CAMDEN ROAD HOSTEL

ACOUSTIC DESIGN REPORT

Acoustics Report A1536 R02

27th April 2020

Report for:	RCKa 29-31 Cowper Street London EC2A 4AT Attention: Wendy Charlton/Andrea Villate
Report also to:	E3 Consulting Engineers Attention: Andy Jarvis
Prepared by: David O'Neill BEng CEng MSc MIOA Director	Checked by: Gavin Irvine BSc MIOA Director
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Ion Acoustics Ltd Consultants in Acoustics, Noise and Vibration 0117 911 3765
30-32 St Nicholas Street . mail@ionacoustics.co.uk
Bristol BS1 1TG www.ionacoustics.co.uk
Registered in England and Wales No. 5920418 Member of the Association of Noise Consultants

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1 Introduction

Ion Acoustics is appointed by RCKa architects to provide acoustic advice to the team in respect of a new hostel at 248-250 Camden Road, London NW6. This report is prepared to document the RIBA Stage 3 acoustic design. A baseline noise survey was carried out and was reported in Ion Acoustics report A1536/R01 dated 29/11/19. A summary is provided here, but reference to the earlier report can be made for further details.

The scheme is a new-build hostel providing temporary accommodation for homeless people proposed on the site of an existing hostel on Camden Road. As well as needing to achieve Building Regulations Part E requirements, it is the intention that the new hostel would achieve the Home Quality Mark (HQM) ONE standard delivered by BRE. These are discussed in this report.

In particular, the report addresses:

- Acoustic performance requirements including internal noise limits and sound insulation requirements;
- Summary of noise levels affecting the site
- Proposed form of volumetric construction and assessment of the sound insulation;
- Building envelope sound insulation
- Building services acoustic strategy

2 Scheme Description

There is currently a four-storey hostel on the site which will be demolished as part of the scheme. There is an outdoor space/yard at the front with a vehicle ingress/egress zone and a small grassed area with several large trees. The new scheme would provide a new hostel building constructed on the site on a similar footprint but using a volumetric modular construction method. The new building would provide similar temporary hostel accommodation.

The existing site is shown in Figure 1 below with the measurement positions MP1 and MP2 used for the noise survey. The site is exposed to relatively high road noise levels from Camden Road on the north-west façade, but has lower levels in the more shielded garden at the rear.

The proposed site plan is shown in Figure 2.

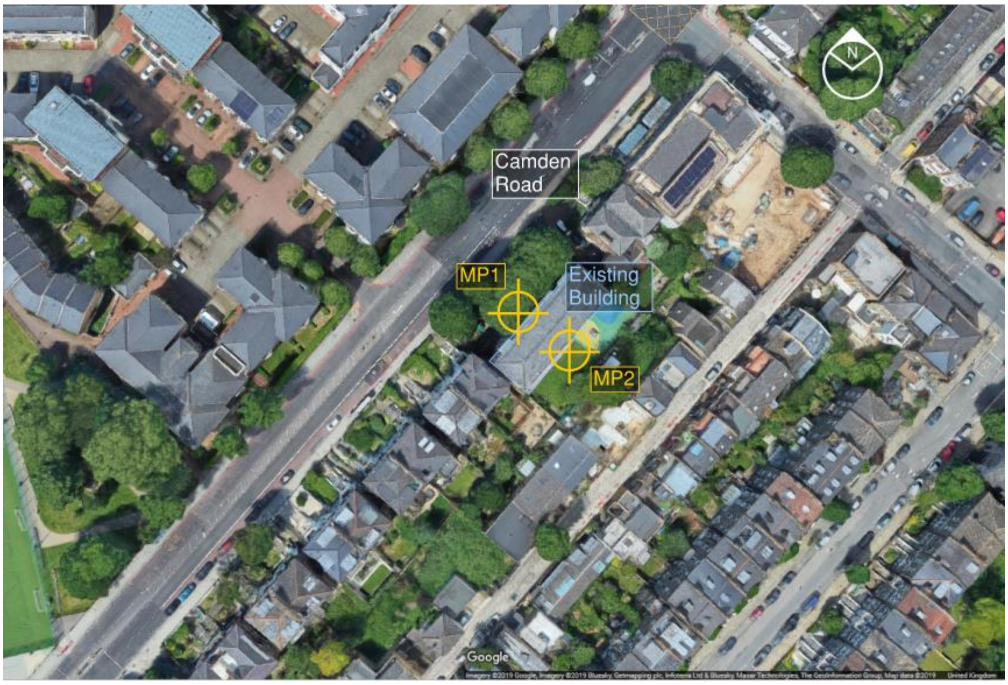

Figure 1 – Aerial View (© Google) showing existing hostel and noise measurement positions

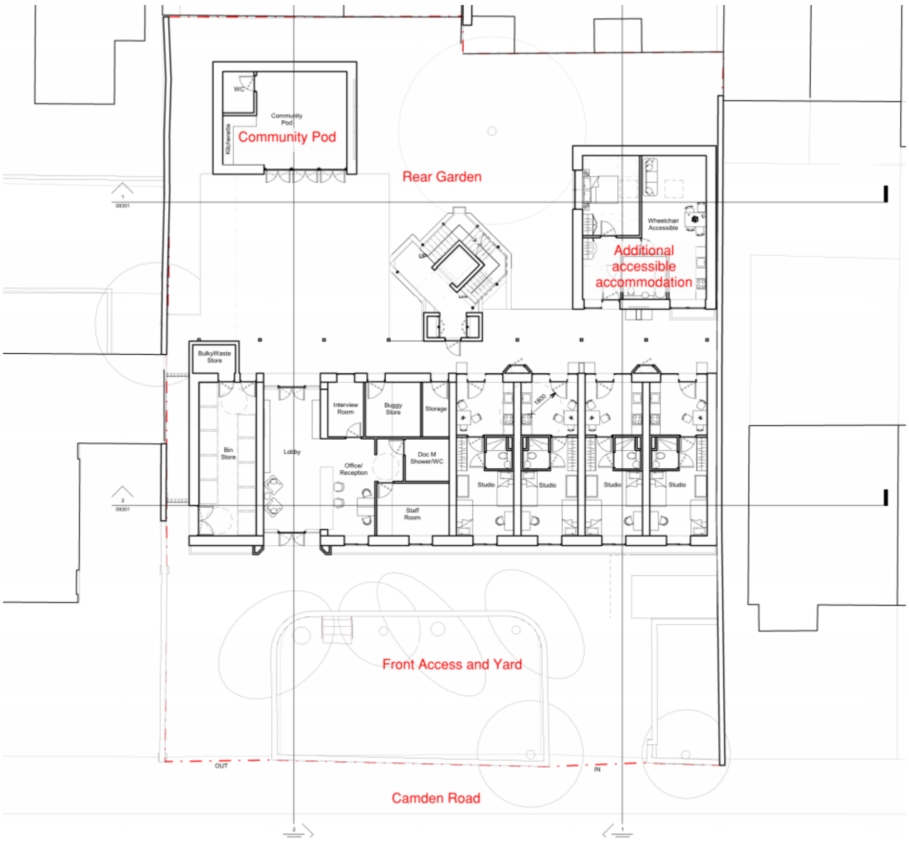

Figure 2 – Proposed Site Arrangement

3 Acoustic Criteria

Acoustic requirements have been set based on the following requirements:

- expected planning requirements (internal noise levels and external plant noise limits);
- compliance with the Building Regulations Part E (internal sound insulation); and,
- the Home Quality Mark One Standard. The HQM also provides criteria in respect of internal noise levels and internal sound insulation.

3.1 Planning Criteria

The site does not yet have planning permission. Based on their planning guidance from March 2018 Camden Council are expected to potentially include planning conditions relating to noise; these may relate to:

- Internal noise levels in residential accommodation;
- Plant noise emissions.

These issues have been discussed in detail in the noise report. In summary, it is expected the internal noise limits for residential accommodation from BS 8233: 2014 would be implemented, and that a plant noise limit would be set in accordance BS 4142: 2014 in relation to the typical background noise.
Camden's planning guidance is set out in their Local Plan (2017) and Camden Planning Guidance Amenity (March 2018). In respect of internal limits within dwellings, the former sets numerical requirements which correspond with Lowest Observed Adverse Effect Level (LOAEL) and the Significant Observed Adverse Effect Level (SOAEL) and a range between. The internal limits for habitable rooms correspond with the L_{Aeq} values in BS 8233:2014 (see Table 1 below). The L_{Amax} values give L_{Amax} 42dB for the LOAEL range, with L_{Amax} 40-73 dB in the LOAEL to SOAEL range. For this scheme it is proposed to achieve the LAeq LOAEL limits and to achieve L_{Amax} 45dB, which is at the lower end of the LOAEL to SOAEL range; where Camden planning guidance states "*noise is observed to have an adverse effect level, but which may be considered acceptable when assessed in the context of other merits of the development*".

3.2 Internal Noise Criteria – BS8233:2014

Appropriate internal noise levels are recommended in BS 8233:2014 (shown in Table 1 below) and in the World Health Organisation (WHO) Guidance "Guidelines for Community Noise", 1999.

Table 1 – Indoor Ambient Noise Levels from BS 8233: 2014

Activity	Location	Day (07:00 to 23:00)	Night (23:00 to 07:00)
Resting	Living rooms	35 dB $L_{Aeq,\ 16\ hour}$	
Dining	Dining room/area	40 dB $L_{Aeq,\ 16\ hour}$	
Sleeping - night Resting - day	Bedrooms	35 dB $L_{Aeq,\ 16\ hour}$	30 dB $L_{Aeq,\ 8\ hour}$

WHO Guidelines propose internal limits of L_{Aeq} 35dB for living/dining rooms and L_{Aeq} 30dB / 45 dB L_{AFmax} inside a bedroom at night.

Notably BS 8233:2014 does not contain any quantitative limits for the assessment of *L*AFmax values, however guidance within ProPG (2017) added to the criteria references within BS 8233:2014, including a quantitative limit for the assessment of L_{AFmax} values. The guidance within ProPG regarding L_{AFmax} values is as follows:

45 dB $L_{Amax,F}$ within Bedrooms during the hours of 23:00 to 07:00 with the following note attached:

NOTE 4 Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$, depending on the character and number of events per night. Sporadic noise events could require separate values.

In most circumstances in noise sensitive rooms at night (e.g. bedrooms) good acoustic design can be used so that individual noise events do not normally exceed 45dB $L_{Amax,F}$ more than 10 times a night. However, where it is not reasonably practicable to achieve this guideline then the judgement of acceptability will depend not only on the maximum noise levels but also on factors such as the source, number, distribution, predictability and regularity of noise events.

3.3 BS 4142: 2014

The standard method for assessing plant noise affecting nearby housing is British Standard BS 4142 "Method for rating and assessing industrial and commercial sound". A BS 4142 assessment is made by determining the difference between the plant noise under consideration and the background sound level as represented by the L_{A90} parameter, determined in the absence of the intrusive noise. The L_{A90} parameter is defined as the level exceeded for 90% of the measurement time. Therefore, it represents the underlying noise in the absence of short-term events.

The plant noise is assessed in terms of the ambient noise level, L_{Aeq}, but a character correction penalty can be applied where the noise exhibits certain characteristics such as distinguishable tones, impulsiveness or, if the noise is distinctively intermittent. The ambient noise level, L_{Aeq} is defined as the steady-state noise level with the same energy as the actual fluctuating sound over the same time period. It is effectively the average noise level during the period. The plant noise level (L_{Aeq}) with the character correction (if necessary) is known as rating level, L_{Ar}, and the difference between the background noise and the rating level is determined to make the BS 4142 assessment. The standard then states:

- *"Typically, the greater the 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 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 standard outlines a number of methods for defining appropriate 'character corrections' to determine the rating levels to account for tonal qualities, impulsive qualities, other sound characteristics and/or intermittency.

The standard also highlights the importance of considering the context in which a sound occurs. The standard indicates that factors including the absolute sound level, the character of the sound, the sensitivity of the receptor and the existing acoustic character of the area should be considered when assessing the noise impact.

The standard states that the objective of a noise survey *"is not simply to ascertain a lowest measured background sound level, but rather to quantify what is typical during particular time periods"*. A typical background sound level is usually derived by means of statistical analysis as opposed to, for example, a mean average or the lowest. This is typically achieved by creating a frequency distribution graph of the background sound levels measured, rounded to the nearest whole number.

Camden's Local Plant sets out typical noise limits applicable to plant and machinery noise in its Appendix 3 Noise Thresholds. This gives the limit as applicable in gardens (free field level) and outside habitable windows (façade level) during the day and outside bedroom windows during the night. The rating level sought to achieve the LOAEL values is 10dB below background level (L_{A90}) or 15dB below the background if there are "audible tonal elements". This is a conservative interpretation as BS 4142 indicates a plant noise rating level equal to the background (L_{Ar} = L_{A90}) represents a "low impact" (subject to context). Nevertheless, the Camden thresholds are implemented here as the design targets. It is also noted that they simply apply a 5dB penalty for tonality, but not for other characteristics; which is different to the current BS4142:2014 approach.

4 Part E Building Regulations

As a minimum, the new flats must comply with the Building Regulations Part E. Parts E1, E2, and E3 are generally applicable. These are described below. Note that for requirements E1 and E2 more onerous performance standards must be achieved for the Home Quality Mark. Therefore achieving the HQM credits for sound insulation would ensure compliance with Part E.

4.1 Part E1 of the Building Regulations – separating floors and walls

Requirement E1 of the Building Regulations states:

"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."

To satisfy Requirement E1, the sound insulation between houses and between flats, and between common areas and the flats, must achieve the numerical standards stated in Approved Document E to the Building Regulations.

The residential accommodation at the hostel is arranged as flats with a bedroom and lounge. The numerical standards for airborne and impact sound insulation for new build flats are shown in Table 2. Airborne sound insulation describes sounds which travel through the air before entering the structure such as voices and TVs etc. Impact sounds are those which occur as a direct impact on the structure such as footsteps and chair scrapes.

Table 2: Sound Insulation Requirements from Approved Document E 2015

New-build Houses and Flats	**Airborne Sound Insulation (Minimum Values) $D_{nT,w}+C_{tr}$ (dB)**	**Impact Sound Insulation (Maximum Values) $L'_{nT,w}$ (dB)**
Separating Walls	45 dB	-
Separating Floors	45 dB	62 dB

Note that for airborne sound, the higher the $D_{nT,w}+C_{tr}$ value, the better the sound insulation whereas for impact sound insulation, the converse is true; the lower the $L'_{nT,w}$ value the better the impact sound insulation. Pre-completion testing will be required to demonstrate that the on-site requirements have been achieved.

4.2 Robust Details

There is an alternative way of demonstrating compliance with the Building Regulations which avoids the need to carry out testing: using Robust Details. Robust Details are constructions which have been devised and tested to achieve a performance which is at least 5 dB better than the Table 1 values **on average**, and with every individual result at least 2dB better than the Table 1 values. If Robust Details are used then pre-completion testing is not necessary. However, the exact Robust Detail must be followed. The volumetric constructions to be adopted for this project do not follow Robust Details and therefore pre-completion testing will be required in this case (as it would for HQM in any case).

4.3 Part E2 of the Building Regulations – internal walls

Requirement E2 of the Building Regulations states:

"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."

To meet requirement E2, Approved Document E states that it will be necessary to use partitions and internal floor constructions which achieve a laboratory sound insulation rating of 40 dB R_w. Note that this is a design requirement only and there is no requirement for on-site testing. Examples of partitions and internal floors which meet the 40 dB R_w requirement are shown in Approved Document E, but this is not an onerous requirement and can be met with the majority of plasterboard-based lightweight constructions.

Part E2 also states:

"Requirement E2 does not apply to: (a) an internal wall which contains a door; (b) and internal wall which separates an en-suite toilet from the associated bedroom; (c) existing walls and floors in a building which is subject to a material change of use."

Therefore in this case Requirement E2 will only apply to the wall between the bathroom and lounge / kitchen.

4.4 Part E3 of the Building Regulations – Control of reverberation in common areas

Requirement E3 of the Building Regulations states:

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

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

However, for this scheme each flat is accessed off an outdoor walkway and therefore this requirement would not apply as there are no common internal parts used to access flats.

5 Home Quality Mark

The scheme is being assessed against the Home Quality Mark One standard. This includes noise limits for internal noise within dwellings and also in outdoor amenity areas in credit 4.3 and also gives credits for achieving particular sound insulation values between dwellings and within dwellings.

5.1 Internal Noise Limits

There are two credits for internal noise limits and up to two credits for external noise levels. The internal and noise limits for habitable rooms are broadly the same as those set out by BS8233:2014 and are reproduced in Table 3.

Table 3 - HQM Internal Noise Limits

Time of day	Habitable rooms $L_{Aeq,T}$	Kitchens $L_{Aeq,T}$	Open Plan room that a kitchen is part of L_{Aeq}
Day (07:00-23:00)	35dB	35dB	Lower* 35dB, Upper* 45dB
Night (23:00-07:00)	30dB (bedrooms only)	35dB	35dB
* Lower limit applies with ventilation system operating on continuous extract. The upper limit applies when the ventilation is operating in boost mode.			

Two credits can be awarded for meeting the internal noise limits in Table 1; the first credit is awarded if a Suitably Qualified Acoustician is appointed, which has happened already.

The noise limits are set out in terms of the L_{Aeq} noise index; the notional steady-state noise levels which has the same energy as the actual fluctuating noise. These limits apply to the combination of noise from the external noise and internal building services.

Commissioning noise measurements carried out in line with the methodology in the HQM manual should be performed to demonstrate compliance.

5.2 External Noise Levels in "External Functional Spaces"

For external noise levels, one or two credits can be awarded, dependent on the external noise level, specifically whether noise levels in the external functional spaces can meet the limits in Table 4.

Table 4 - HQM Noise Limits in External Functional Spaces

Time of day	Credits	Requirement $L_{Aeq,T}$
Day (07:00-23:00)	1	No greater than 55dB
Day (07:00-23:00)	2	No greater than 50dB

HQM states examples of external functional spaces include, but are not limited to, the following:

- A private garden
- A communal garden or courtyard
- Balconies
- Roof terraces
- Patios

In this case, the garden at the rear is considered to be an External Function Space, but not the access area and yard at the front.

5.3 Internal Sound Insulation

For the internal sound insulation HQM gives two different categories: one is the sound insulation of separating floors and walls between dwellings (up to five credits); and, the other is the sound insulation of internal walls and floors (up to four credits).

Table 5 sets out the credits available for sound insulation between dwellings.

Table 5 – HQM requirements for sound insulation of separating floors and walls

Credits	Airborne sound insulation $D_{nT,w}+C_{tr}$ (min values)	Airborne sound insulation $D_{nT,w}$ (min value)	Impact sound insulation $L'_{nt,w}$ (max value – floors only)
1	48 dB	56 dB	56 dB
3	50 dB	58 dB	54 dB
5	53 dB	60 dB	52 dB

The first column relates to the $D_{nT,w}+C_{tr}$, which is the index used for Part E of the building Regulations, whereas the second column is $D_{nT,w}$ which is a different index, although related. All are in-situ test requirements and, when tested, the credits are awarded based on the lowest test result.

The higher values to achieve five credits are very onerous and it is not expected that these will be achievable with the proposed construction. Therefore, currently, following initial assessment three credits are provisionally targeted. This requires sound insulation 5dB better than the minimum Building Regulations E1 requirements for all separating floors and walls, as well as the single figure $D_{nT,w}$ value of 58dB. Note however there is not sufficient evidence to reliably confirm it will be achieved at this stage; this is discussed in more detail later in the report.

Table 6 sets out the credits available for sound insulation of internal walls and floors from HQM.

Table 6 - HQM requirements for sound insulation of internal floors and walls

Credits	Minimum Airborne sound insulation R_w
2	44 dB
3	45 dB
4	48 dB

The values in Table 6 are laboratory ratings and are a design requirement and so would not be tested. The credit can only be achieved if the constructions used have been tested in an acoustics laboratory to demonstrate compliance with the R_w value. There is no assessment method of compliance; so, for example the performance cannot be predicted using software such as Insul. To achieve this credit will therefore require use of a partition type which has already been tested, for example by one of the plasterboard partition manufacturers. This may not be the case for all partition types.

Additionally, there is a further requirement under criterion 3 to enable the credit to be met, which is that the SQA must pass on specific information relating to mitigating design issues which have the potential to reduce the sound insulation, and in particular:

- Information on the means to ensure that sockets, switched, downlights and other services or other perforations maintain the acoustic performance where otherwise it may be compromised.
- Guidance relating to appropriate junction details at the head, foot and perimeter of the partition or floor.

This guidance is set out later in this report. The performance requirements are also set out on the acoustic requirement drawing showing a typical upper floor in Appendix B.

5.4 Suitably Qualified Acoustician

A Suitably Qualified Acoustician needs to be appointed to achieve the credits. For the noise survey and noise report the SQA was Tony James. Tony has over 3 years of experience within the industry of acoustic consultancy, a 1st Class Hons in Audio & Recording Technology supplemented with the IoA Post graduate Diploma, and is an associate grade member of the Institute of Acousticians (IoA), additionally furthering his expertise through continuous professional development sessions.

For the Stage 3 acoustic design stage, the SQA is David O'Neill BEng CEng MSc MIOA. David has a degree in Engineering Acoustics and Vibration from the Institute of Sound and Vibration Research (ISVR) at Southampton University and over 25 years' continuous experience in acoustic consultancy. He is a Member of the Institute of Acoustics, has an MSc with distinction in Acoustics from South Bank University and is a Chartered Engineer. This meets the requirements for a "Suitably Qualified Acoustician".

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6 Proposed Construction

The proposed form of construction is a prefabricated volumetric modular system. At this stage, the system proposed is by Lesko and is being developed specifically for this project. The system will be a single structural module for each flat; these will be installed on site and an external cladding system added to the exterior, with an external walkway system and stairs on the rear façade. The cladding will likely be brickwork at ground level and terracotta tiles to upper floors.

Additionally, there will be two accessible units in the garden which are assumed to be formed from a similar construction.

The proposed build up comprises an enclosed cuboid module with a lid and a base. The system is steel framed with plasterboard and other board linings. Each is discussed separately in the relevant section below.

7 Sound Insulation Between Dwellings

7.1 Separating Floors

The separating floors will be formed from a module base sitting on top of a module lid which results in the following construction as a separating floor, as indicated in the draft floor build up in Figure 3.

Base of upper module (from top down)

- 18mm floor finish (either timber board or potentially vinyl)
- 15mm cement particle board
- 18mm OSB on
- 200mm steel floor structure spanning between 220-250mm perimeter beams (only the perimeter beams bear on the lower module)

Top of lower module (from top down)

- 18mm sheathing board (assumed OSB)
- 150mm steel ceiling structure
- Primary (upper) ceiling comprising 15mm fireboard and 15mm dense (>820 kg/m^3) plasterboard
- 289mm service void, with secondary ceiling of 12.5mm standard plasterboard ceiling fixed on strap hangers or similar

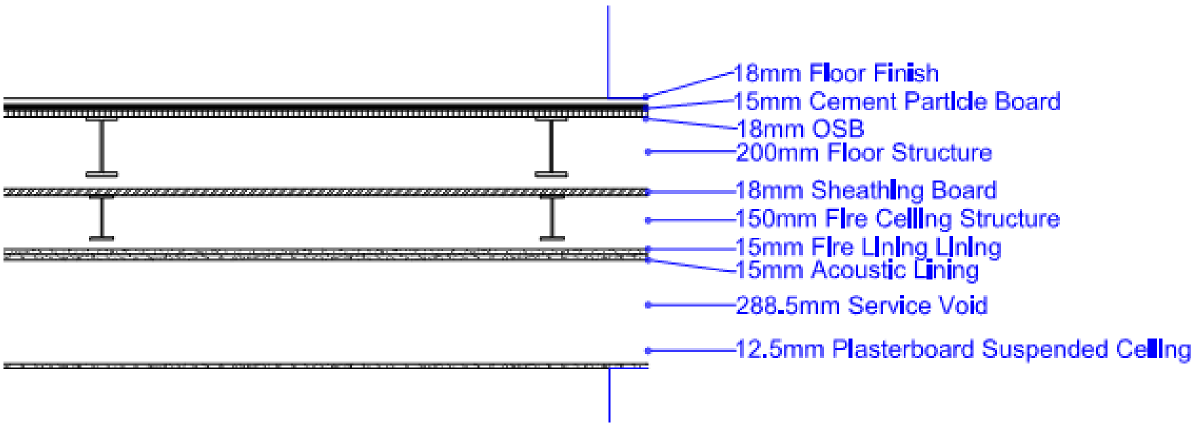


Figure 3: Separating Floor Construction.

We understand that Lesko have no tested sound insulation data for this system. We have therefore modelled it using Insul[1] specialist sound insulation prediction software. There are some areas of uncertainty and the software only allows modelling a triple layer build up. The services ceiling has been omitted from the calculation, and a separate assessment made.

The performance would depend on the form of junction between the modules and it is assumed that they will be linked only around the perimeter structural beams, so the centre zone and intermediate structure will effectively be separate and not resting on the module below.

Airborne Sound Insulation

Based on this we estimate sound insulation performance of order R_w 71 dB (C_{tr} -15dB) giving R_w+C_{tr} 56 dB. Assuming a reasonable design tolerance of 5dB this predicts sound insulation $D_{nT,w}+C_{tr}$ 50dB and $D_{nT,w}$ 65dB. This is good sound insulation, but only just manages to meet the minimum requirement in respect of $D_{nT,w}+C_{tr}$. It is possible that slightly higher performance may be achieved in practice and as flanking conditions and construction quality would be good, potentially lower than 5dB design tolerance may be required. However, if a sheathing board is added to the underside of the top module that could reduce the effective cavity depth, which may slightly reduce performance.

Therefore, it is expected that the system can comfortably meet the minimum Building Regulations E1 requirements ($D_{nT,w}+C_{tr}$ 45dB) and likely the HQM requirements for one credit. But it is not certain that the HQM requirements for three credits will be achieved. It is possible that sufficient performance may be achieved, but not reliably especially as the credits are based on the lowest measured value rather than an average. Further work on the details is required and potentially if some test data can be obtained that may refine the assessment. However, the three credits should only be targeted tentatively at this stage.

Impact Sound Insulation

The impact sound insulation is particularly difficult to model. The system is expected to meet the minimum Building Regulations E1 requirements as proposed. With a carpet finish or a resiliently backed vinyl or timber board, it would be expected to meet the uplifted HQM requirements for impact sound, $\leq L'_{nT,w}$ 54 dB. With no resilient material added below the upper layer, there is still separation between the main structural elements, but there would be a structural sound path round the perimeter and the sound insulation would be limited. We would recommend therefore that, unless testing can be carried out to demonstrate otherwise or test results provided, a resilient layer should be included in the upper build up. This would typically be a 5mm thick neoprene or similar sheet. A foamed-backed vinyl would also be suitable. This could be specified on the basis of providing an impact sound improvement of not less than 17 dB ΔL_{nw}.

7.2 Separating Walls

The separating walls are formed from a pair of modules placed adjacent to each other. We understand there is a gap between them meaning that the system will effectively be a twin frame construction. The proposed build-up comprises a twin framed plasterboard system, with an additional plasterboard lined services zone on each side, although the depth of this is not finalised yet. In principle, the system comprises:

[1] www.insul.co.nz

- 12.5mm standard plasterboard on 19 to 55mm deep timber battens forming a service zone
- 2 x 15mm standard plasterboard on 100mm deep steel structural frame with 100mm mineral fibre between studs
- 50mm gap between modules
- 2 x 15mm standard plasterboard on 100mm deep steel structural frame with 100mm mineral fibre between studs
- 12.5mm standard plasterboard on 19 to 55mm deep timber battens forming a service zone

Again, this has been modelled using Insul software; the performance will depend on some extent to the cavity of the services zone, but this may reduce the performance slightly by adding a shallow resonant cavity. The performance is predicted as around R_w 65-69dB (C_{tr} -10 to -9 dB). This is predicted to be able to meet the Part E requirement, but to be slightly below the HQM 3 credit requirement.

There is a Robust Detail (E-FT-1) which is similar in form to this, although has heavier plasterboard and timber studs. That is accredited to achieve 3dB over the building regulation requirement ($D_{nT,w}+C_{tr}$ 48dB), but not 5dB. As it is a Robust Detail it would achieve +5dB "on average", but not for all cases and therefore not reliably enough. Therefore, again it is possible that the partitions may meet the requirement for the 3 credits from HQM, but not confidently so.

The performance could be improved slightly to optimise the chances of compliance by using 15mm dense plasterboard instead of 15mm standard plasterboard, and by providing mineral wool in the services cavity and using a metal stud instead of a timber batten.

7.3 Key Sound Insulation Detailing

To achieve the separating wall and floor requirements in line with the HQM and building regulations requirement, the following additional recommendations are made:

- Power sockets and light switches should, if they are required, have putty pads or be installed within a services void.
- The main linings should all be imperforate
- The modules should only be supported at the perimeters and the separating walls should have a full gap from module to module for the length of the wall. A mechanical fixing or link at each end is permitted
- Typically, flanking sound needs to be carefully addressed in the design. In this case the use of a modular build ensure that the walls do not form continuous flanking paths past the end of separating floors and walls. The linings do however need to be sealed with no openings to the void cavity to ensure there is no leakage.
- Flanking via ductwork and services will need to be considered. This is addressed later in the report.

8 Sound Insulation Within Dwellings

The requirement for sound insulation within dwellings from Building Regulations Part E2 is that the partition must achieve at least R_w 40dB. This is the minimum acceptable for this scheme. However, the HQM credits are sought and these give different performance requirements for credits; in this case the highest performance is sought, with 4 credits available for R_w 48dB. This is a design requirement and does not need to be tested on site. However, it does require a laboratory test result for compliance. So it cannot be simply modelled. Therefore, a recognised system or a construction identical to a recognised system would need to be used.

Examples of partitions which can achieve R_w 48dB are given below. These are all taken from British Gypsum systems and the system reference is stated to demonstrate compliance. However, other drywall manufacturers will have similar systems which may have similar test results.

- 2 x 12.5mm standard wallboard on both sides of 48mm metal studs with 25mm mineral wool (system A206035 R_w 49dB)
- 2 x 12.5mm standard wallboard on both sides of 70mm metal studs with 25mm mineral wool (system A206047 R_w 49dB)
- 2 x 12.5mm dense Soundbloc on both sides of 70mm metal studs with no mineral wool (system A206166 R_w 49dB)

The particular arrangement does not include any significant internal walls within a dwelling. The bathroom is en-suite to the bedroom, so has a direct door access and the requirement would not apply. Therefore, the only internal wall would be the small section of wall between the bathroom and the living area as that is the only wall within a dwelling with no door in it.

8.1 Key Sound Insulation Detailing

To achieve R_w 48dB in line with the HQM requirement, the internal walls should have:

- Head detail well sealed and if a deflection head is provided this needs to ensure a full seal under deflection. A full mastic bead seal should be provided.
- Power sockets and light switches should, if they are required, have putty pads or be installed within a services void.
- Crosstalk between the bathroom and the living room via the duct should be assessed to ensure the transmission is commensurate with R_w 48dB; this may require crosstalk attenuators. This is a design requirement and does not require testing.

9 Internal Noise Levels

9.1 Limits

The overall noise limits are as follows, taking into account HQM, BS 8233: 2014 and ProPG guidance:

- Bedrooms: L_{Aeq} 35dB (day), L_{Aeq} 30dB and L_{Amax} 45dB (night)
- Living areas: L_{Aeq} 35dB

The noise limits apply to the contribution from external noise and plant noise. The external noise is controlled by the building envelope sound insulation. For this scheme, the building envelope calculations indicate that for the bedrooms on the most exposed Camden Road side, the L_{Amax} values determine the building envelope sound insulation. That is, the glazing specified to meet L_{Amax} 45dB (for planning purposes, not HQM) results in internal L_{Aeq} values likely to be around 3dB lower than the limit of L_{Aeq} 30dB in bedrooms.

This result is somewhat convenient as the rooms will be mechanically ventilated. To ensure the combined level is within the HQM / BS 8233 limits, the plant and the external noise (L_{Aeq}) should then both be controlled to a level 3dB below the overall limit at night to result in an overall level of L_{Aeq} 30dB. Hence, the noise limits are stated separately in Table 7.

Table 7 – Overall internal Noise limits

Room	Overall Noise Limits	External Noise	Building Services background ventilation	Building Services. Boost or intermittent extract ventilation
Bedrooms Night	L_{Aeq} 30dB L_{Amax} 45dB	L_{Aeq} 27dB L_{Amax} 45dB	L_{Aeq} 27dB	
Bedrooms Day	L_{Aeq} 35dB	L_{Aeq} 32dB	L_{Aeq} 32dB	
Living Rooms Day	L_{Aeq} 35dB	L_{Aeq} 32 dB	L_{Aeq} 32dB	L_{Aeq} 45dB

The initial advice on the sound insulation of the building envelope is given below, and the preliminary discussion on the strategy to control services noise is given in section 10

9.2 Typical Building Envelope Sound Insulation Requirements

Initial building envelope calculations have been prepared to demonstrate the general extent of sound insulation required. The noise levels at the front are quite high and require provision of good building envelope sound insulation. In particular the L_{Amax} values at night determine the building envelope requirements. The higher maxima values all have a frequency spectrum dominated by high values at 250Hz and therefore high sound insulation at this frequency is required to achieve L_{Amax} 45dB internally. Achieving the slightly more onerous Camden "green" LOAEL value of L_{Amax} 42dB is likely to be difficult to reliably achieve and the scheme is developed on the basis of meeting L_{Amax} 45dB which is within the lower end of the "amber" LOAEL to SOAEL range.

The building envelope calculations indicate that for the north-west most exposed façade, the following building envelope sound insulation is likely to be required. The final form of the building envelope is still to be fully developed, although example constructions based on the current proposals which are expected to meet requirements are given as examples.

- Ventilation: Mechanical ventilation with no trickle vents or other vent openings. The windows can however be openable as an occupier choice.
- Building Envelope: External wall rated at R_w 58 dB e.g the following based on the Lesko build up: terracotta external cladding to module with mineral fibre insulation to cavity; module comprising cementitious external, 100mm steel frame with mineral wool infill, 30mm plasterboard internal lining (plus additional 12.5mm board forming services zone if required)
- Windows: Glazing type A (See Table 8 below), typically achieving 42 dB R_w with minimum spectrum as shown; e.g. *10mm glass / 16mm airgap/ 8.4mm laminated glass.* Alternatively, secondary glazing would also be acceptable.
- Roof: Module roof construction typically achieving Rw 48 dB minimum;

The levels at the rear are significantly lower and none of the rooms at the rear are bedrooms, so the L_{Amax} does not need to be addressed. The entrance door is directly into the lounge/dining area with no lobby, so the door requires consideration of the sound insulation. The ventilation here is also to be provided by attenuated natural ventilation.

- Ventilation: In wall/In frame trickle ventilator achieving 29 dB $D_{ne,w}$ as a minimum
- Building Envelope: External wall rated at R_w 44 dB minimum – typically; *Brick Panel, 100mm cavity, and 2x12.5mm wallboard lining*.
- Windows/glazed doors: Glazing type B (See Table 8 below), typically achieving 32 dB R_w; e.g. *6mm glass / 12-16mm airgap/ 6mm glass.*
- Roof: as above.

Table 8 – Octave band glazing requirements to be achieved

Glazing Type	Octave Band Insertion Loss Values (Hz) (dB)							
	63	125	250	500	1k	2k	4k	R_w dB
Type A	23	25	33	40	42	40	40	45
Type B	N/A							32

It should be noted that the values above are to be achieved by the glazed units in total, inclusive of frames, seals, etc. An example which can achieve this is the AluK Option 58BW window achieving Rw 42dB (build-up 8.4 acoustic lam, 16mm cavity, 10mm)

9.3 External Noise Levels in Gardens

The noise level in the front yard area would be well over the L_{Aeq} 55 dB limit, however this is not considered a functional outdoor space (in terms of the HQM definition) as it is mainly used for vehicular and pedestrian access and there is an alternative rear amenity area.

The rear garden must be considered as a functional outdoor space. The levels measured (in the absence of the building works) were L_{Aeq} 53dB as a façade level. The free field level would therefore be around L_{Aeq} 50dB. However, the measurements were made at an elevated location on the rear façade; levels in the garden itself may benefit from slightly more shielding from distant road sources and it is expected that L_{Aeq} 50dB would be met in most of the garden area.

The HQM requirements allow 1 credit for meeting L_{Aeq} 55dB and two for achieving L_{Aeq} 50 dB. In this case the noise levels in most of the garden are expected to be just within the L_{Aeq} 50dB level, although some areas of the garden may exceed this. At this stage it is recommended that one credit is assumed in this respect as reliably achieved, although two are possible.

10 Building Services Strategy

The building services strategy is that the residential units will all be mechanically ventilated using an MVHR system with a Hybrid VRF system providing heating and cooling via a single FCU in each flat. There will be external condensers and air source heat pumps. The current proposal is:

- MVHR unit located in cupboard at rear opening onto the access walkway located on the party wall line with one MVHR units serving two flats. Each flat will have a ducted supply and return air form the MVHR unit.
- FCU located in "corridor zone" between living room and bedroom with supply to bedroom side only and bleed into the living room (via open door; there is no other passive path) providing heating and cooling.

- External condensers located on a flat plant roof to the south end of the building on the fourth-floor levels. The current proposal is for two heating/cooling condensers (PURY P300 YLM) and four air source heat pumps which will be located in an acoustic enclosure.

Key Acoustic Implications – Building Services Noise Levels

- The overall internal noise limit is L_{Aeq} 30 dB (bedrooms) and L_{Aeq} 35dB (Living Rooms). But there is a significant contribution from external road noise to the bedrooms and the services noise, in background ventilation mode, needs to achieve L_{Aeq} 27dB to ensure the overall limit is not exceeded. The limit, according to HQM, includes "*noise from building services…where they are required for normal background ventilations and heating purposes ie heat pumps, boilers, active ventilation systems.*" Presumably this would therefore exclude cooling from the FCUS, but would include the FCUs being used for heating. We propose that the FCUs in cooling mode should be designed to achieve L_{Aeq} 30dB in the bedroom in isolation.

- The MVHR units will require down duct attenuation to meet the limits. There is also likely to be a requirement for crosstalk control between flats, so it may be that these attenuators can provide fan noise control and cross talk sound insulation control. Detailed calculations will be required.

- The FCU unit is ducted to the bedroom and the return air will be via the ceiling in the corridor zone. To meet the onerous limits of L_{Aeq} 27dB in bedrooms (heating) and L_{Aeq} 30dB (cooling), these are expected to need attenuation to the FCU inlet and outlet spigots.

- The external condensers are located on the roof and are close to the windows of the adjacent residential building (246 Camden Road) which has windows at high level in the roof looking toward the new hostel. The screen will need to be tall enough to provide full shielding to these windows at least; and it is possible that other noise control measures will need to be considered in order to meet the planning noise limits (see section 11.

Key Acoustic Implications – Sound Insulation

- As there is a single MVHR unit serving two flats, there will be some common ductwork close to the unit, assuming that there is not a separate feed to each flat. Crosstalk from flat to flat via common supply and extract needs to be sufficient to achieve at least 5dB higher than the uplifted sound insulation requirement of $D_{nT,w}$ 58dB and $D_{nT,w}+C_{tr}$ 50dB and it is expected that induct cross talk attenuators will be required.

- The sound insulation from bathroom to bedroom within a flat has a requirement for the partition of R_w 48dB from HQM, which also requires the detailing of sound insulation to be assessed. Therefore, if there were common extract grilles to the bedroom and the bathroom of the same duct, then cross talk attenuation may be required to provide commensurate performance. The current draft layout does not have common extract, so that would not be an issue.

11 Plant Noise Emission Limits

The plant noise emissions limits will likely be implemented by Camden in any planning condition, and are in any case required to avoid disturbance to neighbours. The requirement is, for non-tonal plant, for the plant noise to be 10dBA below the background level. The distribution of day and night background noise levels measured in the baseline noise survey are shown in Appendix C at the front and back. Based on these levels, the plant noise limits have been derived and are shown in Table 9. These apply at 1m from the outside of residential windows during day and night or in any garden during the day.

Table 9: Representative background levels and plant noise limits.

Location	Period	Representative background level L_{A90}	Plant noise limit - L_{Ar}
front (pos MP1)	day	60dB	50dB
	night	50dB	40dB
rear (pos MP2)	day	47dB	37dB
	night	41dB	31dB

A full calculation of the building services emissions to these sensitive receptors will be required, but it appears that the key receptor will be the roof dormer window on the north end of the adjacent building 246 Camden Road which is assumed to be residential.

12 Conclusion

Ion Acoustics has carried out a design assessment during Stage 3 for the proposed hostel at 248-250 Camden Road. This report documents the acoustic design for this stage. The acoustic performance requirements are discussed in this report in respect of planning, Part E Building Regulations and requirements for Home Quality Mark One. The proposed form of building construction has been reviewed and the implications in respect of acoustics and meeting the criteria considered. Initial strategic commentary is made on the building services in respect of internal and external noise levels.

Glossary of Acoustic Terms

Appendix A - Glossary of Acoustic Terms

Decibel dB Unit used to describe quantify sound pressure levels or noise levels. 0 dB is the approximate threshold of hearing and 120 – 140 dB is the threshold of pain. A decibel is a logarithmic quantity and for sound pressure is calculated relative to a reference sound pressure level of 20 µPa. A change of 1 dB is just detectable under carefully controlled listening conditions.

A weighted decibel dB(A) The dB(A) unit used to describe a sound pressure level with the frequency spectrum weighted to account for the sensitivity of human hearing at different frequencies. Human hearing is less sensitive at low and high frequencies and most sensitive at speech frequencies, typically 500 Hz to 2kHz. The dB(A) weighting better describes the subjective effect. A change of 3 dB(A) is typically the minimum noticeable difference for noises with a similar character. A change of 10 dB(A) is equivalent to a subjective doubling or halving of loudness. A-weighted noise levels are denoted by a suffix 'A' as in L_{Aeq}, L_{Amax} etc.

Hertz, Hz Unit used to describe frequency of noise equivalent to the number of cycles per second. Human hearing is normally taken to extend from 20 Hz to 20,000 Hz but with reduced sensitivity at lower and higher frequencies (see dB(A) above). The 'Noise Spectrum' is the distribution of the noise across different frequency bands.

D_w Weighted sound level difference, dB. This represents a single figure sound insulation between a pair of rooms which accounts for all sound paths including those through partitions, via flanking paths, the absorption in the receiver room and the quality of installation.

$D_{nT,w}$ Normalised, weighted sound level difference, dB. This represents a single figure sound insulation between a pair of rooms which accounts for all sound paths including those through partitions, via flanking paths, the absorption in the receiver room and the quality of installation. The value is corrected for the reverberation time in the receiving room and normalised to a value of 0.5 seconds which is typical of many domestic rooms.

R_w Weighted sound reduction index, dB. This is a laboratory rating of the sound insulation of a particular element (e.g. partition, window, door) in idealised conditions. It is not interchangeable with the D_w.

R'_w Apparent weighted sound reduction index, dB. This is an in-situ measured rating of the sound insulation of a particular element (e.g. partition, window, door) in real conditions. It is usually 5 to 10 dB lower than the R_w for the same element.

C_{tr} The C_{tr} is a spectral adaptation term which places more importance on the low frequency sound insulation of a building element. The term is added to the $D_{nT,w}$ value to provide a new rating $D_{nT,w}+C_{tr}$. This is the rating value for domestic sound insulation stated in Approved Document E 2010 to the Building Regulations 2010.

α_w The weighted acoustic absorption coefficient between 0.0 and 1.0. This is a single figure value used to describe the general acoustic absorption of a material. It is calculated by comparing the absorption spectrum of a material with a shifted reference curve. A higher value relates to greater absorption.

$L_{Aeq,T}$ Equivalent continuous sound level is a notional steady sound level which contains the same amount of energy as the actual and possibly fluctuating sound over a period of time, T (dB). This is commonly used to describe the ambient noise level.

$L_{A90,T}$ The sound level exceeded for 90% of the measurement period T. Often used to describe the background noise level.

$L_{A10,T}$ The sound level exceeded for 10% of the measurement period T. Describes typical maxima during the measurement period, but not the highest level measured.

$L_{AFmax,T}$ The highest sound level measured during the measurement period T.

NR The Noise Rating, NR, is used to describe steady noise levels such as mechanical services noise. A family of curves is defined in octave frequency bands and the NR rating for a particular noise is the lowest NR curve which is entirely above the spectrum of the noise under consideration.

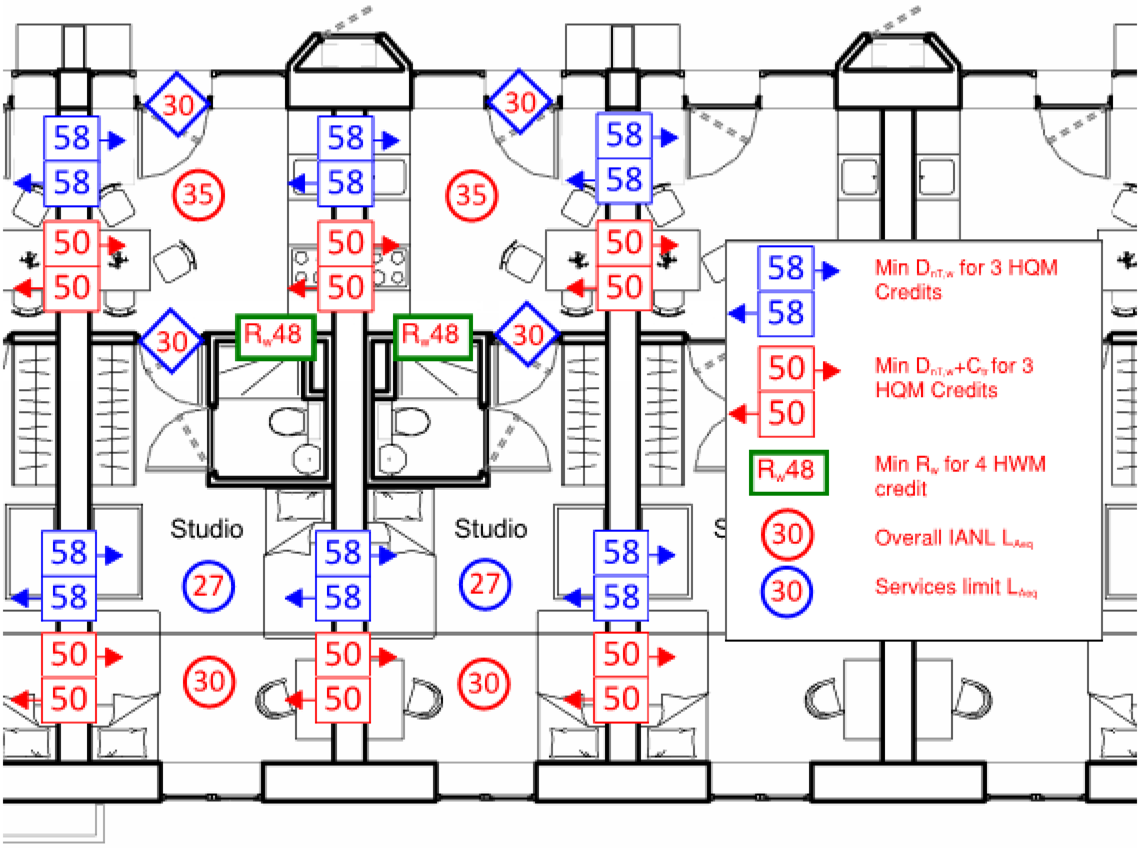
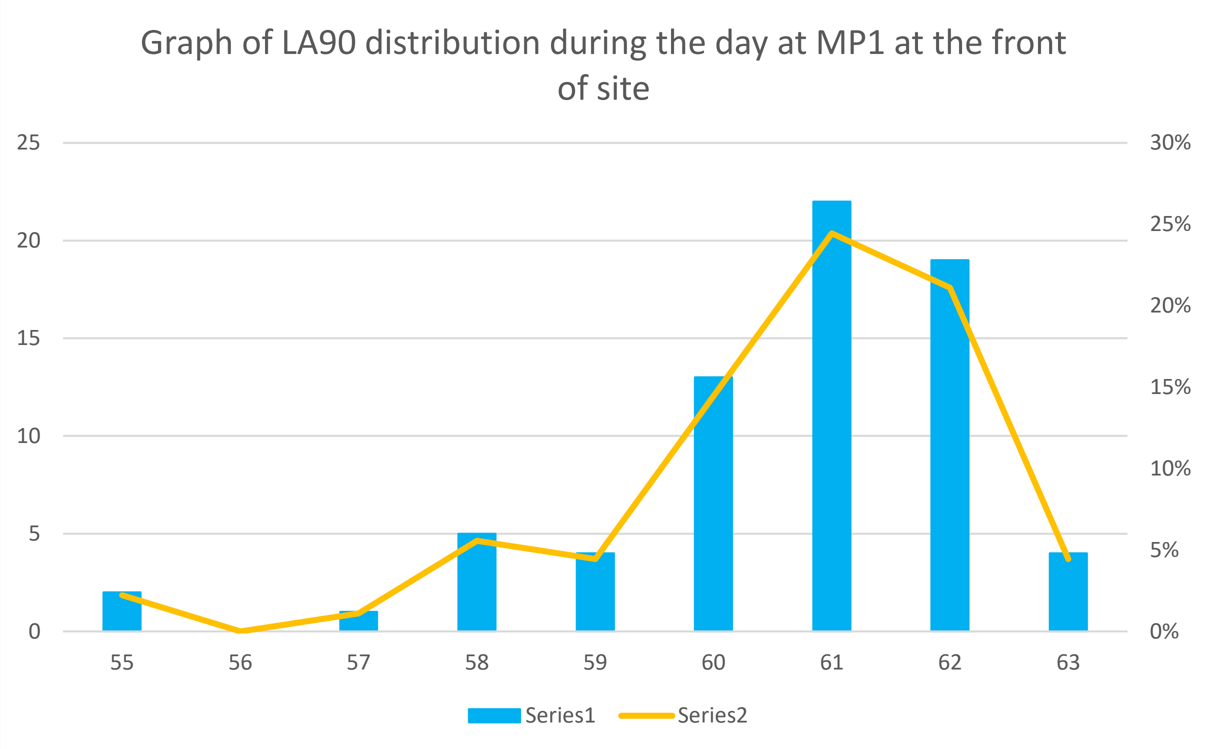
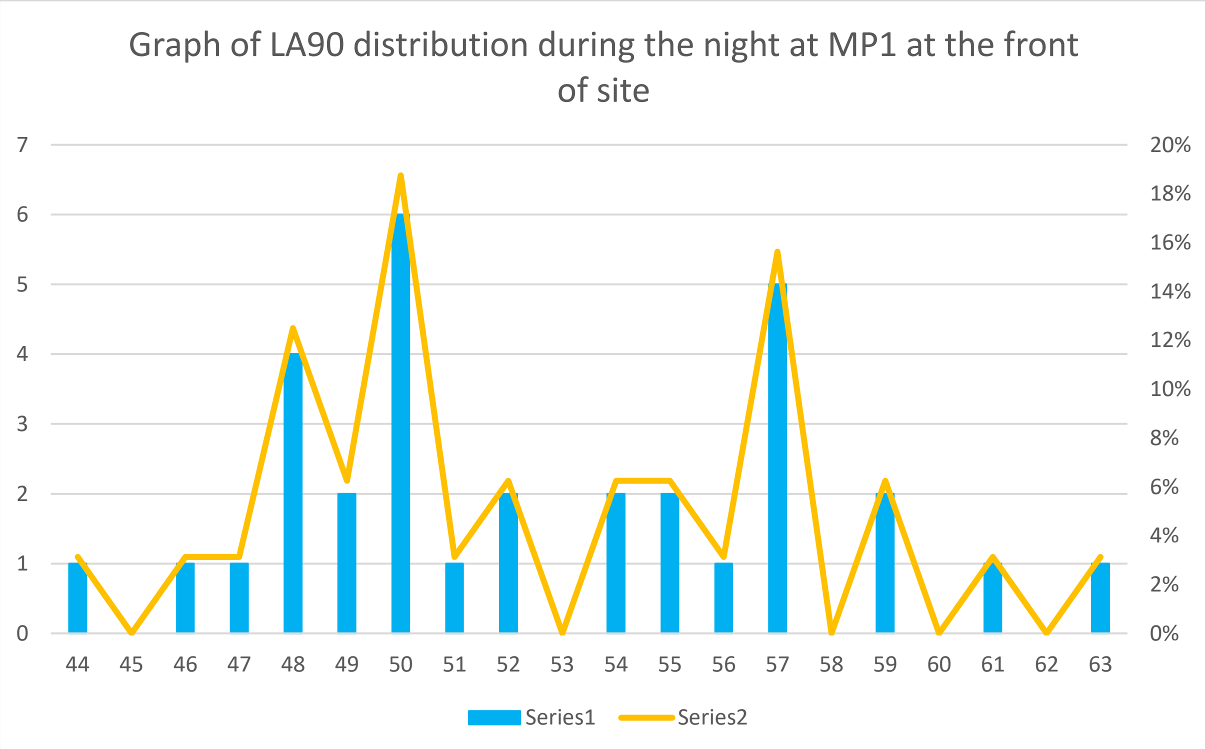
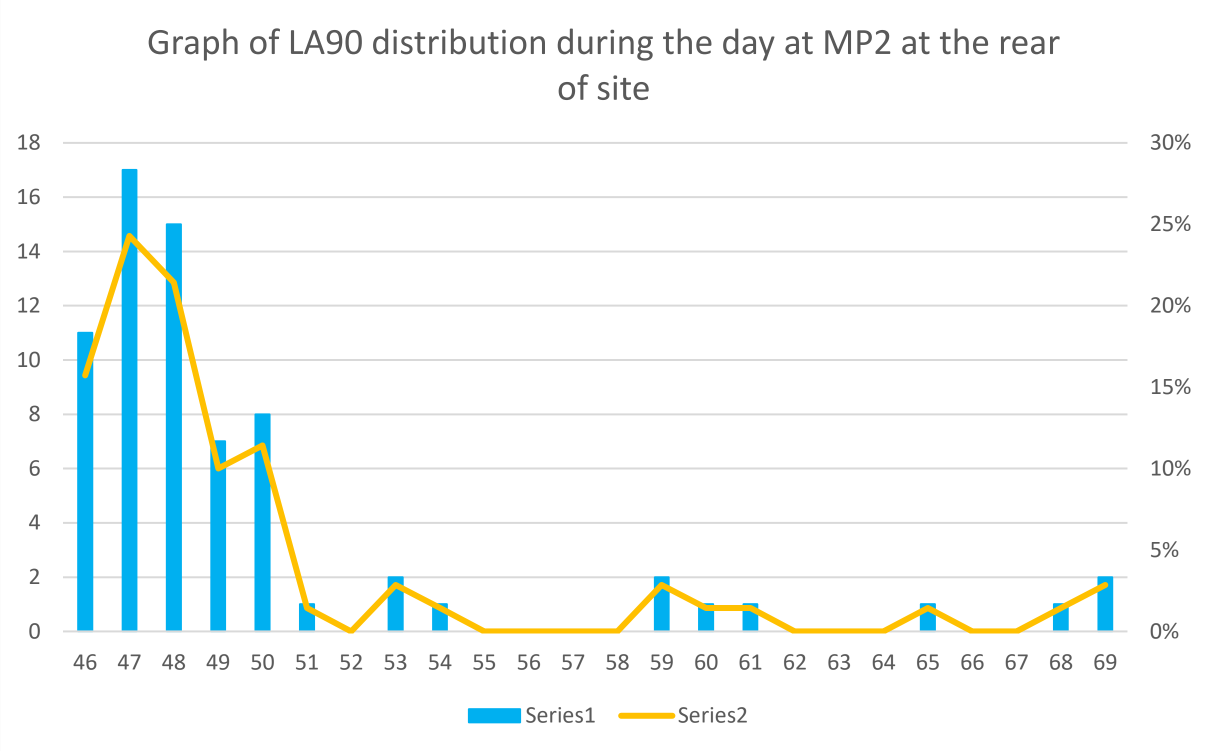
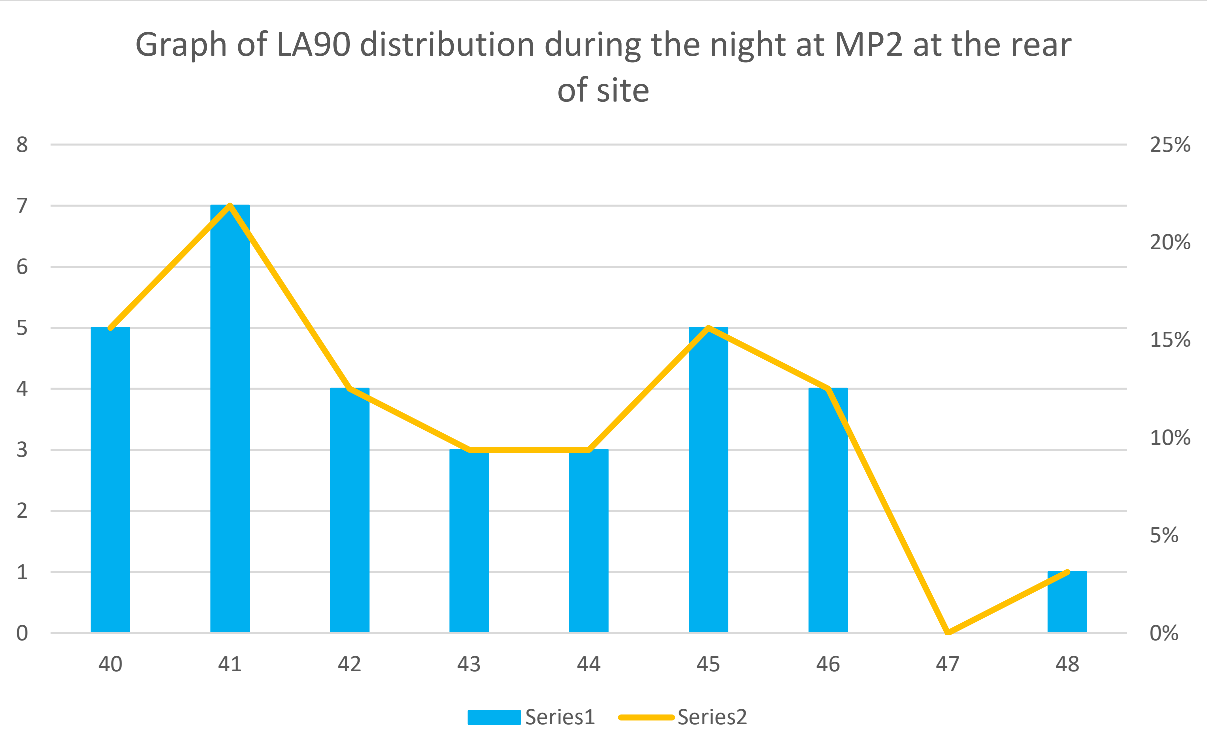


Figure B1: Acoustic Performance Requirements for Typical Floor


Graph of LA90 distribution during the day at MP1 at the front of site
25
20
15
10
5
0
30%
25%
20%
15%
10%
5%
0%
55 56 57 58 59 60 61 62 63
Series1
Series2


Graph of LA90 distribution during the night at MP1 at the front of site
7
6
5
4
3
2
1
0
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63
Series1
Series2


Graph of LA90 distribution during the day at MP2 at the rear of site
18
16
14
12
10
8
6
4
2
0
30%
25%
20%
15%
10%
5%
0%
46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69
Series1
Series2


Graph of LA90 distribution during the night at MP2 at the rear of site
8
7
6
5
4
3
2
1
0
25%
20%
15%
10%
5%
0%
40 41 42 43 44 45 46 47 48
Series1
Series2

CAMDEN ROAD HOSTEL
Example sound insulation calculations of the external façade
Appendix D

Building Envelope Sound Insulation Calculation According to EN 12354-3

Camden Road	**Date**	24/04/2020
Bedroom on Front Façade	**Room**	Bedroom

Incident noise levels

	Term	Label	Octave band centre frequency (Hz) 63	125	250	500	1 k	2 k	4 k	dB(A)
$L_{eq,ff}$	Measured L_{eq}	Façade A night LAeq	2.5	-3.9	-3.1	-4.6	-2.9	-8.0	-17.8	63.8
	Measured spectrum	L: Façade A night LAeq : Adj Spectrum	66.3	59.9	60.7	59.2	60.9	55.8	46.0	63.8
		K	3	3	3	3	3	3	3	
$L_{max,ff}$	Measured L_{max}	Façade A Night LAFmax	-9.1	-4.3	5.7	-3.5	-10.9	-15.3	-23.4	79.4
		M: Façade A Night LAFmax: Adj Spectrum	70.3	75.1	85.1	75.9	68.5	64.1	56.0	78.8
		K	6	6	6	6	6	6	6	

Room Details

Term	Derivation	Value	Term	Derivation	Value
V	Volume (m^3)	38.1	Sew	Sf - Swi - Sr	7.2
RT	RT (secs)	0.3	Srr	Area of ceiling (m^2)	14.1
Sf	Facade area (inc. window) (m^2)	8.9	S	Sf + Srr	23.0
Sr	Panel Area	0.0	Ao	Ref Area for Dnew	20.0
Swi	Window area (m^2)	1.7	Attenuation to roof		-10.0

		63.0	125	250	500	1000	2000	4000	
Octave Band Rev	Reverberation multiplication factor	1.3	1.2	1.1	1	1	1	0.8	0.3
	corrected reverberation	0.4	0.4	0.3	0.3	0.3	0.3	0.2	

	Term	Label/element	Octave band centre frequency (Hz) 63	125	250	500	1 k	2 k	4 k	Rw
vent openings	$D_{n,e}$	Mechanical Vent	100	100	100	100	100	100	100	101
	$A_0/S \times 10^{-Dn/10}$	B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
		L_{eq} Internal SPL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		L_{max} Internal SPL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
window	R_{wi}	AluK 10/16/8.4 HW620	23	25.8	32.5	40.6	42.2	44	44	42
	$S_{wi}/S \times 10^{-Rwi/10}$	C	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
		L_{eq} Internal SPL	39.7	30.2	23.9	13.9	14.0	7.1	-3.7	21.0
		L_{max} Internal SPL	46.7	48.4	51.3	33.6	24.6	18.4	9.4	43.4
Primary wall	R_{ew}	Brick Panel, 100mm cavity with 50mm of Rockwo	18	31	45	57	62	60	60	54
	$S_{ew}/S \times 10^{-Rew/10}$	D	0.005	0.000	0.000	0.000	0.000	0.000	0.000	
		L_{eq} Internal SPL	50.9	31.2	17.6	3.7	0.4	-2.7	-13.5	25.3
		L_{max} Internal SPL	57.9	49.4	45.0	23.4	11.0	8.6	-0.5	39.1
Roof	R_{rr}	None/Infinite	100	100	100	100	100	100	100	101
	$S_r/S \times 10^{-Rrr/10}$	E	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
		L_{eq} Internal SPL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		L_{max} Internal SPL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Calculated Internal Noise Levels

	Term	Label	63	125	250	500	1 k	2 k	4 k	dB(A)
	10 Log (B+C+D+E)	F	-22.7	-33.5	-42.8	-51.4	-53.3	-54.8	-54.8	
	A (furnished)	Room Absorption	16	17	18	20	20	20	25	
	10 log (S/A)	G	1.7	1.3	1.0	0.5	0.5	0.5	-0.4	
L_{eq}	Calc Tolerance	T	3	3	3	3	3	3	3	
	Internal $L_{eq,2}$	L+F+G+K+T	51.2	33.7	24.8	14.3	14.2	7.5	-3.2	26.7
L_{max}	Calc Tolerance	T	3	3	3	3	3	3	3	
	Internal $L_{max,2}$	M+F+G+K+T	58.2	51.9	52.2	34.0	24.8	18.8	9.8	44.8