Hatton Garden Properties Ltd
72 – 80 Leather Lane, London

Acoustic Design Report

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Contents

Executive Summary

MLM Consulting Engineers Ltd has been appointed to advise on acoustic design issues associated with the proposed mixed-use, residential development at 72 – 80 Leather Lane, London. This report records the provisions made to achieve compliance with Planning Conditions 7 and 9.

The key acoustic issues are summarised below:

Internal Building Fabric

Appropriate criteria have been presented for all separating walls and floors based on the Building Regulation Approved Document E requirements, taking into account the enhancements required to achieve compliance with Planning Condition 9.

The proposed floors and walls are expected to achieve sound reduction which is compliant with the project acoustic requirements, provided that workmanship is to a very high standard, and all detailing is correct.

Reverberation

Measures must be taken to control the reverberation in the common internal parts of buildings containing flats or rooms for residential purposes. In this instance, it is desirable to use hard finishes throughout the common areas, and therefore the sound reduction performance of the specified doors has been increased to account for the increase in reverberant noise build-up. The approach used has been agreed with Building Control.

Building Services

Plant noise limits are provided in accordance with BS4142:2014 and Local Authority requirements (Planning Condition 7). Plant specifications are to be chosen and designed to meet these requirements as the design progresses.

1 Introduction

MLM Consulting Engineers Ltd have been commissioned by Hatton Garden Properties Ltd to advise on acoustic design issues associated with the Planning Conditions, for the proposed mixed-use development, at 72 – 80 Leather Lane, London.

The proposed development is understood to comprise the refurbishment of the basement and ground floor levels, to form retail spaces and a new bike store and refuse room. The existing residential dwellings on the first floor will be converted into offices. Residential refurbishments are proposed on the 2nd, 4th and 5th floor, and the 3rd floor will be converted from the existing office use into residential dwellings. Proposals also include for the demolition of existing roof and erection of two storey rooftop extension in order to create 4 additional residential units (Class C3), infilling of existing lightwells, internal reconfiguration and shopfront restoration.

This report records the provisions made to achieve compliance with Planning Conditions 7 and 9. It firstly defines the acoustic design criteria in line with the Local Authority requirements and Approved Document E, and provides an assessment of the existing scheme design information and advises on the likely ability of the proposed scheme to achieve the required performance standards, making recommendations for additional acoustic treatment, where necessary.

The report is intended to assist in informing external parties, including the Local Planning Authority and Building Control of the approach to address acoustics and noise control.

A planning stage Noise Assessment Report was undertaken by others and is referred to where necessary.

Whilst every effort has been made to ensure that this report is easily understood, it is technical in nature; a Glossary of Terms is included in Appendix A to assist the reader.

2 Relevant Standards and Guidance Documents

A summary of the British Standards and guidance documents used to inform the acoustic design of the scheme is presented below, further detail on each item is provided in Appendix B.

- Building Regulations - Approved Document E;
- BS 4142:2014 "Method for Rating and Assessing Industrial and Commercial Sound"; and
- Local Authority Acoustic Requirements – Camden Council.

3 Site Description and Development Proposals

3.1 Site Description

The site is located to the south of Hatton Wall and east of Leather Lane. It falls within the jurisdiction of Camden Council. The surrounding area is a mixture of residential and commercial premises.

The location of the proposed site and development site is identified in Figure 1.

Figure 1: Site Location (approximate red line)

The nearest/worst-affected existing noise-sensitive receptors are expected to be the residential properties on Leather Lane, opposite the proposed development, as well as residential properties in the courtyard to the southeast.

3.2 Proposed Development

It is understood that the proposed development comprises the refurbishment of the basement and ground floor levels to form retail spaces and a new bike store and refuse room. The existing residential dwellings on the first floor will be converted into offices. Residential refurbishments are proposed on the 2nd, 4th and 5th floor, and the 3rd floor will be converted from the existing office use into residential dwellings. Proposals also include for the demolition of existing roof and erection of two storey rooftop extension in order to create 4 additional residential units (Class C3), infilling of existing lightwells, internal reconfiguration and shopfront restoration.

4 Internal Sound Insulation Assessment

4.1 Overview

The advice provided below is based on the information available at the time of the writing of this report. This report contains an appraisal of the proposed/preferred separating walls and floors and provides a review of the expected sound reduction to determine whether compliance with the minimum acoustic requirements of Approved Document E (ADE) and Planning Condition 9. Planning Condition 9 requires that a 5dB enhancement over the Building Regulation ADE requirements is achieved throughout the proposed development. A summary of the proposed works and the statutory sound reduction requirements is provided in the Table below.

Table 1: Sound Reduction Requirements

Level – work type	Level – work type	ADE Applicable	ADE Requirements	Planning Condition 9 Requirements (+5dB)	Other considerations
Basement – Retail refurbishment and new bike store and refuse	Ground - Retail refurbishment	No	-	-	
Ground – Retail refurb	1st - Change of use from residential to office	No	-	-	Ensure sufficient sound reduction between retail and offices
1st – Change of use from residential to office	2nd - Residential refurbishment	Yes	Airborne > 43dB $D_{nTw} + C_{tr}$	48dB $D_{nTw} + C_{tr}$	
2nd – Residential refurbishment	3rd - Change of use from office to residential	Yes	Airborne > 43dB $D_{nTw} + C_{tr}$ Impact < 64dB $L'_{nT,w}$	Airborne > 48dB $D_{nTw} + C_{tr}$ Impact < 59dB $L'_{nT,w}$	
3rd – Change of use from office to residential	4th - Residential refurbishment	Yes	Airborne > 43dB $D_{nTw} + C_{tr}$ Impact < 64dB $L'_{nT,w}$	Airborne > 48dB $D_{nTw} + C_{tr}$ Impact < 59dB $L'_{nT,w}$	
4th – Residential refurbishment	5th - Residential refurbishment	Yes	No worse than existing	n/a	Client request for improved sound insulation
5th – Residential refurbishment	6th - New build residential	Yes	Airborne > 45dB $D_{nTw} + C_{tr}$ Impact < 62dB $L'_{nT,w}$	Airborne > 50dB $D_{nTw} + C_{tr}$ Impact < 57dB $L'_{nT,w}$	
6th – New build Residential	7th - New build Residential (floor separating same dwelling)	Yes	40dB R_w	45dB R_w	

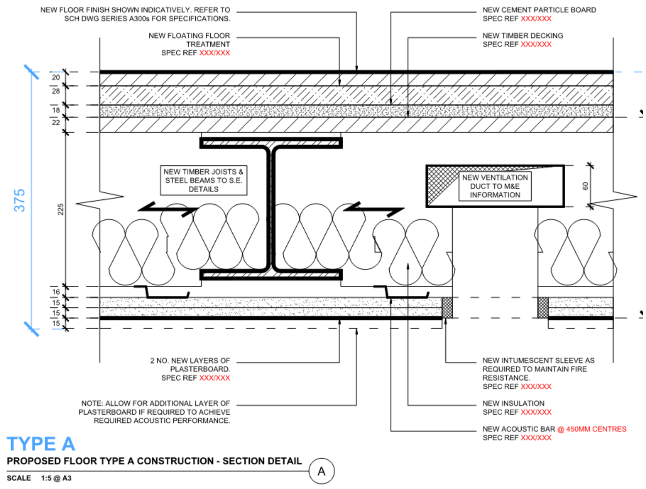
4.2 Separating Floors

New Build Requirement: 50 dB D_{nTw} + Ctr & 57 dB L'_{nTw}

Change of Use Requirement: 48 dB D_{nTw} + Ctr & 59 dB L'_{nTw}

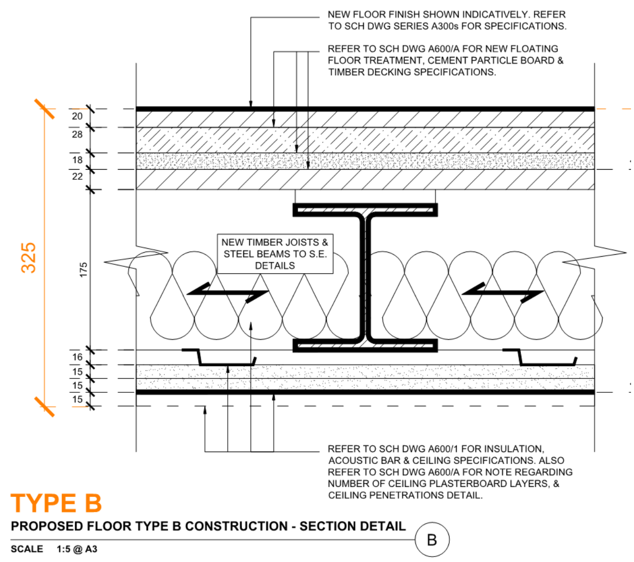
It is understood that all existing floors are to be replaced. Table 2 below provides details on the proposed new-build and change of use separating floor constructions and a summary of the predicted sound reduction performance.

Table 2: Separating Floors – Proposed Constructions

<table>
<tr><th>Floor Type</th><th>Section Detail</th><th>Predicted Sound Reduction Performance</th></tr>
<tr><td>Type A – New Build
- Floor finish
- Cellecta Screedboard 28
- 18mm Cement Particle Board
- 22mm Timber Decking
- 225mm Timber Joists and Steel Beams
- 100mm Mineral Wool Insulation (10-36kg/m^3)
- 2 – 3 x 15mm SoundBloc Plasterboard Ceiling on Resilient Bars/hangers</td>
<td>
</td>
<td>49 – 51 dB $D_{nT,w}$ + C_{tr}

The lower value is the predicted sound reduction with a two layer ceiling, the higher value is with a three layer ceiling.

55 – 57 dB $L'_{nT,w}$

The higher value is the predicted impact level with a two layer ceiling, the lower value is with a three layer ceiling.</td></tr>
<tr><td>Type B – Change of Use
- Floor finish
- Cellecta Screedboard 28
- 18mm Cement Particle Board
- 22mm Timber Decking
- 175mm Timber Joists and Steel Beams
- 100mm Mineral Wool Insulation (10-36kg/m^3)
- 2 – 3 x 15mm SoundBloc Plasterboard Ceiling on Resilient Bars/hangers</td>
<td>
</td>
<td>48 – 50 dB $D_{nT,w}$ + C_{tr}

The lower value is the predicted sound reduction with a two layer ceiling, the higher value is with a three layer ceiling.

55 – 57 dB $L'_{nT,w}$

The higher value is the predicted impact level with a two layer ceiling, the lower value is with a three layer ceiling.</td></tr>
</table>

It is understood that the proposal is to construct a ceiling with two layers of plasterboard, test the sound reduction performance, and add an additional layer of plasterboard to the ceiling where required. The predictions demonstrate that compliance with the project requirements is expected with two or three plasterboard layers in the ceiling depending on location.

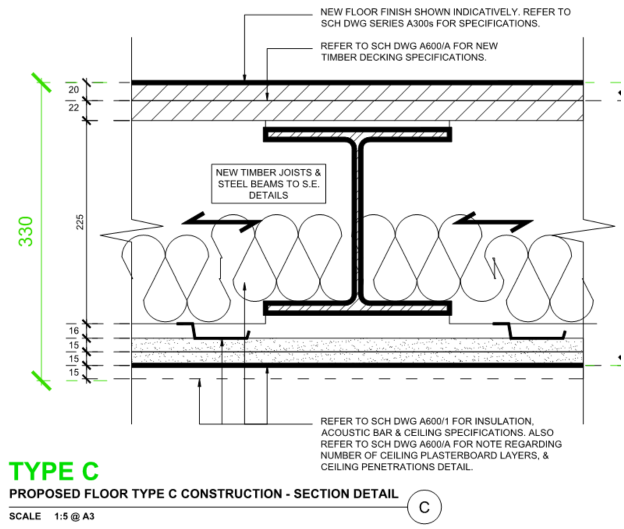
All floating floor treatments should achieve the following requirements:

- Must be installed in accordance with the manufacturer's instructions; and
- Require 6mm (min) resilient flanking strips around the perimeter of the flooring board to isolate floor from walls and skirting.

4.3 Internal Floors

New Build Requirement: 45dB R_w

The new build 7th floor is an internal floor separating rooms within the same dwelling. The Table below provides details on the proposed build-up and the predicted laboratory sound reduction index.

Table 3: Internal Floors – Proposed Constructions		
Floor Type	Section Detail	Predicted Sound Reduction Performance
Type C – New Build • Floor finish • 22mm Timber Decking • 225mm Timber Joists and Steel Beams • 100mm Mineral Wool Insulation (10-36kg/m³) • 2 – 3 x 15mm SoundBloc Plasterboard Ceiling on Resilient Bars/hangers		58dB R_w

The predicted sound reduction index of the proposed internal floor construction is compliant with the project requirements.

There is no enhanced Building Regulation sound insulation requirement for separation between non-residential and residential premises, however consideration should be given to upgrading the sound insulation performance between the first and second floors where possible.

4.4 New Separating Walls between Residential Units

New Build Requirement: 50 dB $D_{nTw} + C_{tr}$

Change of Use Requirement: 48 dB $D_{nTw} + C_{tr}$

Table 4 below provides details on the proposed wall constructions currently shown in separating wall locations and a summary of the laboratory sound reduction indices and the predicted in-situ sound reduction performance.

Table 4: Separating Walls – Proposed Constructions		
Wall Type	Predicted Sound Reduction Performance	Requirement
Existing Masonry wall: • Assumed to be deep brickwork, minimum 480kg/m^2 • Gypliner GL1 lining channel framework fixed to one side to give 35mm cavity • Cavity filled with 25mm Isover APR 1200 • 2 x 12.5mm SoundBloc to liner (Spec: K10/165)	Laboratory = 55 $R_w + C_{tr}$ In-situ ≈ 51dB $D_{nT,w} + C_{tr}$	48 dB $D_{nTw} + C_{tr}$
Cavity Masonry wall: • Assumed 100mm brick leaves • Minimum brick density 1600kg/m^3 • Minimum cavity 100mm • 13mm lightweight plaster on both faces (minimum mass per unit area 10 kg/m^2). • Gypliner GL1 lining channel framework fixed to one side to give 35mm cavity • Cavity filled with 25mm Isover APR 1200 • 2 x 12.5mm SoundBloc to liner (Spec: K10/165)	Laboratory = >55 $R_w + C_{tr}$ In-situ ≈ >51dB $D_{nT,w} + C_{tr}$	48 dB $D_{nTw} + C_{tr}$
New Drylined Partitions: • 2 x 15mm SoundBloc on both sides • Twin Gypframe 48 I 50 'I' Stud frameworks • 50mm Isover APR 1200 in the cavity • Cavity width 140mm (Spec: K10/129)	Laboratory = 58 $R_w + C_{tr}$ In-situ ≈ 51dB $D_{nT,w} + C_{tr}$	Change of Use = 48 dB $D_{nTw} + C_{tr}$ New Build = 50 dB $D_{nTw} + C_{tr}$

The proposed separating wall constructions detailed above are confirmed as capable of achieving compliance with the Building Regulation ADE +5dB requirements of Planning Condition 9. This is based on the assumptions outlined above as well as high quality workmanship and detailing.

4.5 Internal Walls

Requirement: 45 dB R_w

These walls should achieve the numeric performance requirements by design intent.

Table 5 below provides details on the proposed internal wall constructions and a summary of the laboratory sound reduction indices.

Table 5: Internal Walls – Proposed Constructions		
Construction	Predicted Sound Reduction Performance	Requirement
Types 1 and 2: New Drylined Partitions: • 2 layers of plasterboard (25mm British Gypsum Wallboard as minimum) on both sides • 70mm 'C' Stud • (Spec: K10/125 & 126)	Laboratory = 45 R_w	Laboratory = 45 R_w

The proposed internal wall build-up is compliant with the Building Regulation ADE +5dB requirements of Planning Condition 9.

4.6 Lift Noise

BS 8233:2014 advises that noise levels in rooms resulting from the operation of lifts should not exceed the following maximum noise levels.

Table 6: Maximum Noise Levels Resulting from Lift Operations	
Room Type	Maximum Noise Level dB L_{Amax}
Bedrooms	25
Living Rooms	30
Other Areas	35
Lift Lobbies	55
NOTE: The figures detailed above relate solely to lift noise levels and do not take account of any other potential noise sources. These values include noise from the lifts, irrespective of the transmission mechanism (i.e. they include both airborne and structure-borne noise).	

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

Lifts should also be positioned in order to minimize noise disturbance from the operation of the control gear. Lift doors should also operate quietly and acoustic signals indicating the arrival of lifts should not be audible within habitable rooms.

4.7 Junction detailing - Control of Flanking Transmission

Appropriate junction detailing and high quality workmanship is paramount to ensure that the acoustic integrity of the separating walls and floors is not compromised. The following general guidance should be noted and incorporated into the design of the building elements where applicable.

4.7.1 Junction of a Separating Wall with a Separating Floor

The separation between dwellings must be maintained throughout. It is important to note that the installed floating floors and suspended ceilings should not be continuous at the junction of the floors and the separating walls and that any gaps between the bottom edges of the separating wall boards and floors should be minimised and well-sealed with non-setting mastic.

The floating floor and suspended ceiling should not have a rigid contact with the partition wall; this is achieved by using flexible acoustic sealants and a resilient flanking strip between the floating floor and the surrounding walls. An indicative junction detail is shown in Figure 2 below; this is taken from the Robust Details Handbook. The construction types are similar to those proposed, but not identical and therefore this does not represent the exact specification. Alternatives to this detailing may be acceptable but should be signed off by MLM Consulting Engineers Ltd before construction.

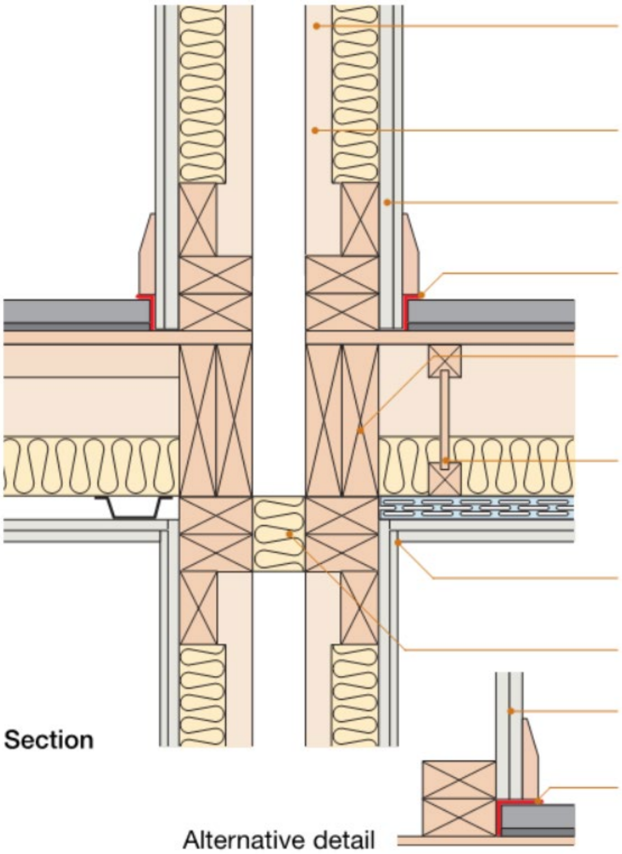


Figure 2: Separating Wall to Separating Floor Indicative Junction Detailing

4.7.2 Junction of an External Wall with a Separating Floor or Wall

There are likely to be a number of junction details with the external walls. The important principles to be followed in these areas are as follows:

- The inner layers of the external walls should not be continuous across the separating walls and separating floors;

- The void within the external wall system at the line of the separating wall or separating floor should be closed with a flexible mineral wool closer where applicable; and
- It is understood that external walls are to be lined within apartments on at least every other floor, so that if one apartment has exposed brickwork external walls, the apartments above and below will have Gypliner Universal linings with 35mm cavities, 25mm Isover APR insulation, and 2 x 12.5mm SoundBloc internal linings. This is expected to sufficiently limit flanking transmission provided all areas are detailed correctly.

4.7.3 Junction of a Separating Wall with a Corridor Wall

Where separating walls form a "T" junction at the corridors, the inner leaf of the plasterboard lining, which forms the head of the "T", should not to cross the line of the leg of the "T". Plasterboard linings of the flanking wall should be double boarded.

4.7.4 Junction of an Internal Wall with a Separating Wall

Where an internal partition meets a separating wall, the partition should be fixed to the face of the separating wall.

4.7.5 Control of Flanking Transmission – General Guidance

The following general principles should be considered.

- Joints in wall linings should be staggered to avoid air paths;
- Downlighters may be installed at no more than one light per 2m^2 of ceiling area, at centres not less than 0.75m, into openings not exceeding 100mm diameter or 100mm x 100mm; and
- Only downlighters which have been satisfactorily assessed in accordance with the procedure described in Appendix F of the Robust Details Handbook, June 2018, are acceptable.

4.7.6 Integration of Structural Elements - Cladding around Columns in Separating Walls

The integration of columns into infill separating walls is the most common situation where structural elements need to be considered.

Any columns that are on the line of the separating wall must be integrated so they do not act as a bridge through the wall for sound transmission. It is important to ensure that the gypsum lining is not fixed directly to the columns, and to provide some resilience between the column and the separating wall structure. This is usually achieved by providing 25 mm of dense mineral wool board around the column.

An indicative detail is provided below. This shows a concrete column however similar principles apply to steel columns also.

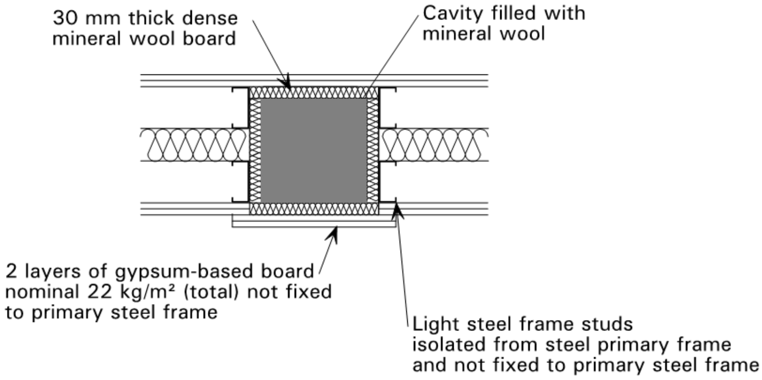


Figure 4: Indicative Structural Column Integration Detailing (Plan View)

4.7.7 Workmanship

Workmanship will affect the ultimate performance of the separating floors or walls. In addition to the points raised above:

- All partitions should be well sealed carefully with non-setting mastic around their perimeter to achieve an air tight seal;
- Services penetrations should be well sealed; and
- To avoid solid bridging between the floating floor and the base floor construction, the base floor should be smooth and clean before the floating floor is laid and the resilient layer should be turned up at the edges to encase the floating floor system. A small gap will be left between the skirting board and the floating floor, which may be filled with non-hardening sealant.

It should be ensured that any services between the floating floor and the structural floor do not bridge the resilient layer where applicable.

4.8 Penetrations

4.8.1 Socket Penetrations

Socket penetrations within separating walls should be avoided wherever possible. Acoustic tests on projects where clients have had a policy of avoiding socket penetrations on separating walls have led to superior results when compared to those obtained from projects where no effort has been made in relation to socket positioning.

If socket penetrations are unavoidable on separating walls, back-to-back sockets should be avoided, with sockets staggered by at least one stud dimension.

All socket penetrations should be treated by either of the following methods:

- Option 1: Plasterboard boxing - Socket boxes should be boxed-in with 2 layers of 15mm dense plasterboard (min 12.6 kg/m^2). All interfaces should be well sealed with mastic; and
- Option 2: Hilti Putty Pads - Socket boxes should be backed with Hilti putty pads.

If back-to-back socket penetrations or service penetrations are unavoidable, then it is generally advised that a sacrificial lining is introduced on one side of the separating wall, with a layer of 25mm mineral wool within the void.

4.8.2 Service Penetrations

Where a partition has a separating function between residential dwellings and/or dwellings and non-residential areas, all service penetrations through separating partitions must be fully sealed in order to ensure the acoustic performance requirements are achieved. In practice, improper sealing is one of the most common and significant causes of failure to achieve the sound insulation performance requirements, so service penetrations are not recommended. Good practice dictates that where services are required to enter flats from common areas, the services should be routed to enter above the flat entrance doors. Where other penetrations of separating walls cannot be avoided, suitably robust detailing must be employed.

4.8.3 Pipework Runs

Vertical Stacks

Where Soil Vent Pipework and/or Rain Water Pipework penetrates separating floors within the flats, these pipes should be boxed in using 2 layers of 12.5mm plasterboard with a 25mm (un-faced) mineral wool quilt within the cavity in addition to a fire-stopping layer at floor level (penetration through this layer should be flexible).

Horizontal Pipe Runs

Horizontal pipe runs can often result in noise problems, especially at the vertical – horizontal transition, and warrant particular consideration.

a) In the first instance, noise problems can often be avoided by zoning bends and horizontal runs away from habitable rooms (bedrooms and living rooms);
b) There is very little, if any, accurate research on the acoustic performance of pipes. However, the limited information available suggests cast iron pipes or composite type pipes (e.g. Friaphon) have a better acoustic performance than standard PVC pipes. It is therefore recommended that the pipework for horizontal runs be of the cast iron or a composite (sound attenuated) type. Plumbing considerations permitting, any change in pipe type should occur at least one floor level above the vertical – horizontal transition.
c) The pipework should be wrapped with 50mm thickness mineral wool (10kg/m^3 minimum).
d) The pipework should then be independently boxed with 2 layers of 12.5mm SoundBloc, the standard ceiling should then be introduced below the boxing.

In order to prevent structure-borne noise problems, it is important all pipework penetrations of floors are flexible with the pipes supported via brackets containing neoprene inserts.

4.8.4 Service Risers

In order to prevent noise transfer across the separating floors via the risers, mineral wool cavity closers/fire-stops should be installed at the line of the separating floors.

4.9 Doors

An upgraded specification is proposed for front doors to the residential units which will be a solid timber core of minimum thickness 54mm, with a minimum mass per unit area of 30 kg/m^2 or a minimum sound reduction index of 35 dB R_w (measured according to BS EN ISO 140- 3:1995 and rated according to BS EN ISO 717- 1:1997). Where possible, doors should be fitted within rebated frames with compressible neoprene/rubber seals fitted at head and jambs.

The installation of drop-threshold seals, whilst not essential, should be considered good acoustic practice where neighbouring front doors are closer than 2m away from each other.

There is no minimum performance requirement for doors within apartments. Notwithstanding this, it is recommended that, wherever possible, doors should be solid core and fitted within fully rebated frames.

4.10 Control of Reverberation

4.10.1 Residential Common Areas

Under the current revision of Approved Document E, Section 7 states that measures must be taken to control the reverberation in the common internal parts of buildings containing flats or rooms for residential purposes. These will normally comprise the use of absorbent finishes such as carpets and acoustic ceiling tiles in common areas.

4.10.2 Extent of treatment

It has been clarified by the Communities and Local Government (CLG) that only areas giving direct access to the residential accommodation need to be considered.

Based on the current drawing layouts, treatment could therefore be limited to the following areas:

- Stairwells
- Common corridors; and
- Lift Lobbies.

4.10.3 Treatment Methodology

There are two methods for demonstrating compliance with the Building Regulation requirements as described below.

Method A

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

For Entrance Halls, Corridors or Hallways, cover an area equal to or greater than the floor area with a Class C absorber or better.

For Stairwells or a Stair Enclosure, calculate the combined area of the stair treads, the upper surface of the intermediate landings, the upper surface of the landing and the ceiling area on the top floor. Either cover at least an area equal to this calculated area with a Class D absorber, or cover an area equal to 50% of this calculated area with a Class C absorber or better. The absorptive material should be distributed equally between all floor levels.

Method B

Determine the minimum amount of absorptive material using a calculation procedure in octave bands. In comparison to Method A, this method takes into account the existing absorption provided by all surfaces. This method is intended only for corridors, hallways and entrance halls.

For Entrance Halls, a minimum of 0.2 m2 total absorption area per cubic metre of the volume should be provided.

4.10.4 Demonstrating Compliance

The intention is to use hard finishes throughout in stairwells and in the small common corridors leading to apartments. There will be doors between the stairwells and the small corridors, however these will be on hold-open systems for the majority of the time, and this means that stairwells provide direct access to the residential accommodation.

The aim of Section 7 of Approved Document E is to protect residential accommodation from excessive reverberant noise build-up in the communal areas. It is therefore determined that upgrading the sound insulation between the communal corridors and the apartments would achieve a similar result.

The reverberation time has been calculated for one floor including the stairwell and the small access corridors to each apartment with hard finishes throughout. The calculation assumes that the stairwell volume is limited to that of one floor level; this is considered representative due to the small and enclosed nature of the stairs. The calculated reverberation time using the Sabine calculation method is 0.98 seconds. The same calculation was undertaken including the minimum amount of absorption that would be required to achieve compliance with Method B; the resultant reverberation time was 0.53 seconds.

This increase in the internal reverberant noise level for a steady sound source within the communal areas, based on the predicted increase in reverberation time (from 0.53 to 0.98 seconds), is just less than 3dB. It is therefore concluded that increasing the apartment entrance door specification from 29dB, to 35dB, as currently proposed, would sufficiently reduce the excess noise build-up which occurs due to the proposals for hard finishes in the communal areas. This approach has been agreed with Building Control.

5 Building Services External Noise Emissions

5.1 Proposed Plant Installations

At this stage of the design there are no specific details on the proposed installations and therefore a noise limiting exercise has been undertaken. Plant is to be designed to achieve the limiting criteria and compliance with the requirements of Planning Condition 7 will be demonstrated at a later stage.

5.2 Nearest Noise Sensitive Receivers (NNSR)

The nearest/worst-affected existing noise-sensitive receptors are expected to be the residential properties to the east and south.

5.3 External Sound Level Criteria

The assessment of external building services noise is undertaken in accordance with the following standards/guidance:

- Local Authority Acoustic Requirements – Camden Council Planning Condition 7; and
- British Standard 4142:2014 Method for Rating and Assessing Industrial and Commercial Sound.

The noise criteria set out in Table 16 are proposed in accordance with the local authority criteria. These limits are based on achieving a level 10dB below or lower than the measured background noise level at the nearest noise sensitive receptor, during a typical period. These limits apply to operating hours of the installation, which may be during the day and night time periods.

The measured background noise levels are taken from the planning stage Noise Assessment Report written by Cole Jarman, report reference 16/0440/R1. It should be ensured that the planning stage data is warranted for use in this assessment.

Table 8: Proposed Plant Noise Rating Limits

Location	Operating Period	Measured Background Noise Level $L_{A90,T}$	Proposed “Rating Level” At The Nearest Noise Sensitive Receptor $L_{Ar,T}$
NNSR (1m from nearest window)	Daytime (07:00-23:00)	49	39
	Night-time (23:00-07:00)	40	30

The above limits apply to the total sound emission level from all static plant and processes within the proposed development. Individual plant items may need to be designed to a lower limit such that the overall total achieves the stated criteria above. Should the proposed plant items be found to be tonal, or impulsive in nature (so as to attract attention), a penalty correction would likely be applied to the plant rating level.

Compliance with the above limiting noise levels would result in a low impact at existing receptors.

5.4 Practical Control Measures

Screening of any external plant as well as provision of sound attenuators to items of plant may be necessary to control the transmission of sound and achieve the above criteria as well as to reduce the sound level produced by the plant to a reasonable extend around the footprint of the building itself.

Environmental attenuators and possibly other means of sound mitigation such as acoustic louvres or acoustic screens may be required to control sound emanating from the plantrooms, air intake and discharge points or from externally mounted plant.

Locating the future plant installation as far as possible from the NNSR and using the proposed building to screen any future plant items would to ensure compliant emissions sound levels.

5.5 Regenerated Noise

Noise in ventilation systems is generated by the flow of air past diffusers, grilles, dampers, sound attenuators, turning vanes and duct fittings, as well as by the fan. The noise level generated at each location in the system depends on the air velocity and the local geometry and fittings. The ventilation systems need to be effectively designed to minimise airflow regenerated noise as far as possible.

Systems should be designed to avoid airflow generated noise from excessive air velocities, fittings, duct mounted components and terminal devices. As a general rule, the duct velocities stated below should not be exceeded. These duct velocities are based on a system with good geometry and reasonable spacing of fittings (three to four duct dimensions). For systems in which these factors are compromised, lower velocities should be employed.

Table 9: Recommended Maximum Duct Velocities

Internal Ambient Noise Level Requirement Noise Level NR	Air velocity m/s		
	Main Ducts	Branch Ducts	Final Connections
20	4.5	3.5	2.0
25	5.0	4.5	2.5
30	6.5	5.5	3.2
35	7.5	6.0	4.0
40	9.0	7.0	5.0

5.6 Control of Vibration from Building Services

In order to prevent detectable vibration from reaching the occupied areas of the building, and to control noise transmission resulting from vibrating plant, it is necessary to ensure that all such plant is effectively isolated. This is achieved by mounting the machine on vibration isolators, normally comprising springs or rubber, neoprene or glass fibre blocks which are semi - compressed under the load of the plant and its associated base. The lower the forcing frequency of the plant, the greater the static deflection needed to ensure good isolation at the forcing frequency. Increased static deflections are required when plant is located on the upper floors of a building, where the floor itself deflects and acts like a spring.

Vibration can also be transmitted into the building via pipework and ductwork connections. In order to avoid this, flexible connections should be specified between plant and the connected ductwork and/or pipework. Resilient pipe and duct hangers should be specified within the plant rooms and for any ductwork or pipework which is immediately adjacent to any noise sensitive area. Electrical connections to vibrating plant should be looped to control vibration transmission into the building structure. Where pipes and ducts penetrate walls, the perimeter seal (also required to control airborne sound transmission) should be flexible to prevent vibration transmission from the pipe or duct into the adjacent wall.

5.7 Routing Services through or near Acoustically Sensitive Spaces

The routing of building services should be considered carefully by the contractor during the construction design stage.

Services serving acoustically sensitive spaces must not be routed through noisy spaces or through other acoustically sensitive spaces. Services serving other areas must not be routed through acoustically sensitive spaces. Noise can enter a duct or pipe in one space and be transmitted down the duct or pipe to another.

Rainwater pipes transmit noise from outside and radiate flow noise in storms. They should be routed outside acoustically sensitive spaces, and should not be attached to the structure of acoustically sensitive spaces. Similar care must be taken in routing of drainage pipes from showers, washbasins and toilets. Rainwater pipes passing through noise sensitive areas must be fully enclosed and insulated to prevent noise break out and cross-talk effects. Double skin enclosures would be required for this purpose. The same treatment would be required at bases of stacks and change of direction.

5.8 Services distribution

It is strongly recommended that where possible penetrations through acoustically rated partitions between acoustically sensitive areas should be avoided. Where this cannot be avoided, specialist treatment to the penetration is likely to be required. Penetrations which occur where ducts and pipes pass through walls, floors and partitioning are to have flexible, airtight seals to prevent the transmission of vibration into the structure and to maintain the sound insulation performance of the sound insulating element. This is achieved by forming a penetration which leaves a gap of approximately 15mm around the duct or pipe, packing the gap tightly with mineral fibre and caulking the perimeter from both sides, using non-hardening sealant.

The recommendations and requirements for acoustic sealing should be coordinated with the requirements for fire protection of penetrations and for the sealing of plenum voids. Indicative services penetration details can be found in Appendix H.

Where services penetrate separating elements, and are common through different areas, particularly those requiring privacy, there will be a need to treat crosstalk with appropriate attenuators. For guidance, these should provide at least the same degree of cross talk attenuation via common ductwork between two rooms as the sound insulation offered by the building fabric separating those rooms. Where ductwork passes through an acoustically rated wall, an airtight seal is also essential and lagging is likely to be required.

Services passing into independent structures (e.g. independent plasterboard ceilings) must not bridge the independent structure to the building structure, and so will require flexible connections and other vibration isolation measures.

5.9 Cross Talk Attenuation

Control of ‘crosstalk’ (noise from one room entering a duct and being transmitted through the duct to another room), will be needed between spaces that require acoustic separation but are served by a common air system, and also where ductwork passes through high performance structures. In many cases attenuators and areas of external acoustic lagging will be required. Ducts serving adjacent acoustically sensitive rooms should be routed via the circulation spaces and not directly room-to-room, to reduce the requirements for crosstalk attenuation.

5.10 Lift Installation

The lift installations need to be carefully considered / designed with regard to any nearby noise sensitive spaces. Lift machinery and associated equipment should be vibration isolated.

5.11 Electrical

Mains transformers, dimmer racks and voltage regulators may have to be mounted on proprietary rubber pads if these items are in close proximity to noise sensitive areas. It may be necessary to use surface mounted light fittings in acoustically critical spaces (e.g. recessed fittings could compromise the sound insulation of their ceilings etc.).

6 Conclusion

MLM Consulting Engineers Ltd has been commissioned by Hatton Garden Properties Ltd to undertake an assessment of current construction proposals for the proposed residential development, in terms of their ability to achieve compliance with Part E of the Building Regulations.

Accordingly, this report presents appropriate acoustic design criteria for the various areas of the development and, based upon current architectural proposals, provides design advice aimed at satisfying the project requirements.

This report demonstrates how compliance with Planning Condition 9 will be achieved. The assessment demonstrating compliance with Planning Condition 7 will be provided at a later stage once plant specifications have been finalised.

Appendix A - Glossary of Acoustic Terminology

Wording	Description
Sound Pressure	Sound, or sound pressure, is a fluctuation in air pressure over the static ambient pressure.
Sound Pressure Level (Sound Level)	The sound level is the sound pressure relative to a standard reference pressure of 20μPa (20x10-6 Pascal's) on a decibel scale.
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s1 and s2 is given by 20 log10 (s1 / s2). The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20μPa.
A-weighting, dB(A)	The unit of sound level, weighted according to the A-scale, which takes into account the increased sensitivity of the human ear at some frequencies.
Noise Level Indices	Noise levels usually fluctuate over time, so it is often necessary to consider an average or statistical noise level. This can be done in several ways, so a number of different noise indices have been defined, according to how the averaging or statistics are carried out.
$L_{eq,T}$	A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.
$L_{max,T}$	A noise level index defined as the maximum noise level during the period T. L_{max} is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
$L_{90,T}$	A noise level index. The noise level exceeded for 90% of the time over the period T. L_{90} can be considered to be the "average minimum" noise level and is often used to describe the background noise.
$L_{10,T}$	A noise level index. The noise level exceeded for 10% of the time over the period T. L_{10} can be considered to be the "average maximum" noise level. Generally used to describe road traffic noise.
Free-Field	Far from the presence of sound reflecting objects (except the ground), usually taken to mean at least 3.5m
Facade	At a distance of 1m in front of a large sound reflecting object such as a building façade.
Fast Time Weighting	An averaging time used in sound level meters. Defined in BS 5969.
Insertion Loss	The sound level reduction at a given location due to the insertion of a noise control device, expressed in decibels. The difference, in decibels, between the sound pressure level before and after the effect of a sound-attenuating device.

Wording	Description
R_w	Sound Reduction Index: laboratory measurement that characterises the sound insulating properties of a material or building element in a stated frequency band. It is calculated through the following formula: R = L1 – L2 + 10 log (S/A), where L1 is the average sound pressure level in the source room, L2 is the average sound pressure level in the receiving room, S is the area of the test specimen in m2 and A is the equivalent sound absorption area of the receiving room). The w weighting is used to provide a single-number quantity for the sound reduction performance of a material or building element, and it is calculated in line with BS EN ISO 717-1.
D_{nTw}	Standardized Level Difference: in-situ sound insulation measurement between two rooms, which includes the effects of flanking transmission, different room sizes and other on-site considerations (differing from a laboratory measurement). This index corrects the measured level difference between rooms to a standardized reverberation time of 0.5 seconds. This RT value is often cited as approximately average for a medium sized, carpeted and furnished living room. The level difference per each frequency band is calculated using the following formula: D_{nT} = D + 10 log (T/T0), where D is the level difference (L1-L2), T is the reverberation time in the receiving room and T0 is the reference reverberation time (0.5 seconds for habitable rooms). The w weighting is used to provide a single-number quantity for the sound reduction performance of a material or building element, and it is calculated in line with BS EN ISO 717-1.
C_{tr}	Spectrum adaption term for an urban traffic noise spectrum, which is usually added to R_w or D_{nTw} values in order to characterise their sound insulation performance taking into account low frequency noise. This C_{tr} adaption term is calculated using the BS EN ISO 717-1.
L_i	Impact Sound Pressure Level: average sound pressure level in a one-third octave band in the receiving room when the floor under test is excited by the standardized impact sound source; it is expressed in decibels.
L'_{nTw}	Weighted Standardized Impact Sound Pressure Level: in-situ impact sound pressure level in a stated frequency band, corrected for the standardized reverberation time of 0.5 seconds for a medium sized, carpeted and furnished living room. It is calculated using the following formula: L_{nT} = Li - 10 log (T/T0), where Li is the impact sound pressure level, T is the reverberation time in the receiving room and T0 is the reference reverberation time (0.5 seconds for habitable rooms). The w weighting is used to provide a single-number quantity for the impact sound pressure level of a floor, calculated in line with BS EN ISO 717-2. The L_{nTw} is the equivalent index for laboratory measurements.

In order to assist the understanding of acoustic terminology and the relative change in noise, the following background information is provided.

The human ear can detect a very wide range of pressure fluctuations, which are perceived as sound. In order to express these fluctuations in a manageable way, a logarithmic scale called the decibel, or dB scale is used. The decibel scale typically ranges from 0 dB (the threshold of hearing) to over 120 dB.

The ear is less sensitive to some frequencies than to others. The A-weighting scale is used to approximate the frequency response of the ear. Levels weighted using this scale are commonly identified by the notation dB(A).

In accordance with logarithmic addition, combining two sources with equal noise levels would result in an increase of 3 dB(A) in the noise level from a single source.

A change of 3 dB(A) is generally regarded as the smallest change in broadband continuous noise which the human ear can detect (although in certain controlled circumstances a change of 1 dB(A) is just perceptible). Therefore, a 2 dB(A) increase would not be normally be perceptible. A 10 dB(A) increase in noise represents a subjective doubling of loudness.

A noise impact on a community is deemed to occur when a new noise is introduced that is out of character with the area, or when a significant increase above the pre-existing ambient noise level occurs.

For levels of noise that vary with time, it is necessary to employ a statistical index that allows for this variation. These statistical indices are expressed as the sound level that is exceeded for a percentage of the time period of interest. In the UK, traffic noise is measured as the L_{A10}, the noise level exceeded for 10% of the measurement period. The L_{A90} is the level exceeded for 90% of the time and has been adopted to represent the background noise level in the absence of discrete events. An alternative way of assessing the time varying noise levels is to use the equivalent continuous sound level, LAeq.

This is a notional steady level that would, over a given period of time, deliver the same sound energy as the actual fluctuating sound.

To put these quantities into context, where a receiver is predominantly affected by continuous flows of road traffic, a doubling or halving of the flows would result in a just perceptible change of 3 dB, while an increase of more than 25%, or a decrease of more than 20%, in traffic flows represent changes of 1 dB in traffic noise levels (assuming no alteration in the mix of traffic or flow speeds).

Note that the time constant and the period of the noise measurement should be specified. For example, BS 4142 specifies background noise measurement periods of 1 hour during the day and 15 minutes during the night. The noise levels are commonly symbolised as $L_{A90,1hour}$ dB and $L_{A90,15mins\ dB}$. The noise measurement should be recorded using a 'FAST' time response equivalent to 0.125 ms.

Appendix B - Acoustic Design Criteria

B1 Building Regulations - Approved Document E

B1.1 Separating Walls and Floors

The requirements under the 2010 Part E of the Building Regulations are as follows:

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

E2. Dwelling-houses, flats and rooms for residential purposes shall be designed and constructed in such a way that (a) internal walls between a bedroom or a room containing a water closet and other rooms and (b) internal floors, provide reasonable resistance to sound. This requirement does not apply to internal walls containing doors, to internal walls separating ensuite toilets from the associated bedrooms or existing walls and floors in a building subject to a material change of use.

E3. The common parts of buildings which contain flats and 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.

The performance standards defining "reasonable resistance to sound" are quantified in Approved Document E. These numerical standards are listed in Table 1 below. For this project Requirements E1, E2 and E3 apply.

The following numerical performance standards apply to the residential element of the proposed development:

Table B1: Numeric Performance Standards

Dwelling-Flats		Airborne standard $D_{nT,w} + C_{tr}$ dB	Impact standard $L'_{nT,w}$ dB
Purpose built dwelling-houses and flats	Walls	≥ 45	-
	Floors and stairs	≥ 45	≤ 62

B1.2 Internal Floors and Walls within Residences

Approved Document E also sets a minimum performance requirement of 40 dB R_w for internal walls surrounding bedrooms and internal partitions surrounding WCs. It should be noted that the 40 dB R_w criterion is a laboratory rating only and cannot be measured on-site. It should also be noted that this criterion specifically does not apply to any walls containing doors or to walls between en-suite bathrooms and the associated bedroom.

B1.3 Reverberation in Common Parts

This requirement only applies to corridors, stairwells, hallways and entrance halls which give access to the flats.

B1.4 Non-Domestic Uses

The sound insulation requirements presented in Approved Document E are designed to provide a "reasonable resistance" to the passage of sound from normal domestic activities from other parts of the same building or adjoining buildings. A higher standard of sound insulation may be required between spaces used for domestic purposes and communal or non-domestic purposes. In these situations the appropriate level of sound insulation will depend on the noise generated in the communal or non-domestic space.

In this particular case, non-domestic use areas as part of the development are considered to be any proposed plantrooms and the Community Centre which as far as it is understood, shares a separating floor with residential units located on the first floor level of Braithwaite House.

Good practice dictates that in order to ensure the effects of industrial noise within the plantroom does not unduly affect the occupants of the residences above/adjacent, the separating partitions should be capable of reducing plantroom noise levels to such an extent that they are indiscernible within the adjacent residence. To ensure a specific sound is indiscernible to the occupants of the receiving room, it is generally considered appropriate that a resultant level of at least 10 dB(A) below the otherwise prevailing L_{Aeq} noise climate is targeted within in the receiving room.

In accordance with the requirements of BS8233:2014 and Local Authority, maximum internal noise levels of 30 dB L_{Aeq} and 35 dB L_{Aeq} have been proposed for the bedrooms and living room areas respectively. As such, as a worst case, the separating partitions between any plantroom and the residential areas of the development should be capable of reducing noise levels emanating from within the non-residential areas to a maximum level of 20 dB L_{Aeq} (NR15) within the adjacent residential receiving rooms.

B2 British Standard 8233:2014 "Guidance on sound insulation and noise reduction for buildings"

BS 8233:2014 *Guidance on sound insulation and noise reduction for buildings* draws on the results of research and experience to provide information on achieving internal acoustic environments appropriate to their functions. The guideline values provided are in terms of an average (L_{Aeq}) level.

The standard advises that, for steady external noise sources, it is desirable for residential internal ambient noise levels to not exceed the guidance values, as detailed below in Table 2.

Table B2: BS8233:2014 Indoor Ambient Noise Level Guidance

Activity	Location	Daytime	Night Time
Resting	Living room	35 dB $L_{Aeq,16hour}$	-
Dining	Dining room	40 dB $L_{Aeq,16hour}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,16hour}$

BS 8233:2014 goes on to suggest that where a development is considered necessary or desirable, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions will still be achieved.

With regards to maximum noise levels, the Standard identifies that regular individual noise events (such as passing trains or scheduled aircraft etc.) can cause sleep disturbance. The Standard does not provide a guideline design target, but simply goes on to suggest that a guideline value may be set in terms of SEL or L_{AFmax}, depending upon the character and number of events per night. It goes on to suggest that more sporadic noise events could require separate values.

In respect of external noise levels, the guidance in BS 8233:2014 suggests that "it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$ with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments."

BS 8233:2014 provides a much more detailed narrative on noise levels in external amenity areas and acknowledges that it may not always be necessary or feasible to ensure that noise levels remain within these guideline values.

In respect of gardens and patios, BS 8233:2014 states; "however it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited."

It is clear from the narrative of BS 8233:2014, that proposed development within noisy environments should be designed to ensure that the recommended internal design standards are achieved, and that noise levels in external amenity areas are designed to effectively control and reduce noise levels, although it acknowledges that in certain circumstances meeting the external design recommendations may not be feasible, or necessary, especially where the provision of such spaces is desirable for other technical, planning or policy reasons.

B3 British Standard 4142:2014 "Method for Rating and Assessing Industrial and Commercial Sound"

BS 4142 describes the method for assessing whether noise sources of an industrial, commercial or fixed nature are likely to cause and adverse impact on people residing in the area.

New development can often incorporate plant and processes that have the potential to generate noise, especially if operated at night-time when background noise levels are at their lowest.

BS 4142 sets out a method to assess whether noise from factories, industrial premises or fixed installations and sources of an industrial nature in commercial premises are likely to give rise to complaints from noise-sensitive receptors in the vicinity.

The procedure contained in BS 4142 for assessing the likelihood of adverse impact is to compare the measured or predicted noise level from the source in question, the $L_{Aeq,T}$ 'specific noise level', immediately outside the dwelling with the $L_{A90,T}$ background noise level.

Where the noise contains a tonality, impulsivity, intermittency and other sound characteristics, then a correction depending on the grade of the aforementioned characteristics of the sound is added to the specific noise level to obtain the $L_{Ar,Tr}$ 'rating noise level'. A correction to include the consideration of a level of uncertainty in noise measurements, data and calculations can also be applied when necessary.

BS 4142 states: "*The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs*". An estimation of the impact of the specific noise can be obtained by the difference of the rating noise level and the background noise level and considering the following:

Typically, the greater this difference, the greater the magnitude of the impact.

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

A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context.

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

The periods associated with day and night, for the purposes of the Standard, are considered to be 07.00 to 23.00 and 23.00 to 07.00, respectively.

B4 Local Authority Acoustic Requirements – Camden Council

B4.1 Planning Conditions

Planning Condition 7

The external noise level emitted from plant, machinery or equipment with specified noise mitigation at the development hereby approved shall be lower than the lowest existing background noise level by at least 10dBA, by 15dBA where the source is tonal, as assessed according to BS4142:2014 at the nearest and/or most affected noise sensitive premises, with all machinery operating together at maximum capacity.

Planning Condition 9

Prior to commencement of the development, details shall be submitted to and approved in writing by the Council, of an enhanced sound insulation value $D_{nT,w}$ 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 any bedroom of separate dwellings]. Approved details shall be implemented prior to occupation of the development and thereafter be permanently retained.

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