with non-hardening sealant. Any cladding material and associated framework must not come into contact with the steelwork. Any voids created should be filled with mineral wool.

ELECTRICAL SOCKETS

7.16 Electrical sockets are not recommended to be chased into solid-masonry separating walls unless the remaining solid-brick element is at least 200 mm thick.

7.17 If electrical sockets are required on both sides of lightweight separating walls, these shall be staggered 1000 mm on either side of separating wall in openings minimised to suit the socket size. Provide either (a) a custom backing to the socket of two layers of dense plasterboard, totalling at least ≥ 20 kg/m^2 mass per area; or (b) a proprietary socket box, generally Robust Details compliant.

DOWNLIGHTING AND VENTILATION

7.18 It is understood that ceilings may need to carry ventilation in wet rooms of all clusters. Associated apertures can drastically decrease the acoustic integrity of the sound-insulating ceiling. Bathrooms of the development will not be subject to pre-completion testing.

7.19 A pendant lighting strategy is recommended for this development, particularly in existing parts of the building where timber separating floors are to be used.

7.20 If downlights are to be installed, they shall be spaced no more than one light per $2m^2$ ceiling area, in openings not exceeding 100 mm diameter. An acoustically rated downlight shall be used as laboratory verified as compatible with Appendix F of Robust Detail Handbook as to cause detriment to airborne and impact performance of ≤ 1 dB.

8 NOISE FROM BUILDING SERVICES

8.1 In accordance the requirements of LBCC – Planning Conditions 8 and 19 the following outline guidance is provided.

EXTERNAL NOISE LEVEL EMISSIONS

8.2 Selections of specific plant items have not yet been made and are expected to be selected later in the design. However, they are expected to be contained within a rooftop plant area at 4F above Unit 5. The proposed plant items are understood to be as follows:

- Condenser Units; and
- Extract Fan Terminations.

8.3 In order to assess feasibility of achieving the external noise limits, an assessment is recommended to be undertaken prior to procurement of equipment, as part of separate scope, such that indicative mitigation measures can be defined.

8.4 It is therefore recommended that allowance is made at this stage for the following mitigation options:

- Induct silencers on extract fans;
- Acoustic louvres for plant rooms; and/or
- Acoustic screens for rooftop items (e.g. chillers and condensers)

8.5 It should be noted that it would be the responsibility of the contractor to ensure that the plant noise limits do not exceed the limiting rating levels in Table 11, on selection of the equipment. It is therefore recommended that reviews of the proposed items of plant are undertaken, by a suitably qualified Acoustic Consultant, to ensure that the plant noise limits are achieved.

INTERNAL BUILDING SERVICES NOISE

8.6 It is understood that mechanical ventilation would be required to the Unit 1 - Basement Media Room. The selection of mechanical plant items has not yet been undertaken and would likely be selected later in the design. Therefore, a detailed assessment of internal noise levels cannot be undertaken at this stage.

8.7 The contractor should therefore ensure that the internal building services noise levels stated in Table 7 are achieved on selection of the equipment through either:

- Selection of quiet plant items; and/or
- Specification of suitable mitigation measures (e.g. induct silencers, acoustic louvres etc.)

8.8 It is recommended that a detailed review of the proposed equipment is undertaken, by a suitably qualified Acoustic Consultant, such that the internal ambient noise level requirements are achieved.

VIBRATION ISOLATION

8.9 All equipment to be mounted adjacent or above flats and in the ground floor plant room shall accord to vibration isolation selection from Table 4.56 of CIBSE Guide B4 (2016).

8.9.1 This information has been included within Appendix J.

8.9.2 A review of appropriate isolators cannot be undertaken within this document whereby the mounting conditions and final plant selections are not known at the time of writing.

8.10 It shall be noted that any equipment possible to cause vibration induced noise (such as AHUs, chillers, pumps, axial or centrifugal fans) shall be isolated using high efficiency vibration isolators to provide the rated deflections of the CIBSE isolation selection table.

8.11 As a general guide, freestanding or restrained spring isolators have a lower natural frequency when compared to composite rubber. In turn, springs can provide greater levels of vibration isolation when compared to rubber mounts. This will be required for vibrating machinery of a lower forcing frequency and/or to provide higher levels of isolation efficiency.

8.12 Concrete inertia bases will be required for certain plant items to lower the isolated system centre of gravity and provide suitable support. As an example, any base mounted water pumps in the basement of > 4 kW power will require an inertia base and 25 mm deflection spring isolators.

8.13 Flexible duct connections will be required for all vibrating plant moving air in and out of the building, as not to transmit vibration along ceiling mounted HVAC system

9 CONCLUSIONS

9.1.1 SSC has undertaken a noise impact assessment and provided acoustic design advice, in order to discharge planning conditions relating to noise stipulated by LBCC (ref. 21/00230/PFUL2 (PP-09431799), for the proposed development known as 11-12 Grenville St, London WC1N 1LZ.

9.1.2 The results of the assessment indicate that the site is exposed to the highest levels of noise at the eastern boundaries; these noise levels are caused by road traffic movements.

9.1.3 From the noise survey data and recommended sound insulation requirements as provided in BS 8233:2014, assessments of the acoustic performance requirements of the external building fabric have been undertaken. These have been based upon the plans received from TAL Architects. Results of the assessment have been used to provide the acoustic performance specifications for the glazed elements and trickle ventilation installations to the external building fabric around the proposed residential flats.

9.1.4 Based on the internal wall layout drawings received from TAL Architects, recommended masonry or timber constructions have been given to achieve a 5dB improvement above the acoustic performance criteria as referenced in Approved Document E (2010 Edition, including 2004, 2010, 2013 and 2015 amendments). Further upgrades and recommendations, to achieve a 10 dB improvement, have been provided for separations between commercial premises and dwellings

9.1.5 Outline guidance has been provided to reduce the impact of structure borne noise from proposed mechanical ventilation systems.

9.1.6 From the noise survey data, limiting noise emission levels of mechanical plant have been provided based on the outline proposals. These include internal noise breakout to other parts of buildings; and external noise breakout to nearest noise-sensitive receptors. At this stage plant selections and final locations are not known and therefore outline mitigation options have been provided It is recommended that an assessment of plant noise be undertaken later in the design stage such that limiting levels can be demonstrated as achieved.

9.1.7 This report should be suitable in terms of discharging the Planning Conditions 9, 20 and 21 related to noise, thereby satisfying the requirements of LBCC.

9.1.8 Whilst it has been demonstrated that the discharging of Planning Conditions 8 and 19 could be feasible with good design, a separate scope of works should be undertaken to fully discharge each Planning Condition further into the design process once the procurement of plant items is finalised.

Appendix A: Glossary of Acoustic Terms

'A' weighting dB(A): Correction applied to the frequency range of a noise in order to approximate the response of the human ear. Noise measurements are often A-weighted using an electronic filter in the sound level meter.

Attenuation: Sound reduction, measured in decibels (dB).

Ambient Sound: The totally encompassing sound in a given situation at a given time usually composed of sound from many sources near and far. Note: The ambient sound comprises the residual sound and the specific sound when present.

Absorption: the conversion of sound energy into heat, often using a porous material.

ADE: Building Regulations 2010 Approved Document E (2003 Edition incorporating 2004, 2010, 2013 & 2015 amendments).

Airborne sound: sound propagating through the air e.g. from conversational speech or a television.

Airborne sound insulation: insulation that reduces the transmission of airborne sound.

Background sound level: A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T, measured using time weighting F and quoted to the nearest whole number of decibels.

Calibration: A check of the function of a sound level meter by comparing the meter reading with a known sound pressure level.

Decibel (dB): the unit used to describe various acoustic quantities to indicate a relative level with respect to a reference level.

Floating floor: a flooring system using resilient layers to provide isolation to surrounding structures.

Flanking element: any building element that contributed to sound transmission between rooms of a building that is not the separating element.

Flanking sound: sound travelling between rooms of a building, other than directly through the separating element.

Flanking strip: or edge strip, a resilient strip that is located about the perimeter of a floating floor to isolate the floor surface layer(s) from the perimeter walls and skirtings.

Frequency (Hz): The pitch of the sound, measured in Hertz.

Impact sound: sound impacting on a floor and propagating through building structure, re-radiated as structure-borne sound e.g. footsteps.

Impact sound insulation: insulation that reduces the transmission of impact sound.

Internal wall / floor: a wall / floor that divides the dwelling into different functions but does not provide separation between adjoining dwellings.

$L_{Aeq,T}$: The A-weighted equivalent continuous sound pressure level during a period. It is the sound level of a notionally steady sound having the same energy as a fluctuating sound over a specified measurement period, T.

Mass per unit area: or surface density, expressed in kilograms per square metre (kg/m^2).

Octave-bands: A division of the frequency range into recognised bands.

Rating level, $L_{Ar,Tr}$: The specific sound level plus any adjustment for the character of the sound.

Residual sound: Ambient sound remaining in the absence of the specific sound or that it is supressed as not to contribute to the ambient sound level.

Residual sound level, L_r or $L_{eq,T}$: The equivalent continuous A-weighted sound pressure level of the residual sound at the assessment location over a given reference time interval, T.

Separating wall / floor: a wall / floor that separates adjoining dwellings.

Sound pressure level (SPL): The basic measure of sound, expressed in decibels, usually measured with an appropriate frequency weighting (e.g. the A-weighted SPL in dB(A)).

Sound power level (L_w): The sound energy radiated per unit time by a sound source measured in watts (W). Sound power can be weighted (e.g. A-weighted) and is not influenced by environmental or physical factors such as weather or distance.

Specific sound: Sound source being assessed.

Specific sound level, L_s or $L_{eq,T}$: The equivalent continuous A-weighted sound pressure level at the assessment position produced by the specific noise source over a given reference time interval, T.

Weighted sound reduction index R_w: a single number quantity of airborne sound insulation of building elements from laboratory measurements, using a weighted curve of reference values.

Weighted standardised impact sound pressure level $L'_{nT,w}$: a single number quantity of impact sound insulation from field measurements, using weighted curves of reference values; following the specific method within Annex B of Approved Document E.

Weighted standardised level difference $D_{nT,w} + C_{tr}$: a single number quantity of airborne sound insulation between rooms from field measurements, using weighted curves of reference values; following the specific method within Annex B of Approved Document E.

Appendix B: Glossary of Material Terminology

All proprietary products provided in this section shall be read as examples where alternatives are available from range of manufacturers. As design consultants, Sound Solution Consultants Limited do not endorse any one product or system from any one manufacturer.

8 kg/m² plasterboard: typically, 12.5 mm thick as providing a mass per area of ≥ 8 kg/m². E.g. British Gypsum Gyproc Wallboard 12, or equivalent.

10 kg/m² plasterboard: typically, 12.5 mm thick as providing a mass per area of ≥ 10 kg/m². E.g. British Gypsum Gyproc Soundbloc 12, or equivalent.

12.5 kg/m² plasterboard: typically, 15 mm thick as providing a mass per area of ≥ 12.5 kg/m². E.g. British Gypsum Gyproc Soundbloc 15, or equivalent.

15 kg/m² plasterboard plank: typically providing a mass per area of ≥ 15 kg/m² and used within floating floor systems or heavy wall linings. E.g. British Gypsum Gyproc Plank, or equivalent.

10 kg/m² platform floating floor: a thin, lightweight floating floor system typically applicable for use on concrete flooring. E.g. Hush-Panel 17, or equivalent.

20 kg/m² platform floating floor: typically, 28 mm deep and providing a mass per area of ≥ 20 kg/m². E.g. Hush-Panel 28, or equivalent.

25 kg/m² platform floating floor: typically, 28 mm deep and providing a mass per area of ≥ 25 kg/m². E.g. Hush-Panel Cem 28, Cellecta Screedboard 28, or equivalent.

Acoustic batten: nominal 50 – 70 mm deep timber batten with resilient layer, forming part of a timber raft floor. E.g. Hush-Batten 55/70m, Monafloor Acoustic Batten, or equivalent.

Acoustic cradle: supporting cradle for timber floor battens, with resilient layer, forming part of a timber raft floor and allowing an adjustable height. E.g. Hush-Cradle, or equivalent.

Acoustic downlight: a proprietary downlight that has been tested in accordance with the laboratory method of Robust Details Handbook Appendix F. E.g. PhotonStar LED Group CeilingStar / EcoStar LED.

Acoustic hanger: a resilient ceiling system used to isolate ceilings from structural elements, to be installed in accordance with manufacturers details. E.g. Thermo Economics Isosonic Hanger (timber) or British Gypsum Gypframe GAH1 Acoustic Hanger (metal frame), or equivalent.

Acoustic socket box: backing for sockets in lightweight separating walls, typically providing a mass per area of 20 kg/m² which can otherwise be formed from two layers of 12.5 mm dense plasterboard. E.g. Sound Reduction Systems Acoustic Socket Box, or equivalent.

Absorptive ceiling (tile): ISO 11654 Class C rated mineral tile, provided with a stick-on backing or lay-in grid. E.g. 30 mm deep SoundSorba Echosorba / British Gypsum Gyptone Quattro 22, or equivalent.

Absorptive ceiling (plasterboard): ISO 11654 Class C rated plasterboard, normally used as part of a metal frame ceiling. E.g. British Gypsum Gyptone Quattro 41, or equivalent.

Flanking strip: or edge strip, a resilient strip that is located about the perimeter of a floating floor to isolate the floor surface layer(s) from the perimeter walls and skirtings.

Lightweight density block (aerated): typically, of dry density 400 – 850 kg/m^3.

Medium density block (lightweight aggregate): typically, of dry density 1,350 – 1,600 kg/m^3.

High density block (dense aggregate): typically, of dry density 1,850 – 2,300 kg/m^3.

Metal frame ceiling: a proprietary system used to support ceilings. E.g. British Gypsum Casoline, or equivalent.

Mineral wool slab: a rigid slab of mineral wool, typically of 33 – 45 kg/m^3 density. E.g. Rockwool RWA 45, Rockwool Flexi Slab, or equivalent.

Mineral wool quilt: a lightweight quilt of mineral wool, typically 12 – 24 kg/m^3 density**.** ISOVER APR1200, or equivalent.

Resilient bar: typically, 16 mm deep and isolation between structural walls, floors and plasterboard layers. E.g. British Gypsum RB1, or equivalent.

Resilient under-screed layer: typically, 8 - 10 mm deep isolation between structural walls, floors and a floating screed. E.g. Regupol E48, or equivalent.

Resilient mat / underlay: typically, 3 – 4.5 mm deep isolation on top of concrete or timber flooring systems as rated ≥ 17 dB with ISO 140-8:1998. E.g. Regupol 4515 multi, or equivalent.

Type A wall tie: a wall tie that has a certified (laboratory tested) dynamic stiffness < 4.8 MN/m^3, with consideration of both the cavity width and the wall tie spacing. E.g. 225 mm Staifix HRT4 wall ties within a 100 mm cavity wall, at a standard density of 2.5 ties per square metre (a practical spacing of 900 mm horizontal x 450 mm vertical centres).

Appendix C: Location Plan Highlighting Measurement Positions

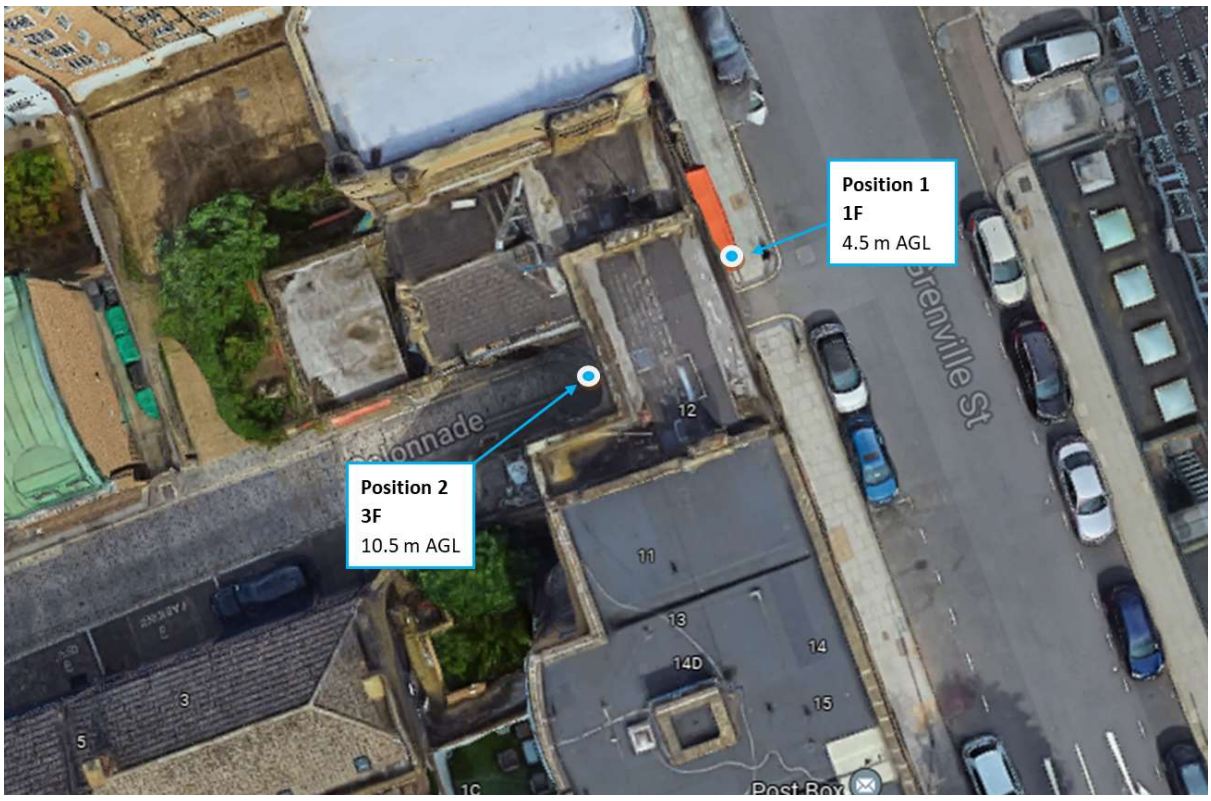


Figure C1 – Summary of Monitoring Positions

Appendix D: Scheme Design

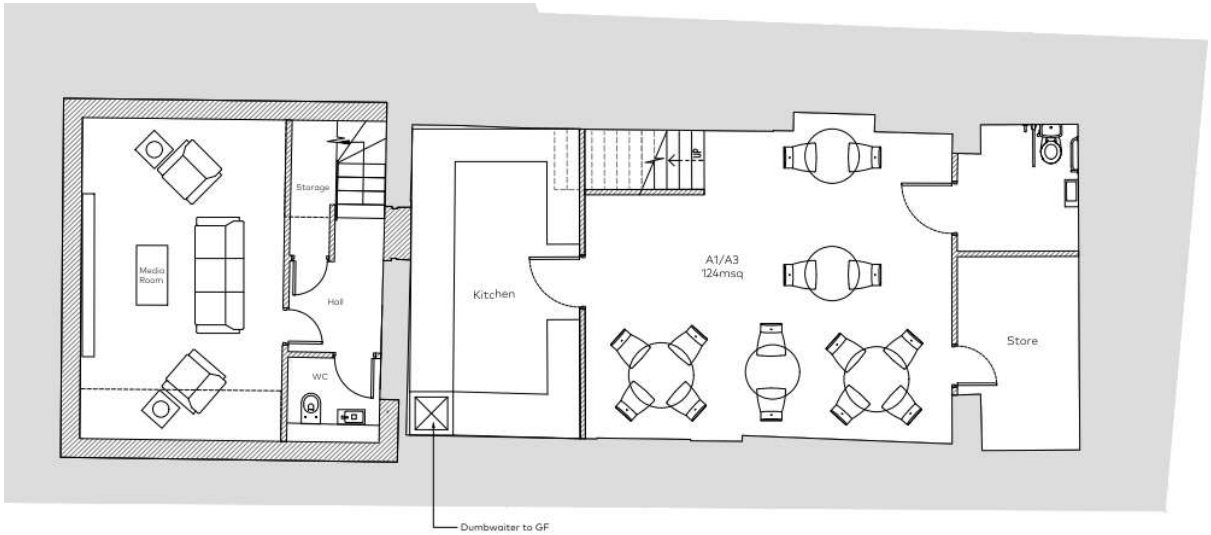


Figure D1 – Basement Plan

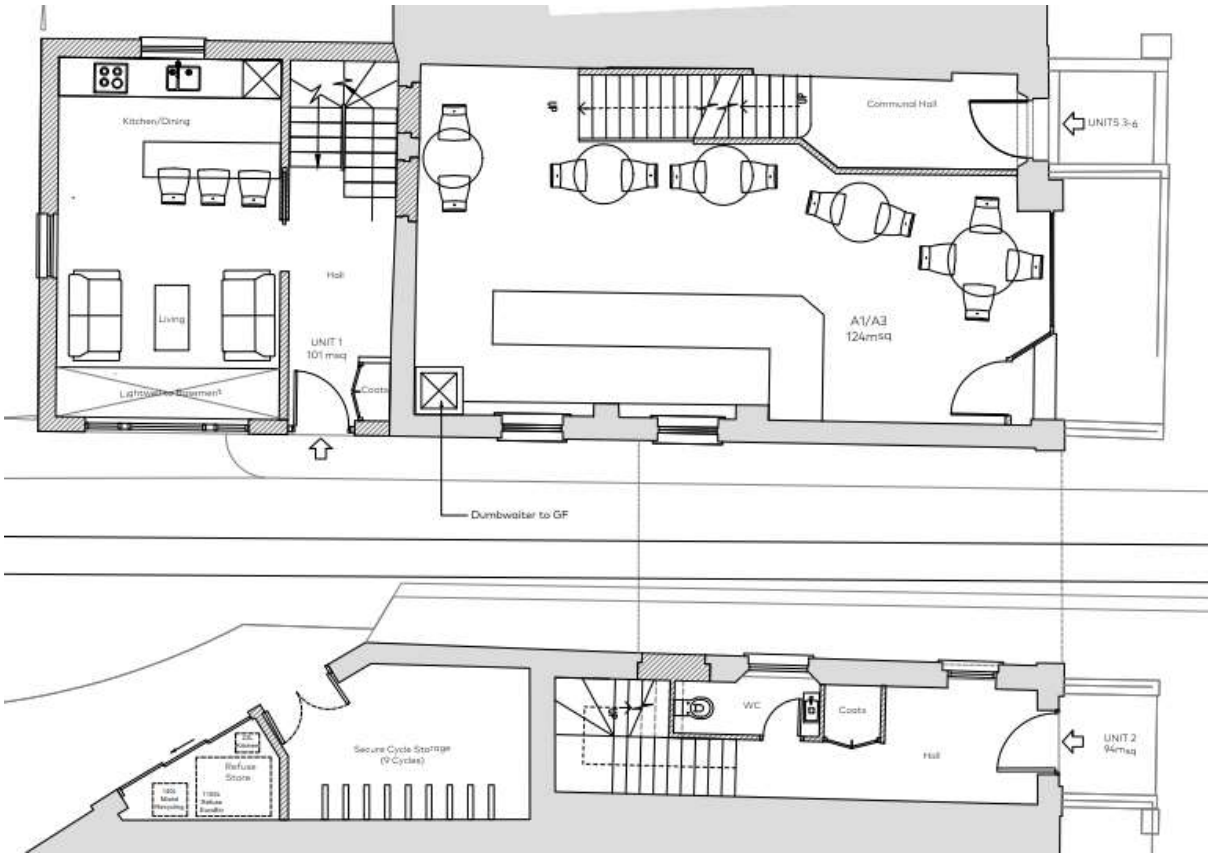


Figure D2 – Ground Floor Plan

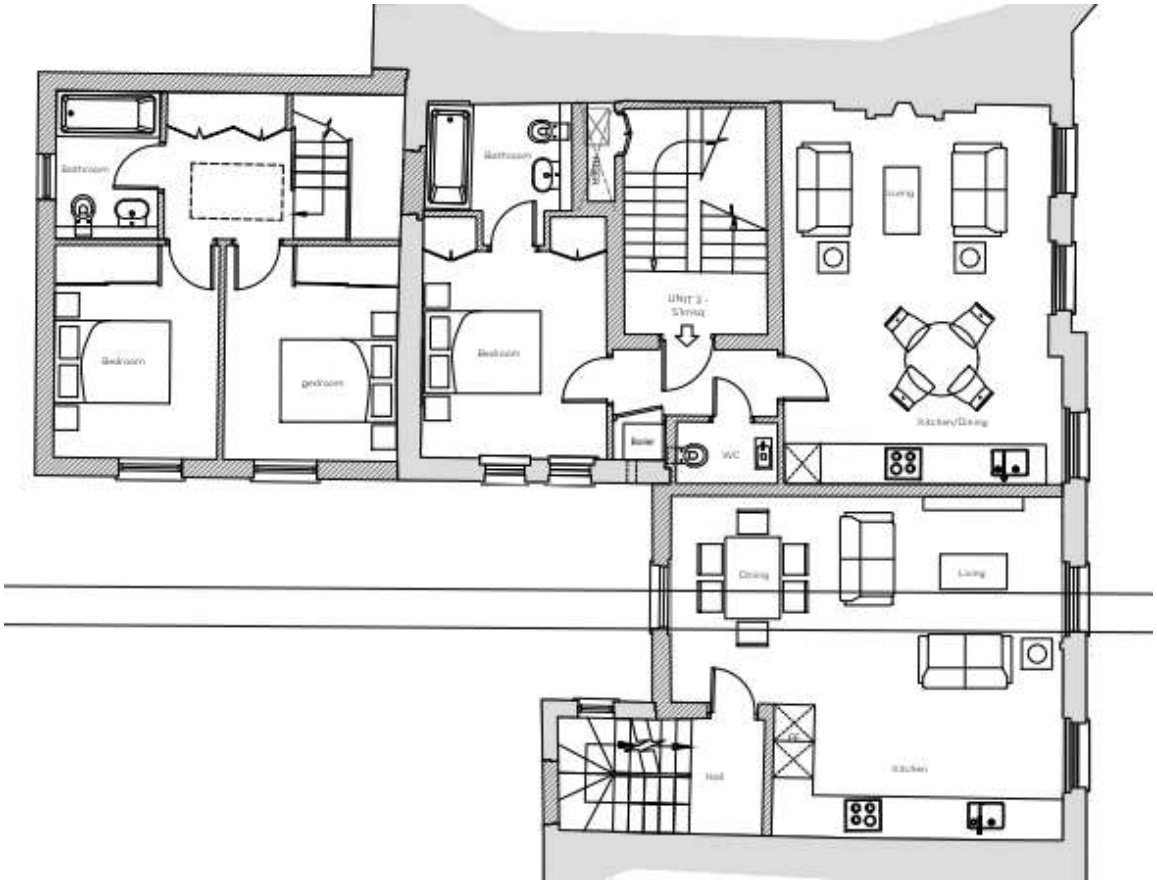


Figure D3 – First Floor Plan

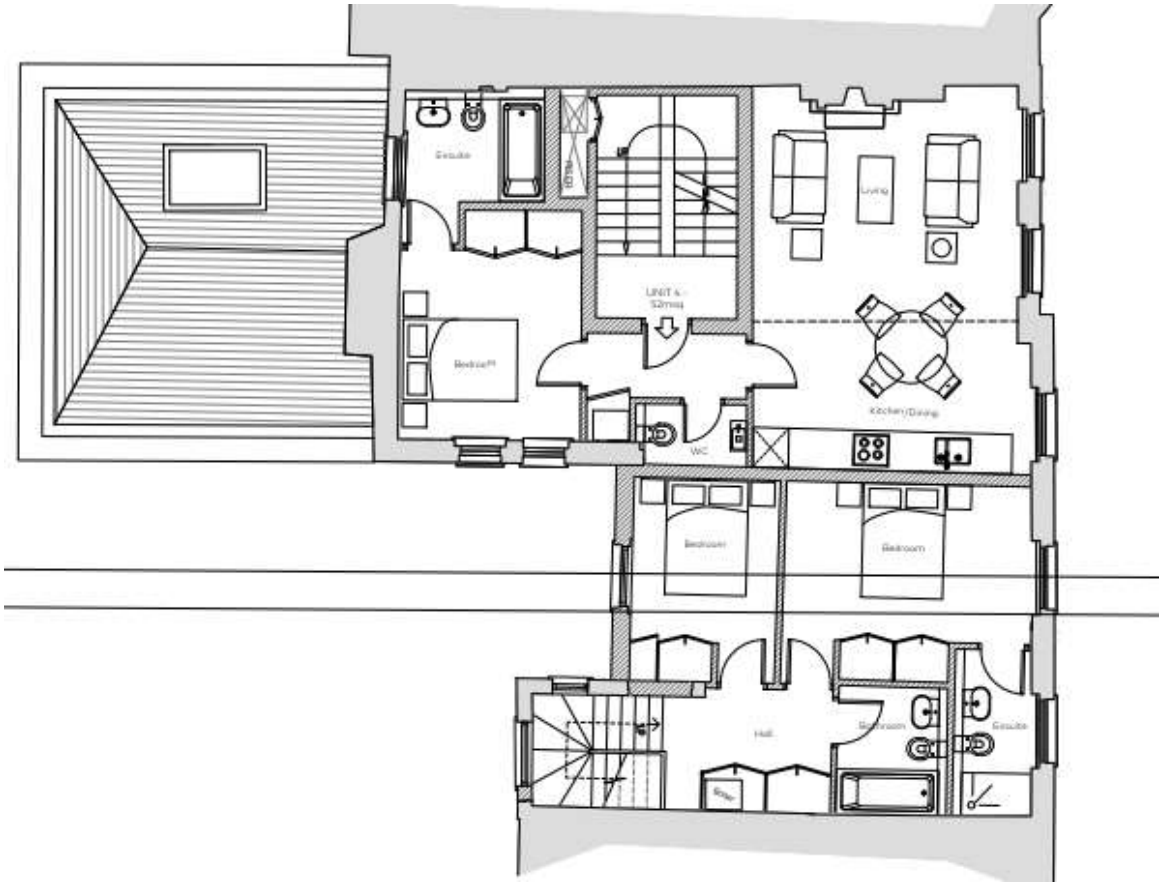


Figure D4 – Second Floor Plan

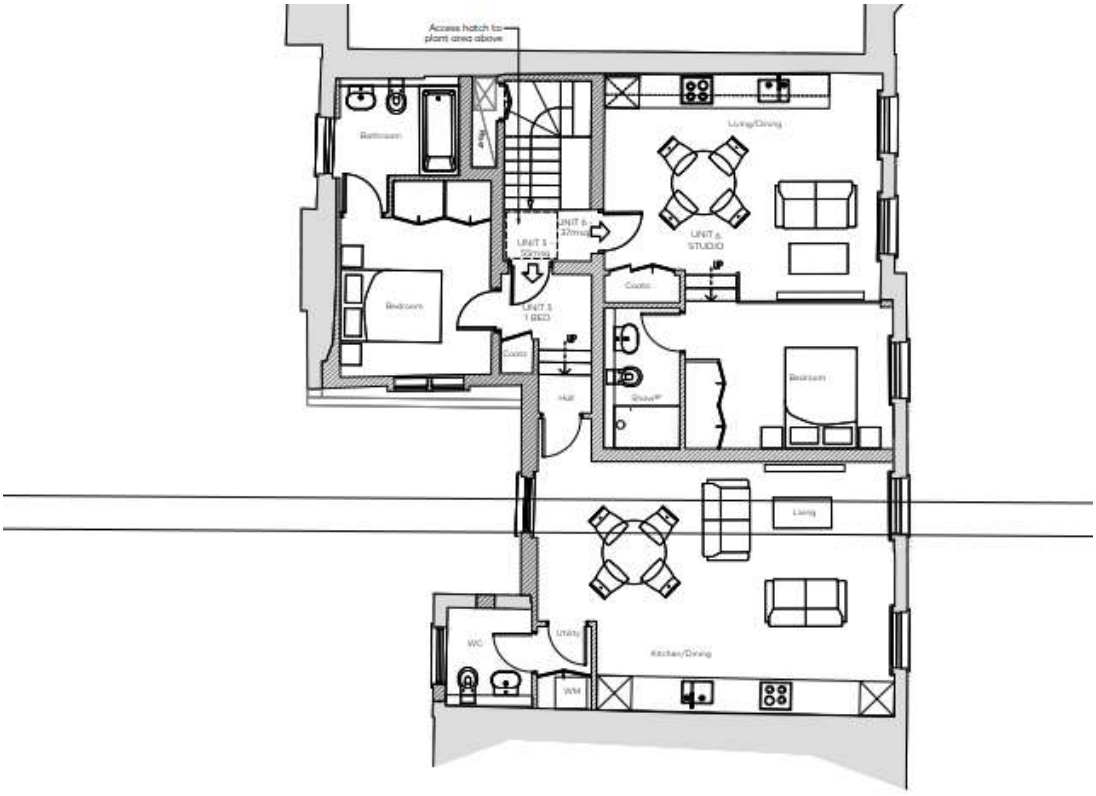


Figure D5 – Third Floor Plan

Appendix E: Survey Summary

The equipment used during the survey consisted of the following precision monitoring equipment and accessories which conform to BS EN 61672-1:2003 (Class 1) for sound level meters and BS EN 60942 (Class 1) for sound calibrators. All equipment listed in the Table below has traceable calibration history valid during the relevant times of the site assessment; no greater than two years for sound level meters and one year for sound calibrators.

Position No.	Manufacturer	Model No.	Description	Serial No.	Calibration Due Date
1	Larson Davis	LxT (ST)	3rd octave band sound level meter	4170	
	Larson Davis	PRMLxT 1L	Microphone preamplifier (low range)	36076	
	Larson Davis	337B02	½" electret microphone	151485	
2	Larson Davis	LxT (SE)	3rd octave band sound level meter	3934	
	Larson Davis	PRMLxT 1L	Microphone preamplifier (low range)	29332	
	Larson Davis	337B02	½" electret microphone	146990	
All	Larson Davis	CAL200	Sound level calibrator	11165	

Table E1 – Sound monitoring equipment.

The calibration of the sound level meter was checked using the handheld calibrator CAL200 at its verified reference level and frequency, 114 dB at 1kHz, before any measurements were taken. Validation checks at the end of the survey demonstrated acceptable drift across all parts of the study, across all sound level measurement equipment used, of ≤ 0.10 dB.

Weather conditions	Start	Finish	Additional comments
Wind velocity	< 5m/s Average < 0m/s Gust	< 5m/s Average < 0m/s Gust	Rain was present during the setup of the survey. But noted stop within a hour of survey commencement. Therefore, not deemed to have a significant impact on results.
Wind direction	East	Southwest	
Cloud cover/rain	80 %, 5mm rain	0 %, no rain	
Temperature	18 °C	21 °C	

Table E2 – Recorded weather conditions.

Interval noise data was recorded at the measurement positions on site from Tuesday 14th September 2021 to Wednesday 15th September 2021 at 15-minute periods, time synchronised to BST and between sound level meters. Weather conditions at the times of reported site measurements were deemed to be conducive to environmental surveying, being absent of strong winds (<< 5m/s) and rain over the reported period.

Sound levels at the front of the development site, at Position 1, were relevant to high street traffic along Grenville Street. A typical diurnal pattern can be seen with ambient and background levels

increasing during the daytime and decreasing into the night. Intermittent high peaks are understood to have occurred from passing sirens.

At the rear of the development site, the relative levels at Position 2 were markedly lower comprising of low-level ambient traffic emanating over the adjacent buildings from surrounding road network. Intermittent community noises were evident from the local area however any plant associated with the current use of the development site was not noted to be in use.

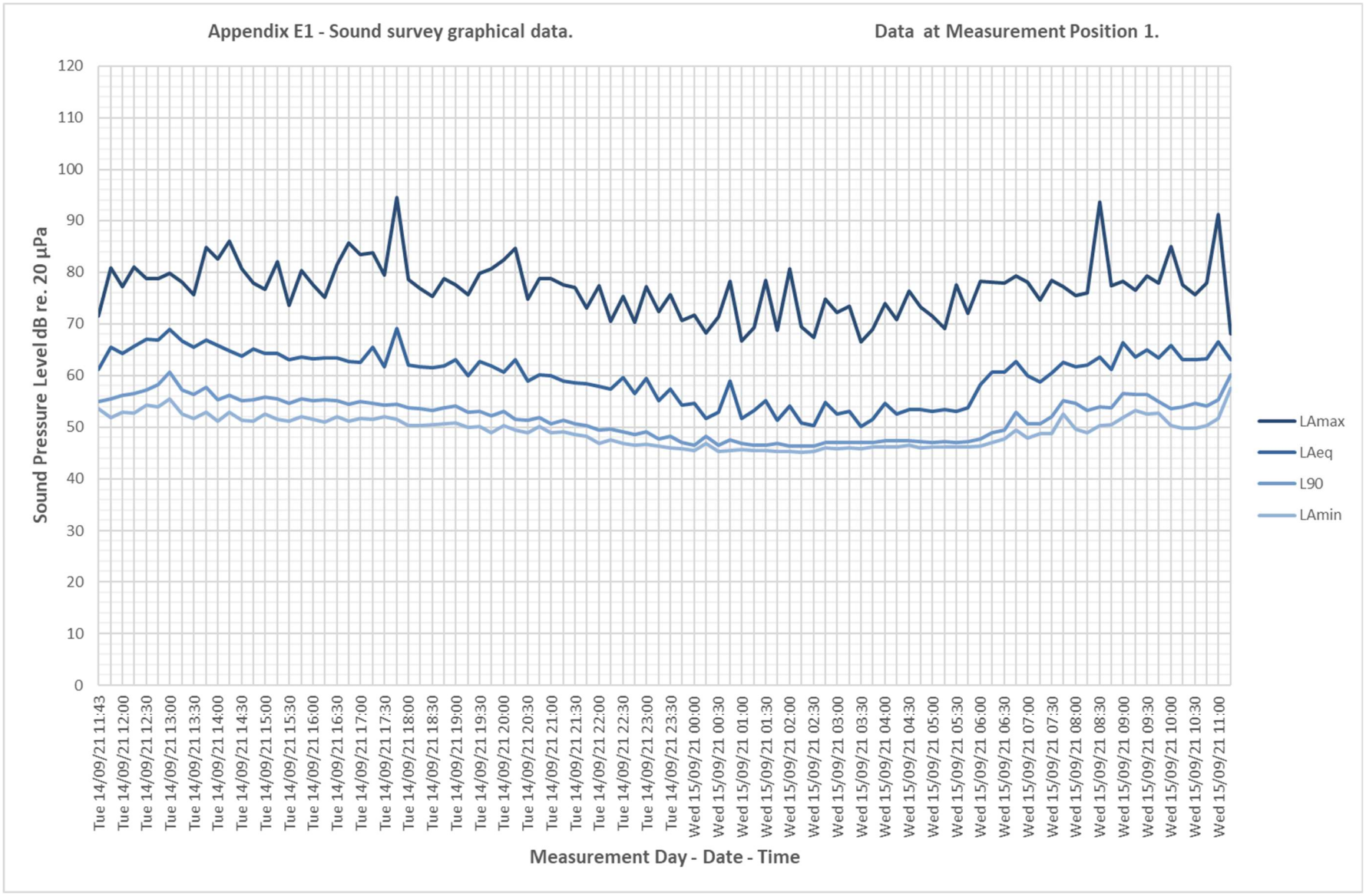


Figure E1 – Survey Results Summary – Position 1

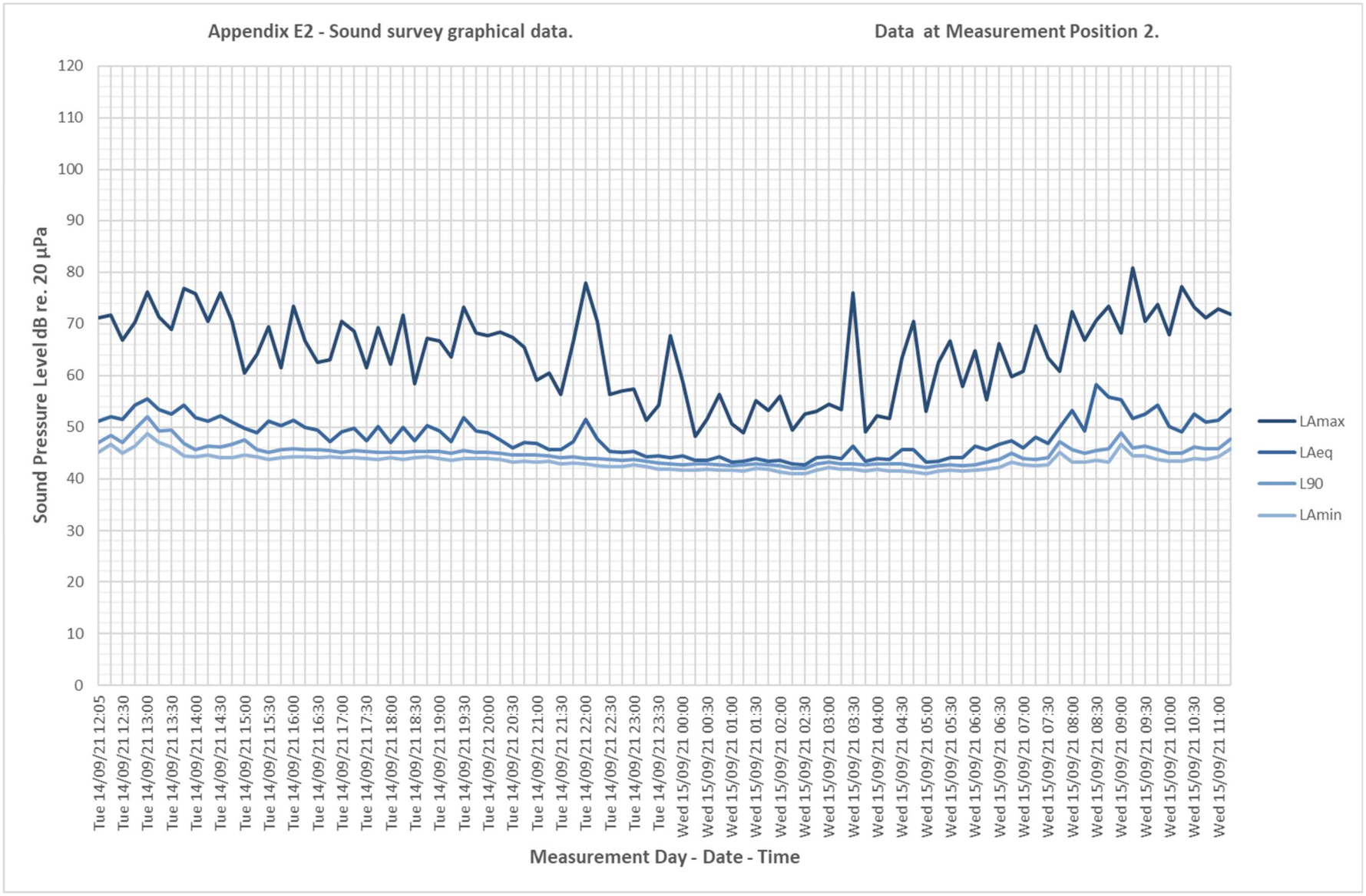


Figure E2 – Survey Results Summary – Position 2

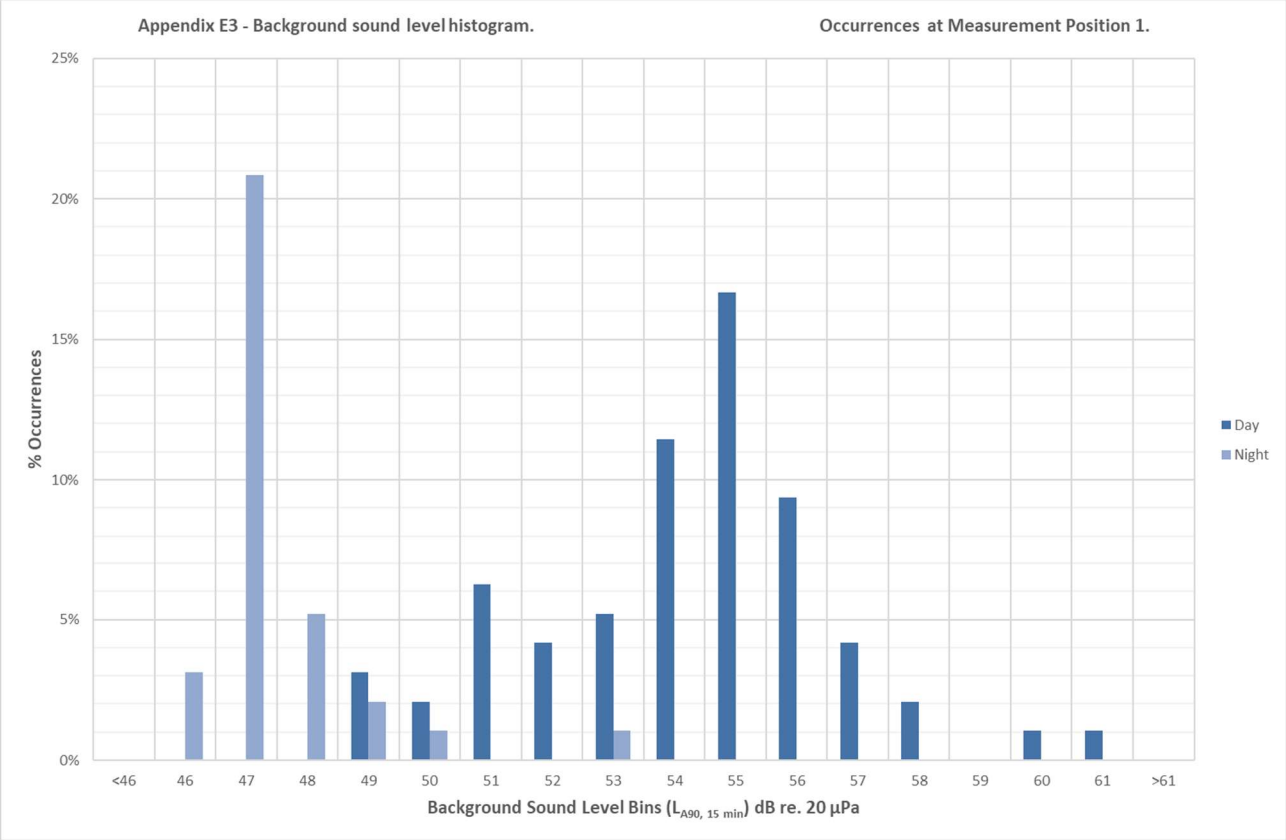


Figure E3 – Background Sound Level Summary – Position 1

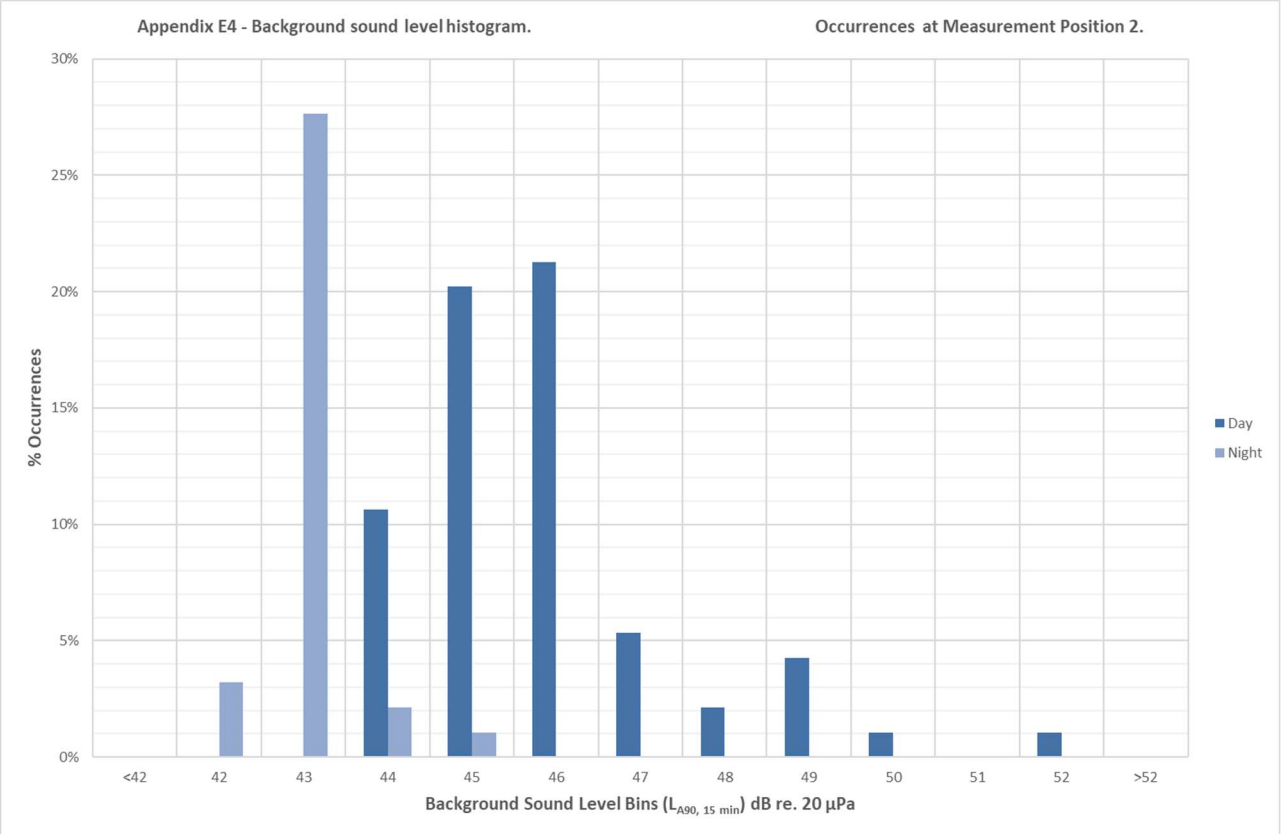


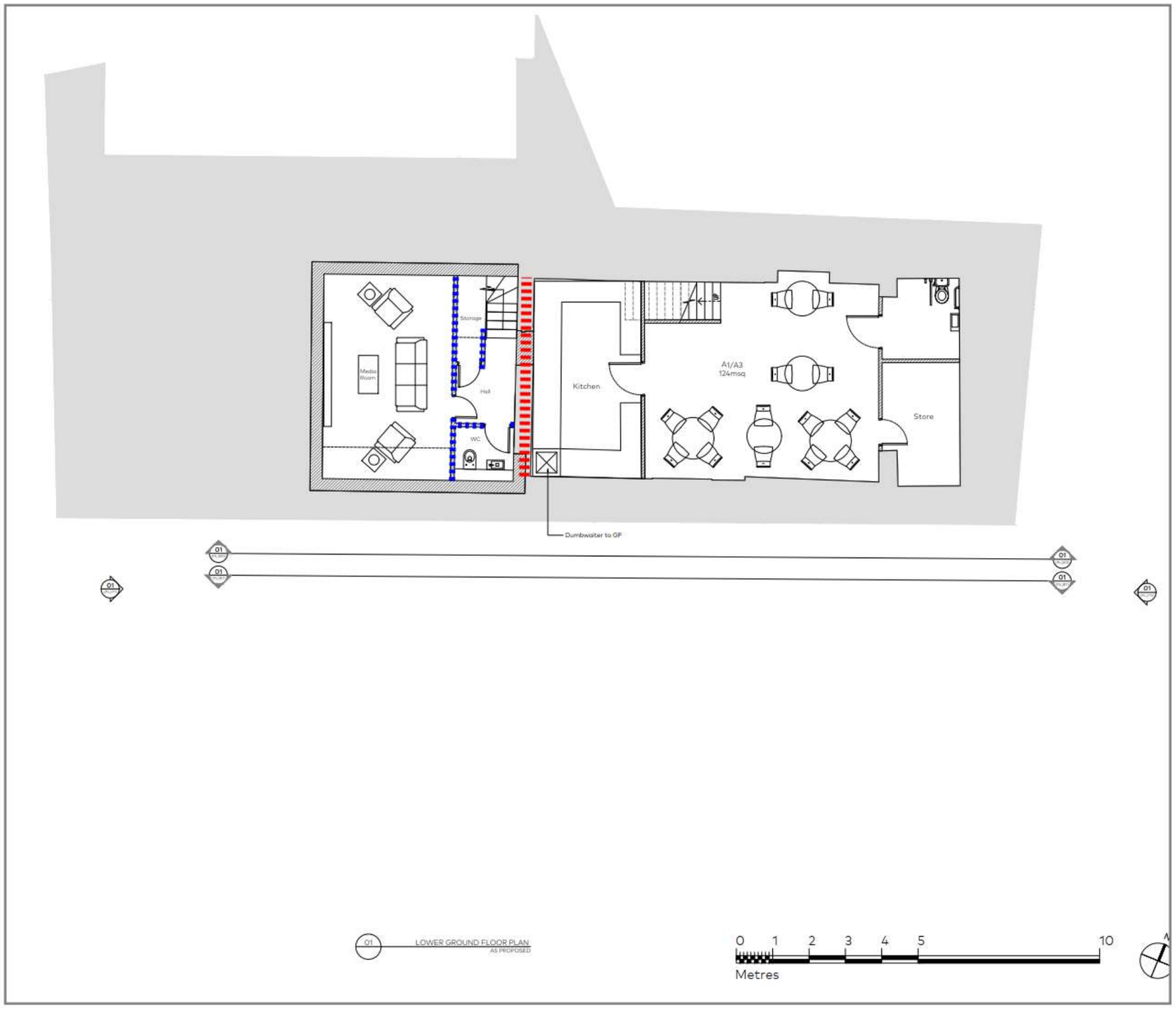
Figure E4 – Background Sound Level Summary – Position 2

Appendix F: Noise Break-in Calculations

Ref	Room Name	Façade Wall		Glazing		Ventilation		Roof		External Noise	External Noise Result Day							External Noise Result Night							External Noise Result Max						
		Type	Rw	Type	Rw	Type	Dne,w	Type	Rw	Type	125	250	500	1k	2k	4k	A	125	250	500	1k	2k	4k	A	125	250	500	1k	2k	4k	A
1	Unit 1 Living	Solid Masonry	57	4 (20) 4	30	4000L	34	None	-	Position 2	35	31	22	16	10	11	26	29	26	14	9	0	-4	20	46	43	31	26	17	13	37
2	Unit 1 Bed	Solid Masonry	57	4 (20) 4	30	4000L	34	Proposed Tile Roof	57	Position 2	33	29	21	20	14	13	26	27	24	14	12	3	-2	19	44	41	31	29	20	15	36
3	Unit 2 Living	Solid Masonry	57	4-14-6	35	AL-dB 40	40	None	-	Position 1	37	33	25	20	17	12	28	31	27	18	12	8	1	22	52	48	39	33	29	22	43
4	Unit 3 Living	Solid Masonry	57	4-14-6	35	AL-dB 40	40	None	-	Position 1	38	34	26	21	19	14	30	32	29	20	14	9	2	24	53	50	41	35	30	23	45
5	Unit 3 Bed	Solid Masonry	57	4 (20) 4	30	4000L	34	None	-	Position 2	33	29	21	19	13	12	26	27	24	14	12	3	-3	19	44	41	31	29	20	14	36
6	Unit 4 Living	Solid Masonry	57	4-14-6	35	AL-dB 40	40	None	-	Position 1	37	33	25	21	18	12	29	31	28	19	13	9	1	23	52	49	40	34	30	22	44
7	Unit 4 Bed	Solid Masonry	57	4 (20) 4	30	4000L	34	None	-	Position 2	33	30	21	20	14	13	26	28	24	14	12	3	-2	19	45	41	31	29	20	15	36
8	Unit 2 Bed (Front)	Solid Masonry	57	4-14-6	35	AL-dB 40	40	None	-	Position 1	37	33	28	23	20	13	30	31	28	22	16	11	1	24	52	49	43	37	32	22	45
9	Unit 2 Bed (Rear)	Solid Masonry	57	4 (20) 4	30	4000L	34	None	-	Position 2	34	31	23	21	15	14	27	29	25	16	14	5	-1	21	46	42	33	31	22	16	38
10	Unit 5 Living	Solid Masonry	57	4-14-6	35	AL-dB 40	40	Proposed Tile Roof	57	Position 1	35	31	25	20	17	11	28	29	26	19	13	8	-1	21	50	47	40	34	29	20	42
11	Unit 5 Bed	Solid Masonry	57	4 (20) 4	30	4000L	34	Flat Roof	51	Position 2	34	31	22	20	14	13	27	29	26	15	13	4	-2	20	46	43	32	30	21	15	37
12	Unit 6 Living	Solid Masonry	57	4-14-6	35	AL-dB 40	40	None	-	Position 1	36	32	26	21	18	11	29	30	27	19	13	9	0	22	51	48	40	34	30	21	43
13	Unit 6 Bed	Solid Masonry	57	4-14-6	35	AL-dB 40	40	None	-	Position 1	37	32	28	24	20	12	30	31	27	22	16	11	1	24	52	48	43	37	32	22	45

Appendix F1 – BS233 Break-in Calculations

Appendix H: Internal Sound Insulation Drawings



MINIMUM SOUND INSULATION REQUIREMENTS

SEPARATING WALLS:
MINIMUM IN-SITU PERFORMANCE
50 dB $D_{nT,w+Ctr}$

INTERNAL WALLS:
MINIMUM LAB RATING
40 dB R_w

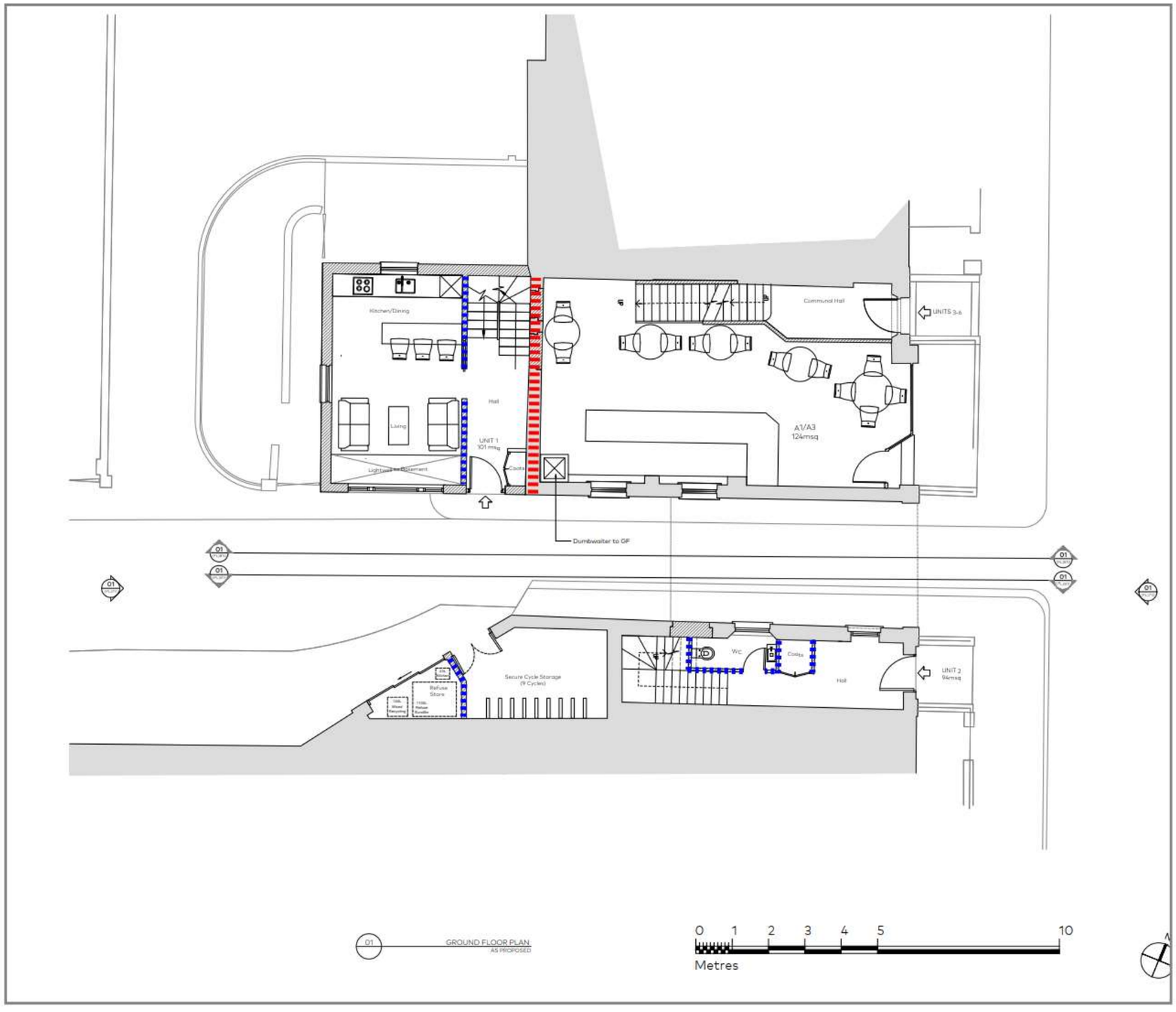
DOORS:
MINIMUM LAB RATING
29 dB R_w

OTHER ELEMENTS:
55 dB $D_{nT,w+Ctr}$

DATE	REV	DESCRIPTION	BY
10/09/21	1	DESIGN	LD

11-12 GRENVILLE STREET
SOUND INSULATION MARK-UP
BASEMENT
REF: 37195-MK-SI-LB

soundsolution CONSULTANTS



MINIMUM SOUND INSULATION REQUIREMENTS

SEPARATING WALLS:

MINIMUM IN-SITU PERFORMANCE

50 dB $D_{nT,w+Ctr}$

INTERNAL WALLS:

MINIMUM LAB RATING

40 dB R_w

DOORS:

MINIMUM LAB RATING

29 dB R_w

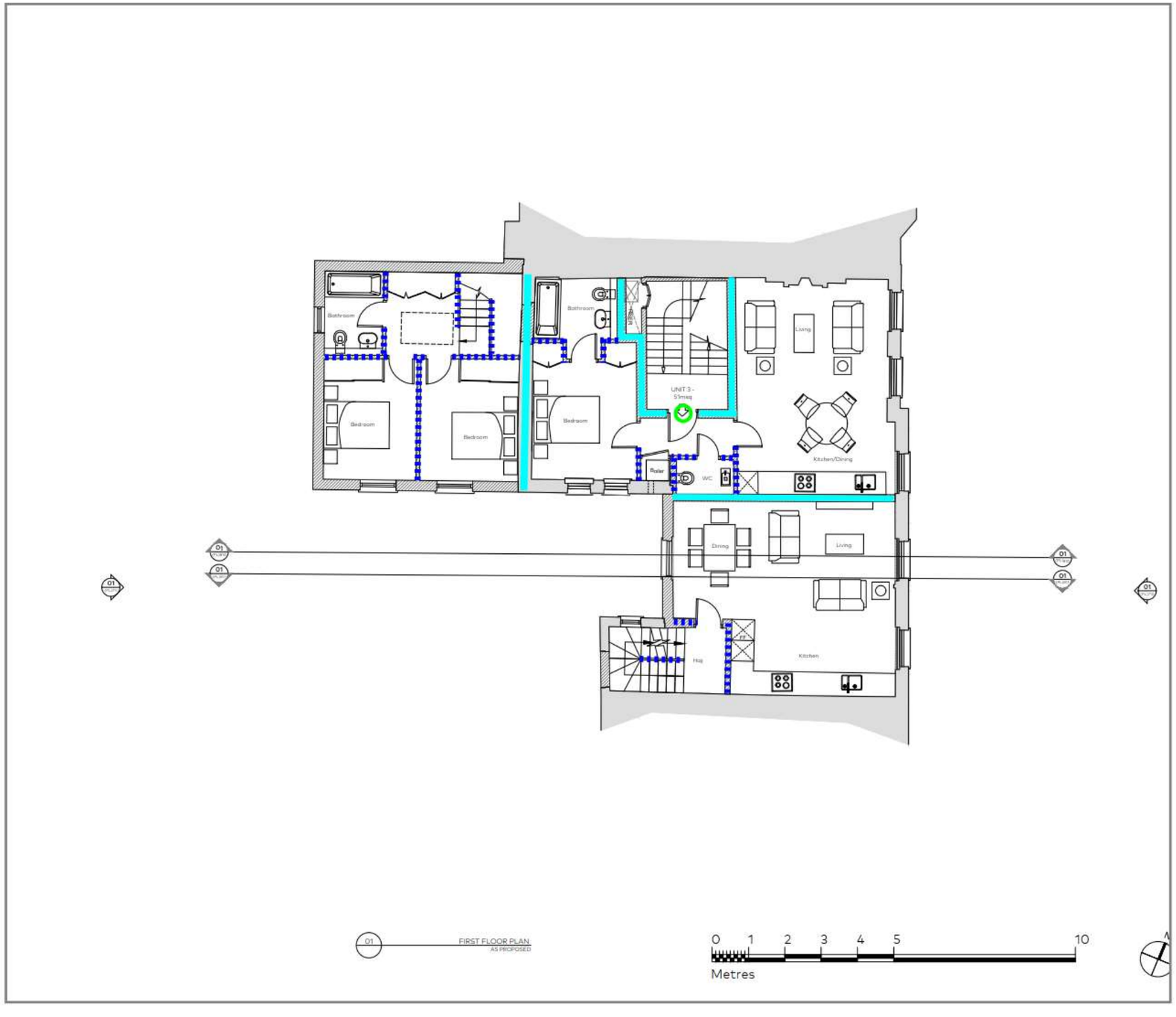
OTHER ELEMENTS:

55 dB $D_{nT,w+Ctr}$

DATE	REV	DESCRIPTION	BY
10/09/21	1	DESIGN	LD

11-12 GRENVILLE STREET
SOUND INSULATION MARK-UP
GROUND FLOOR
REF: 37195-MK-SI-L00

soundsolution CONSULTANTS



MINIMUM SOUND INSULATION REQUIREMENTS

SEPARATING WALLS:

MINIMUM IN-SITU PERFORMANCE

50 dB $D_{nT,w+Ctr}$

INTERNAL WALLS:

MINIMUM LAB RATING

40 dB R_w

DOORS:

MINIMUM LAB RATING

29 dB R_w

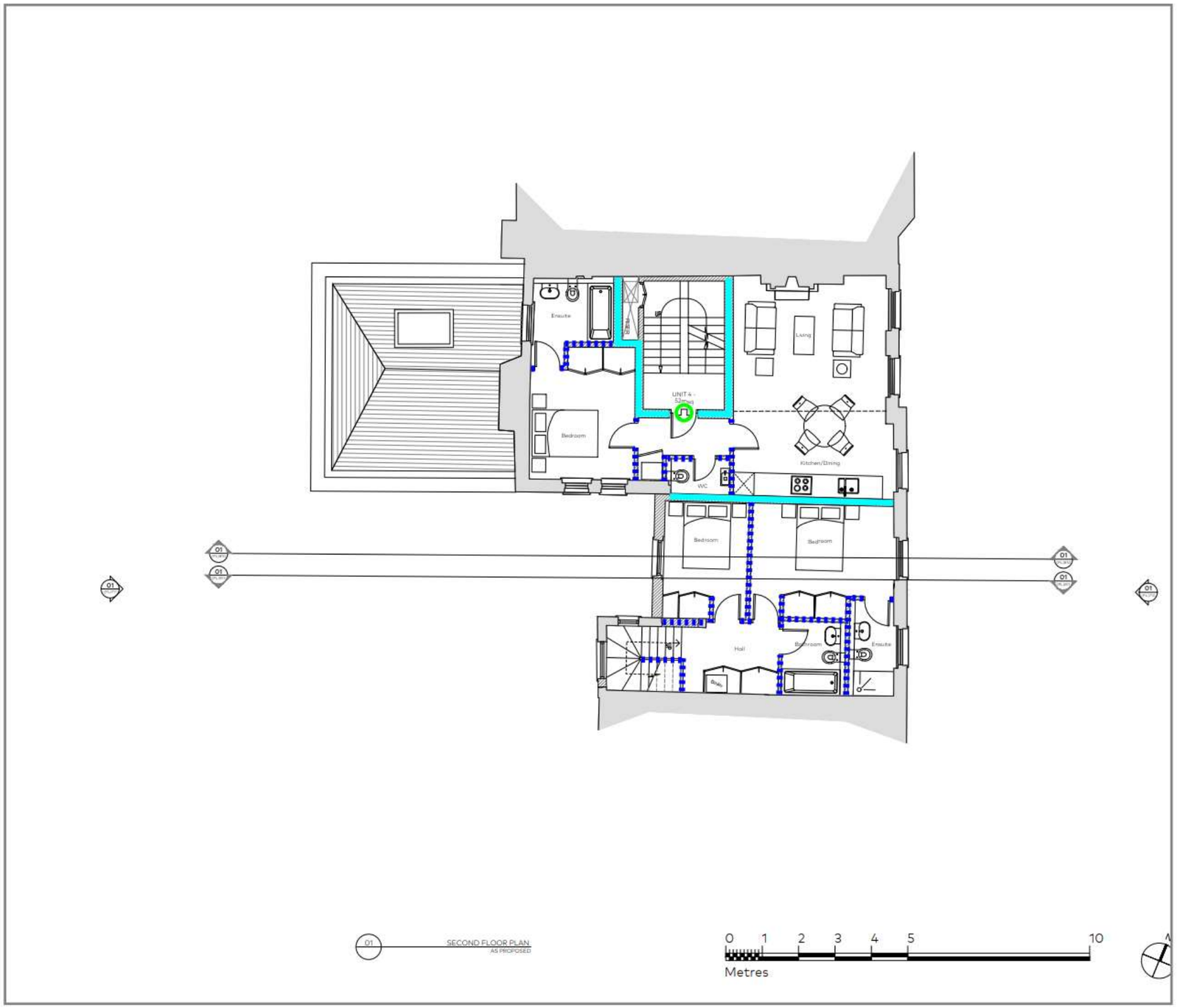
OTHER ELEMENTS:

55 dB $D_{nT,w+Ctr}$

DATE	REV	DESCRIPTION	BY
10/09/21	1	DESIGN	LD

11-12 GRENVILLE STREET
SOUND INSULATION MARK-UP
FIRST FLOOR
REF: 37195-MK-SI-L01

soundsolution CONSULTANTS



MINIMUM SOUND INSULATION REQUIREMENTS

SEPARATING WALLS:

MINIMUM IN-SITU PERFORMANCE

50 dB $D_{nT,w+Ctr}$

INTERNAL WALLS:

MINIMUM LAB RATING

40 dB R_w

DOORS:

MINIMUM LAB RATING

29 dB R_w

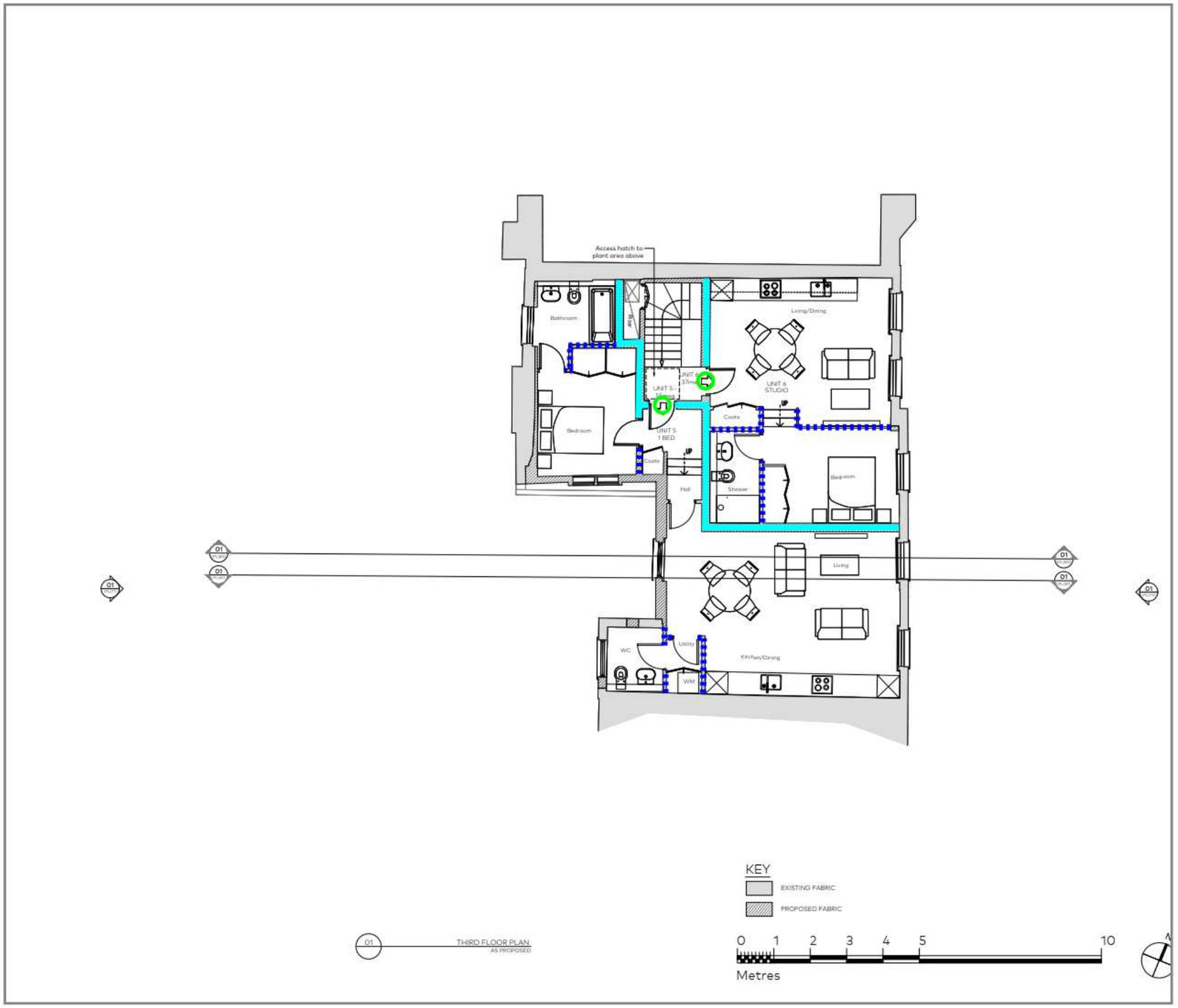
OTHER ELEMENTS:

55 dB $D_{nT,w+Ctr}$

DATE	REV	DESCRIPTION	BY
10/09/21	1	DESIGN	LD

11-12 GRENVILLE STREET
SOUND INSULATION MARK-UP
SECOND FLOOR
REF: 37195-MK-SI-L02

soundsolution CONSULTANTS



MINIMUM SOUND INSULATION REQUIREMENTS

SEPARATING WALLS:

MINIMUM IN-SITU PERFORMANCE

50 dB $D_{nT,w+Ctr}$

INTERNAL WALLS:

MINIMUM LAB RATING

40 dB R_w

DOORS:

MINIMUM LAB RATING

29 dB R_w

OTHER ELEMENTS:

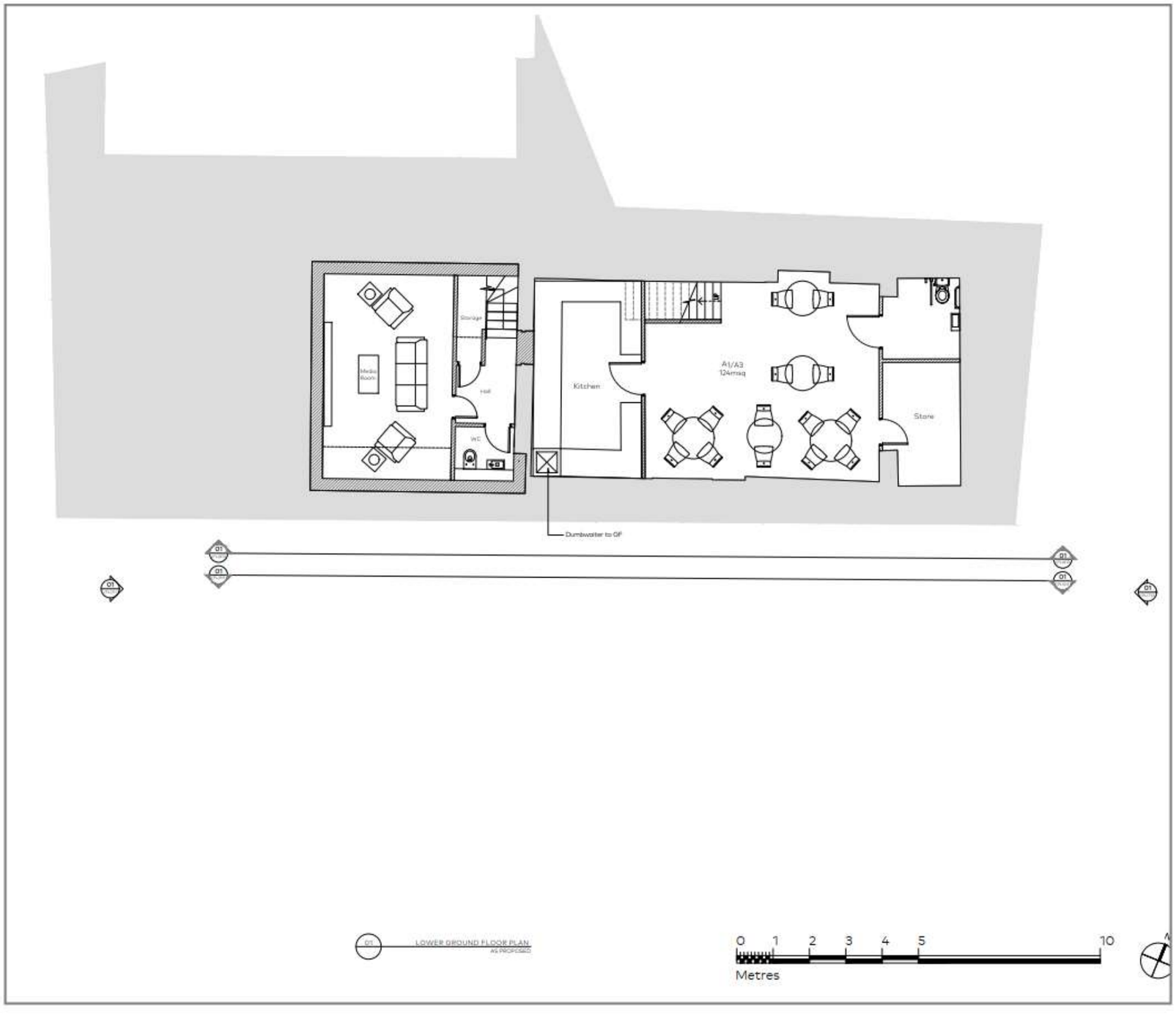
55 dB $D_{nT,w+Ctr}$

DATE	REV	DESCRIPTION	BY
10/09/21	1	DESIGN	LD

11-12 GRENVILLE STREET
SOUND INSULATION MARK-UP
THIRD FLOOR
REF: 37195-MK-SI-L03

soundsolution CONSULTANTS

Appendix I: Absorption Requirement Drawings



MINIMUM REVERBERATION TIME REQUIREMENTS

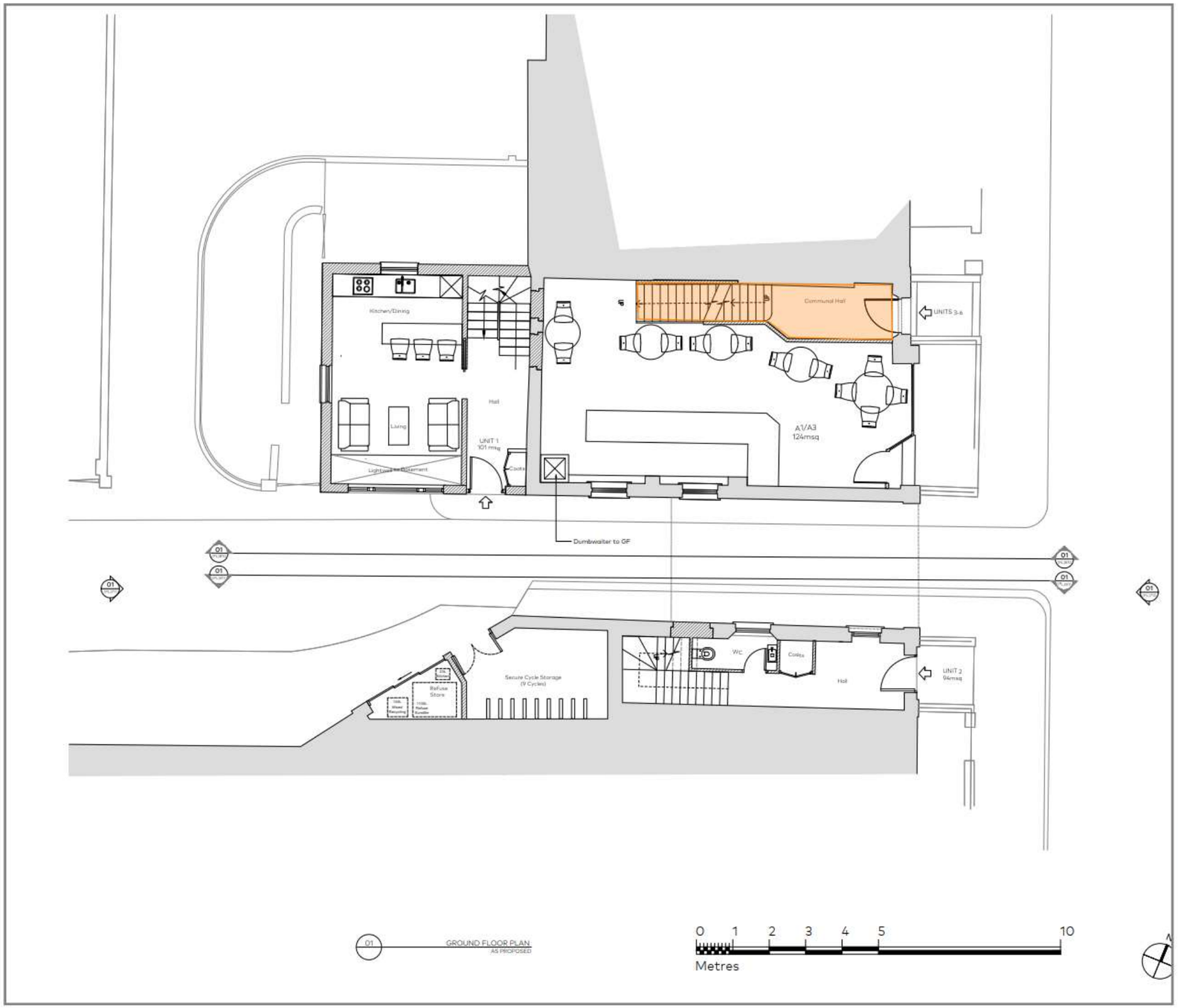
APPROVED DOCUMENT E - REVERBERATION IN COMMON PARTS:

Refer to Section 6 SSC Acoustic Report (ref. 37195-R!)

DATE	REV	DESCRIPTION	BY
10/09/21	1	DESIGN	LD

11-12 GRENVILLE STREET
REVERBERATION TIME MARK-UP
BASEMENT
REF: 37195-MK-RT-LB

soundsolution CONSULTANTS



MINIMUM REVERBERATION TIME REQUIREMENTS

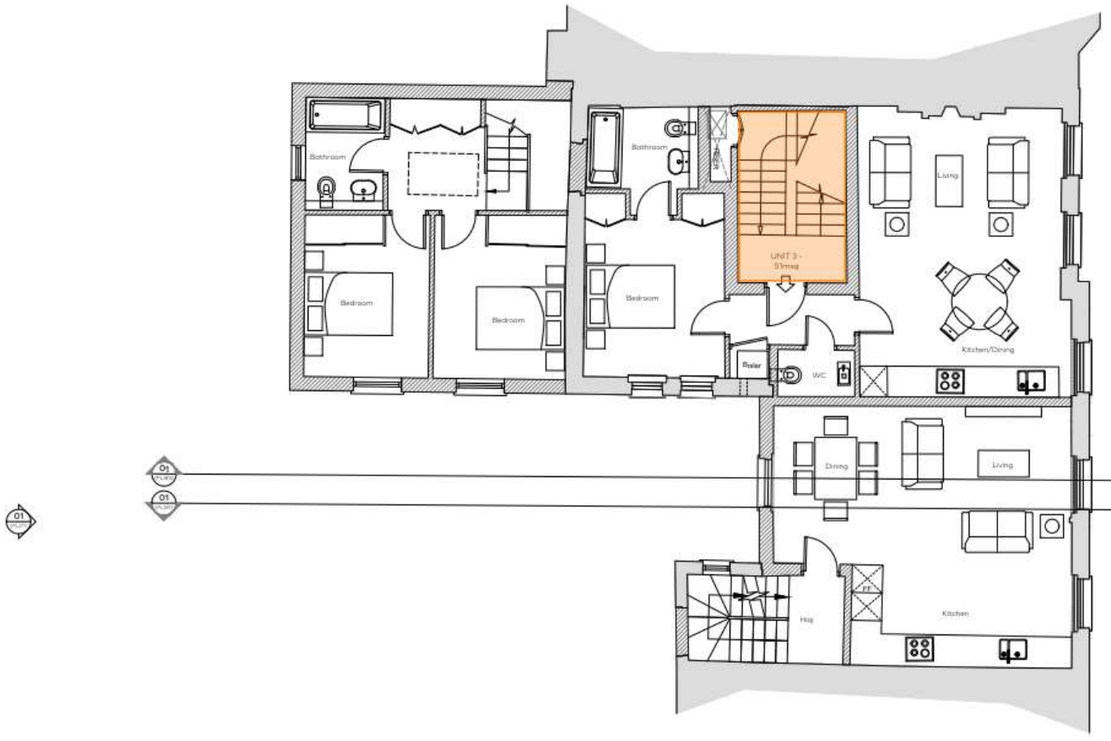
APPROVED DOCUMENT E - REVERBERATION IN COMMON PARTS:

Refer to Section 6 SSC Acoustic Report (ref. 37195-R!)

DATE	REV	DESCRIPTION	BY
10/09/21	1	DESIGN	LD

11-12 GRENVILLE STREET
REVERBERATION TIME MARK-UP
GROUND FLOOR
REF: 37195-MK-RT-L00

soundsolution CONSULTANTS



MINIMUM REVERBERATION TIME REQUIREMENTS

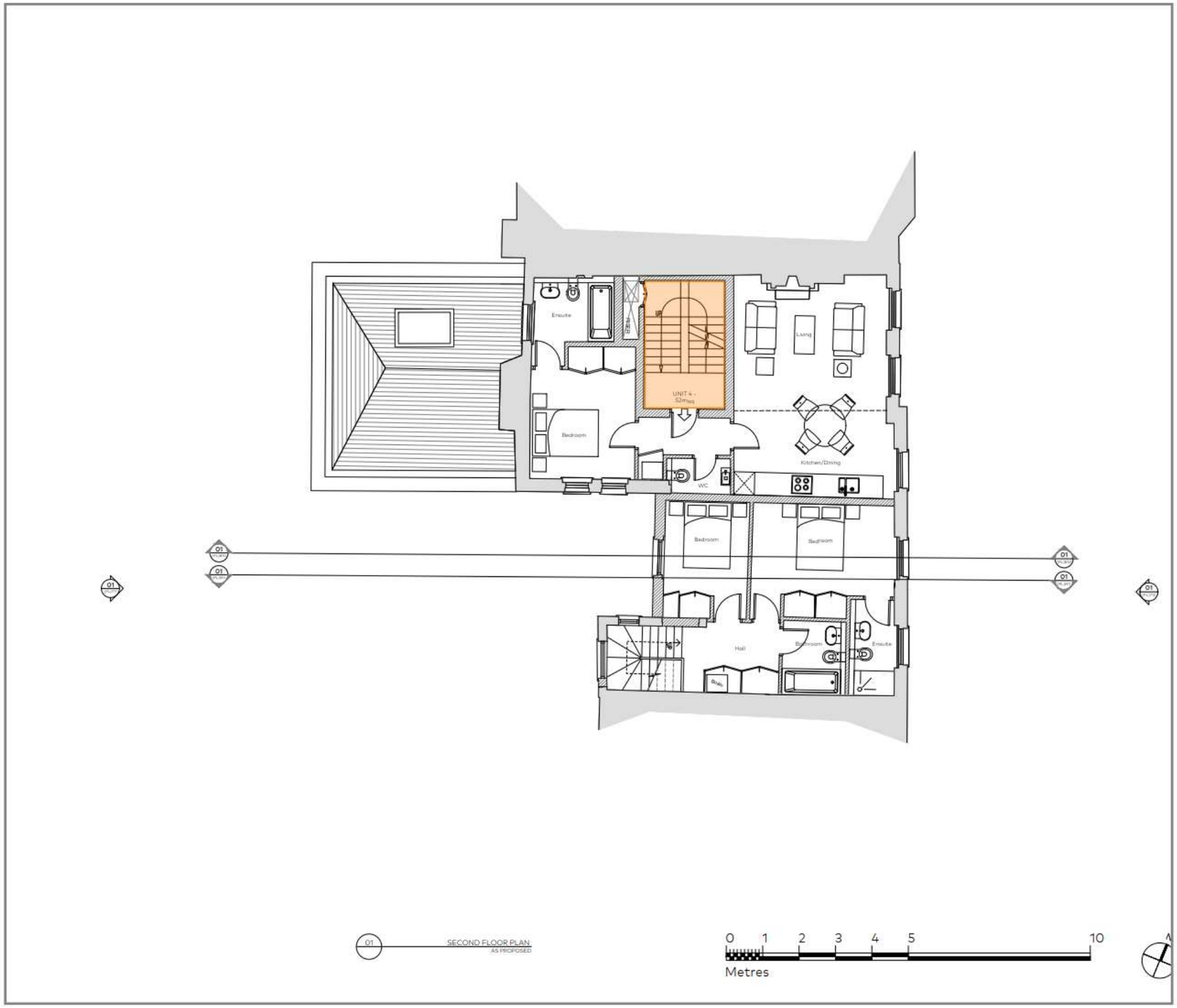
APPROVED DOCUMENT E - REVERBERATION IN COMMON PARTS:

Refer to Section 6 SSC Acoustic Report (ref. 37195-R!)

DATE	REV	DESCRIPTION	BY
10/09/21	1	DESIGN	LD

11-12 GRENVILLE STREET
REVERBERATION TIME MARK-UP
FIRST FLOOR
REF: 37195-MK-RT-L01

soundsolution CONSULTANTS



MINIMUM REVERBERATION TIME REQUIREMENTS

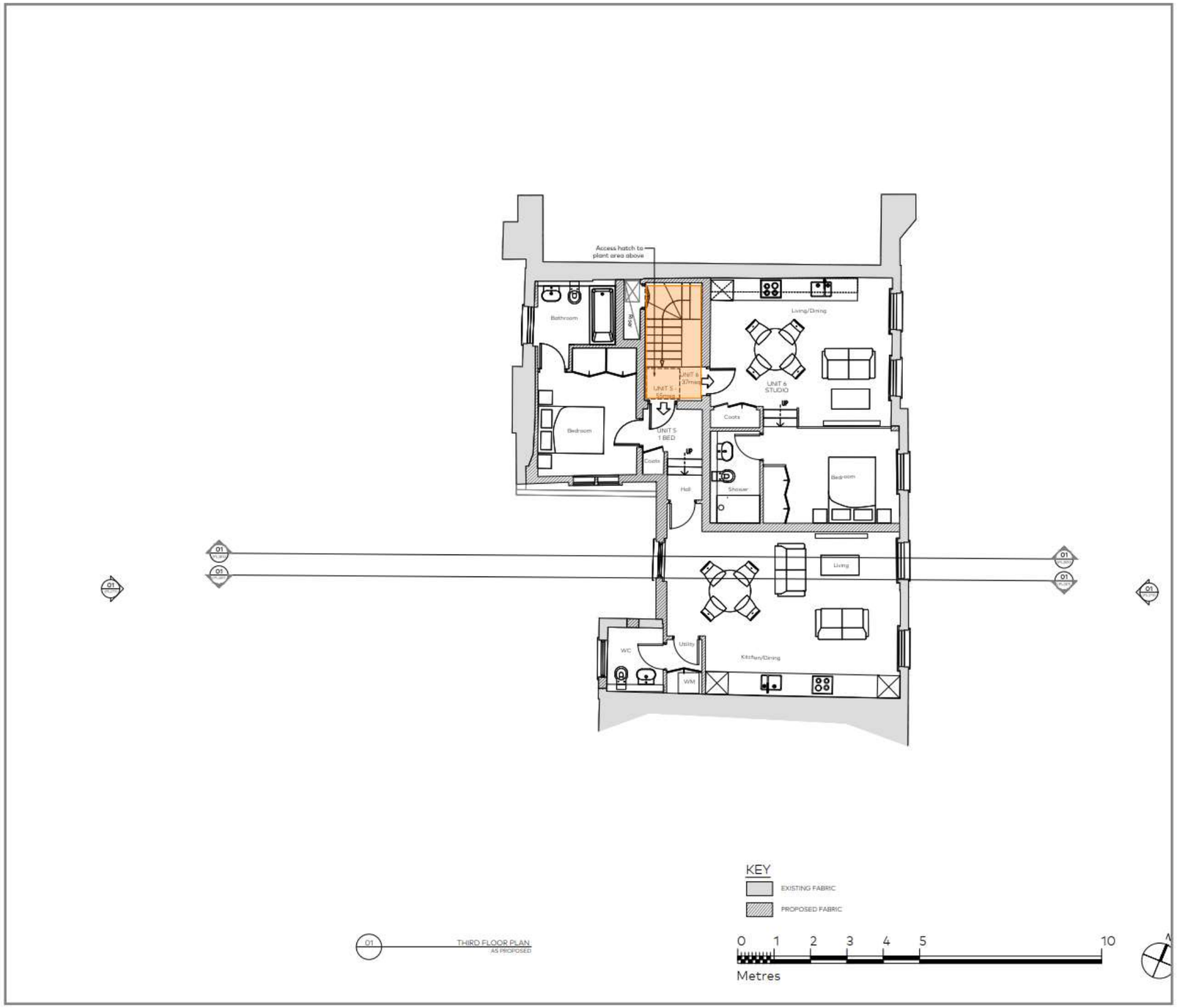
APPROVED DOCUMENT E - REVERBERATION IN COMMON PARTS:

Refer to Section 6 SSC Acoustic Report (ref. 37195-R!)

DATE	REV	DESCRIPTION	BY
10/09/21	1	DESIGN	LD

11-12 GRENVILLE STREET
REVERBERATION TIME MARK-UP
SECOND FLOOR
REF: 37195-MK-RT-L02

soundsolution CONSULTANTS



MINIMUM REVERBERATION TIME REQUIREMENTS

APPROVED DOCUMENT E - REVERBERATION IN COMMON PARTS:

Refer to Section 6 SSC Acoustic Report (ref. 37195-R!)

DATE	REV	DESCRIPTION	BY
10/09/21	1	DESIGN	LD

11-12 GRENVILLE STREET
REVERBERATION TIME MARK-UP
THIRD FLOOR
REF: 37195-MK-RT-L03

soundsolution CONSULTANTS

Appendix J: CIBSE Guide B4 (2016) - Table 4.56

Table 4.56 Vibration isolation selection chart

Equipment	Basement			6 m floor span			9 m floor span			12 m floor span			15 m floor span		
	Minimum static deflection / mm	Mount type*	Base type†	Minimum static deflection / mm	Mount type*	Base type†	Minimum static deflection / mm	Mount type*	Base type†	Minimum static deflection / mm	Mount type*	Base type†	Minimum static deflection / mm	Mount type*	Base type†
Refrigeration machines:															
— absorption	6	F/N	—	20	S	—	40	L	SBB	40	L	SBB	40	L	SBB
— centrifugal, scroll	6	F/N	—	20	S	—	40	L	SBB	40	L	SBB	40	L	SBB
— open centrifugal	6	N	CIB	20	S	CIB	40	L	CIB	40	L	CIB	40	L	CIB
Reciprocating chillers:															
— 500–750 r/min	25	L	—	40	L	CIB	60	L	CIB	60	L	CIB	90	L	CIB
— >751 r/min	25	L	—	20	L	CIB	40	L	CIB	60	L	CIB	60	L	CIB
Reciprocating air or refrigeration compressors:															
— 500–750 r/min	25	S	—	40	S	CIB	60	S	CIB	70	S	CIB	90	S	CIB
— >751 r/min	25	S	—	20	S	CIB	40	S	CIB	60	S	CIB	70	S	CIB
Boilers or steam generators	6	F	—	12	S	SBB	20	L	SBB	40	L	SBB	70	L	SBB
Pumps (water):															
— close coupled <4 kW	6	N	SBB	12	S	CIB	20	S	CIB	20	S	CIB	20	S	CIB
— close coupled >4 kW	20	S	CIB	20	S	CIB	40	S	CIB	60	S	CIB	60	S	CIB
— base mounted <4 kW	9	F	CIB	12	S	CIB	40	S	CIB	50	S	CIB	60	S	CIB
— base mounted >4 kW	25	S	CIB	20	S	CIB	40	S	CIB	60	S	CIB	90	S	CIB
Packaged unitary air handling units (low pressure, <750 Pa)															
— suspended <4 kW	20	S	—	20	S	—	20	S	—	20	S	—	20	S	—
— suspended >4 kW, <500 r/min	30	S	—	40	S	—	40	S	—	50	S	—	60	S	—
— suspended >4 kW, >501 r/min	25	H	—	25	H	—	25	H	—	40	H	—	50	H	—
— floor mounted <4 kW	6	N	—	25	S	SBB	25	S	SBB	25	S	SBB	25	S	SBB
— floor mounted >4 kW, <500 r/min	12	S	SBB	40	S	SBB	50	S	SBB	50	S	SBB	60	S	SBB
— floor mounted >4 kW, >501 r/min	12	S	SBB	25	S	SBB	25	S	SBB	40	S	SBB	50	S	SBB
Axial fans (floor mounted):															
— <4 kW	6	N	—	25	S	SBB	25	S	SBB	25	S	SBB	25	S	SBB
— 4–15 kW, <500 r/min	12	S	SBB	40	S	SBB	50	S	SBB	50	S	SBB	60	S	CIB
— 4–15 kW, >501 r/min	12	S	SBB	25	S	SBB	25	S	SBB	40	S	SBB	50	S	SBB
— >15 kW <500 r/min	20	S	SBB	50	S	SBB	60	S	CIB	70	S	CIB	90	S	CIB
— >15 kW >501 r/min	12	S	SBB	25	S	SBB	30	S	SBB	40	S	SBB	50	S	SBB
Centrifugal fans (floor mounted) (low pressure, <750 Pa):															
— <4 kW	6	N	SFB	25	S	SFB	25	S	SFB	25	S	SFB	25	S	SFB
— >4 kW, <500 r/min	12	S	SFB	40	S	SFB	50	S	SFB	50	S	SFB	60	S	SFB
— >4 kW, >501 r/min	12	S	SFB	25	S	SFB	25	S	SFB	40	S	SFB	50	S	SFB
Centrifugal fans (floor mounted) (high pressure, >750 Pa)															
— <15 kW, 175–300 r/min	9	N	SFB	60	S	SFB	60	S	SFB	90	S	CIB	120	S	CIB
— <15 kW, 301–500 r/min	12	S	SFB	50	S	SFB	50	S	SFB	60	S	SFB	90	S	CIB
— <15 kW, >501 r/min	9	N	SFB	30	S	SFB	30	S	SFB	50	S	SFB	60	S	SFB
— >15 kW, 175–300 r/min	40	S	SFB	60	S	CIB	90	S	CIB	120	S	CIB	140	S	CIB
— >15 kW, 301–500 r/min	25	S	SFB	50	S	CIB	60	S	CIB	90	S	CIB	120	S	CIB
— >15 kW, >501 r/min	12	S	SFB	30	S	CIB	50	S	CIB	60	S	CIB	90	S	CIB
Cooling towers:															
— <500 r/min	12	L	SBB	12	L	SBB	50	L	SBB	60	L	SBB	90	L	SBB
— >501 r/min	9	F/N	—	9	F/N	—	25	L	SBB	40	L	SBB	60	L	SBB
Internal combustion engines (standby power generation):															
— <20 kW	9	F	CIB	12	S	CIB	50	S	CIB	60	S	CIB	60	S	CIB
— 20–75 kW	12	S	CIB	50	S	CIB	60	S	CIB	90	S	CIB	90	S	CIB
— >75 kW	25	S	CIB	60	S	CIB	90	S	CIB	120	S	CIB	120	S	CIB
Gas turbines (standby power generation):															
— <5 MW	6	F	CIB	6	F	CIB	6	F	CIB	9	F	CIB	9	F	CIB

The floor plan refers to the largest dimension between supporting columns. The equipment is assumed to be at mid-span.
* F = glass fibre, H = hanger, L = restrained spring, N = rubber, S = freestanding spring.
† SBB = steel beams, SFB = steel frame base, CIB = concrete inertia base.

Appendix K: Acousticians Qualifications and Status

Lee Denson BSc. (Hons) MSc. MIOA

Position Held:	Principal Acoustic Consultant.
Qualifications:	BSc. (Hons) Music Technology
	MSc. (Hons) Music Technology
	Institute of Acoustics Diploma in Acoustics and Noise Control.
Affiliations:	Corporate Member of the Institute of Acoustics.
Acoustics Experience:	8 years.
Core Competences:	Building acoustics, Noise control for building services.

Approval:	**Mark Page MIOA**
Position Held:	Managing Director.
Qualifications:	Institute of Acoustics Diploma in Acoustics and Noise Control.
Affiliations:	Corporate Member of the Institute of Acoustics.
Acoustics Experience:	20 years.
Core Competences:	Environmental acoustics, building acoustics.