

Acoustic Assessment at



39 The Terrace

Gravesend

Document Ref: 032324

Date: 19/06/2023

Author: N Johnson MSc. MIOA



Executive Summary

Ned Johnson Acoustic Consultants Limited has been appointed to undertake an acoustic assessment for the proposed new dwellings at 39 The Terrace, Gravesend.

This report provides the results of the acoustic survey, which covers the noise sources affecting the proposed dwellings.

As a result of the survey, this report makes recommendations for noise performance of glazing for the dwellings that will adequately protect future occupants from noise. This will ensure that the internal sound recommendations in BS8233:2014 and the $L_{AF\ Max}$ metric in the World Health Organisation Guidelines for Community Noise are met.

The report also discusses the enhanced internal sound insulation of separating elements between units.



Contents

Executive Summary	2
1. Introduction	4
2. Site Description	5
3. Planning Reference Documents	7
4. Methodology	15
5. Noise Survey Results	16
6. Evaluation of Results	17
7. Mitigation	20
Appendix 1 Glossary of Terms	31
Appendix 2 Calibration Certificates	33
Appendix 3 Data	36
Appendix 4 Detail	42



1. Introduction

- 1.1 Ned Johnson Acoustic Consultants Limited has been appointed to undertake an acoustic assessment for the proposed development at 39 The Terrace, Gravesend.
- 1.2 The proposed development is for the increase in the number of flats within the existing listed building. This will involve the replacement of the existing windows.
- 1.3 The Local Planning Authority have raised concerns regarding external noise from road traffic, as The Terrace forms part of the one-way system through Gravesend. They have also requested a higher level of airborne sound insulation for separating walls and floors between units in comparison to those required by Approved Document E of the Building Regulations.
- 1.4 The assessment takes account of the existing noise environment, which has been quantified using direct measurement. The sound levels inside the building have been compared to the internal sound recommendations contained in BS8233:2014 and the World Health Organisation *Guidelines for Community Noise*. The detailed method in BS8233:2014 was used to calculate the necessary level of glazing for bedrooms and the living rooms.

2. Site Description

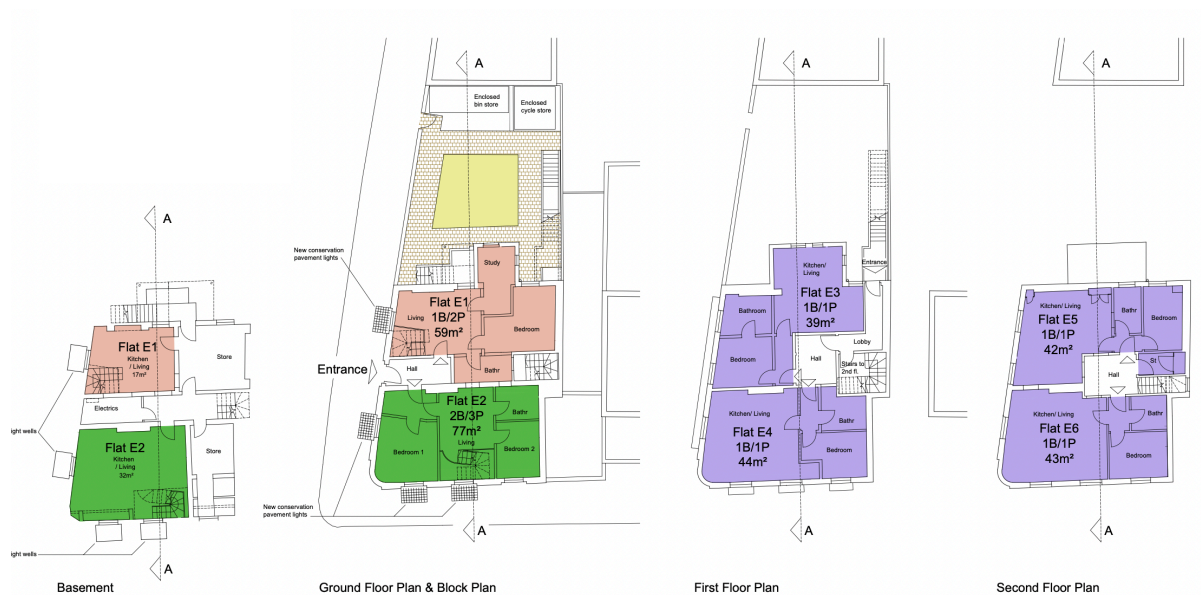
- 2.1 The proposed development is a listed building located at 39 The Terrace, which is on the one-way system around Gravesend centre. The dominant noise source in this location is road traffic which equally affects all facades as the site is on the corner of The Terrace and Harmer Street.
- 2.2 Figure 1 below shows the location of the development. The red arrow denotes the measurement location.

Figure 1.



2.3 Figure 2 below shows the proposed site layout.

Figure 2.



2.4 The increase in the number of flats has led to concerns from the local authority in relation stacking of kitchen/living rooms over bedrooms in the proposed layout.



3. Reference Documents

National Planning Policy Framework

- 3.1 The Department of Housing, Communities and Local Government published the National Planning Policy Framework (NPPF) in July 2021.
- 3.2 Paragraphs 174 (e) 185(a), (b) and 187 refer to noise in terms of policy approach:

174. Planning policies and decisions should contribute to and enhance the natural and local environment by:

e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans; and

185. Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life.

b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason

187. Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed.

Noise Policy Statement for England

- 3.3 The Department for Environment, Food and Rural Affairs published the *Noise Policy Statement for England* (NPSE) in March 2010. The explanatory note of NPSE defines the terms used in the NPPF:

"2.20 There are two established concepts from toxicology that are currently being applied to noise impacts, for example, by the World Health Organisation. They are:

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

LOAEL – Lowest Observed Adverse Effect Level. This is the level above which adverse effects on health and quality of life can be detected.

2.21 Extending these concepts for the purpose of this NPSE leads to the concept of a significant observed adverse effect level.

SOAEL – Significant Observed Adverse Effect Level. This is the level above which significant adverse effects on health and quality of life occur.”

- 3.4 The NPSE does not define the SOAEL numerically, stating at paragraph 2.22:

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

- 3.5 There is no local or national guidance on how the three terms should be defined numerically.
- 3.6 The first aim of the NPSE states that significant adverse effects on health and quality of life should be avoided while also taking into account the guiding principles of sustainable development.
- 3.7 The second aim of the NPSE refers to the situation where the impact lies somewhere between LOAEL and SOAEL. It requires that all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development. This does not mean that such adverse effects cannot occur.

- 3.8 This aim seeks, where possible, positively to improve health and quality of life through the pro-active management of noise while also taking into account the guiding principles of sustainable development, recognising that there will be opportunities for such measures to be taken and that they will deliver potential benefits to society. The protection of quiet places and quiet times as well as the enhancement of the acoustic environment will assist with delivering this aim.

British Standard 8233:2014

- 3.9 The scope of British Standard 8233: 2014 *Sound insulation and noise reduction for buildings – Code of practice* is the provision of recommendations for the control of noise in and around buildings. It suggests appropriate criteria and limits for different situations, which are primarily intended to guide the design of new or refurbished buildings undergoing a change of use.
- 3.10 The standard suggests suitable internal noise levels for residential dwellings, as shown in Table 1. Below.

Table 1.

Activity	Location	07:00 - 23:00 $L_{Aeq, 16 \text{ hour}}$	23:00 - 07:00 $L_{Aeq, 8 \text{ hour}}$
Resting	Living Rooms	35	-
Dining	Dining Area	40	-
Sleeping	Bedrooms	35	30

- 3.11 In terms of this development the internal noise levels have been compared to the internal noise levels in Table 1. It is suggested in this

report that by meeting these noise levels the development would be classed as NOAEL.

3.12 In respect of outdoor amenity areas BS8233:2014 states:

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

3.13 With respect to the night-time noise levels, the World Health Organisation guidelines state:

"Where noise is continuous, the equivalent sound pressure level should not exceed 30dB_A indoors if negative effects on sleep are to be avoided.'

'For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dB LAF max more than 10-15 times per night."

No specific day time indoor noise levels are proposed but in terms of interference of speech there is reference to a figure of 35dB_A.

3.14 The Approved Document E (ADE)

The main parameters that are used throughout this document to express airborne and impact sound insulation of separating constructions are $D_{nT,w} + C_{tr}$ and $L'_{nT,w}$ respectively. All specifications in this report will, therefore, be given with respect to these descriptors.

To satisfy the requirements of the Building Regulations, the minimum sound insulation performance criteria, as shown in Table 2, should be met through the separating elements between independent residential dwellings.

Dwellings - houses and flats – performance standards for separating walls, separating floors that have a separating function.

Description of Area	Airborne Sound Insulation	Impact Sound Insulation
	$D_{nT,w} + C_{tr}$ dB (minimum values)	$L'_{nT,w}$ dB (maximum values)
Purpose-built dwelling- houses and flats:		
Walls	45	-
Floors	45	62
Dwelling-houses and flats formed by material change of use:		
Walls	43	-
Floors	43	64



3.15 Environmental Health made the following comments in relation to the proposed development:

'Noise from traffic:

The property is in a town centre location adjacent to the A226 one-way system which is heavily trafficked. No consideration has been given by the applicant to traffic noise with habitable rooms being located at the road frontage of the building on all floors. A noise assessment will be needed to assess the impact of traffic noise on future occupants and mitigation (as appropriate) will be required to ensure that internal noise levels are in accordance with BS8223.

Internal noise:

There are some concerns with the stacking arrangements of the proposal. The kitchen and part of the bathroom of flat E4 is over bedroom 2 of Flat E2 and the kitchen of Flat E3 is over the bedroom of Flat E1. Rooms such as kitchens and bathrooms can have higher noise levels than bedrooms particularly at night-time, which could result in sleep disturbance.

Being a Listed building, it is possible that the sound insulation quality of the internal floor/ceiling and also wall partitions may not be that robust. As the building is Listed providing suitable and sufficient sound insulation for both internal (room to room) noise transmission and also insulating against external noise may be difficult to achieve without significant structural alterations. These alterations are likely to be contrary to Conservation stipulations.



The quality and the standard of the sound insulation properties of the building should be assessed to ensure that future residents are not impacted by internal noise between the flats, especially if the stacking arrangements are not ideal. A noise assessment should be undertaken to assess this. The assessment should include details of the assessment methodology and any enhanced sound insulation performance of the construction that separates the residential and ground floor commercial use and internal partitions between flats. This should resist the transmission of airborne sound such that the weighted standardised difference ($DnT, W + C_{tr}$) is not less than 53 decibels (i.e. an enhancement of the minimum levels stated in the Building Regulations of 10dB).

The assessment should look at any required mitigation measures to ensure that internal noise levels are appropriate. Overheating and ventilation must be considered in the design of any mitigation and noise from any mechanical ventilation systems (if required as a mitigation measure for air quality - see below), should be included.'



4. Survey Methodology

- 4.1 The survey was conducted over a 63-hour period from June 21st to June 24th 2023. The measurement point can be seen in Figure 1.
- 4.2 The instrument used for the survey were Bruel & Kjaer 2260 sound level meter.
- 4.3 The sound level meter was calibrated immediately before and after use with a Bruel & Kjaer 4231 Acoustic Calibrator producing 94dB at 1KHz and no drift was noted in calibration readings. Both calibration results were 93.9dB.
- 4.4 The measurements at MP1 were taken with the 2260 with the microphone housed in a Bruel & Kjaer UA1404 with a 3-metre extension cable, mounted on a tripod on a balcony facing on to Harmer Street.
- 4.5 The sound level meter was set to log every 15 minutes. The metrics measured were L_{Aeq} and $L_{AF Max}$. No unusual events appear to have occurred during the survey. The data has been corrected by 3dB to represent free field conditions.
- 4.6 The weather during the survey was dry. The temperature ranged between 15°C - 29°C with wind speed less than 5m/s.



5. Noise Survey Results

5.1 The table below shows the results of measurements taken during the survey.

Table 2. Summary of measured noise levels at MP1

Start Date	Duration	$L_{Aeq,T}$	10 th Highest $L_{AF Max}$
21/06/2023	20:00 – 23:00	64	N/A
21/06/2023	23:00 – 07:00	57	78
22/06/2023	07:00 – 23:00	65	N/A
22/06/2023	23:00 – 07:00	59	78
23/06/2023	07:00 – 23:00	66	N/A
23/06/2023	23:00 – 07:00	57	75

5.2 The next sections discuss the sound insulation required based on calculations made using the detailed method in BS8233:2014. The full measured data can be seen in Appendix 3.



6 Evaluation of results

- 6.1 The suitability of the site for residential development has been determined by comparing the measured noise levels with the criteria set out in Section 3 of this report.
- 6.2 When comparing the results of the measurement points to the Noise Risk Assessment in ProPG, the results show that the site, with no mitigation, is in the medium-risk category for day and night for all facades.
- 6.3 In terms of good acoustic design the Pro PG states that the following aspects should be properly considered be:
- Check the feasibility of relocating, or reducing noise levels from relevant sources
 - Consider options for planning the site or building layout
 - Consider the orientation of proposed building(s).
 - Select construction types and methods for meeting building performance requirements.
 - Examine the effects of noise control measures on ventilation, fire regulation, health and safety, cost, CDM (construction, design and management) etc.
 - Assess the viability of alternative solutions.
 - Assess external amenity area noise.
- 6.4 In terms of the proposed dwellings there is no way of reducing noise exposure. Changing the orientation of the layout is not possible. There are no alternative solutions in this development to adequate sound insulation of the dwellings to be constructed.
- 6.5 The development, with suitable glazing and sound insulation, will be able to meet the recommendations in BS8233:2014 for internal sound.



The sound pressure levels, incident upon the facades of the proposed dwelling are not unusual for such an environment and appropriate glazing and sound insulation is proposed in the next section. The next section makes recommendations for glazing arrangements to meet the internal noise levels in BS8233:2014.

- 6.6 The internal sound levels with windows open during the day and night would exceed the internal sound levels in recommended in BS8233:2014. For this reason, alternative ventilation will be required at the development in order to allow cooling of the dwellings without compromising the internal sound levels. The next section provides more detail on proposed ventilation of the development. The ventilation will not involve sealed facades.
- 6.7 With suitable glazing and sound insulation installed the internal sound levels at the property are considered acceptable for residential development, as they will be within the range of values deemed to be NOEL. This is consistent with the Noise Policy Statement England. Considering the noise levels as NOEL is justified here as the internal noise levels will meet those recommended in BS8233:2014, which is judged to be the point where there will be no adverse effect on human health.
- 6.8 In terms of other relevant issues, as stated above, with suitable sound insulation the proposed dwellings will comply with national planning guidance and meet the recommended internal noise levels set-out in BS8233:2014. The dwellings will be compliant with Part 25 in that future residents will be adequately protected from external noise.
- 6.9 In terms of unintended adverse consequences the most likely one would be in relation to ventilation. However, as the development will not have



a sealed façade there will not be prevention of control of the personal environment.

- 6.10 The balconies are too small to be used as recreational space and for this reason they are not discussed further in this report.

7. Mitigation

- 7.1 The weakness in any structure are the windows, which vary in performance, depending upon the thickness of the glass and the space between the panes. The main structure of the dwellings is brick which has a sound insulation performance of at least 50R_w dB with pitched roofs that have a sound insulation performance of 43R_w dB (figures taken from BS8233:2014).
- 7.2 The minimum glazing performance for living rooms and bedrooms on all facades must be a minimum of 38R_w dB (33 R_w+C_{tr} dB) as this is the level of sound reduction needed to meet the recommended sound pressure levels as set-out in BS8233:2014 for L_{Aeq-T} and the L_{AF Max} in the WHO guidance for bedrooms and living rooms and is calculated using the detailed method in BS8233:2014. This can be achieved with a double-glazing using an arrangement of (for example) 6/16/8.8, which will be sufficient for the purposes of this building in this location. The following table shows the minimum performance required in each octave band centre frequency:

Table 3. Acoustic performance of windows

	Octave band centre frequency, Hz					
	125	250	500	1000	2000	4000
Acoustic Performance	26	27	36	43	42	45

- 7.3 The building is listed and therefore the existing windows, which need replacing, are likely to be replaced with the same style of sash window. This type of window alone is unlikely to achieve the necessary level of



sound insulation to meet the recommendations in BS8233:2014 for internal sound due to external sources. For this reason, secondary glazing will be necessary. We would therefore recommend that a secondary glazing system is installed, such as those provided by SelectaGlaze, who provide several systems which would achieve the project requirements:

- S20 Vertical Sliding System, comprised of 50mm cavity from the existing window system, with 4-6.4mm standard glass (Provides 39dB Rw with primary window)
- HS10 Horizontal Sliding System, comprised of 50mm cavity from the existing window system, 4-6.4mm standard glass (Provides 39dB Rw with primary window)
- HC45 Hinged Casement System, comprised of 50mm cavity from the existing window system, 4-6.4mm standard glass (Provides 41dB Rw with primary window)

- 7.4 Any glazing manufacturer should provide certificates that their windows will meet the required sound insulation standard; the performance must be for the whole window and not just the glass.
- 7.5 The full sound insulation value of any window cannot be realized if there are air gaps. These commonly occur around frames due to insecure fixing, shrinkage of wood and poor maintenance. A double-glazed unit must be used in a frame with good seals to realize its full insulating potential. Any gaps or poor fitting could reduce the glazing performance by up to 5dB.
- 7.6 The above glazing recommendation would ensure that during the daytime and night-time noise levels in the property would be 35dB_A and 30dB_A respectively due to external sources.

- 7.7 The minimum specification for all entrance doors to is R_w 30 (dB). This can be achieved by a solid core timber door with high quality acoustic perimeter and threshold seals.
- 7.8 BS8233:2014 also states that if internal noise standards are achieved only with windows closed an alternative means of ventilation should be provided. The aforementioned British Standard states that an open window will provide 15db of sound attenuation, this means that if façade levels are more than 50dB_A during the day or 45dB_A during the night then the internal noise targets will be exceeded with windows open and alternative ventilation is required.
- 7.9 Approved Document F of the Building Regulations has four template systems for ventilation of a dwelling and the description of these systems is in the table below.

Table 4.

Ventilation System	Whole Dwelling Ventilation	Extract Ventilation	Purge Ventilation
System 1: Background ventilators and intermittent extract fans	Background ventilators (trickle vents)	Intermittent extract fans	Typically provided by opening windows
System 2: Passive stack (natural)	Background ventilators (trickle vents) and passive stack ventilation	Continuous via passive stack	Typically provided by opening windows

System 3: Continuous mechanical extract (MEV)	Continuous mechanical extract – minimum low rate Trickle vents provide inlet air	Continuous mechanical extract – minimum high rate Trickle vents provide inlet air	Typically provided by opening windows
System 4: Continuously mechanical supply and extract with heat recovery	Continuous mechanical extract – minimum low rate	Continuous mechanical extract – minimum high rate	Typically provided by opening windows

7.10 In regard to the development, the monitoring data shows that during the day and night the dwellings will have façade noise levels, which are above 50dB_A and 45dB_A respectively. As the façade noise levels are exceeded it is recommended that an alternative means of ventilation to just opening windows should be incorporated into the design to allow residents to ventilate the rooms without having to open the windows.

7.11 Should the developer install trickle vents, the minimum acoustic performance is shown in Table 5.



Table 5. Acoustic performance of trickle vents

	Octave band centre frequency, Hz					
	125	250	500	1000	2000	4000
Acoustic Performance	36	31	33	43	50	40

7.12 Should mechanical extract or supply & extract be used as part of the ventilation strategy the noise from such systems should be controlled so as not to cause an unacceptable rise in internal noise levels. The following table proposes indoor ambient noise levels from mechanical services.

Table 6. Noise from mechanical services.

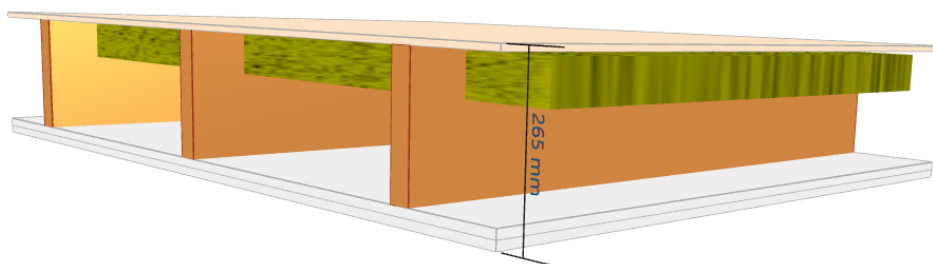
Ventilation Condition	Possible ADF System	Desirable Internal Ambient Noise Levels from Mechanical Services
ADF- Whole Dwelling Ventilation	System 3 System 4	Bedrooms $\leq L_{Aeq}$ 26dB Living Rooms $\leq L_{Aeq}$ 30dB
ADF- Extract Ventilation	System 1 System 3 System 4	Bedrooms $\leq L_{Aeq}$ 26dB Living Rooms $\leq L_{Aeq}$ 30dB Bathroom/WC/Kitchen $\leq L_{Aeq}$ 45dB
ADF- Purge Ventilation	Manually controlled fan exchanging a minimum of 4 air changes per hour	No desirable noise levels are proposed

7.13 It is assumed the separating floor / ceiling between existing flats is a timber frame base with plasterboard ceiling to the underside of the joists.

We have modelled the existing floor and ceiling structure to establish baseline sound insulation values throughout the building.

The modelled construction is shown in the figure below and the modelled results are presented in the table below:

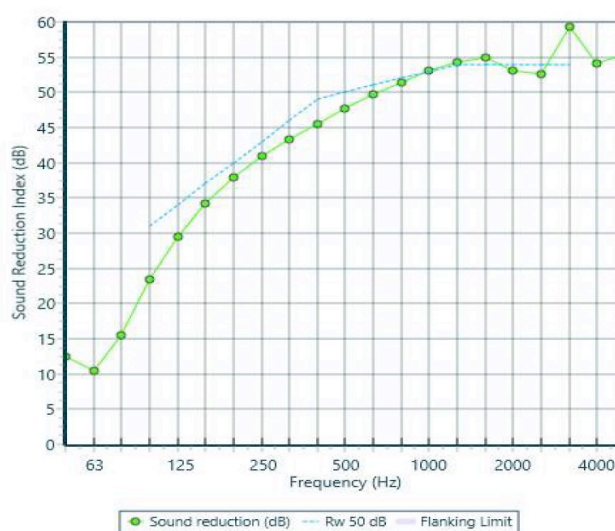
Figure 3.



Existing floor / ceiling construction

Table 7

freq.(Hz)	R(dB)	R(dB)
50	13	
63	10	12
80	15	
100	23	
125	30	27
160	34	
200	38	
250	41	40
315	43	
400	46	
500	48	47
630	50	
800	51	
1000	53	53
1250	54	
1600	55	
2000	53	53
2500	53	
3150	59	
4000	54	56
5000	55	



Rw 50 dB
C -3 dB
Ctr -9 dB

Ln,w 64 dB

Modelling of existing separating floor / ceiling construction

7.14 Due to non-ideal stacking arrangement for the proposed flats on the first and second floors, an enhanced sound insulation scheme is required, in line with the local authority Environmental Health's comments.

7.15 To achieve enhanced sound insulation through the separating floors between all the ground and the first and the first and the second floor



levels, the minimum recommended specification for separating floors is a resiliently hung primary ceiling with an independent acoustic suspended ceiling arrangement.

- 7.16 The minimum recommended acoustic treatment for the existing construction is to install 100mm Rockwool RW45A (or equal approved) insulation between the existing joists and then install 2 x 12.5mm SoundBloc® or FireLine® plasterboard (or equal approved) to the underside of existing joists on resilient bars, RB1 or equal approved and acoustically seal throughout.

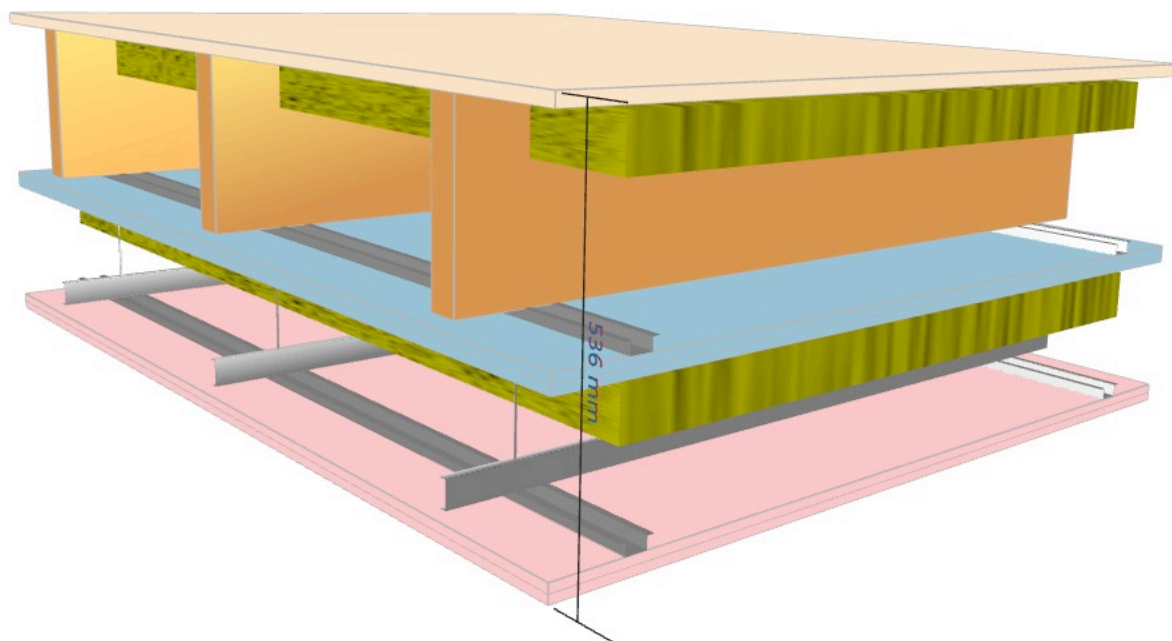
From below, install an independent suspended ceiling on metal (MF system) or timber framing with a minimum of 125mm gap with a minimum of 1 x 12.5mm SoundBloc® or FireLine® plasterboard (or equal approved) to the underside of the framing. This treatment is to be installed throughout on the first floor and between any associated understairs areas and communal areas.

The predicted airborne and impact sound insulation will achieve the required criteria of +10dB above the minimum ADE values, in line with the local authority's EHO comments.

Typical detail of a primary and independent suspended ceiling is shown in the figure below.

See Appendix 4 for more details.

Figure 4.



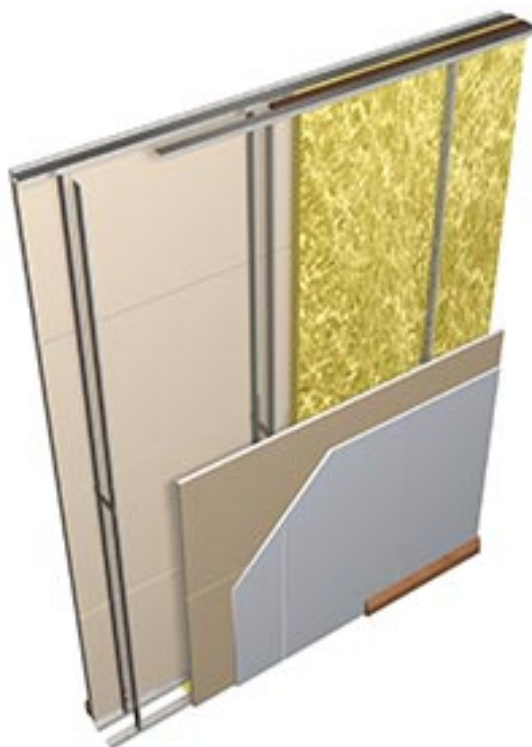
Typical Primary and Independent Ceiling Construction

- 7.17 The minimum recommended specification for all new party walls i.e., between the flats on all levels and also between the flats and the common areas and the flats is a twin independent stud wall construction in metal or timber studs with at least 2 x 12.5mm SoundBloc® plasterboard (or equal approved) to both sides with a minimum of 50mm of acoustic insulation (minimum 45Kg/m³ density) in the cavity.

Information on British Gypsum twin stud wall construction can be found at <https://www.british-gypsum.com/white-book-system-selector/systems-overview/partitions/gypwall-quiet?tab0=0> All manufacturer guidance to be followed in full. See Appendix 4 for sound

insulation data and the technical information on acoustic wall construction.

Figure 5.



Typical twin independent stud wall

- 7.18 The existing portion of the proposed party walls appears to be of brick/block construction with render plaster. We do not know the exact make-up of the external wall, however, on visual inspection, the inner leaf of the internal perimeter wall is lined with a plaster finish.

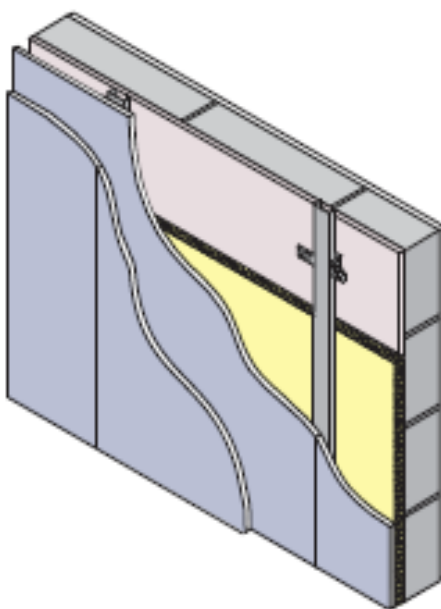
The minimum proposed acoustic treatment to the existing portions of the proposed party walls between flats is to install a minimum 2 x 12.5mm SoundBloc® plasterboard (or equal approved), installed on

metal framing such as Gyproc liner GL1 (or equal approved) with 25mm Isover APR 1200 insulation in the cavity throughout on all sides.

Information on Gyproc lining systems can be found at <https://www.british-gypsum.com/literature/white-book/linings/gyplyner-universal> All manufacturer guidance to be followed in full.

See Appendix 2 for sound insulation data and the technical information on acoustic wall lining – detail 4.

Figure 6.



Typical acoustic wall lining detail



Appendix 1: Glossary of Terms

Daytime Defined in BS8233 and BS4142 as the period 07:00-23:00 hours.

Night-time Defined in BS8233 and BS4142 as the period 23:00-07:00 hours.

Decibel (dB): A unit of level derived from the logarithm of the ratio between the value of a quantity and a reference value. It is used to describe the level of many different quantities. For sound pressure levels the reference quantity is 20 uPa. The threshold of normal hearing is in the region of 0 dB and 140 dB is the threshold of pain. A change of 1 dB is only perceptible under controlled conditions.

dB_A : Decibels measured on a sound level meter incorporating a frequency weighting (A weighting) which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dB_A broadly agree with people's assessment of loudness. A change of 3 dB is the minimum perceptible under normal conditions, and a change of 10 dB corresponds roughly to halving or doubling the loudness of a sound. The background noise in a living room may be about 30 dB_A ; normal conversation about 60 dB_A at 1 metre; heavy road traffic about 80 dB_A at 10 metres; the level near a pneumatic drill about 100 dB_A .

$L_{A10,T}$: The A weighted noise level exceeded for 10% of the measurement period, T. It gives an indication of the upper limit of fluctuating noise such as that from road traffic.

$L_{A90,T}$: The A weighted noise level exceeded for 90% of the measurement period, T. This is defined in BS 4142 as the background noise level.

L_{AE} : The sound exposure level – the level of a sound with a period of 1 second that has the same sound energy as the event considered.



$L_{Aeq,T}$: The equivalent continuous sound level – the sound level of a notionally steady sound having the same energy as a fluctuating sound over a specified measurement period (T).

$L_{A\ Max}$: The highest A weighted noise level recorded during a noise event. The time weighting (slow or fast) should be stated.



Appendix 2: Calibration Certificates

Laboratory Location

Campbell Associates Ltd
5b Chelmsford Road Industrial Estate
GREAT DUNMOW, Essex, GB-CM6 1HD
Phone 01371 871030



Certificate of Calibration

Certificate number: 41049

Test Object: Sound Level Meter, BS EN 60651 and or BS EN 60804 Class 1

Producer: Brüel & Kjær
Type: 2260
Serial number: 2034414
Customer: Ned Johnson Acoustic Consultants Ltd
Address: 378 Church Street,
London. N9 9HS.
Contact Person: Ned Johnson
Order No:

Introduction:

Calibration has been performed as set out in CA Technical Procedures which are based on the procedures for periodic verification of sound level meters as per the **Test Object** listed above. Results and conformance statement are overleaf and detailed results, where appropriate, are provided in the attached Measurement Report.

Tested:	Producer	Type	Serial No	Certificate No
Microphone	Brüel & Kjær	4189	2169417	41048
Calibrator*	Brüel and Kjær	4231	2039392	41047
Preamplifier	Brüel & Kjær	ZC0026	NoCode	Included

* The calibrator was complete with any required coupler for the microphone specified.

Additional items that have also been submitted for verification:

Wind shield	Brüel & Kjær	UA0237 (Large round)
Attenuator	N/A	
Extension cable	N/A	

These items have been taken into account wherever appropriate.

Conditions	Pressure kPa	Temperature °C	Humidity %RH
Reference conditions	101.325	23	50
Measurement conditions	101.07 ±0.03	22.35 ±0.15	42.43 ±1

Calibration Dates:

Received date:	06/05/2022	Reviewed date:	17/05/2022
Calibration date:	17/05/2022	Issued date:	17/05/2022

Technicians: (Electronic certificate)

Calibrated by: *Palanivel Marappan B.Eng (Hons), M.Sc*

Reviewed by: *Darren Batten*

This certificate is issued in accordance with the CA Quality Management system. It provides traceability of measurement to recognized national standards, and to the units of measurement realized at the National Physical Laboratory or other recognized national standards laboratories. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.



Laboratory Location

Campbell Associates Ltd
 5b Chelmsford Road Industrial Estate
 GREAT DUNMOW, Essex, GB-CM6 1HD
 Phone 01371 871030

**Certificate of Calibration****Certificate number: 41048****Test Object: Measurement Microphone**

Producer: Brüel & Kjær
Type: 4189
Serial number: 2169417
Customer: Ned Johnson Acoustic Consultants Ltd
Address: 378 Church Street,
London. N9 9HS.
Contact Person: Ned Johnson
Order No:

Measurement Results	Sensitivity (dB re 1V/Pa)	Sensitivity (mV/Pa)	Capacitance (pF)
Measurement 1	-24.87	57.07	14.09
Measurement 2	-24.87	57.10	14.09
Measurement 3	-24.86	57.14	14.10
Result (Average):	-24.87	57.11	14.09
Expanded Uncertainty:	0.10		1.00
Degree of Freedom:	>100		>100
Coverage Factor:	2		2

The stated sensitivity is the pressure sensitivity at 250Hz, S₂₅₀, and is valid at reference conditions. The following correction factors have been applied during the measurement:

Pressure:-0.01 dB/kPa Temperature:-0.006 dB/°C Humidity:0 dB/%RH

Conditions	Pressure kPa	Temperature °C	Humidity %RH
Reference conditions	101.325	23	50
Measurement conditions	101.108 ± 0.043	22.4 ± 0.1	41.9 ± 0.9

The calibration test report shown on the next page gives details of the response at other frequencies relative to this 250 Hz reference sensitivity. Results ≥100 Hz are obtained using an electrostatic actuator as described in BS EN 61094-6 and those below 100 Hz are obtained in a reference pressure chamber. Detailed results are available from the calibration laboratory upon request.

The reported expanded uncertainty of measurements is based on a standard uncertainty multiplied by the coverage factor of k=2, providing a coverage probability of approximately 95%. Where the degrees of freedom are insufficient to maintain this confidence level, the coverage factor is increased to maintain this confidence level.

Calibration Dates:

Received date: 06/05/2022 Reviewed date: 17/05/2022
 Calibration date: 17/05/2022 Issued date: 17/05/2022

Technicians: (Electronic certificate)

Calibrated by: *Palanivel Marappan BEng(Hons), MSc*
 Reviewed by: *Darren Batten*

This certificate is issued in accordance with the CA Quality Management system. It provides traceability of measurement to recognized national standards, and to the units of measurement realized at the National Physical Laboratory or other recognized national standards laboratories. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

Doc ref: Mic-Cert-Master-V3-03



Laboratory Location

Campbell Associates Ltd

5b Chelmsford Road Industrial Estate
GREAT DUNMOW, Essex, GB-CM6 1HD
Phone 01371 871030

**Certificate of Calibration**Certificate number: **44378**Test Object: **Sound Calibrator**

Producer: **Brüel & Kjær**
Type: **4231**
Serial number: **2039392**
Customer: **Ned Johnson Acoustic Consultants Ltd**
Address: **378 Church Street,
London, N9 9HS**
Contact Person: **Ned Johnson**
Order No: **TBC**

Measurement Results	Level dB	Level Stability dB	Frequency Hz	Distortion %
Measurement 1	94.00	0.02	999.85	0.51
Measurement 2	94.00	0.02	999.85	0.51
Measurement 3	94.00	0.02	999.86	0.65
Result (Average):	94.00	0.02	999.85	0.56
Expanded Uncertainty:	0.1	0.02	1	0.16
Degree of Freedom:	>100	>100	>100	9
Coverage Factor:	2	2	2	2.37

The stated level is relative to 20µPa. The level is traceable to National Standards. The stated level is valid at reference conditions. The following correction factors have been applied during the measurement

Pres:0.0008 dB/kPa Temp:0.0015 dB/°C Humi:0.001 dB/%RH Load volume: 0.0003 dB/mm³

Conditions	Pressure kPa	Temperature °C	Humidity %RH
Reference conditions	101.325	23	50
Measurement conditions	102.046 ±0.041	22.8 ±0.1	39 ±0.8

The reported expanded uncertainty of measurements is based on a standard uncertainty multiplied by the coverage factor of k=2, providing a level of confidence of approximately 95%. Where the degrees of freedom are insufficient to maintain this confidence level, the coverage factor is increased to maintain this confidence level. The uncertainty has been determined in accordance with UKAS requirements.

Records: K:\C A\Calibration\Nor-1504\Nor-1018 CalCal\Current Year\BNK4231_2039392_M1.nmf

Preconditioning

The equipment was preconditioned for more than 4 hours in the specified calibration environment.

Method

Calibration has been performed as set out in the current version of CA Technical procedure TP01

Calibration Dates:

Received date:	25/05/2023	Reviewed date:	01/06/2023
Calibration date:	31/05/2023	Issued date:	01/06/2023

Technicians: (Electronic certificate)

Calibrated by: *Katie Brown*
Reviewed by: *Jenny Crawford*

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

Doc ref: Calb-Cert-Master-V3-06

Appendix 3: Data

MP1

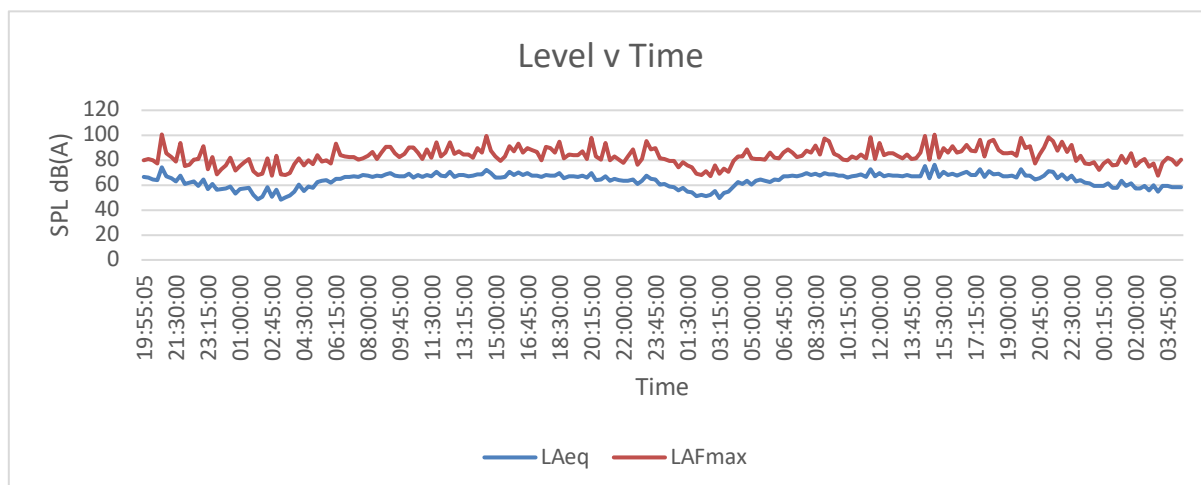


Table 8

Start Time	L _{Aeq} 15min	L _{AF} Max 15min
19:55:05	66.34	80.06
20:00:00	65.91	80.85
20:15:00	64.5	79.98
20:30:00	64.22	77.56
20:45:00	74.03	100.63
21:00:00	66.84	85.61
21:15:00	65.75	82.32
21:30:00	62.83	78.85
21:45:00	67.54	93.73
22:00:00	60.72	75.03
22:15:00	61.76	76.47
22:30:00	62.8	80.59
22:45:00	59.31	81.01
23:00:00	64.64	91.06
23:15:00	56.89	72.56
23:30:00	61.07	82.45
23:45:00	56.29	68.64
00:00:00	56.57	72.6
00:15:00	57.08	75.74
00:30:00	58.65	81.76
00:45:00	53.15	71.62

01:00:00	56.94	75.31
01:15:00	57.35	78.32
01:30:00	57.82	80.99
01:45:00	52.31	71.43
02:00:00	48.61	68.33
02:15:00	50.75	68.93
02:30:00	58.37	81.67
02:45:00	50.81	67.57
03:00:00	56.22	83.5
03:15:00	48.31	68.5
03:30:00	49.87	67.85
03:45:00	51.41	69.63
04:00:00	54.9	76.92
04:15:00	60.48	81.53
04:30:00	55.36	75.91
04:45:00	58.89	79.98
05:00:00	57.71	76.97
05:15:00	62.6	83.89
05:30:00	63.29	78.76
05:45:00	63.8	80.04
06:00:00	62.12	77.22
06:15:00	65.1	93.23
06:30:00	65.27	84.08
06:45:00	66.34	82.97
07:00:00	66.77	82.28
07:15:00	66.99	82.57
07:30:00	66.54	80.45
07:45:00	67.89	81.69
08:00:00	67.68	83.51
08:15:00	66.81	86.45
08:30:00	67.39	80.96
08:45:00	67.18	85.92
09:00:00	68.39	90.53
09:15:00	69.74	90.77
09:30:00	67.79	85.64
09:45:00	67.28	82.5
10:00:00	67.08	85.24
10:15:00	69.04	89.99
10:30:00	66.25	90.38
10:45:00	68.28	86.28
11:00:00	66.49	80.76
11:15:00	68.14	88.73

11:30:00	66.85	82.13
11:45:00	70.72	94.44
12:00:00	67.58	82.74
12:15:00	67.15	86
12:30:00	70.75	94.08
12:45:00	66.79	84.81
13:00:00	67.97	86.95
13:15:00	68.08	84.43
13:30:00	67.09	84.43
13:45:00	67.71	82.03
14:00:00	68.46	89.62
14:15:00	68.44	85.97
14:30:00	72.14	99.3
14:45:00	69.82	87.69
15:00:00	66.17	82.89
15:15:00	65.79	79.64
15:30:00	66.75	83.12
15:45:00	70.77	91.16
16:00:00	67.87	86.98
16:15:00	70.08	93.25
16:30:00	68.22	86.16
16:45:00	69.79	89.84
17:00:00	67.57	88.19
17:15:00	67.58	86.63
17:30:00	66.55	79.69
17:45:00	68.01	90.54
18:00:00	67.53	89.54
18:15:00	67.63	86.19
18:30:00	69.65	94.95
18:45:00	65.31	81.49
19:00:00	66.89	84.37
19:15:00	67.29	83.85
19:30:00	66.54	84.08
19:45:00	67.46	87.13
20:00:00	65.88	80.82
20:15:00	69.73	97.82
20:30:00	64.06	83.18
20:45:00	64.65	80.23
21:00:00	67.02	93.82
21:15:00	63.58	79.98
21:30:00	64.8	82.91
21:45:00	64.04	80.25

22:00:00	63.33	78.02
22:15:00	63.38	83.06
22:30:00	64.62	88.68
22:45:00	60.89	76.06
23:00:00	63.54	81.04
23:15:00	67.44	95.3
23:30:00	64.77	88.85
23:45:00	64.42	89.78
00:00:00	60.37	81.55
00:15:00	61.07	80.84
00:30:00	58.74	79.36
00:45:00	58.22	79.15
01:00:00	55.98	74.22
01:15:00	57.95	78.61
01:30:00	54.5	75.82
01:45:00	54.4	74.05
02:00:00	51.38	68.91
02:15:00	51.95	68.32
02:30:00	50.94	71.05
02:45:00	52.3	67.19
03:00:00	55.39	75.87
03:15:00	49.86	68.88
03:30:00	53.49	73.19
03:45:00	54.79	70.53
04:00:00	58.66	79.62
04:15:00	62.35	82.86
04:30:00	60.9	82.86
04:45:00	63.52	88.38
05:00:00	60.18	81.5
05:15:00	63.52	81.12
05:30:00	64.59	81.08
05:45:00	63.45	80.42
06:00:00	62.51	85.95
06:15:00	64.6	82.03
06:30:00	63.99	81.54
06:45:00	67.32	86.28
07:00:00	67.13	88.5
07:15:00	67.5	85.88
07:30:00	67.25	82.27
07:45:00	67.99	83.57
08:00:00	69.84	87.41
08:15:00	67.89	86.27

08:30:00	69.34	91.85
08:45:00	67.79	84.3
09:00:00	69.73	97.25
09:15:00	68.78	95.13
09:30:00	68.71	85.02
09:45:00	67.77	83.6
10:00:00	67.33	80.48
10:15:00	65.93	79.86
10:30:00	66.84	82.74
10:45:00	67.54	81.7
11:00:00	68.55	84.6
11:15:00	66.62	81.19
11:30:00	72.84	98.31
11:45:00	66.95	80.81
12:00:00	69.63	94
12:15:00	67.19	83.83
12:30:00	68.27	85.53
12:45:00	67.74	85.35
13:00:00	67.64	83.38
13:15:00	67.09	81.47
13:30:00	68.14	84.46
13:45:00	66.82	81
14:00:00	67.01	81.67
14:15:00	66.97	86.15
14:30:00	75.24	99.42
14:45:00	65.71	80.66
15:00:00	76.29	100.29
15:15:00	66.75	81.73
15:30:00	70.72	89.44
15:45:00	67.93	86.06
16:00:00	68.94	91.39
16:15:00	67.44	86.17
16:30:00	69.18	87.05
16:45:00	70.58	92.38
17:00:00	68.07	87.62
17:15:00	67.99	87.29
17:30:00	72.47	96.09
17:45:00	66.64	82.9
18:00:00	71.42	94.57
18:15:00	68.47	96.31
18:30:00	68.9	88.1
18:45:00	66.97	85.44



19:00:00	67.15	85.71
19:15:00	67.75	85.84
19:30:00	65.99	83.75
19:45:00	72.5	97.87
20:00:00	67.53	89.6
20:15:00	67.35	91.14
20:30:00	64.31	77.39
20:45:00	65.59	84.54
21:00:00	67.74	90.16
21:15:00	71.25	98.18
21:30:00	70.87	95.21
21:45:00	65.78	87.49
22:00:00	68.5	94.63
22:15:00	64.69	86.64
22:30:00	67.73	91.98
22:45:00	63.06	79.17
23:00:00	63.81	83.59
23:15:00	62	77.15
23:30:00	61.35	76.82
23:45:00	59.31	78.51
00:00:00	59.2	72.41
00:15:00	59.55	77.33
00:30:00	61.59	79.85
00:45:00	57.95	76
01:00:00	57.87	76.52
01:15:00	63.38	83.7
01:30:00	59.56	77.71
01:45:00	61.2	85.65
02:00:00	57.28	75.4
02:15:00	57.37	78.74
02:30:00	59.28	80.82
02:45:00	55.79	74.94
03:00:00	59.86	77.21
03:15:00	54.96	67.34
03:30:00	59.23	77.76
03:45:00	59.33	81.76
04:00:00	58.27	80.58
04:15:00	58.52	76.29
04:30:00	58.3	80.17

Appendix 4: Detail

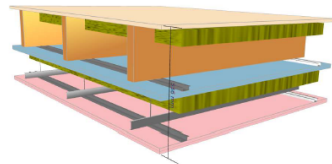
Sound Insulation Prediction (v9.0.22)

Program copyright Marshall Day Acoustics 2017
Margin of error is generally within $R_w \pm 3$ dB
- Key No. 6509
Job Name: 39 The Terrace, Gravesend
Job No. 022324
Date: 27/06/2023
File Name: Separating Floor & Ceiling between flats.ixl

Initials: NJA



Notes:



R_w 61 dB
C -1 dB
Ctr -3 dB

Mass-air-mass resonant frequency = ≈ 0 Hz, 0 Hz

Panel Size = 2.7 m x 4.0 m

Partition surface mass = 53.7 kg/m²

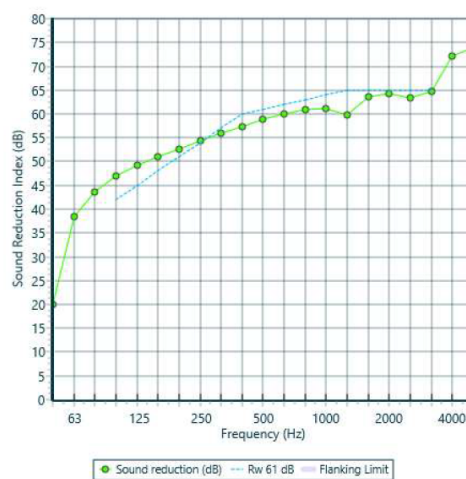
System description

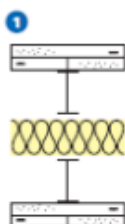
Panel 1 : 1 x 17.5 mm Plywood

Frame: Solid Joist with resilient rail (2.5E2 mm x 45 mm), Stud spacing 600 mm; Cavity Width 268 mm, 1 x Fibreglass (10kg/m³) Thickness 75 mm
Panel 2 : 2 x 12.5 mm Siniat GTEC dB Board 12.5mm

Frame: Suspended Light Steel Grid (2E2 mm x 45 mm), Stud spacing 600 mm; Cavity Width 200 mm, 1 x Fibreglass (10kg/m³) Thickness 75 mm
Panel 3 : 2 x 12.5 mm Siniat GTEC Fire Board 12.5mm

freq.(Hz)	R(dB)	R(dB)
50	20	
63	38	25
80	44	
100	47	
125	49	49
160	51	
200	53	
250	54	54
315	56	
400	57	
500	59	59
630	60	
800	61	
1000	61	61
1250	60	
1600	64	
2000	64	64
2500	63	
3150	65	
4000	72	68
5000	74	



Performance (► Refer to 2 - Basic principles of system design)**EN****Table 1a – GypWall QUIET IWL - Minimum 60mm Gypframe 'I' Studs**

Two layers of board fixed to the outside faces of two Gypframe 'I' Stud frameworks with studs at 600mm centres. 100mm Isovol APR 1200 in the cavity (Cavity width 190mm). Linings as in table.



Three layers of board fixed to the outside faces of two Gypframe 'I' Stud frameworks with studs at 600mm centres. 100mm Isovol APR 1200 in the cavity (Cavity width 190mm). Linings as in table.

Detail	Board type	Lining thickness mm	Partition thickness mm	Approx. weight kg/m ²	Maximum partition height ¹ mm	Sound insulation R _w (R _w + C _{tr}) ² dB	Partition duty	System reference
90 minutes fire resistance EN								
1	SoundBloc	2 x 15	250	55	3900	RD	Severe	A216007
120 minutes fire resistance EN								
1	FireLine	2 x 15	250	55	3900	PCT	Severe	A216006
2	SoundBloc + FireLine	2 x 15 1 x 12.5	275	75	3900	RD	Severe	A216005

RD = Robust Detail E-W5-2 - approved Robust Detail solution.

PCT = Pre-Completion Testing, British Gypsum Approved System (Conversion).

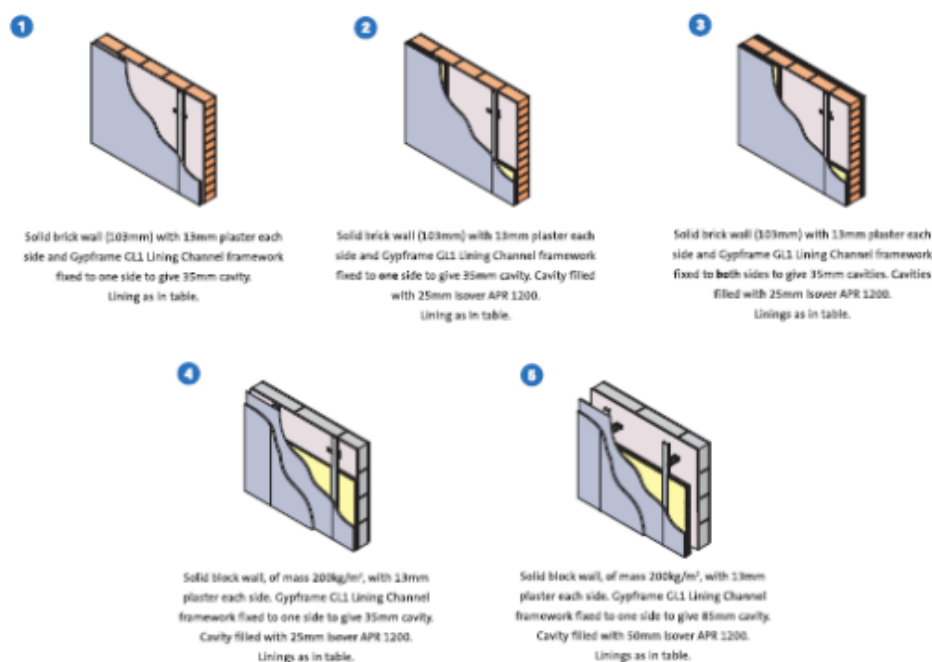
¹ The maximum heights quoted are limited by the fire state field of application or by limiting deflection of U/240 at 200Pa, whichever is the more onerous, and on Gypframe 60 I 70 'I' Stud.

² Sound insulation performance explanation for residential specification shown below:

	Part E requirement D _{nT,w} + C _{tr} dB	Minimum solution ³ (R _w + C _{tr}) dB	Recommended solution ³ (R _w + C _{tr}) dB
Conversions	43	(47)	(52)
New-build	45	(49)	(54)

³ Minimum solutions provide little or no margin of safety to allow for reductions in performance due to flanking transmissions. Recommended solutions have greater potential to satisfy the requirements of national Building Regulations Part E.

EN The fire resistance and sound insulation performances are for imperforate partitions, walls and ceilings incorporating boards with joints taped and filled, or skinned according to British Gypsum's recommendations. The quoted performances are achieved only if British Gypsum components are used throughout, and the Company's fixing recommendations are strictly observed. Any variation in the specifications should be checked with British Gypsum.

Performance (► Refer to section 3 - Basic principles of system design)**Table 3 – Gypliner universal refurbishment - upgrading sound insulation of solid internal walls**

Detail	Board type	Lining thickness mm	Sound insulation		System reference
			$R_w (R_w + C_{tr})$ dB	Improvement over existing wall $R_w (R_w + C_{tr})$ dB	
1	SoundBloc	1 x 12.5	49 (43)	+2 (-1)	B226009
2	SoundBloc	1 x 12.5	57 (50)	+10 (+6)	B226008
3	SoundBloc	1 x 12.5	60 (42)	+13 (-2)	B226010
4	SoundBloc	1 x 12.5	57 (50)	+10 (+6)	B226008
4	SoundBloc	2 x 12.5	60 (55)	+13 (+11)	B226003
5	SoundBloc	1 x 12.5	64 (56)	+17 (+12)	B226007
6	SoundBloc	2 x 12.5	66 (59)	+19 (+15)	B226005

NB The fire resistance and sound insulation performances are for imperforate partitions, walls and ceilings incorporating boards with all joints taped and filled, or skimmed according to British Gypsum's recommendations. The quoted performances are achieved only if British Gypsum components are used throughout, and the Company's fixing recommendations are strictly observed. Any variation in the specifications should be checked with British Gypsum.



Note: The proposed separating elements were modelled utilising sound insulation modelling software Insul™ (Marshall Day Acoustics). The software quotes error margins of ± 3 dB for airborne and ± 5 dB for impact predictions. It should be noted that modelled results are given as a weighted sound reduction index, RW, as predictions are considered under laboratory conditions. Predictive modelling of separating elements for sound insulation is a useful tool in predicting sound insulation performance, however, there is a degree of uncertainty of the number of variables that affect performance in the real world. The recommendations in this report have taken into account the margin of error and the uncertainty to meet the required criteria.

Disclaimer:

This report was completed by Ned Johnson Acoustic Consultant Ltd on the basis of a defined programme of work and terms and conditions agreed with the client. The report has been prepared with all reasonable skill, care and diligence within the terms of the Contract with the Client and taking into account the project objectives, the agreed scope of works, prevailing site conditions and the degree of manpower and resources allocated to the project.

Ned Johnson Acoustic Consultant Ltd accepts no responsibility, following the issue of the report, for any matters arising outside the agreed scope of the works. Any surveys were conducted and this report has been prepared for the private and confidential use of the client only and cannot be reproduced in whole or in part or relied upon by any third party for any use whatsoever without the express written authorisation of Ned Johnson Acoustic Consultant Ltd. If any third party whatsoever comes into possession of this report, they rely on it at their own risk and Ned Johnson Acoustic Consultant Ltd accepts no duty or responsibility to any such third party.

Unless specifically assigned or transferred within the terms of the agreement, Ned Johnson Acoustic Consultant Ltd retains all copyright and other intellectual property rights, on and over the report and its contents.

© Ned Johnson Acoustic Consultant Ltd 2023.