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Architectural & Environmental Consultants

Noise | Vibration | Air Quality

Noise Impact Assessment

99 Frognal, London

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Noise Impact Assessment

Project: 99 FROGNAL, LONDON

Report reference: RP01-23414-R0

Client:
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REVISION	ISSUE DATE	REPORT BY	CHECKED BY	NOTES
0	05 October 2023	Fabio Lassandro, MSc BEng MIOA, Associate Director	Chris McNeillie, MSc CEng MIOA, Director	Initial issue
1	06 December 2023	Fabio Lassandro, MSc BEng MIOA, Associate Director	Sam Bryant, MPhys CEng MIOA, Director	Three new-build dwellings, updated external mechanical plant

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY

1.1 Cass Allen has been instructed by Hayhurst and Co. to assess noise affecting the proposed redevelopment of 99 Frognal, London.

1.2 The assessment was carried out in accordance with relevant local and national planning guidance.

1.3 A noise survey was carried out at the site. Noise levels at the site are dictated by road traffic noise emissions from Frognal.

1.4 Noise affecting the site has been assessed and is considered to be low risk in relation to day and night time levels.

1.5 An assessment of internal noise levels within proposed habitable areas of the site has also been carried out. Noise levels are calculated to comply with BS8233 recommended internal noise levels (including a 5dB relaxation).

1.6 Noise levels in gardens are predicted to comply with BS8233 recommended criteria.

1.7 Noise from proposed Air Source Heat Pumps (ASHPs) associated with the redevelopment have been assessed using Institute of Acoustics (IoA) guidance (Heat Pumps Briefing and Professional Advice notes – November 2022).

1.8 Noise levels from the proposed ASHPs at the locations of existing noise sensitive receptors have been calculated and comply with IoA recommended criteria providing the installation of roof screening where required.

1.9 In summary, it is our view that the proposed redevelopment is acceptable with regards to noise and planning permission may be granted subject to the imposition of suitable planning conditions.

2. INTRODUCTION

2.1 Cass Allen has been instructed by Hayhurst and Co. to assess noise affecting the proposed redevelopment of 99 Frognal, London.

2.2 The assessment has been carried out in accordance with relevant local and national planning guidance.

2.3 The aims of the assessment were:

- to establish the suitability of existing noise levels at the site for the proposed redevelopment;
- where required, identify appropriate measures to optimise the acoustic design of the redevelopment and achieve acceptable noise levels in habitable areas;
- to assess the potential impact of noise emissions from proposed Air Source Heat Pumps (ASHPs) associated with the proposed redevelopment at the positions of existing sensitive receptors in the area.

2.4 This report contains technical terminology; a glossary of terms can be found at www.cassallen.co.uk/glossary.

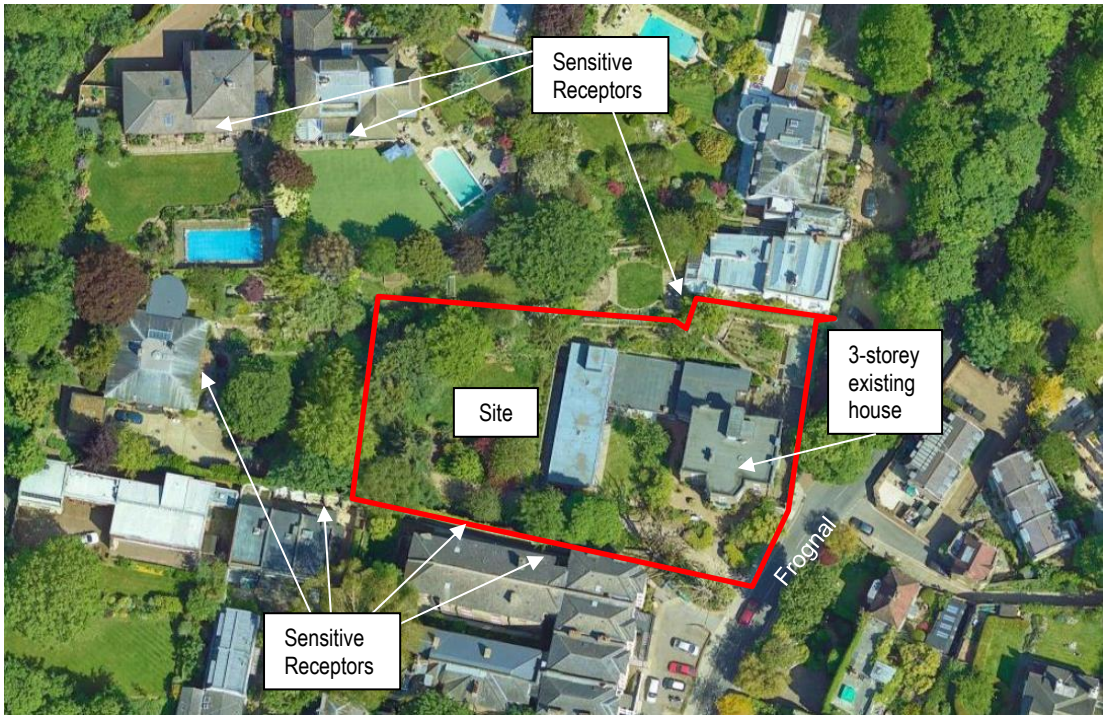
3. PROJECT DESCRIPTION

3.1 The site currently contains Frognal House which is a 3-storey listed building with a number of extensions and an associated garden.

3.2 The site is located in London in a residential area bounded to the east by Frognal, to the north, west and south by a number of noise sensitive residential properties, which are separated from the site by a boundary solid wall.

3.3 The site location together with the approximate site boundaries noise sensitive receptors are shown in Figure 1 below.

Figure 1 Site Location and Surrounding Area (Red Line Approximate)



3.4 The proposal is to:

- refurbish the existing 3-storey grade II listed house to contain new habitable rooms;
- build an extension above the existing house to contain recreational spaces.
- remove existing extension to be replaced by a new kitchen, dining and living areas.
- build 3 new dwellings at the north of the site:

3.5 As part of the proposed scheme, a number of external ASHPs will be installed externally to serve the redevelopment. A drawing of the proposed development with the ASHPs highlighted is shown in Appendix 1.

4. PLANNING POLICY

National Policy

4.1 Outline guidance for the assessment of noise affecting new developments is given in the National Planning Policy Framework (NPPF). Relevant sections in this case are highlighted below:

> *174. Planning policies and decisions should contribute to and enhance the natural and local environment by … preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of …noise pollution.*
>
> *185. Planning policies and decisions should also ensure that a 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.*

Local Policy

4.2 Camden Council's Local Plan (2017) contains a number of policies that regulates noise in relation to new developments and surround areas:

- *Policy A1: managing the impact of developments*

  The Council will seek to protect the quality of life of occupiers and neighbours. We will grant permission for development unless this causes unacceptable harm to amenity. We will:

  …The factors we will consider include:

  … j. noise and vibration levels;…

- *Policy A4: Noise and Vibration*

  The Council will seek to ensure that noise and vibration is controlled and managed. Development should have regard to Camden's Noise and Vibration Thresholds (Appendix 3). We will not grant planning permission for:

  a. development likely to generate unacceptable noise and vibration impacts; or

  b. development sensitive to noise in locations which experience high levels of noise unless appropriate attenuation measures can be provided and will not harm the continued operation of existing uses.

We will only grant permission for noise generating development, including any plant and machinery, if it can be operated without causing harm to amenity. We will also seek to minimise the impact on local amenity from deliveries

4.3 Additional guidance, in line with the above, is provided by Camden Council in the Supplementary Planning Document (March 2018).

4.4 To address the requirements of the national and local policies, the following key acoustic matters have been assessed:

- noise affecting the habitable areas of the proposed development;
- noise emissions from ASHPs associated with the development at the positions of existing sensitive receptors in the area.

5. NOISE AFFECTING THE DEVELOPMENT

Noise survey and initial assessment

5.1 A noise survey was carried out at the site between 30th August and 6th September 2023 to assess existing noise levels in the area. The full methodology and results of the noise survey are provided in Appendix 2.

5.2 Average (LAeq) and maximum (LAmax) noise levels across the site were dictated by road traffic on Frognal. Background noise levels (LA90) across the site were dictated by constant road traffic noise from the surrounding roads.

5.3 Areas of the development at the eastern edges of the site (facing Frognal) will be subject to the highest noise levels:

- Average noise levels during the daytime - 58 dB LAeq,0700-2300hrs
- Average noise levels during the night-time - 50 dB LAeq,2300-0700hrs
- Typical maximum noise levels during the night-time - 71 dB LAmax

5.4 The site is considered to be at 'Low' risk in relation to day and night time noise levels.

Overall acoustic design of the site

5.5 The acoustic design of development has been reviewed in relation to the measured noise levels at the site. The layout of the development (considering the constraints of the listed building) is considered to represent good acoustic design for the following reasons:

- Main gardens are positioned behind the building away from Frognal so that they will be acoustically screened from the noise source.
- Internal layouts of the habitable areas will not change much from the existing layout which positions most sensitive rooms (bedrooms and living rooms) away from Frognal.
- An existing wall surrounds the site:
    - to the east is a 2m high brick wall;
    - to the north-west is a 2.3-2.6m high brick wall. This will provide screening to and from noise generated within and outside the site.
    - to the north-east is a 3.8m high garage wall with 1m high brick wall above the garage roof.
    - to the south-east is a 3m high timber fence with vegetation above.

Internal noise levels

5.6 Appropriate design criteria for acceptable noise levels in acoustically sensitive areas of new developments are given in BS8233:2014 '*Guidance on sound insulation and noise reduction for buildings*'.

5.7 Relevant BS8233 design criteria are summarised in Table 1 below.

Table 1 BS8233:2014 Internal Noise Criteria

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35 dB LAeq,16hour	-
Dining	Dining room/area	40 dB LAeq,16hour	-
Sleeping (daytime resting)	Bedroom	35 dB LAeq,16hour	30 dB LAeq,8hour

5.8 BS8233:2014 also states that where development is considered necessary or desirable, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved. It is considered appropriate to apply this relaxation considering the listed nature of the building (with historic windows).

5.9 During the assessment, noise measurements were taken within future habitable areas located in the existing building with windows open and closed to quantify, as best as possible, the sound insulation performance of the existing building envelope. The results were then used to calculate the internal noise levels within the proposed habitable rooms using the measured external noise levels (day and night time). The assessment assumed that the building envelope associated with the proposed habitable rooms at Frognal House are all constructed in the same way and perform similarly.

5.10 Calculation results are presented in Appendix 3.The results show that noise levels within habitable rooms of Frognal House are capable of complying with BS8233 internal noise limits during the night-time (without the 5dB relaxation). Predicted noise levels in habitable areas during daytime are capable of complying with the noise limits relaxed by 5dB (as introduced in Section 5.8 above).

5.11 It is our view therefore that the existing building envelope provides sufficient levels of sound insulation for the proposed redevelopment.

5.12 The external walls of the three new houses located at the north of the development will be constructed partially using the existing historical masonry garden wall and partially using new-build construction. Detail of the new build construction is currently unknown, therefore it has been assumed that a standard masonry construction will be used (e.g. 102mm brick, 100mm insulated cavity, 100mm concrete block). Consequently, internal noise levels will be dictated by external noise ingress via glazing and ventilators.

5.13 The ventilation strategy has not been confirmed yet. Therefore as worst-case scenario it has been assumed that the units will be ventilated via trickle ventilators in the external facades with openable windows for the provision of purge ventilation.

5.14 Calculations were carried out using facade modelling software in accordance with the “more rigorous” methodology given in BS8233:2014 to establish the sound insulation performance required of the glazing and ventilation to achieve the nominated internal noise criteria in all habitable rooms across the development.

5.15 If acceptable internal noise levels can be achieved in 'worst case' habitable rooms then it follows that acceptable internal noise levels can be achieved in all other habitable rooms of the development using similar glazing and ventilator types.

5.16 The calculations were carried out based on the dimensions/details for facade elements taken from project drawings. The results of the calculations are shown in Appendix 4 and are summarised in Table 2 below.

Table 2 Acoustic Requirements for 'Worst Case' Habitable Rooms

'Worst Case' Rooms (New Build)	Glazing Performance Requirements (inc. Frames)	Ventilator Performance Requirements (in Open Position)
Bedrooms	26 dB Rw+Ctr	32 dB Dne,w + Ctr
Living rooms	26 dB Rw+Ctr	32 dB Dne,w + Ctr

Note The requirements given are approximate only and should be confirmed at the detailed design stage when full design details are available.

5.17 The required sound insulation performance values in Table 2 could typically be achieved by the glazing and ventilator types shown in Table 3.

Table 3 Typical Glazing / Ventilator Acoustic Performances

Glazing (in Good Quality Sealed Frames)	Typical Weighted Sound Reduction (Rw + Ctr)
4/16/4mm standard thermal double glazing	26
Ventilators	**Typical Acoustic Performance (Dnew + Ctr)**
Standard 'hit & miss' in-frame trickle ventilator	32

Note The acoustic performance of the glazing systems (including frames) should always be confirmed with the manufacturer before selection for installation on site.

5.18 It can be seen from the above that BS8233 acceptable internal noise levels will be achievable in the bedrooms and living rooms of the new build dwellings subject to the installation of suitable glazing and ventilation systems. It is our view therefore that the proposed development is, in principle, acceptable with regards to the noise levels that will exist within the habitable rooms.

5.19 It should be noted that it will be possible to use lower acoustic performance glazing and ventilators for habitable rooms on facades that are further from or acoustically screened from the surrounding noise sources. This can be investigated further at the detailed design stage.

Noise levels in external amenity areas

5.20 BS8233 states that it is desirable that noise levels in external amenity areas of residential developments do not exceed 50 dB LAeq and that 55 dB LAeq,T should be regarded as an upper

guideline value. However, BS8233 recognises that these guideline values will not always be achievable in city centres or urban areas adjoining main roads or other transport sources. In these cases, BS8233 states that the development should be designed to achieve the lowest practicable noise levels in the amenity spaces.

5.21 The noise survey results indicate that noise levels in external amenity areas are predicted to generally achieve the BS8233 recommended levels. Noise levels in the external amenity areas of the new houses are also calculated to comply with BS8233 recommended levels.

5.22 The proposed development is therefore also considered to be acceptable based on noise levels in external amenity areas.

Recommendation to decision maker

5.23 It is our view that planning permission may be granted in relation to noise affecting habitable areas of the development subject to the imposition of suitable planning conditions to ensure that acceptable noise levels are achieved in the finished development.

6. ASHP NOISE IMPACT ASSESSMENT

6.1 The proposed redevelopment includes for a number of ASHPs to be installed externally within the site boundaries.

Design criteria – Mechanical plant noise

6.2 In the absence of specific criteria for assessing the ASHPs, we propose to assess the acceptability of the ASHP noise emissions using guidance from the Institute of Acoustics (IoA) Heat Pumps Briefing and Professional Advice notes, November 2022 (hereafter: the "IoA guidance").

6.3 The IoA guidance recommends the following:

> *For the majority of domestic installations, it is recommended that an absolute rating level target, which takes account of the sound character, is a proportionate approach. This advice draws on expertise available at the time of writing and provides an alternative criterion to the implied limit within Permitted Development Rights MCS criteria of 38dB LAeq,T. Larger heat pump installations, which require full planning applications, may require a more comprehensive noise assessment to be undertaken (typically based on BS 4142:2014+A1:2019).*
>
> *Where it is practical to do so, it is recommended that the installation sound rating level does not exceed 35dB at any noise sensitive façade of neighbouring residential premises. If it can be demonstrated that it is not practical to achieve this value, and the local context supports a relaxation, then a higher criterion may be suitable. Under those circumstances it is recommended that the reasons for the relaxation are fully set out and justified. Nevertheless, it is recommended that the sound rating level should not exceed 40dB.*

6.4 Based on the above, 35dB LAeq,T has been adopted as ideal noise limit, but 40dB LAeq,T has been adopted as highest acceptable noise limit for this assessment.

Proposed mechanical plant design

6.5 ASHPs have been assessed below in accordance with the calculation method proposed by the IoA guidance. This procedure involves applying a series of corrections and comparisons to manufacturer's noise data for the ASHP in order to assess compliance.

6.6 The proposed ASHPs locations with noise data are presented in Appendix 5. The following types of ASHPs are proposed:

- One 5kW unit – 64dBA SPL at 3m (82dBA Sound Power Level – SWL)
- Three 10kW and three 12kW units– SWL: 60dBA

6.7 All ASHPs will be placed close to the existing perimeter wall which will provide acoustic screening from existing noise sensitive receptors around the site. In addition to this, ASHPs will also feature an additional localised solid roof which will not to be taller than existing perimeter walls, in order to

provide further acoustic mitigation. The need and the details of any additional roof will be investigated at the detailed design stage.

6.8 Details of the calculations for each ASHPs can be found in Appendix 6.

Assessment results

6.9 The results of the calculations in Appendix 6 show that the proposed ASHPs comply with the noise criterion of 40dB LAeq,T at the facade of nearest noise sensitive receptors. In addition to this, noise levels from the 10kW and 12kW units at the southern edge of the site are also capable of complying with the more stringent recommended criterion of 35dB LAeq,T.

6.10 It is our view therefore that planning permission may be granted in relation to ASHP noise affecting noise sensitive receptors subject to the imposition of suitable planning conditions to ensure that acceptable noise levels are achieved in the finished development.

7. CONCLUSIONS

7.1 Cass Allen was instructed by Hayhurst and Co. to assess noise affecting a proposed new redevelopment at 99 Frognal, London.

7.2 Noise affecting the site has been assessed and is considered to be low risk in relation to day and night time levels.

7.3 Noise levels within proposed habitable rooms are calculated to comply with BS8233 recommended internal noise limits (including a 5dB relaxation).

7.4 Noise levels in gardens comply with recommended BS8233 criteria.

7.5 Noise levels from the proposed ASHPs at the locations of existing noise sensitive receptors have been calculated and comply with the IoA criteria following the installation of the proposed roof screening.

7.6 In summary, it is our view that the site is suitable for the development and the proposed ASHPs are acceptable in terms of noise levels. Planning permission may be granted subject to the imposition of suitable planning conditions.

Appendix 1 Proposed development

PLANNING ISSUE

0 2.5m 5m

Issue/Revision Date Rev

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mail@hayhurstand.co.uk
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Project:	**Refurbishment & Proposed Extension**
Address:	**Frognal House, 99 Frognal, London, NW3 6XU**
Subject:	**Proposed Ground Floor Plan**
Date:	**25/10/2023**
Scale:	**1 : 100**
Original Size:	**A1**
Drawing no:	**298 A110** –

PLANNING ISSUE

Check all dimensions on site. Do not scale off drawings without prior consultation. Any discrepancies to be reported to architects before execution of relevant works. This drawing has been produced for the planning application of Frognal House, 99 Frognal, London, NW3 6XR and for that application alone and is not intended for use by any other person or for any other purpose. Drawings remain copyright of Hayhurst and Co. and may not be reproduced without written consent or licence.

0 2.5m 5m

103 Frognal

External Amenity

House 2 Kitchen

+114.35

House 2 Living

House 2 Bedroom 2

skylight

WC

Store

Study

Living +114.80

+114.80

+110.65

Skylight

Bedroom 3

Bedroom 3 Ensuite

Wardrobe

Dressing Area

Stair

Lobby

+113.55

Master Ensuite

Ante-Room

Master Bedroom +113.55

+115.70

+111.40

+115.62

+111.37

Frognal Mansions

Issue/Revision	Date	Rev

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Project:	**Refurbishment & Proposed Extension**
Address:	**Frognal House, 99 Frognal, London, NW3 6XU**
Subject:	**Proposed First Floor Plan**
Date:	**25/10/2023**
Scale:	**1 : 100**
Original Size:	**A1**
Drawing no:	**298 A111** –

PLANNING ISSUE

0 2.5m 5m

103 Frognal

+114.80

+110.66

+111.40

Bedroom 5
Bedroom 5 Ensuite
Stair
Bedroom 6 Ensuite
Bedroom 6
Lobby
Hall
+116.91
Bedroom 5 Study
Dressing
Lobby
Bathroom
Bedroom 4
+116.91

skylight

Frognal Mansions

Issue/Revision	Date	Rev

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Project:	**Refurbishment & Proposed Extension**
Address:	**Frognal House, 99 Frognal, London, NW3 6XU**
Subject:	**Proposed Second Floor Plan**
Date:	**25/10/2023**
Scale:	**1 : 100**
Original Size:	**A1**
Drawing no:	**298 A112** –

PLANNING ISSUE

0 2.5m 5m

103 Frognal

+114.80

+110.66

+111.40

Attic Room
+120.35

Terrace
+120.50

Stair

WC

skylight

Frognal Mansions

Issue/Revision	Date	Rev

Hayhurst & Co Architects
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Project:	**Refurbishment & Proposed Extension**
Address:	**Frognal House, 99 Frognal, London, NW3 6XU**
Subject:	**Proposed Third Floor Plan**
Date:	**25/10/2023**
Scale:	**1 : 100**
Original Size:	**A1**
Drawing no:	**298 A113** –

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0 2.5m 5m

103 Frognal

+114.80

+111.40

+120.50

Frognal Mansions

Issue/Revision	Date	Rev

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Project:	**Refurbishment & Proposed Extension**
Address:	**Frognal House, 99 Frognal, London, NW3 6XU**
Subject:	**Proposed Roof Plan**
Date:	**25/10/2023**
Scale:	**1 : 100**
Original Size:	**A1**
Drawing no:	**298 A114** –

PLANNING ISSUE

0 2.5m 5m

Issue/Revision Date Rev

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Address:	**Frognal House, 99 Frognal, London, NW3 6XU**
Subject:	**Proposed Basement Floor Plan**
Date:	**28/11/23**
Scale:	**1 : 100**
Original Size:	**A1**
Drawing no:	**298 A115** –

Appendix 2 Survey Results

Survey Summary:

The survey comprised short-term operator attended noise measurements and longer-term unattended noise monitoring at the site. Noise levels at the site were generally dictated by road traffic on surrounding roads and natural sources. During the survey, noise levels were measured in representative rooms with windows closed and open in order to determine the approximatively acoustic sound insulation performance of existing building envelope.

Survey Period:

30/08/2023 to 06/09/2023

Survey Objectives:

- To identify noise sources that contribute to ambient noise levels at the site;
- To measure noise levels around the site over a typical day and night-time period.

Equipment Used:

Type	Manufacturer	Model	Serial Number
Sound level meter[1] (noise logger)	Rion	NL-32	01213688
Sound level meter[1] (noise logger)	Rion	NL-32	00903342
Calibrator	Rion	NC-74	34551703
Sound level meter[1]	Rion	NL-52	00732098

Note 1: All sound level meters were calibrated before and after measurement periods and no significant drift in calibration was found to have occurred. The results of the measurements are therefore considered to be representative.

Weather Conditions:

The observed weather conditions were acceptable for acoustic measurement throughout the attended survey periods (low-medium wind speeds and no rain). Weather records for the area confirmed that weather conditions were also generally acceptable for acoustic measurement during the unattended monitoring.

Measurement Positions:

Position (refer plan below)	Description
N1	Attended noise monitoring position. 1.5m above ground. Free-field. Direct line of sight to Frognal (3m)
N2	Attended noise monitoring position. 1.5m above ground. Free-field. Direct line of sight to Frognal (20m)
N3	Attended noise monitoring position. 1.5m above ground. Free-field.
N4	Attended noise monitoring position. 1.5m above ground. Free-field.
N5	Attended noise monitoring position (1st floor bedroom). 5m above ground level. Free-field. Direct line of sight to Frognal (10m)
N6	Attended noise monitoring position (2nd floor bedroom). 5m above ground level. Free-field. Direct line of sight to Frognal (14m)

Measurement Positions:

Position (refer plan below)	Description
L1	Unattended noise logging position. 3m above ground level. Free-field. Direct line of sight to Frognal (9m)
L2	Unattended noise logging position. 3m above ground level. Free-field.

Site Plan showing Measurement Positions:

Attended Noise Monitoring Results:

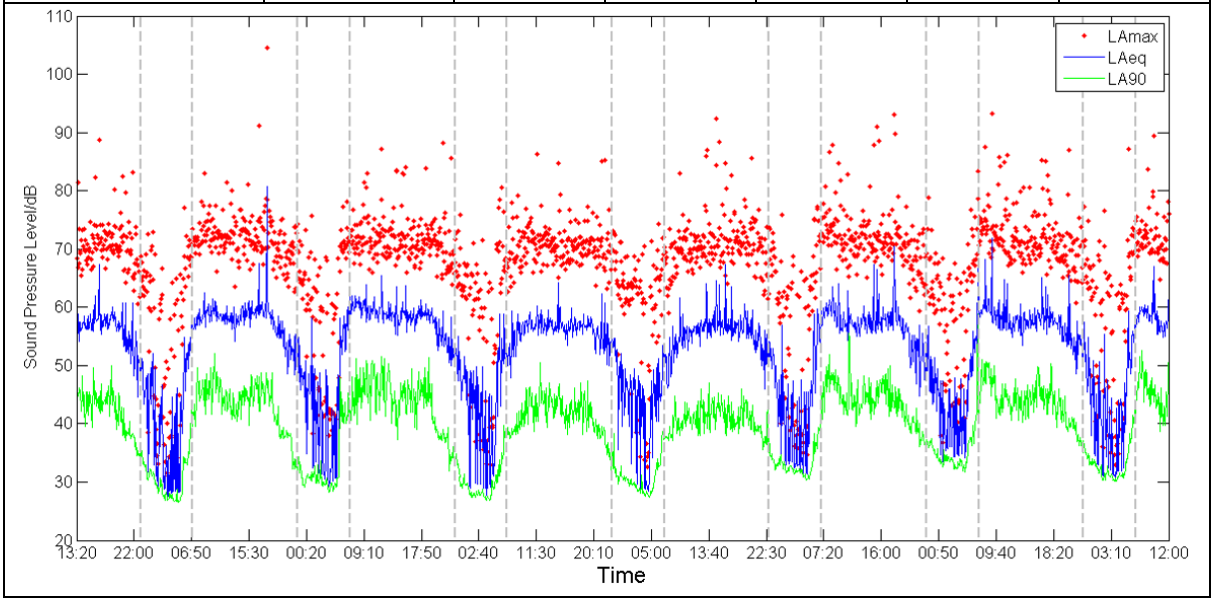
Date	Position	Time	Meas. Length	LAeq, dB	LAmax, dB	LA90, dB	Observations
30/08/2023	N1	13:30	5 mins	61	74	45	Noise dictated by road traffic from Frognal
	N2	13:35	5 mins	53	66	46	Noise dictated by road traffic from Frognal
	N3	13:45	5 mins	47	57	44	Noise dictated by lawnmower in nearby garden
	N4	13:50	5 mins	46	56	42	Noise dictated by lawnmower in nearby garden
	N1	14:00	5 mins	62	80	44	Noise dictated by road traffic from Frognal
	N2	14:05	3 mins	53	63	42	Noise dictated by road traffic from Frognal
	N5	14:10	5 mins	54	66	40	Measurement taken inside habitable room (level 1) of the existing building to be refurbished. Noise dictated by road traffic from Frognal (balcony door open)

Attended Noise Monitoring Results:

Date	Position	Time	Meas. Length	LAeq, dB	LAmax, dB	LA90, dB	Observations
	N5	14:15	5 mins	34	47	21	Measurement taken inside habitable room (level 1) of the existing building to be refurbished. Noise dictated by road traffic from Frognal (balcony door closed)
	N6	14:25	5 mins	31	47	20	Measurement taken inside habitable room (level 2) of the existing building to be refurbished. Noise dictated by road traffic from Frognal (small window closed)
	N4	14:40	1 min	40	48	36	Noise dictated by aeroplane flyover
	N1	14:44	10 secs	63	69	50	Noise dictated by car on Frognal
	N1	14:45	30 secs	63	69	54	Noise dictated by cars and van on Frognal
	N1	14:46	20 secs	50	55	48	Noise dictated by aeroplane flyover
	N1	14:47	30 secs	65	75	54	Noise dictated by ambulance (no siren) on Frognal

Unattended Noise Monitoring Results:

Meas. Period	Position	Daytime (0700-2300hrs)		Night-time (2300-0700hrs)		
		LAeq,16hr, dB	LA90,1hr dB[1]	LAeq,8hr, dB	LA90,5mins, dB[1]	LAmax, dB[2]
30/08/2023 to 06/09/2023	L1	58	45	50	31	71

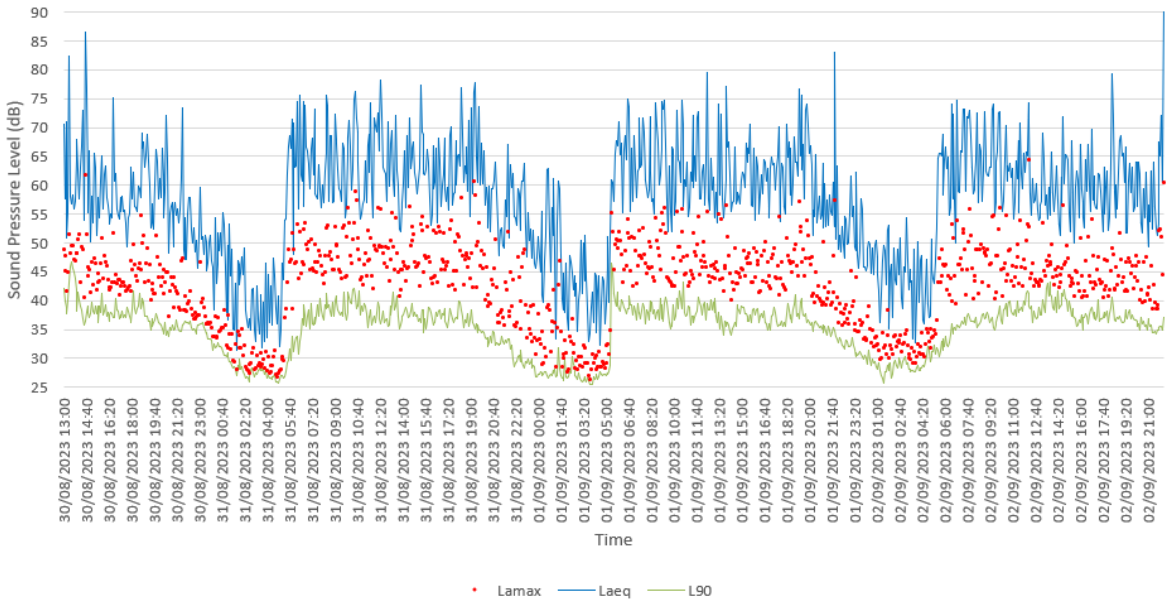


Note 1: Typical lowest measured during the period shown.

Note 2: Highest typical maximum noise level during the night-time (not exceeded more than 10-15 times per night).

Unattended Noise Monitoring Results:

Meas. Period	Position	Daytime (0700-2300hrs)		Night-time (2300-0700hrs)		
		LAeq,16hr, dB	LA90,1hr dB[1]	LAeq,8hr, dB	LA90,5mins, dB[1]	LAmax, dB[2]
30/08/2023 to 06/09/2023	L2	46	37	35	27	61



Note 1: Typical lowest measured during the period shown.

Note 2: Highest typical maximum noise level during the night-time (not exceeded more than 10-15 times per night).

Appendix 3 Internal Noise Levels Existing Building – Worst Case Rooms

Calculated internal noise levels in worst case habitable rooms

					Comment
Measurement in existing room (windows closed) - room 1	**34**	**dB**	**LAeq,5min**		Large window
Measurement in existing room (windows closed) - room 2	**31**	**dB**	**LAeq,5min**		Small window
Measured external noise levels during measurement room 1	**55**	**dB**	**LAeq,5min**		Calculated at facade external to room 1
Measured external noise levels during measurement room 2	**52**	**dB**	**LAeq,5min**		Calculated at facade external to room 2
Reduction provided by building envelope (eastern facade) - room 1	**21**	**dB**			Large window
Reduction provided by building envelope (eastern facade) - room 2	**21**	**dB**			Small window
Measured daytime external noise level	**58**	**dB**	**LAeq,16hrs**		
Measured night-time external noise level	**50**	**dB**	**LAeq,8hrs**		
Calculated internal ambien noise - large windows closed					
Daytime	37	dB	LAeq,16hrs		Compliant with BS8233
Night Time	29	dB	LAeq,8hrs		Compliant with BS8233
Calculated internal ambien noise - small windows closed					
Daytime	37	dB	LAeq,16hrs		Compliant with BS8233
Night Time	29	dB	LAeq,8hrs		Compliant with BS8233

Appendix 4 New-build houses – Facade Calculations

PROJECT:	99 Frognal
ROOM:	Bedroom - new build
VARIANT:	Night Time
NOTES:	LAeq

Room Dimensions [m]	W		L		H	
	4.0	X	3.0	X	2.4	
Room Volume =	28.8	m3				
Partition Area =	12.0	m2				
Ventilation ref area =	10.0	m2				
Free Field SPL K =	3	dB				

SELECT Free Field or Façade SPL for model input >>>

NOTES:

External noise levels affecting windows of the house external amenity are screened due to building itself, therefore have been corrected by -10dB.

EXTERNAL SPECTRUM (A weighted)

	dBA	63	125	250	500	1000	2000	4000	
Direct input - Free Field SPL (A weighted octave bands) dB ----->	-								**No data**
Road traffic spectrum (according to BS 8233:1999 section 6)	40.0								
		21.8	25.9	29.4	32.8	36.0	33.2	28.0	**Reference spectrum**

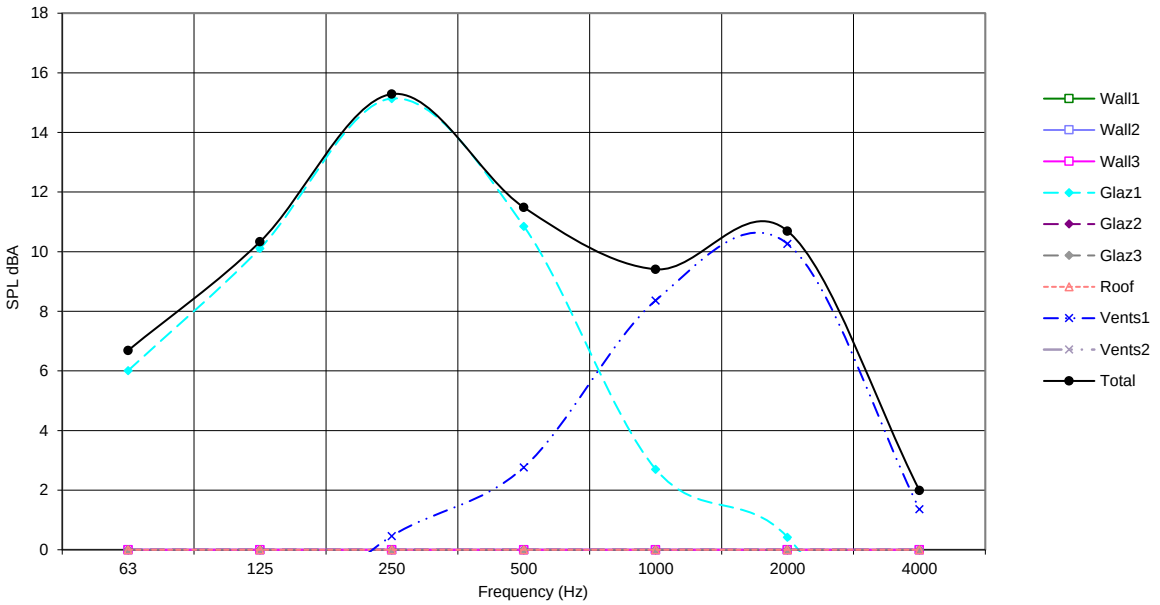
REVERBERATION TIME

DIRECT INPUT ----->								**No data**
EQUAL RT for all bands ----->								
	0.5	0.5	0.5	0.5	0.5	0.5	0.5	**Default - RT set to 0.5s**

Façade Element		Area [m2]	SRI dB to BS EN ISO 140-3:1995								Rw	C	Ctr
Wall 1	Typical - 102mm brick/50mm cavity/100mm block	2.1	36	45	44	47	57	67	77	1%	54	0	-4
	ATTENUATION												
Wall 2	WALLS		0	0	0	0	0	0	0	0%			
	ATTENUATION												
Wall 3	WALLS		0	0	0	0	0	0	0	0%			
	ATTENUATION												
Glazing 1	26 dB Rw + Ctr - Standard Thermal Double Glazing	9.9	19	19	18	25	37	36	38	68%	26 (inc Ctr)	-	-
	ATTENUATION												
Glazing 2	GLAZING		0	0	0	0	0	0	0	0%			
	ATTENUATION												
Glazing 3	GLAZING		0	0	0	0	0	0	0	0%			
	ATTENUATION												
Roof	ROOF / FLOOR		0	0	0	0	0	0	0	0%			
	ATTENUATION												
Resultant composite Façade SRI			20	20	18	26	37	37	39				
Resultant SPL inside room excluding ventilators dB		17.9	6	10	15	11	3	0	-7	73%			

Ventilator Type		Num	$D_{n,e}$ dB to BS EN 20140-10:1992								Dnew	C	Ctr
Ventilation	Hit and miss trickle (4000mm^2) e.g. Titon Trimvent XS13	2	30	35	35	36	34	29	33	25%	32	0	-1
	ATTENUATION												
Ventilation	VENTS		0	0	0	0	0	0	0	0%			
	ATTENUATION												
Resultant SPL inside room through ventilators dB		13.6	-2	-3	0	3	8	10	1	27%			
Total SPL inside room		**19.3**	7	10	15	11	9	11	2				

Element contribution to total internal noise level



FACSIM V2.7.9
- MODELLING OF FACADE ACOUSTIC INSULATION TO BS12354-3 and BS8233

PROJECT:	99 Frognal
ROOM:	Bedroom - new build
VARIANT:	Night Time
NOTES:	LAmax

Room Dimensions [m]	W		L		H
	4.0	X	3.0	X	2.4

Room Volume =	28.8	m3
Partition Area =	12.0	m2
Ventilation ref area =	10.0	m2
Free Field SPL K =	3	dB

SELECT Free Field or Façade SPL for model input >>>

NOTES:

External noise levels affecting windows of the house external amenity are screened due to building itself, therefore have been corrected by -10dB.

EXTERNAL SPECTRUM (A weighted)

	dBA	63	125	250	500	1000	2000	4000	
Direct input - Free Field SPL (A weighted octave bands) dB ----->	-								**No data**
Road traffic spectrum (according to BS 8233:1999 section 6)	61.0								
		42.8	46.9	50.4	53.8	57.0	54.2	49.0	**Reference spectrum**

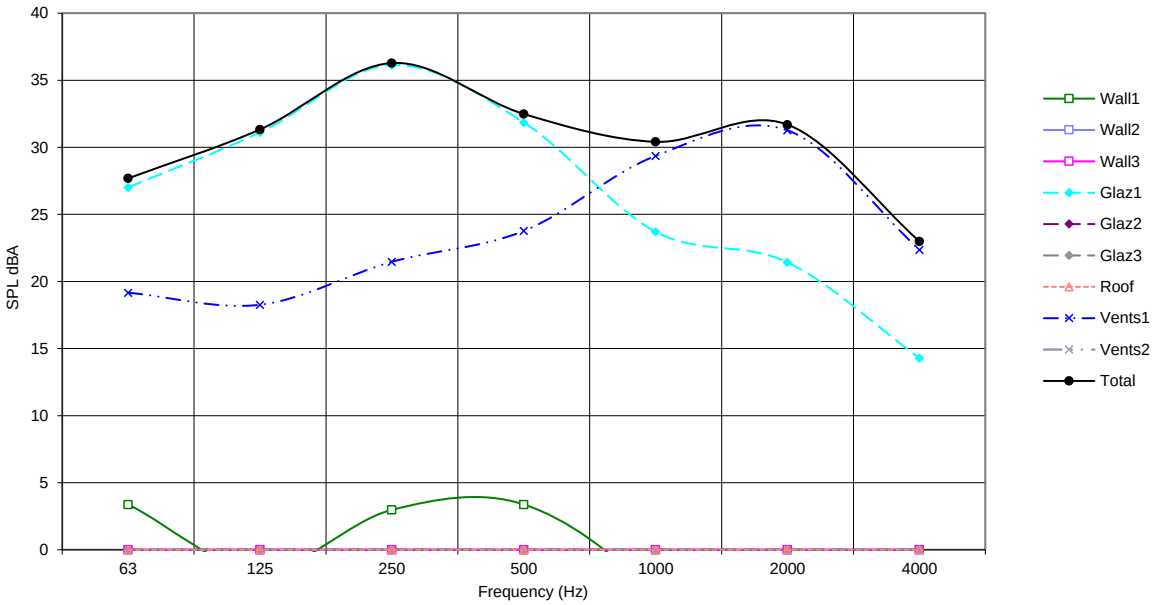
REVERBERATION TIME

DIRECT INPUT ----->								**No data**
EQUAL RT for all bands ----->								
	0.5	0.5	0.5	0.5	0.5	0.5	0.5	**Default - RT set to 0.5s**

Façade Element		Area [m2]	SRI dB to BS EN ISO 140-3:1995								Rw	C	Ctr
Wall 1	Typical - 102mm brick/50mm cavity/100mm block	2.1	36	45	44	47	57	67	77	0%	54	0	-4
	ATTENUATION												
Wall 2	WALLS		0	0	0	0	0	0	0	0%			
	ATTENUATION												
Wall 3	WALLS		0	0	0	0	0	0	0	0%			
	ATTENUATION												
Glazing 1	26 dB Rw + Ctr - Standard Thermal Double Glazing	9.9	19	19	18	25	37	36	38	73%	26 (inc Ctr)	-	-
	ATTENUATION												
Glazing 2	GLAZING		0	0	0	0	0	0	0	0%			
	ATTENUATION												
Glazing 3	GLAZING		0	0	0	0	0	0	0	0%			
	ATTENUATION												
Roof	ROOF / FLOOR		0	0	0	0	0	0	0	0%			
	ATTENUATION												
	Resultant composite Façade SRI		20	20	18	26	37	37	39				
	Resultant SPL inside room excluding ventilators dB	38.9	27	31	36	32	24	21	14	73%			

Ventilator Type		Num	$D_{n,e}$ dB to BS EN 20140-10:1992								Dnew	C	Ctr
Ventilation	Hit and miss trickle (4000mm^2) e.g. Titon Trimvent XS13	2	30	35	35	36	34	29	33	27%	32	0	-1
	ATTENUATION												
Ventilation	VENTS		0	0	0	0	0	0	0	0%			
	ATTENUATION												
	Resultant SPL inside room through ventilators dB	34.6	19	18	21	24	29	31	22	27%			
	Total SPL inside room	**40.3**	28	31	36	32	30	32	23				

Element contribution to total internal noise level



PROJECT:	99 Frognal
ROOM:	Living Room - new build
VARIANT:	Daytime
NOTES:	LAeq

Room Dimensions [m]	W		L		H
	4.0	X	5.0	X	2.4

Room Volume =	48.0	m3
Partition Area =	12.0	m2
Ventilation ref area =	10.0	m2
Free Field SPL K =	3	dB

SELECT Free Field or Façade SPL for model input >>>

NOTES:

External noise levels affecting windows of the house external amenity are screened due to building itself, therefore have been corrected by -10dB.

EXTERNAL SPECTRUM (A weighted)

	dBA	63	125	250	500	1000	2000	4000	
Direct input - Free Field SPL (A weighted octave bands) dB ----->	-								**No data**
Road traffic spectrum (according to BS 8233:1999 section 6)	48.0								
		29.8	33.9	37.4	40.8	44.0	41.2	36.0	**Reference spectrum**

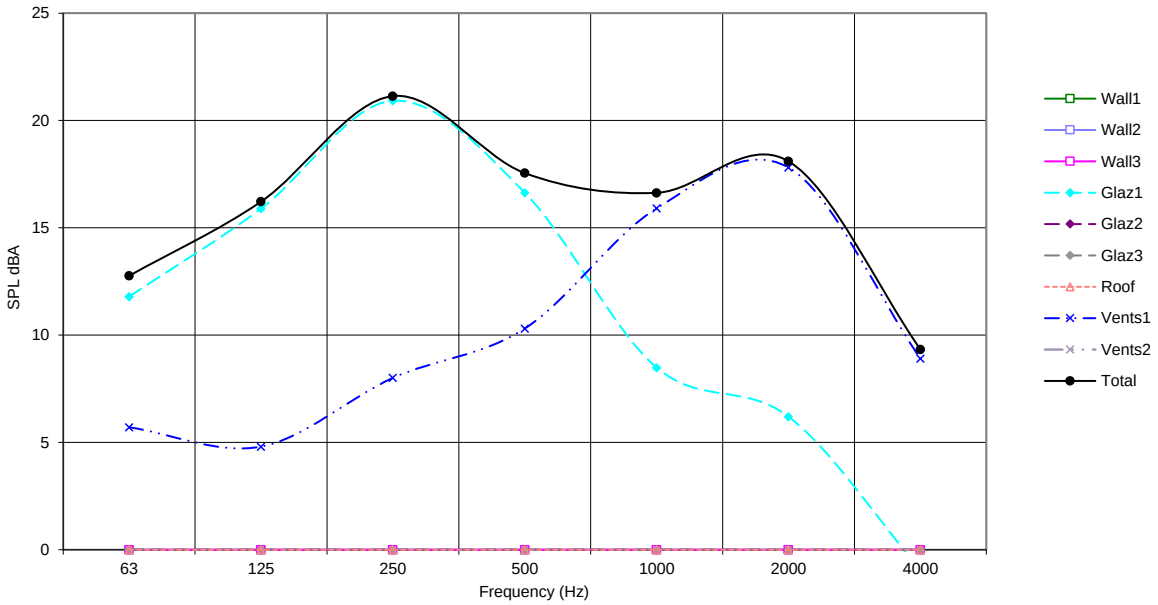
REVERBERATION TIME

DIRECT INPUT ----->								**No data**
EQUAL RT for all bands ----->								
	0.5	0.5	0.5	0.5	0.5	0.5	0.5	**Default - RT set to 0.5s**

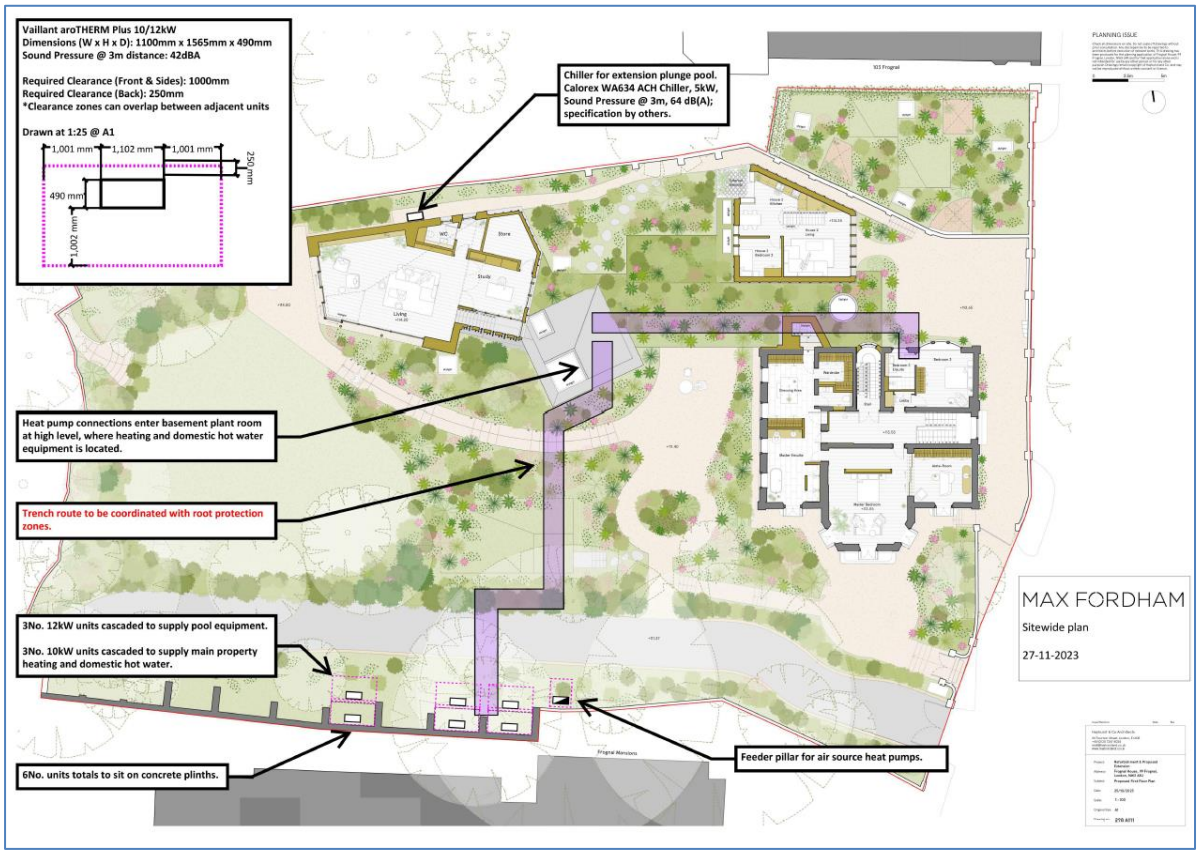
Façade Element		Area [m2]	SRI dB to BS EN ISO 140-3:1995								Rw	C	Ctr
Wall 1	Typical - 102mm brick/50mm cavity/100mm block	2.1	36	45	44	47	57	67	77	0%	54	0	-4
	ATTENUATION												
Wall 2	WALLS		0	0	0	0	0	0	0	0%			
	ATTENUATION												
Wall 3	WALLS		0	0	0	0	0	0	0	0%			
	ATTENUATION												
Glazing 1	26 dB Rw + Ctr - Standard Thermal Double Glazing	9.9	19	19	18	25	37	36	38	63%	26 (inc Ctr)	-	-
	ATTENUATION												
Glazing 2	GLAZING		0	0	0	0	0	0	0	0%			
	ATTENUATION												
Glazing 3	GLAZING		0	0	0	0	0	0	0	0%			
	ATTENUATION												
Roof	ROOF / FLOOR		0	0	0	0	0	0	0	0%			
	ATTENUATION												
	Resultant composite Façade SRI		20	20	18	26	37	37	39				
	Resultant SPL inside room excluding ventilators dB	23.7	12	16	21	17	8	6	-1	64%			

Ventilator Type		Num	$D_{n,e}$ dB to BS EN 20140-10:1992								Dnew	C	Ctr
Ventilation	Hit and miss trickle (4000mm^2) e.g. Titon Trimvent XS13	3	30	35	35	36	34	29	33	35%	32	0	-1
	ATTENUATION												
Ventilation	VENTS		0	0	0	0	0	0	0	0%			
	ATTENUATION												
	Resultant SPL inside room through ventilators dB	21.2	6	5	8	10	16	18	9	36%			
	Total SPL inside room	**25.6**	13	16	21	18	17	18	9				

Element contribution to total internal noise level



Appendix 5 ASHPs locations and noise levels



Back to top

Specifications

	Unit	3.5kW VWL 35 / 6	5kW VWL 55 / 6	7kW VWL 75 / 6	10kW VWL 105 / 6	12kW VWL 125 / 6
General information						
Width	mm	1,100	1,100	1,100	1,100	1,100
Height	mm	765	765	965	1565	1565
Depth	mm	449	449	449	449	449
Noise emissions, heating mode						
Sound power, EN 12102, EN 14511 LWA, A7/W35	dB(A)	51	51	53	58	58
Sound power, EN 12102, EN 14511 LWA, A7/W45	dB(A)	53	53	53	58	58
Sound power, EN 12102, EN 14511 LWA, A7/W55	dB(A)	54	54	55	60	60
Efficiency						
Energy efficiency class 35°C	(A+++ to F)	A+++	A+++	A+++	A+++	A+++
Energy efficiency class 55°C	(A+++ to F)	A++	A++	A++	A++	A++
Combination with uniTOWER						

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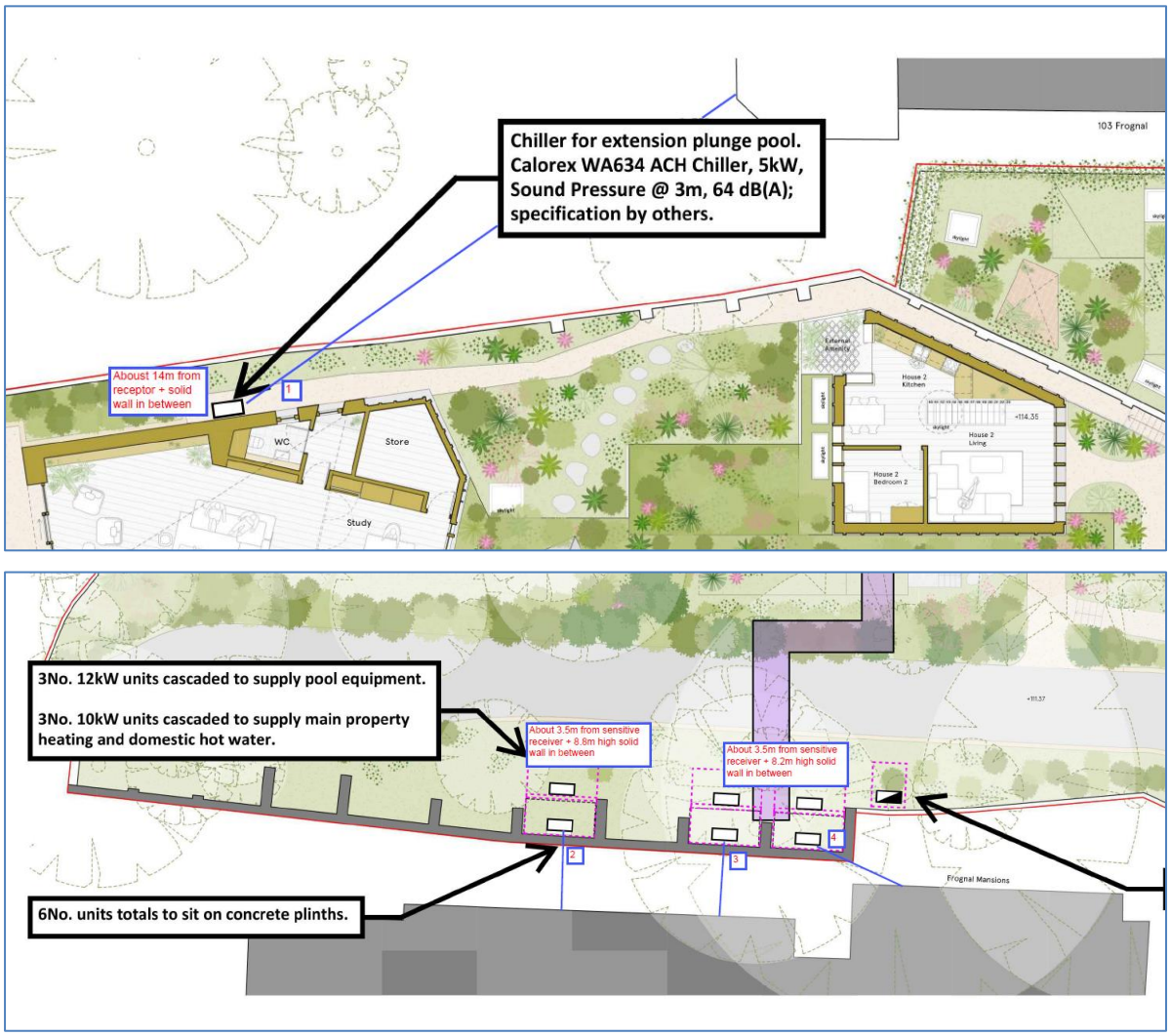
Back to top

Appendix 6 ASHPs Noise Calculation – IoA Method



Calculation 1

Step 1	SWL dBA	82	
Step 2	Directivity (Q)	4	Near wall and on ground
Step 3	Distance from heat pump to assessment position (m)	14	
Step 4	dB distance reduction	-28	*note using formulae not table
Step 5	Barrier correction (-10dB, -5dB, 0dB)	-10	Completely obscured
Step X	Character adjustment dB	6	
Step 6	Calculate SPL	50	
	Additional roof screening above units	40	

Calculations 2, 3 and 4

Step 1	SWL dBA	60	
Step 2	Directivity (Q)	4	Near wall and on ground
Step 3	Distance from heat pump to assessment position (m)	3.5	
Step 4	dB distance reduction	-16	*note using formulae not table
Step 5	Barrier correction (-10dB, -5dB, 0dB)	-10	Completely obscured
Step X	Character adjustment dB	6	
Step 6	Calculate SPL	40	
	Correction for number of units (2 units)	43	
	Additional roof screening above units	33	

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Noise | Vibration | Air Quality

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