



BARRATT DAVID WILSON HOMES

LAND SOUTH OF WATER LANE, ANGMERING

**DISCHARGE OF CONDITION 9
ARUN DISTRICT COUNCIL PLANNING
PERMISSION REF. A/99/17/OUT**

SOUND INSULATION ASSESSMENT

SEPTEMBER 2020

the journey is the reward

BARRATT DAVID WILSON HOMES

LAND SOUTH OF WATER LANE, ANGMERING

**DISCHARGE OF CONDITION 9
ARUN DISTRICT COUNCIL PLANNING
PERMISSION REF. A/99/17/OUT**

SOUND INSULATION ASSESSMENT

SEPTEMBER 2020

Project Code:	24612
Prepared by:	Harry Russell-Lees (Hons)
Approved by:	Paul Gray BSc(Hons) MIOA
Issue Date:	September 2020
Status:	Ver 1.0

Land South of Water Lane, Angmering
Discharge of Condition 9 of
Arun District Council Planning Ref. A/99/17/OUT
Sound Insulation Assessment

List of Contents

Sections

1	Introduction	1
2	Site Description	3
3	Proposed Development.....	5
4	Design Criteria and Assessment Methodology	7
5	Existing Noise Environment	7
6	Computational Noise Modelling	23
7	Sound Insulation Scheme	25
8	Performance Verification.....	30
9	External Amenity	32
10	Conclusions	34

Figures

Figure 2.1: Site in Relation to the Local Highway Network.....	3
Figure 3.1: Proposed General Arrangement of Site.....	6
Figure 4.1: ProPG Internal Noise Level Design Guidance	9
Figure 5.1: Automated Measurement Locations	11
Figure 5.2: A1 Noise Monitoring Results	14
Figure 5.2: A2 Noise Monitoring Results	14
Figure 5.2: A3 Noise Monitoring Results	15
Figure 5.2: A4 Noise Monitoring Results	15
Figure 5.1: Attended Measurement Locations	16
Figure 6.1: Daytime Noise Model LAeq,16hour	23
Figure 6.2: Night-time Noise Model LAeq,8hour	24
Figure 7.1: Acoustic Performance Recommendations.....	28
Figure 8.1: Plots Selected for Performance Verification	30
Figure 9.1: Noise Levels in External Amenity Areas.....	32

Tables

Table 4.1: BS 8233 Indoor Ambient Noise Level Design Guidance	7
---	---

Table 5.1: Noise Monitoring Locations	12
Table 5.2: Instrumentation Details	12
Table 5.3: Weather	13
Table 5.4: Attended Noise Monitoring Locations	17
Table 5.5: Instrumentation Details	17
Table 5.6: Manual Measured Sound Levels.....	18
Table 5.6: A1 Estimated Daytime $L_{Aeq, 16\text{hour}}$ and Night-time $L_{Aeq, 8\text{hour}}$ Noise Levels	19
Table 5.7: A2 Estimated Daytime $L_{Aeq, 16\text{hour}}$ and Night-time $L_{Aeq, 8\text{hour}}$ Noise Levels	20
Table 5.8: A3 Estimated Daytime $L_{Aeq, 16\text{hour}}$ and Night-time $L_{Aeq, 8\text{hour}}$ Noise Levels	20
Table 5.9: A4 Estimated Daytime $L_{Aeq, 16\text{hour}}$ and Night-time $L_{Aeq, 8\text{hour}}$ Noise Levels	21
Table 5.10: Calculated Daytime and Night-time $L_{Aeq, T}$ values.....	22
Table 7.1: Estimated Apparent SRI for Solid External Walls Elements.....	26
Table 7.2: Corrections for Multiple Ventilators	29

Sound Insulation Assessment

1 Introduction

1.1 Mayer Brown Limited has been commissioned by Barratt David Wilson Homes, to provide acoustic consultancy advice to assist with the detailed design of sound insulation provisions for a new residential development on land South of Water Lane, Angmering.

1.2 Outline planning consent for the development was granted by Arun District Council on 26/06/2017 (ref. A/99/17/OUT). Condition 9 of the Outline Planning Permission granted requires:

“Prior to the commencement of development a noise mitigation scheme shall be submitted for approval to the Local Planning Authority. The noise mitigation scheme shall include details relating to acoustic barriers and the façade treatment of all houses facing onto the A280 and Water Lane. The approved noise mitigation shall be implemented in accordance with the details submitted. All facades of all houses facing onto the A280 and Water Lane should be provided with acoustically treated mechanical ventilation to all habitable rooms.”

1.3 This report seeks to provide relevant information regarding the sound insulation of properties and protection of outdoor amenity spaces to discharge the above condition. This report is structured as follows:

- ✦ **Section 2** describes the location of the site in relation to the existing transport infrastructure and neighbouring land uses;
- ✦ **Section 3** outlines the proposed development;
- ✦ **Section 4** sets out the technical design requirements it is proposed to adopt;
- ✦ **Section 5** presents the results of environmental noise monitoring undertaken at the site;
- ✦ **Section 6** presents the results of computational noise modelling to assist in understanding the variation of noise levels around the site;
- ✦ **Section 7** outlines the proposed sound insulation scheme;
- ✦ **Section 8** provides a summary of calculated internal noise levels for the scheme, based on detailed sound insulation calculations in accordance with BS EN ISO 12354: 2017: “Building Acoustics - Estimation of Acoustic Performance of Buildings from the Performance of Elements - Part 3: Airborne Sound Insulation Against Outdoor Sound”, which are also appended to this assessment;
- ✦ **Section 9** provides a summary of calculated noise levels in external amenity areas of the site

Sound Insulation Assessment

- ❖ Conclusions are presented in **Section 10**.
- 1.4 A glossary of the acoustic terminology used in this report is attached at **Appendix A**.

Sound Insulation Assessment

2 Site Description

- 2.1 The location of the proposed development in relation to the local highway network and infrastructure is shown below in **Figure 2.1**.

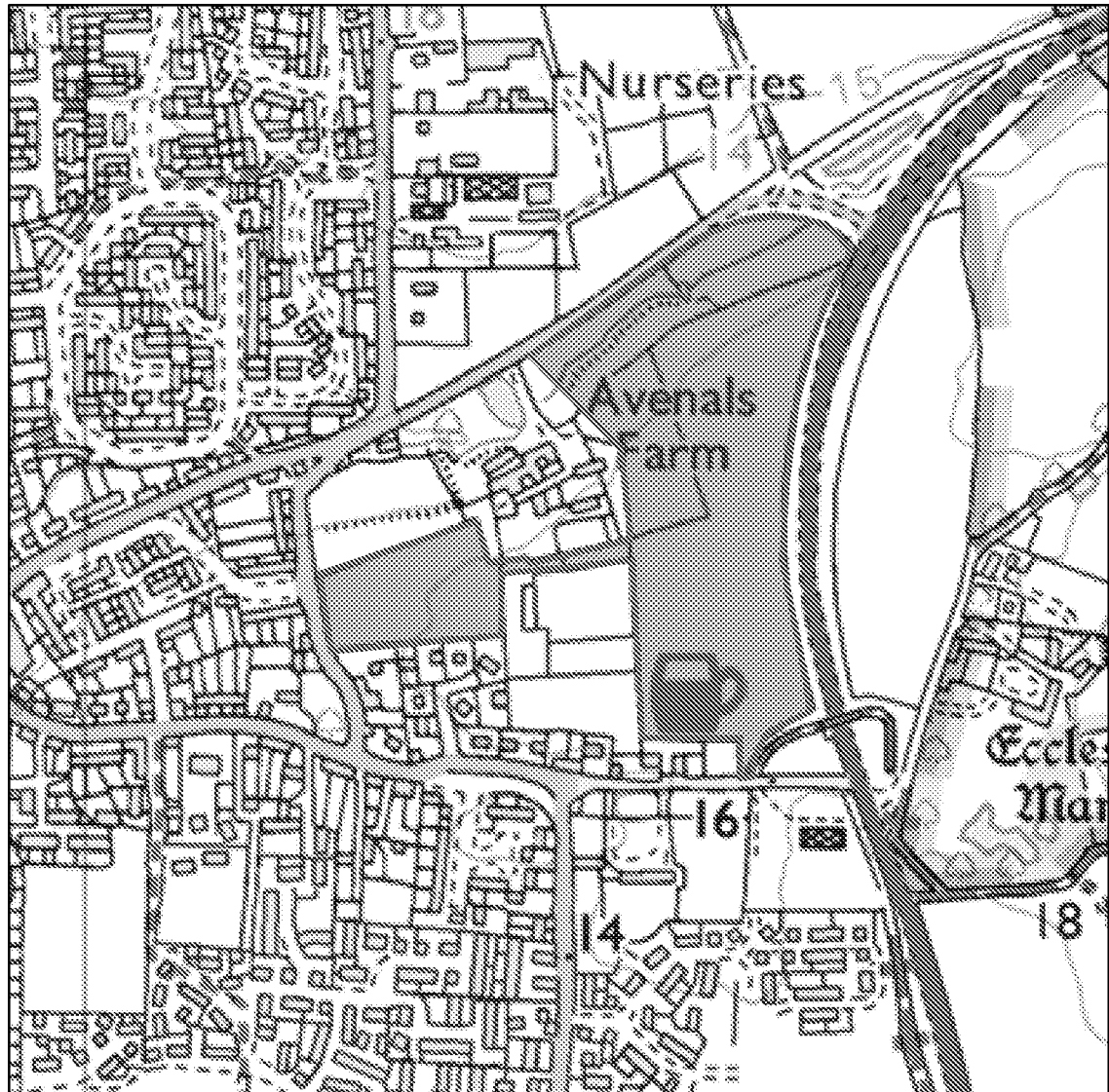


Figure 2.1: Site in Relation to the Local Highway Network

- 2.2 The site is located to the east of Angmering town centre, and to the west of the A280.
- 2.3 The site currently consists of open fields marked with hedgerows. The site includes a western parcel of land connected by a corridor. The site comprises of approximately 7.5 hectares of agricultural land.
- 2.4 To the north the site is bounded by Water Lane, a single carriageway leading off the A280 and onto Station Road. Further North of Water Lane are areas of open grassland.
- 2.5 To the east the site is bounded by the A280.

Sound Insulation Assessment

- 2.6 To southern boundary of the site is formed with a commercial unit currently occupied by a restaurant/public house (The Spotted Cow), further south are residential properties.
- 2.7 To the West of the site are two large residential dwellings, surrounding the residential properties are vast areas of open felids. Further west of the fields are residential properties.

Sound Insulation Assessment

3 Proposed Development

- 3.1 Outline planning consent for the development was granted by Arun District Council (ADC) on 26/06/2017 (ref. A/99/17/OUT).
- 3.2 The outline planning permission (ref. A/99/17/OUT) permits the development of:
- ✦ Up to 175 dwellings, including affordable homes;
 - ✦ A local play area
 - ✦ Public open space;
 - ✦ Strategic landscaping;
 - ✦ All associated and ancillary infrastructure and development.
- 3.3 The proposed general arrangement of the site proposed in the reserved matters application is shown in **Figure 3.1** overleaf:

Sound Insulation Assessment

4 Design Criteria and Assessment Methodology

- 4.1 Whilst the reason for Condition 9 is clear (i.e. *“For the protection of health and residential amenity”*), the condition does not make any specific reference to noise intrusion design targets or recommendations for external amenity areas.
- 4.2 The design recommendations presented in this report have therefore been informed by the guidance set out in:
- BS 8233: 2014: *“Guidance on Sound Insulation and Noise Reduction for Buildings”*, and
 - *“ProPG: Planning & Noise – Professional Practice Guidance on Planning & Noise - New Residential Development”* published by the Association of Noise Consultants, Institute of Acoustics and Chartered Institute of Environmental Health, May 2017.
- 4.3 Both documents are referenced in paragraph 015, Reference ID: 30-015-20190722 of the Government’s Planning Practice Guidance¹.

BS 8233: 2014 Sound Insulation and Noise Reduction for Buildings

- 4.4 BS 8233: 2014 *Sound Insulation and Noise Reduction for Buildings* offers the following design guidance for indoor ambient noise levels within dwellings:

Activity	Location	07.00 to 23.00 hours	23.00 to 07.00 hours
Resting	Living Room	35dB L _{Aeq,16hour}	--
Dining	Dining Room/Area	40dB L _{Aeq,16hour}	--
Sleeping (daytime resting)	Bedroom	35dB L _{Aeq,16hour}	30dB L _{Aeq,8hour}

Table 4.1: BS 8233 Indoor Ambient Noise Level Design Guidance

- 4.5 A note accompanying the above table states:

“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.”

¹ <https://www.gov.uk/guidance/noise--2>

Sound Insulation Assessment

- 4.6 The planning condition also makes reference to noise levels in external amenity spaces. Section 7.7.3.2 of BS 8233: 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.

ProPG: Professional Practice Guidance on Planning and Noise

- 4.7 ProPG: Planning & Noise was published in May 2017. The guidance was authored by the Chartered Institute of Environmental Health (CIEH), Institute of Acoustics (IOA) and Association of Noise Consultants (ANC) and seeks to consolidate and standardise existing industry best practice in order to expedite the planning process with regard to the consideration of noise.
- 4.8 The guidance essentially promotes a two-stage assessment process to determine the suitability of a site for residential development and an appropriate noise mitigation strategy for addressing potential noise constraints.
- 4.9 A “Stage 1” assessment considers the initial noise “risk” of the site. An assessment in accordance with this guidance was presented in the “Noise and Vibration Assessment” prepared by Mayer Brown Limited which accompanied the outline planning application. This concluded that subject to adherence to a good acoustic design process, the site would be suitable for residential development.
- 4.10 This Noise Survey and Mitigation Scheme report therefore focusses on the more detailed requirements of Stage 2 of the ProPG guidance. In essence, this requires consideration of four key elements:
- ❖ **Element 1** – Good Acoustic Design Process
 - ❖ **Element 2** – Internal Noise Level Guidelines
 - ❖ **Element 3** – External Amenity Area Noise Assessment
 - ❖ **Element 4** – Assessment of Other Relevant Issues

Sound Insulation Assessment

4.11 Element 1 (Good Acoustic Design Process) encourages the development of sites with due regard to the following hierarchy of mitigation strategies:

- ✦ Reducing noise “at source”;
- ✦ Providing “buffer” zones to limit noise exposure;
- ✦ Reducing noise propagation across site (e.g. through the use of barriers);
- ✦ Developing the layout of the site to optimise acoustic protection (e.g. through the use of “barrier” blocks to help further limit noise propagation and the use of courtyard style development to protect external amenity areas);
- ✦ The orientation/general internal arrangement of buildings (e.g. by locating non-habitable rooms on ‘noisier’ facades and more sensitive uses on acoustically screened facades); and
- ✦ Providing buildings with appropriate sound insulation through the specification of appropriate external fabric constructions (in particular windows) and providing appropriate alternative means of ventilation if acceptable internal noise levels cannot be achieved if windows are open.

4.12 In relation to Element 2 (Internal Noise Design Targets), Figure 2 of ProPG makes the following design recommendations:

ACTIVITY	LOCATION	07:00 – 23:00 HRS	23:00 – 07:00 HRS
Resting	Living room	35 dB $L_{Aeq,16hr}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16hr}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,8hr}$ 45 dB $L_{max,C}$ (Note 6)

Figure 4.1: ProPG Internal Noise Level Design Guidance

4.13 The above recommendations are accompanied by a number of notes. Of particular relevance are:

- ✦ **Note 4** – which clarifies that the recommended $L_{Amax,fast}$ value should not normally be exceeded 10 times per night; and
- ✦ **Note 5** – which states “Where it is not possible to meet internal target levels with windows open, internal noise levels can be assessed with windows closed, however any façade openings used to provide whole dwelling ventilation (e.g. trickle ventilators) should be assessed in the “open” position and, in this scenario, the internal L_{Aeq} target levels should not normally be exceeded....”.

4.14 It should be noted that the above design guidance is primarily intended for sites characterised by noise from transportation sources. Where existing noise levels are

Sound Insulation Assessment

dominated by industrial or commercial noise, ProPG recommends that reference is made to the assessment methodology of BS 4142: 2014².

4.15 For sites where industrial or commercial noise may be present but not “dominant”, ProPG suggests that the industrial noise component may be included and combined with the transportation noise component and professional judgement used to determine appropriate mitigation. ProPG clarifies that noise can be considered “dominant” where the impact would be rated as “adverse or greater, subject to context”. This implies a plant rating level that is at least 5dB above the typical background level, when rated in accordance with BS 4142.

4.16 In relation to Element 3 (External Amenity Area Noise Assessment), the following guidance is given:

“The acoustic environment of external amenity areas that are an intrinsic part of the overall design should always be assessed and noise levels should ideally not be above the range 50 – 55 dB $L_{Aeq, 16hr}$.

These guideline values may not be achievable in all circumstances where development might be desirable. In such a situation, development should be designed to achieve the lowest practicable noise levels in these external amenity spaces.”

4.17 Element 4 (Assessment of Other Relevant Issues) does not set out any quantitative technical guidance, but requires consideration of “issues that should be considered about the noise aspects of a particular planning proposal for new residential development”.

² This standard has now been replaced by BS 4142: 2014 + A1: 2019.

Sound Insulation Assessment

5 Existing Noise Environment

General

- 5.1 Existing baseline noise conditions at the site have been established using a combination of automated and manned noise surveys.

Automated Noise Monitoring

- 5.2 The automated survey was undertaken over a notional seven day period between approximately 13.00 hours on 29 July 2020 to 13:00 hours on 05 August 2020.
- 5.3 Noise levels were monitored at four locations as indicated in **Figure 5.1** below and described in **Table 5.1** overleaf



Figure 5.1: Automated Measurement Locations

Sound Insulation Assessment

Position	Description
A1	On the south-eastern boundary of the site, attached to the boundary fence. The measurement microphone was positioned approximately 2.5 metres above ground level in free field conditions.
A2	At the north-eastern corner of the site, approximately 10m from the A280 The measurement microphone was positioned approximately 1.5 metres above ground level in free field conditions.
A3	On the northern boundary of the site, attached to the boundary fence adjacent to the entrance to Avenals Farm. The measurement microphone was positioned approximately 2.5 metres above ground level in free field conditions.
A4	On the northern boundary of the western parcel of the site, attached to the boundary fence. The measurement microphone was positioned approximately 2.5 metres above ground level in free field conditions.

Table 5.1: Noise Monitoring Locations

5.4 The following instrumentation was used:

Location	Description	Manufacturer	Model	Serial No.	Calibration Date
A1	Sound Level Meter	Svantek	SVAN 71	55551	16/06/2020
	Microphone		7052E	63681	
	Preamplifier		SV18	57254	
	Outdoor Mic. Kit		SA271U	n/a	n/a
A2	Sound Level Meter	Svantek	SVAN 71	55550	16/06/2020
	Microphone		7052E	63684	
	Preamplifier		SV18	57249	
	Outdoor Mic. Kit		SA271U	n/a	n/a
A3	Sound Level Meter	Svantek	SVAN 71	72535	13/07/2020
	Microphone		7052E	72235	
	Preamplifier		SV18	68261	
	Outdoor Mic. Kit		SA271U	n/a	n/a
A4	Sound Level Meter	Convergence Instruments	NSRT_MK 3	CnvcrdU4UXU Vjngx+jxID	13/05/2019
All	Calibrator	Rion	NC-74	34651766	13/07/2020

Table 5.2: Instrumentation Details

5.5 The sound level analysers were calibrated before the survey and checked upon completion. No drift in calibration was observed.

Sound Insulation Assessment

Survey Procedure

- 5.6 The sound level analysers were configured to record the L_{A90} , L_{Aeq} , $L_{Amax,fast}$ and $L_{Amax,slow}$ sound levels over consecutive 15 minute periods. The meters were also programmed to log noise levels at higher (1 second resolution) and to make audio recordings to assist with post analysis discrimination of noise events/sources.

Weather

- 5.7 Whilst weather conditions during the automated survey were not actively measured, observations at the time of site attendances and publicly available historic online data indicates that weather conditions were typically characterised as set out in **Table 5.3** below:

2020	Temp. (°C)	Humidity (%)	Wind Speed (km/h)	Wind Direction	Pressure (hPa)		Rainfall(mm)
July/Aug	Avg.	Avg.	Avg.	Avg.	Max	Min	total
29	15	74	1	WSW	1021	1019	0.00
30	20	65	1	S	1019	1014	0.00
31	23	65	1	SSE	1014	1009	0.00
1	19	65	2	W	1016	1013	0.00
2	17	84	2	W	1017	1015	0.00
3	18	64	3	NW	1016	1014	0.00
4	16	74	3	WSW	1017	1014	0.00
5	19	81	1	WSW	1015	1013	0.00

Table 5.3: Weather

Sound Insulation Assessment

Measurement Results

5.8 The results of the automated noise monitoring are presented in **Figures 5.2 to 5.5** below. Higher resolution copies of these time history graphs are also attached at **Appendix B**.

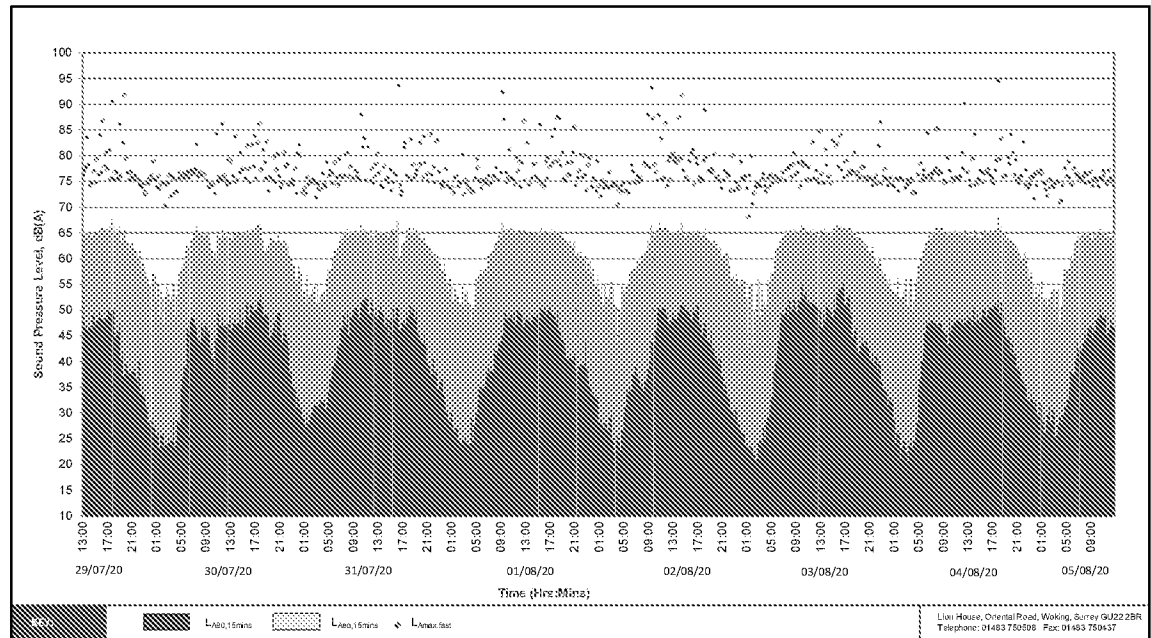


Figure 5.2: A1 Noise Monitoring Results

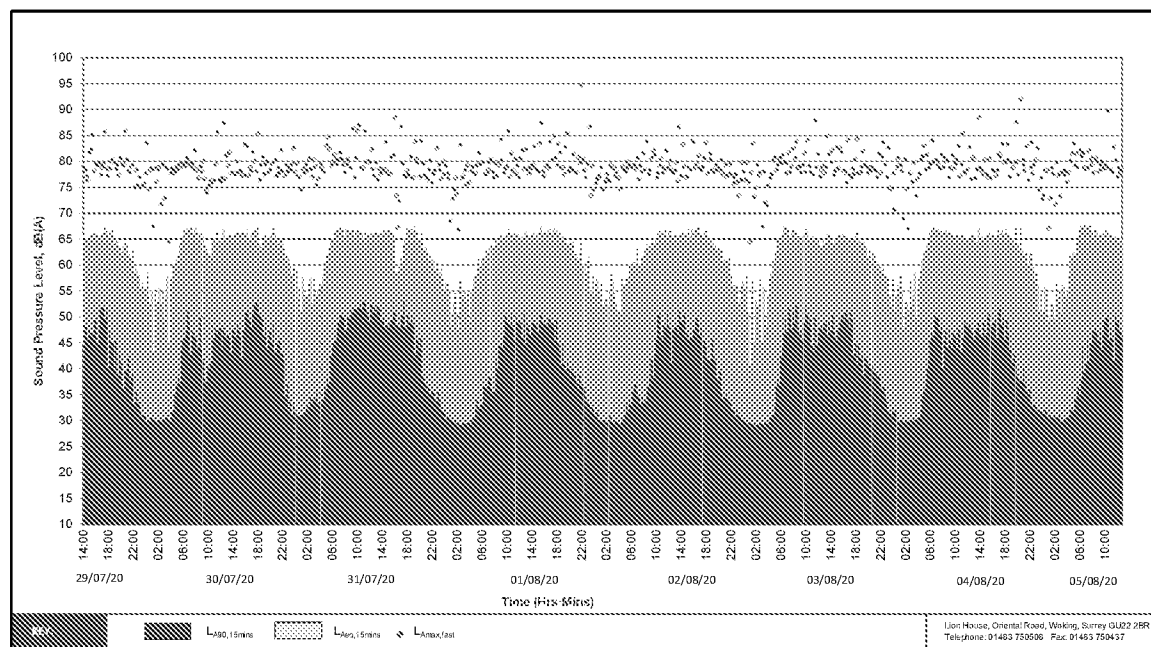


Figure 5.2: A2 Noise Monitoring Results

Sound Insulation Assessment

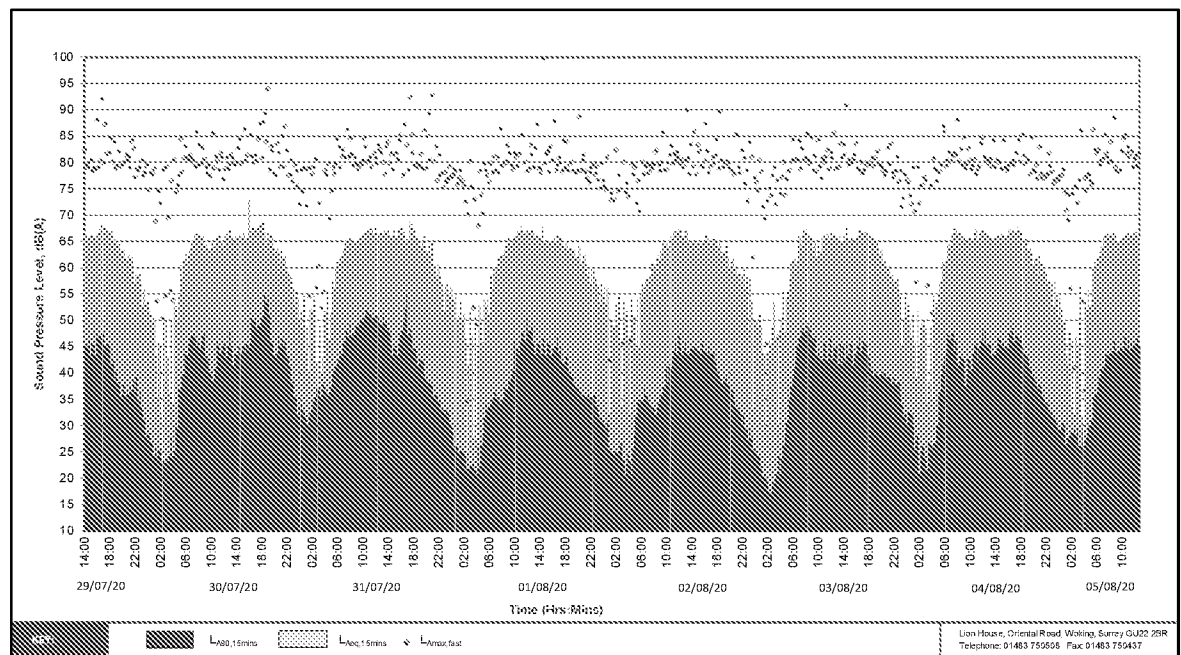


Figure 5.2: A3 Noise Monitoring Results

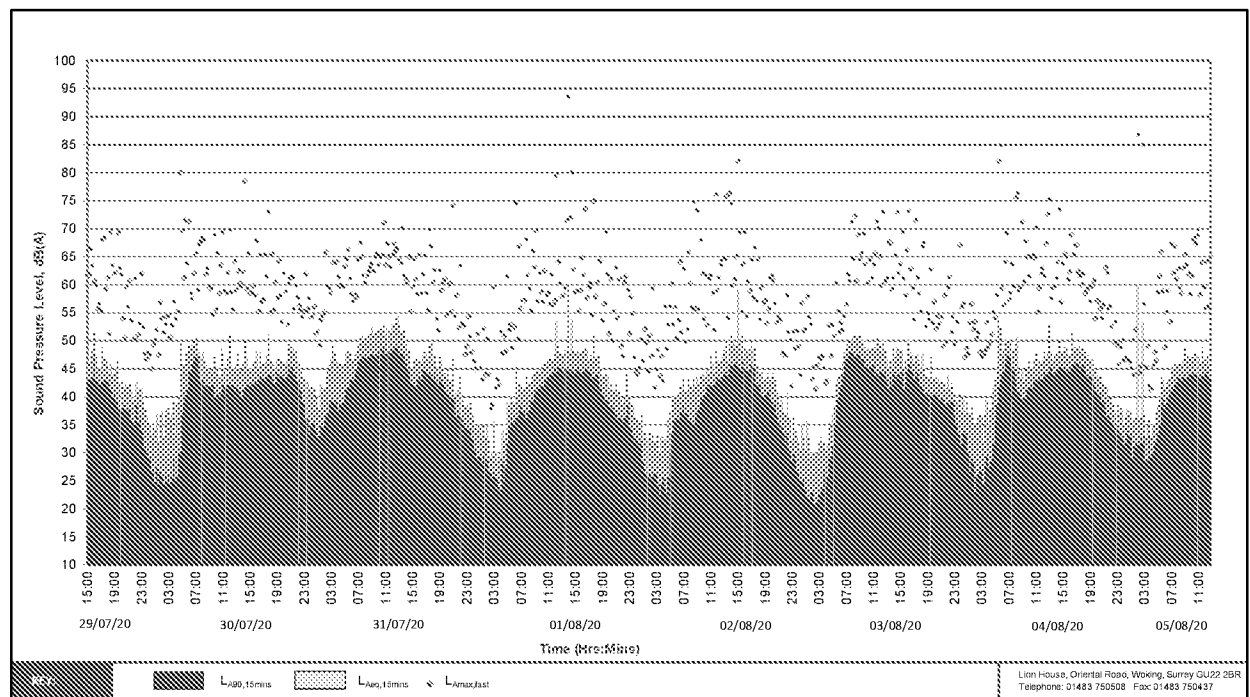


Figure 5.2: A4 Noise Monitoring Results

Observations

- 5.9 During site attendances, it was observed that noise levels characterising the site were dominated by road traffic noise.
- 5.10 The prevailing wind direction during the survey was variable and included periods of both downwind and upwind propagation from adjoining dominant road traffic sources.

Sound Insulation Assessment

Attended Monitoring

- 5.11 In order to supplement the automated noise monitoring, additional attended noise measurements were undertaken during our site attendances on 29th July 2020 and 5th August 2020.
- 5.12 Noise measurements were made at six locations shown in **Figure 5.1** below and described in **Figure 5.4** overleaf.



Figure 5.1: Attended Measurement Locations

Sound Insulation Assessment

Position	Description
M1	At the north-eastern corner of the site, approximately 10 meters from the curb of the A280. The measurement microphone was positioned approximately 1.5 metres above ground level in free field conditions.
M2	On the eastern boundary of the site, approximately 15 meters from the curb of the A280. The measurement microphone was positioned approximately 1.5 metres above ground level in free field conditions.
M3	At the south-eastern corner of the site, approximately 15 meters from the curb of the A280. The measurement microphone was positioned approximately 1.5 metres above ground level in free field conditions.
M4	At the northern corner of the site, approximately 4m from the curb of Water Lane. The measurement microphone was positioned approximately 1.5 metres above ground level in free field conditions.
M5	On the northern boundary of the site, adjacent to the entrance of Avenals Farm. The position is approximately 4m from the curb of Water Lane. The measurement microphone was positioned approximately 2.5 metres above ground level in free field conditions.
M6	To the west of the site, along Water Lane. The position is approximately 2m from the curb of Water Lane. The measurement microphone was positioned approximately 1.5 metres above ground level in free field conditions.

Table 5.4: Attended Noise Monitoring Locations

5.13 The following instrumentation was used

Location	Description	Manufacturer	Model	Serial No.	Calibration Date
M1-6	Sound Level Meter	NTI	XL2-TA	A2A-13108-E0	12/07/2019
	Microphone		M2230A	A14228	
	Preamplifier		MC230A	6832	
	Outdoor Microphone Kit		-	-	n/a
All	Calibrator	Rion	NC-74	34651766	13/07/2020

Table 5.5: Instrumentation Details

5.14 The weather during the survey on 29th July 2020 (M4-M6) was dry and cloudy with a temperature of around 15°C, little/no wind and with around 5 oktas of cloud cover. Weather during the additional survey on 5th August 2020 (M1-M3) was dry and cloudy with a temperature of around 20°C, little/no wind and with around 3 oktas of cloud cover.

Sound Insulation Assessment

Survey Procedure

- 5.15 At each location, attended noise measurements were undertaken over a three-hour period, in general accordance with the 'shortened measurement procedure' of the "Calculation of Road Traffic Noise"³.
- 5.16 The sound level analyser was configured to measure the L_{A90} , L_{A10} , L_{Aeq} and $L_{Amax,fast}$ noise indices over a notional 15 minute time period. The measured value is taken to be representative of the hour in which the measurement was taken.

Attended Survey Results

- 5.17 The measurement results are presented in **Table 5.6** overleaf:

Location	Time	$L_{A90,15mins}$	$L_{Aeq,15mins}$	$L_{A10,15mins}$	$L_{Amax,fast}$
M1	13.00 – 14.00	52	65	70	78
	14.00 – 15.00	53	64	68	77
	15.00 – 16.00	51	64	68	84
M2	13.00 – 14.00	52	62	66	73
	14.00 – 15.00	53	62	62	74
	15.00 – 16.00	54	63	66	73
M3	13.00 – 14.00	48	62	67	73
	14.00 – 15.00	46	63	67	79
	15.00 – 16.00	49	63	67	79
M4	13.00 – 14.00	48	71	76	84
	14.00 – 15.00	47	70	75	85
	15.00 – 16.00	49	70	75	85
M5	13.00 – 14.00	47	69	74	82
	14.00 – 15.00	48	69	73	83
	15.00 – 16.00	46	68	73	85
M6	13.00 – 14.00	48	69	73	83
	14.00 – 15.00	42	67	72	81
	15.00 – 16.00	42	67	72	82

Table 5.6: Manual Measured Sound Levels

³ Department of Transport. (1998) Calculation of Road Traffic Noise (CRTN). HMSO. London.

Sound Insulation Assessment

Observations and Discussion

- 5.18 The noise measurements were dominated by road traffic noise from the A280 and Water Lane.

Analysis of Data

Automated Noise Data

- 5.19 The measurement data has been post-processed using SvanPC++ data analysis software provide an indication of likely daytime ($L_{Aeq,16hr}$) and night-time ($L_{Aeq,8hr}$) values. These are summarised in **Table 5.6** to **Table 5.9** below:

A1	Day-time $L_{Aeq,16hr}$ (07:00 – 23:00)	Night-Time $L_{Aeq,8hr}$ (23:00 – 07:00)
29/07/20	65	58
30/07/20	64	58
31/07/20	65	56
01/08/20	64	56
02/08/20	64	57
03/08/20	65	58
04/08/20	65	57
05/08/20	65	-

Table 5.6: A1 Estimated Daytime $L_{Aeq,16hr}$ and Night-time $L_{Aeq,8hr}$ Noise Levels

Sound Insulation Assessment

A2	Day-time $L_{Aeq,16hr}$ (07:00 – 23:00)	Night-Time $L_{Aeq,8hr}$ (23:00 – 07:00)
29/07/20	65	61
30/07/20	65	61
31/07/20	65	58
01/08/20	65	57
02/08/20	65	60
03/08/20	65	61
04/08/20	65	61
05/08/20	66	-

Table 5.7: A2 Estimated Daytime $L_{Aeq,16hour}$ and Night-time $L_{Aeq,8hour}$ Noise Levels

A3	Day-time $L_{Aeq,16hr}$ (07:00 – 23:00)	Night-Time $L_{Aeq,8hr}$ (23:00 – 07:00)
29/07/20	65	56
30/07/20	66	55
31/07/20	66	53
01/08/20	65	53
02/08/20	64	55
03/08/20	65	56
04/08/20	65	56
05/08/20	66	-

Table 5.8: A3 Estimated Daytime $L_{Aeq,16hour}$ and Night-time $L_{Aeq,8hour}$ Noise Levels

Sound Insulation Assessment

A4	Day-time $L_{Aeq,16hr}$ (07:00 – 23:00)	Night-Time $L_{Aeq,8hr}$ (23:00 – 07:00)
29/07/20	45	44
30/07/20	47	45
31/07/20	50	37
01/08/20	48	37
02/08/20	47	39
03/08/20	48	45
04/08/20	47	46
05/08/20	47	-

Table 5.9: A4 Estimated Daytime $L_{Aeq,16hour}$ and Night-time $L_{Aeq,8hour}$ Noise Levels

Attended Noise Measurements

5.20 Daytime and night-time sound levels for the attended noise measurement locations have been estimated in accordance with the shortened measurement procedure of CRTN⁴. This analysis yields a predicted $L_{A10,18hour}$ value from which the $L_{Aeq,16hour}$ and $L_{Aeq,8hour}$ values have been estimated using the procedures developed by TRL/Casella Stanger for DEFRA⁵.

5.21 Calculated values are summarised in **Table 5.10** below.

Location	Day-time $L_{Aeq,16hr}$ (07:00 – 23:00)	Night-Time $L_{Aeq,8hr}$ (23:00 – 07:00)
M1	65	57
M2	62	54
M3	64	55
M4	72	63
M5	70	61
M6	69	60

⁴ Department of Transport. (1988) "Calculation of Road Traffic Noise". HMSO, London.

⁵ TRL/Casella Stanger (2006) for DEFRA. Method for Converting the UK Road Traffic Noise Index $L_{A10,18h}$ to the EU Noise Indices for Road Noise Mapping.

Sound Insulation Assessment

Table 5.10: Calculated Daytime and Night-time $L_{Aeq,T}$ values

Covid-19

- 5.22 It should be noted that the noise survey work was undertaken during the Covid-19 “lockdown” and thus on-site noise levels may not be fully representative of (may underestimate) “normal” (pre-pandemic) noise levels.
- 5.23 The Association of Noise Consultants (ANC) and the Institute of Acoustics (IOA) has published guidance⁶ on the reliability of baseline noise surveys and noise impact assessments which states that;

“...it is still important to minimize uncertainties in surveying and to select appropriate baseline conditions, in a clear and transparent way. Furthermore, by good communication between those preparing the reports and those that will be reviewing them, the planning process (and other relevant processes) will be able to continue as smoothly as possible.....”

Methodology

For transport schemes, there will have to be a reliance on predicted sound levels to describe the baseline conditions, with a corresponding need to source flow/activity data. There are now many sources of transport data available and these should be used, where possible, along with previously made direct site measurements to describe baseline conditions”

- 5.24 As noted earlier, noise levels at the site are dominated by road traffic noise. Data published by the government during the survey period⁷ indicate that the public usage of the road network is estimated to have reduced to around 13% of “normal” activity for all motor vehicles. It follows that measured noise levels may be around 1dB lower than “pre-Covid” noise levels. In order to account for this, a correction of 1dB will be applied to the measurement data to provide a more robust indication of existing noise levels. With this correction applied, measured noise levels also show consistency with environmental noise survey work historically undertaken at the site to inform the original outline application.

⁶ Association of Noise Consultants [ANC] and the Institute of Acoustics [IOA] *Joint Guidance on the Impact of COVID-19 on the Practicality and Reliability of Baseline Sound Level Surveying and the Provision of Sound & Noise Impact Assessments* (April 2020)

⁷ <https://www.gov.uk/government/statistics/transport-use-during-the-coronavirus-covid-19-pandemic>

Sound Insulation Assessment

6 Computational Noise Modelling

- 6.1 In order to obtain a detailed understanding of the propagation of noise across the development site, a computational noise model has been developed using Datakustic CadnaA® noise modelling software. This software implements the “*Calculation of Road Traffic Noise*”⁸ (CRTN).
- 6.2 The noise model was constructed using OS topographical data and AAP Architecture Drawing No. Site Layout Plan (Drawing Ref: PLN-1-1101).

Daytime Noise Model

- 6.3 **Figure 6.1** below presents modelled daytime ($L_{Aeq, 16\text{hour}}$) noise levels (calculated at 1.5m above local ground level).



Figure 6.1: Daytime Noise Model $L_{Aeq, 16\text{hour}}$

⁸ Department of Transport. (1988). “*Calculation of Road Traffic Noise*”. HMSO, London.

Sound Insulation Assessment

Night-time Noise Model

6.4 **Figure 6.2** below presents modelled night-time ($L_{Aeq,8hour}$) noise levels (calculated at 4m above local ground level).



Figure 6.2: Night-time Noise Model $L_{Aeq,8hour}$

7 Sound Insulation Scheme

General

- 7.1 The level of sound insulation required of a building façade will be determined by:
- ✦ **The noise levels incident on a particular area of façade.** In the case of this development, it is clear that higher levels of sound insulation will be required for facades looking “towards” neighbouring roads, than for units facing away from such sources.
 - ✦ **The sound insulation capabilities of the constituent building elements.** For windows set within masonry external walls, noise intrusion will generally be determined by the acoustic performance of the windows.
 - ✦ **The relative proportion of building elements.** The sound insulation required will increase as the façade area to a room increases. The sound insulation required of weaker performing elements (e.g. windows) will also increase when the proportional area of these is increased.
 - ✦ **The acoustic conditions of the receiving room.** Noise intrusion into acoustically hard (reverberant) rooms, will increase sound insulation requirements.
- 7.2 In order to assess sound insulation, detailed noise intrusion calculations have been undertaken in accordance with BS EN 12354-3:2017 *“Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound”*.
- 7.3 The baseline data and assumptions used in these calculations are outlined in the following sections.

Incident Noise Levels

- 7.4 Incident noise levels have been evaluated based on the noise levels determined from the computational noise models outlined in Section 6. Incident octave band sound levels have been determined by applying the normalised spectrum corrections to the modelled $L_{Aeq,T}$ sound level.

Sound Insulation Assessment

Architectural Design Information

- 7.5 All calculations are based on relevant drawings for each house/block of flats prepared by AAP Architecture.

External Wall Construction

- 7.6 Noise intrusion into buildings is normally determined by the acoustic performance of the windows, since these represent the “weakest” element acoustically. For preliminary calculation purposes, it is assumed that “solid” external wall construction will maintain the following minimum apparent sound reduction indices.

Apparent Sound Reduction Index, dB					
125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz
41	43	48	50	55	55

Table 7.1: Estimated Apparent SRI for Solid External Walls Elements

The above performance values should also be achievable with a masonry faced steel or timber framed construction system and therefore provides a robust assessment basis for reviewing the likely acoustic performance requirements of windows and feasibility of maintaining an appropriate level of sound insulation.

Room Acoustic Conditions

- 7.7 As noted earlier, noise intrusion into flats/houses will also be partially determined by the internal room finishes, which will determine the reverberation times within the building. For the purpose of this assessment, a reverberation time of 0.5 seconds has been assumed for all rooms, in line with the standardised reverberation time implemented in Approved Document E of the Building Regulations 2010.

Ventilation Strategy

- 7.8 It is understood that the whole building and extract ventilation requirements of Approved Document E are to be achieved through the use of continuous mechanical extract system, in line with System 1 of Approved Document F of the Building Regulations 2010 (as amended), i.e. passive ventilators (e.g. trickle vent) and intermittent extract.

Glazing & Ventilator Sound Reduction Performance Requirements

- 7.9 Calculations have been undertaken in accordance with the methodology of BS EN ISO 12354-3: 2017: *“Building acoustics. Estimation of acoustic performance in buildings from the performance of elements. Airborne sound insulation against outdoor sound”* to

Sound Insulation Assessment

determine typical sound reduction performance requirements for windows and ventilators.

- 7.10 The calculations indicate that noise intrusion into the majority of properties on the site should be readily controlled in line with the guidance of BS 8233: 2014 guidance with the use of “standard” thermal double glazing (e.g. windows glazed with 4mm glass / 16mm cavity / 4mm glass, which would typically offer a performance of around R_w 29dB) and standard trickle vents (e.g. vents offering a notional performance of $D_{ne,w}$ 32 dB).
- 7.11 For those properties fronting the A280 exposed to higher levels of noise in order that windows can remain closed, alternative ventilation through the use of enhanced performance acoustically rated trickle ventilators (offering of performance up to $D_{ne,w}$ 38dB) is also recommended.
- 7.12 The proposed sound insulation scheme is summarised in **Figure 7.1** below.

Sound Insulation Assessment



Figure 7.1: Acoustic Performance Recommendations

Sound Insulation Assessment

- 7.13 The acoustic performance values are expressed in terms of octave band “Sound Reduction Indices” (R) and “Normalised Sound Level Differences” (D_{ne}) as determined in accordance with BS EN ISO 10140-2:2010: ‘*Acoustics. Laboratory Measurement of Sound Insulation of Building Elements. Measurement of Airborne Sound Insulation.*’ and BS EN ISO 10140-4:2010: ‘*Acoustics. Laboratory measurement of sound insulation of building elements. Measurement procedures and requirements*’.
- 7.14 The sound insulation offered by a window system is not solely dependent upon the thickness of glass and separating airspace. The framing details, sealing arrangements etc. will all affect how the system will perform in practice. In view of this, it is not normally appropriate to recommend specific glazing configurations to meet the specified performance requirements and compliance should be verified by reference to acoustic data from proposed manufacturer’s/suppliers.
- 7.15 It should be noted that the trickle ventilator performance indicated assume a single trickle vent per habitable room. If more than one ventilators needs to be installed, the acoustic performance value for **each** ventilator will need to be increased in line with the corrections set out in the following table:

No of Ventilators	Correction to be Applied to Specified D_{ne} Performance Value
1	0
2	+3
3	+5

Table 7.2: Corrections for Multiple Ventilators

- 7.16 It is recommended that the acoustic performance requirements set out above form part of the tender documentation and that suppliers are requested to submit appropriate evidence to demonstrate compliance with the specified values.

8 Performance Verification

- 8.1 In order to verify the adequacy of the sound insulation recommendations above, detailed calculations have been undertaken for a representative sample of rooms on each elevation of the building, implementing the same performance data and assumptions set out in Section 7 above. Selected plots are shown in **Figure 8.1** below:

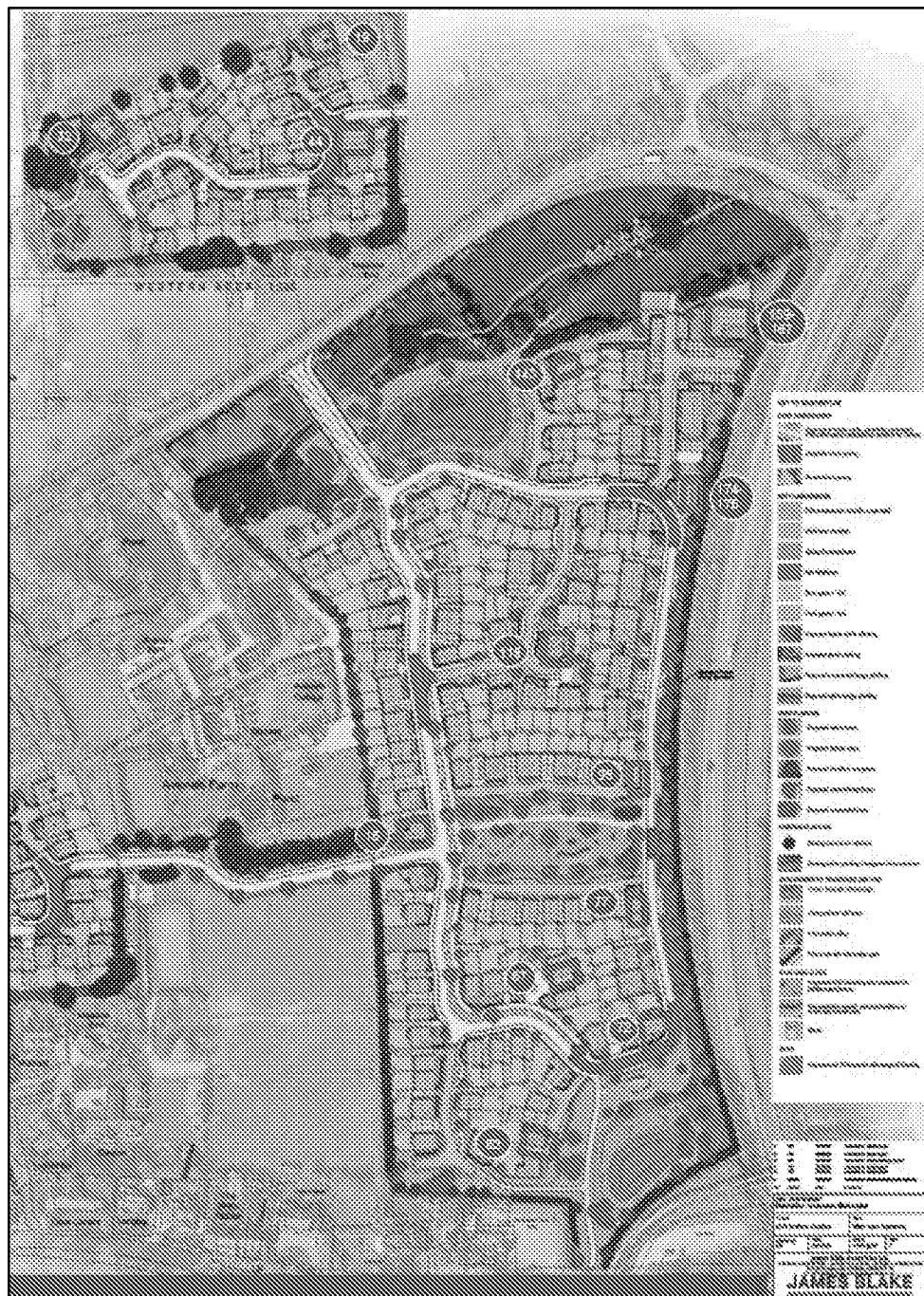


Figure 8.1: Plots Selected for Performance Verification

Sound Insulation Assessment

- 8.2 Calculation sheets for the above plots are attached at **Appendix C**.
- 8.3 The calculations sheets confirm that implementation of the acoustic design strategy outlined in **Section 7** above is fully compatible with controlling noise intrusion levels into the development in accordance with the guidance of BS 8233: 2014 and as such provide an adequate scheme of insulation as required by Condition 9 of the outline planning permission.

Sound Insulation Assessment

9 External Amenity

- 9.1 The guidance of BS 8233 and the WHO's "Guidelines for Community Noise" both recommend that noise levels in external amenity spaces are below 55dB $L_{Aeq,T}$, where it is practicable for this to be achieved.
- 9.2 **Figure 9.1** below shows the noise levels in the external areas of the site. Noise levels below $L_{Aeq,16hour}$ 55 dB are shown in "GREEN". Noise levels which exceed $L_{Aeq,16hour}$ 55dB are shown in "RED".

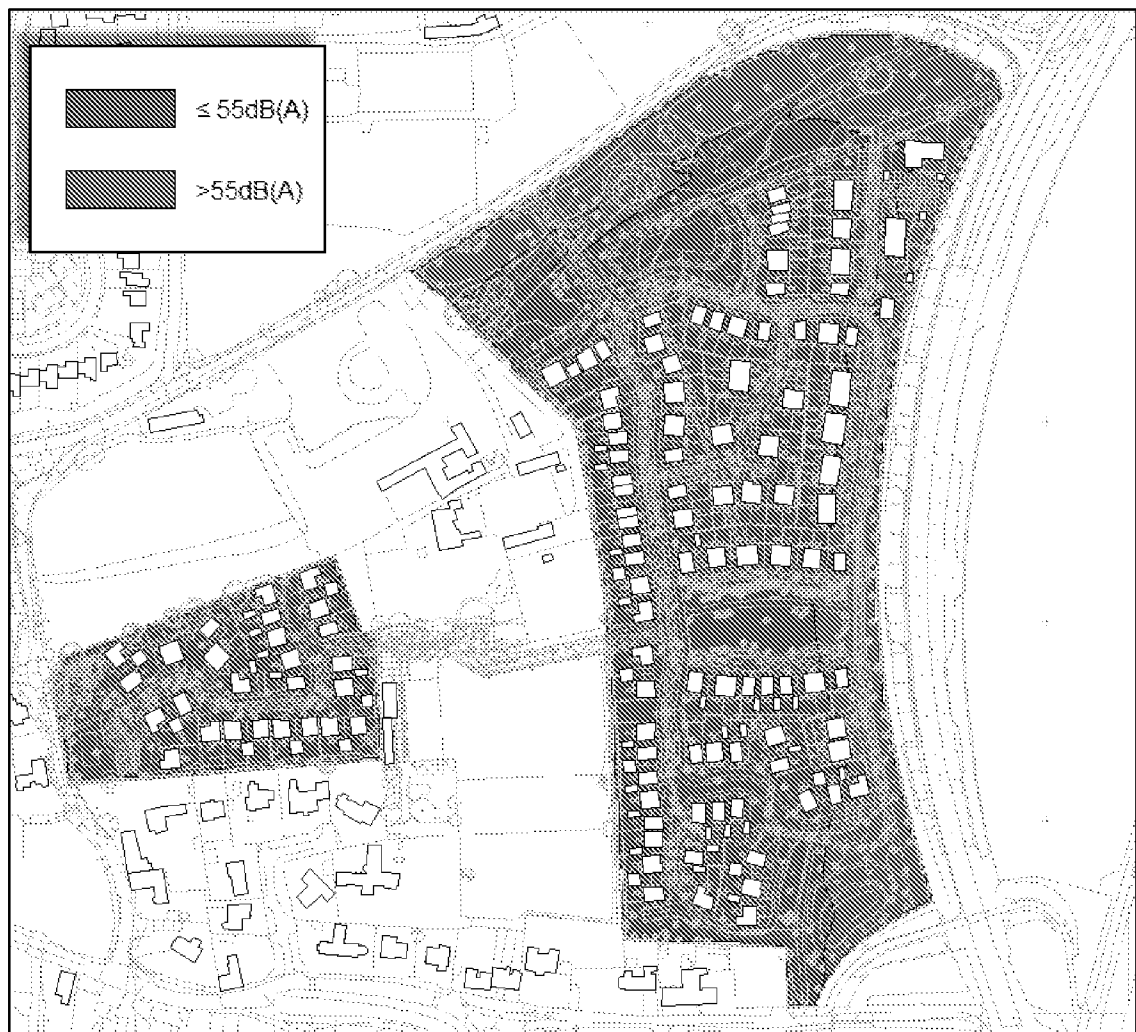


Figure 9.1: Noise Levels in External Amenity Areas

- 9.3 As shown in **Figure 9.1** the general massing of buildings and orientation of the dwellings will help minimise the propagation of noise from the A280 and shows that noise levels in amenity spaces should generally be compliant with the aspirational noise levels indicated in both WHO and BS 8233 guidance.

Sound Insulation Assessment

- 9.4 It should be noted that the above modelling does not make allowance for boundary treatments to individual properties. It should be noted however that dwellings will have 1.8m high close boarded timber fencing as a matter of course which will further assist in minimising noise levels in external amenity areas. Residents will also have access to the extensive public amenity areas being created by the wider development site.

Sound Insulation Assessment

10 Conclusions

Existing Noise Environment

- 10.1 The results of noise monitoring providing information to inform detailed design analyses are presented.

Computational Noise Modelling

- 10.2 Computational noise modelling of the site has been developed to assist with developing noise mitigation strategies.

Noise Intrusion

- 10.3 Performance requirements for glazing and ventilators, compatible with delivering the technical requirements of BS 8233: 2014, are presented.
- 10.4 Detailed calculations in accordance with BS EN ISO 12354-3: 2017 are presented to verify the acceptability of these design recommendations.

Conclusion

- 10.5 It is concluded that proposed noise mitigation adequately protects the future occupiers of the site from traffic noise, as required by Condition 9 of the outline planning permission granted for the development.

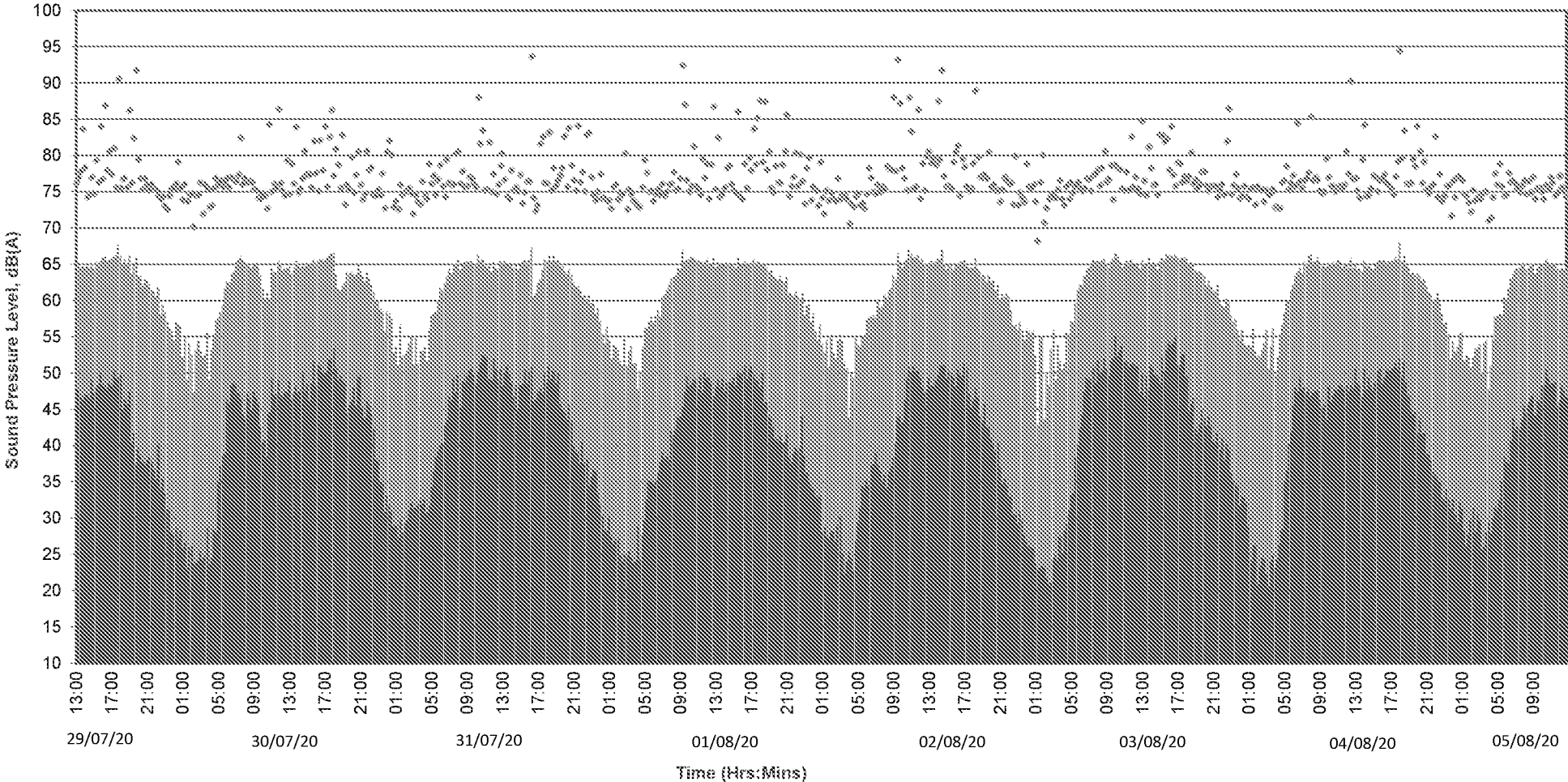
APPENDIX A: Glossary of Acoustic Terminology

- Cannot generally perceive a sound level difference of less than 3dB(A)
- Will perceive a sound level difference of 4-5dB(A) as "noticeable"
- Will perceive a sound level difference of 10dB(A) as a doubling (or halving) of loudness.

APPENDIX B: Noise Monitoring Time History Plots

Time History Graph A1

Project: Angmering
Measurement Location: A1
Survey Period: 29/07/20 - 05/08/20



KEY: LA90,15mins LAeq,15mins LAmax,fast

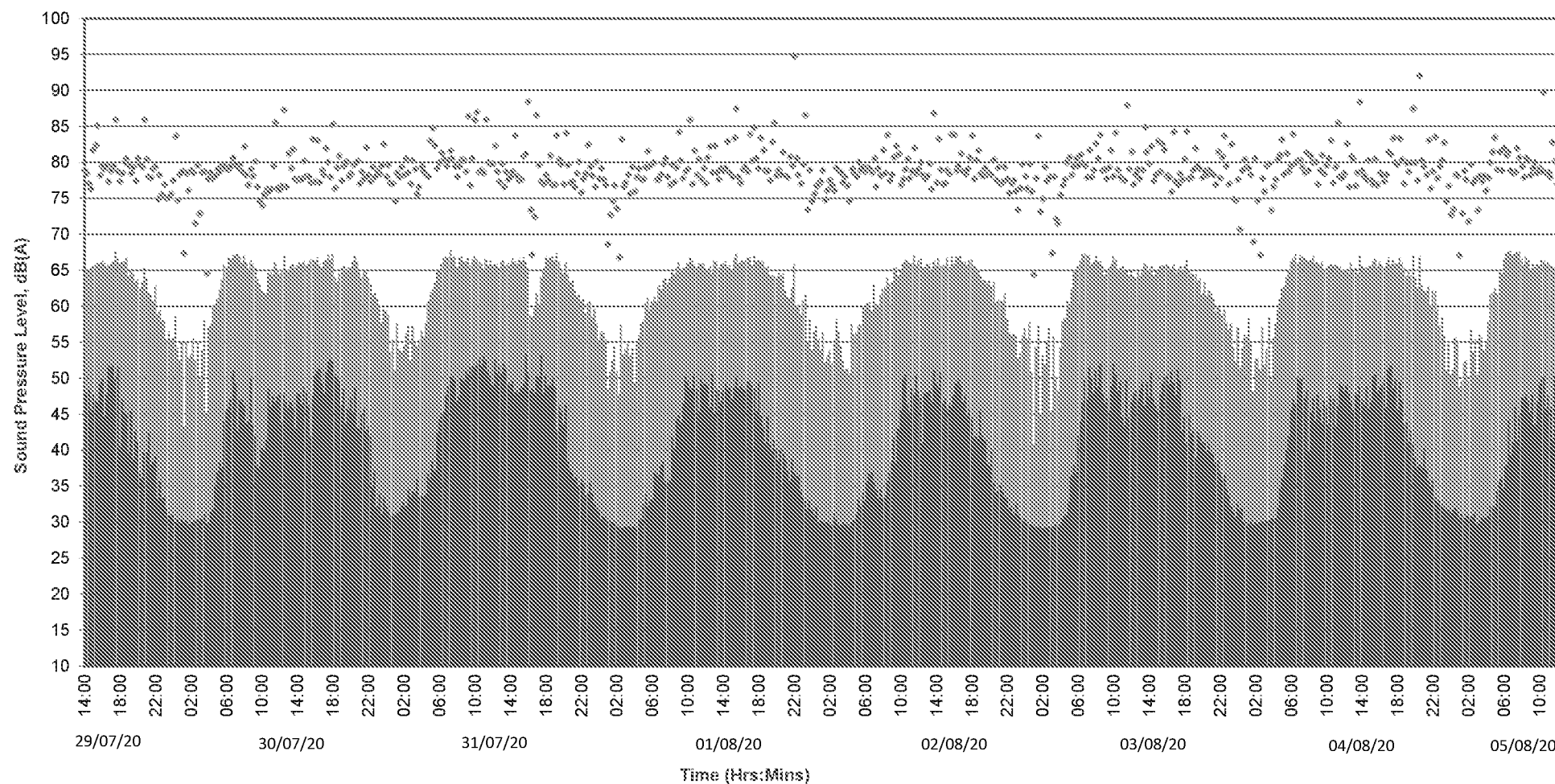
Lion House, Oriental Road, Woking, Surrey GU22 2BR
Telephone: 01483 750508 Fax: 01483 750437

Time History Graph A2

Project: Angmering

Measurement Location: A2

Survey Period: 29/07/20 - 05/08/20

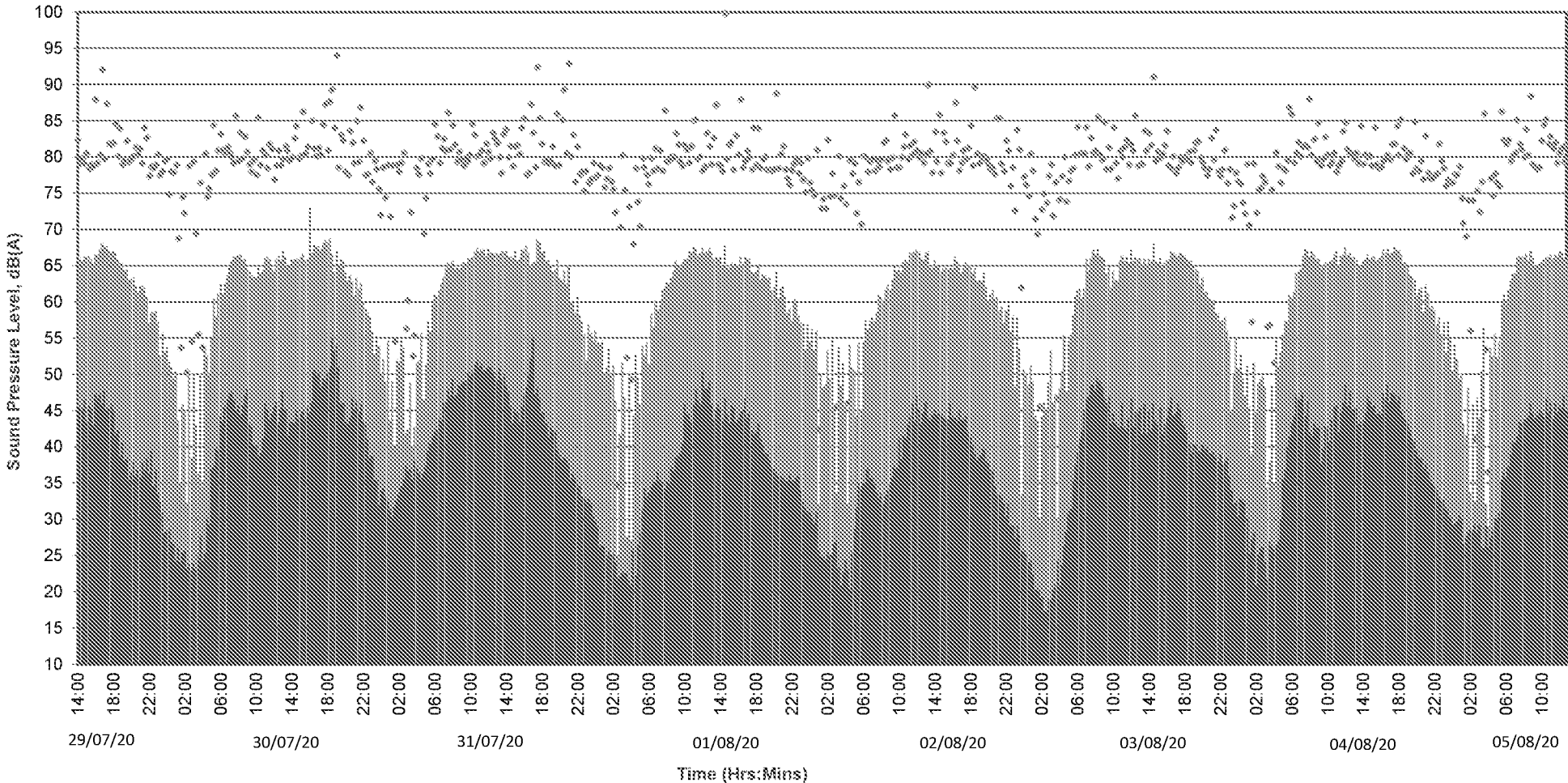


KEY: L_{A90,15mins} L_{Aeq,15mins} L_{Amax,fast}

Lion House, Oriental Road, Woking, Surrey GU22 2BR
Telephone: 01483 750508 Fax: 01483 750437

Time History Graph A3

Project: Angmering
Measurement Location: A3
Survey Period: 29/07/20 - 05/08/20



KEY: LA90,15mins LAeq,15mins LAmax,fast

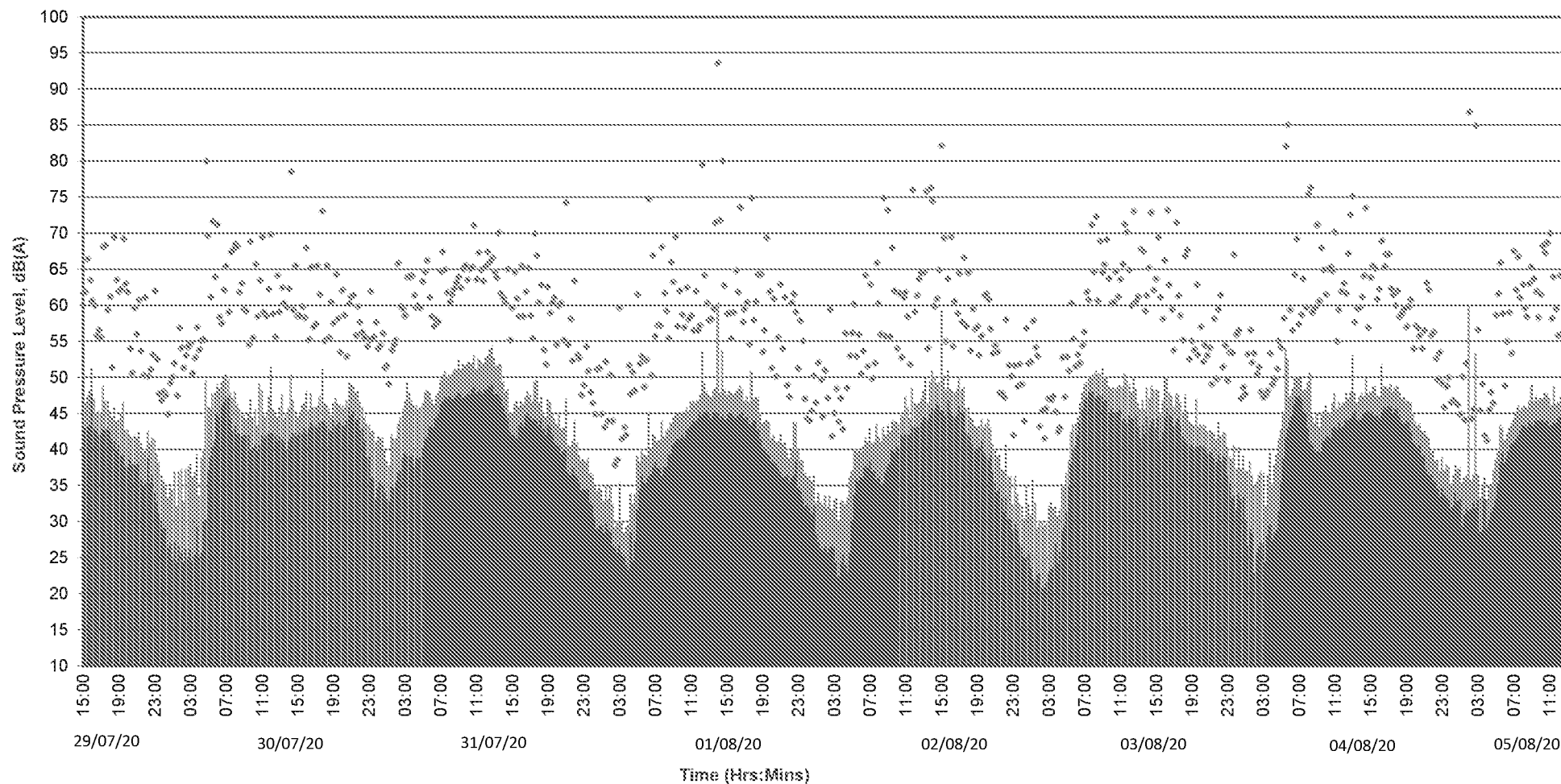
Lion House, Oriental Road, Woking, Surrey GU22 2BR
Telephone: 01483 750508 Fax: 01483 750437

Time History Graph A4

Project: Angmering

Measurement Location: A4

Survey Period: 29/07/20 - 05/08/20



KEY: $L_{A90,15mins}$ $L_{Aeq,15mins}$ $L_{Amax,fast}$

Lion House, Oriental Road, Woking, Surrey GU22 2BR
Telephone: 01483 750508 Fax: 01483 750437

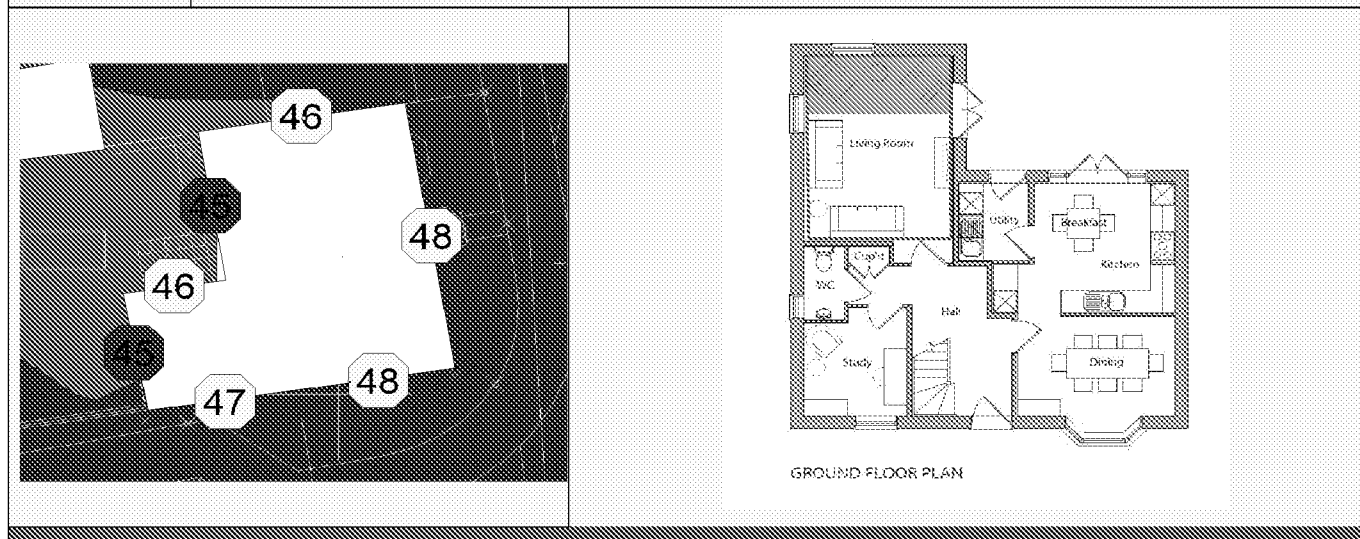
APPENDIX C: Sound Insulation Verification Calculations

Calculation Sheet	1	Receiver	Plot 16 - Gnd Floor		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Area (m ²)	m ²	m ³
Living Room	4.20	2.60	1.20	17.2	44.7

Term	Description	Units	Value
Sf	Total façade area	m ²	10.9
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	1.2
Sew	External Wall Area	m ²	9.7
V	Volume of receiving room	m ³	44.7
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	14.4

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{snrT}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ft, Daytime	48	44	40	44	40	31	47	L _{Aeq,16hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-29	-26	-31	-27	-31	-33	--	Total Apparent SRI
D _{snrT}	-27	-24	-30	-26	-30	-32	--	Total Standardized Difference
Room Correction	-1	-1	-1	-1	-1	-1	--	Room Absorption Correction
Sound Level	21	20	11	19	11	-1	20	Daytime L _{Aeq,16hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for ground floor and Architect's general arrangement drawing.

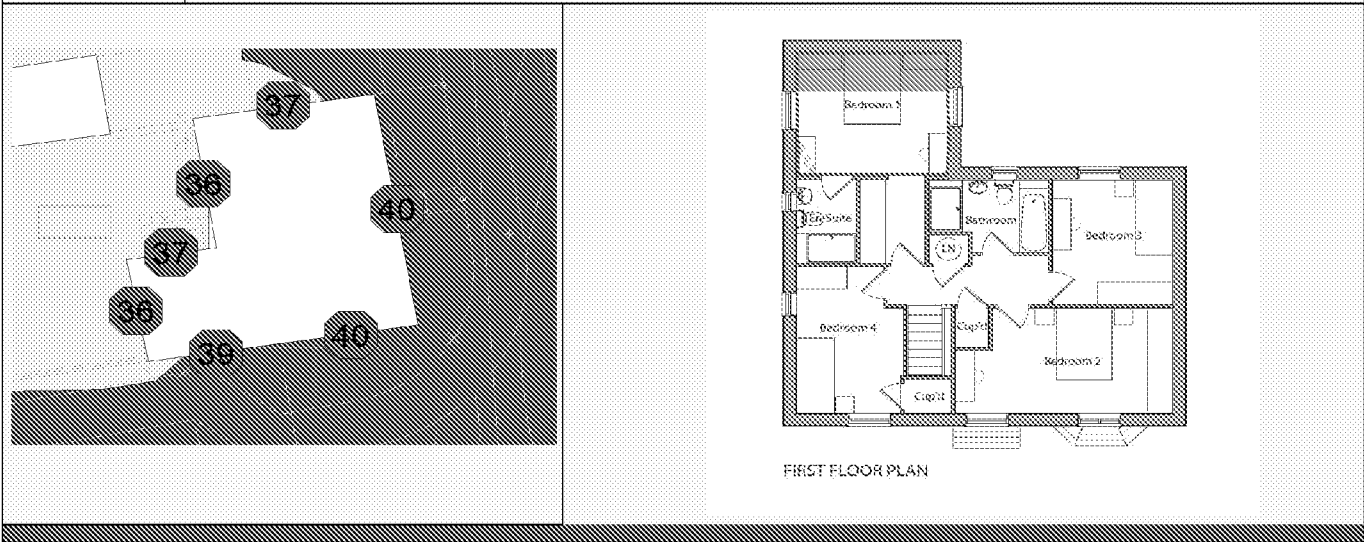


Calculation Sheet	2	Receiver	Plot 16 - 1st Floor		
Room Type	Facade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Area (m ²)	m ²	m ³
Bedroom	4.00	2.20	1.20	10.40	22.88

Term	Description	Units	Values
Sf	Total façade area	m ²	8.8
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	1.2
Sew	External Wall Area	m ²	7.6
V	Volume of receiving room	m ³	22.9
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	7.4

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{min}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq ff, Night-time	40	36	32	36	32	23	39	L _{Aeq,8hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R _w	-28	-25	-30	-26	-30	-32	--	Total Apparent SRI
D _{minT}	-29	-26	-31	-27	-31	-33	--	Total Standardized Difference
Room Correction	1	1	1	1	1	1	--	Room Absorption Correction
Sound Level	16	15	6	13	5	-6	15	Night-time L _{Aeq,8 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for first floor and Architect's general arrangement drawing.

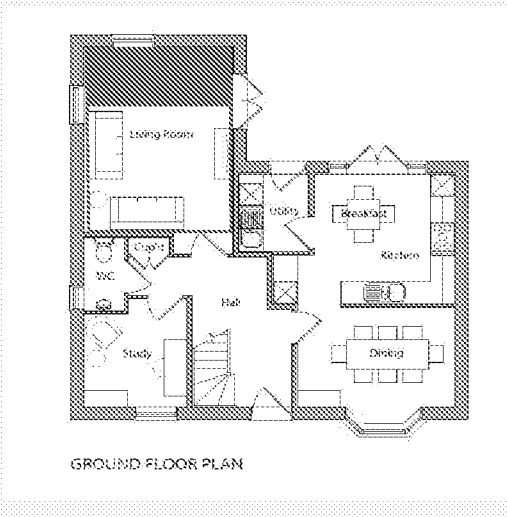
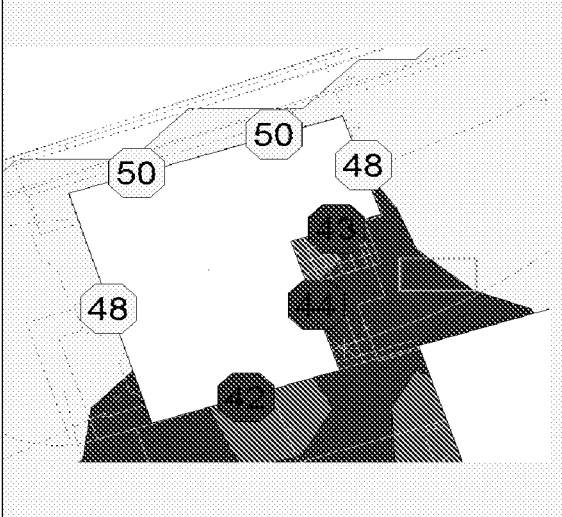


Calculation Sheet	3	Receiver	Plot 19 - Gnd Floor		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Area (m ²)	m ²	m ³
Living Room	4.20	2.60	1.20	17.2	44.7

Term	Description	Units	Value
Sf	Total façade area	m ²	10.9
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	1.2
Sew	External Wall Area	m ²	9.7
V	Volume of receiving room	m ³	44.7
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	14.4

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{snrT}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ft, Daytime	51	47	43	47	43	34	50	L _{Aeq,16hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-29	-26	-31	-27	-31	-33	--	Total Apparent SRI
D _{snrT}	-27	-24	-30	-26	-30	-32	--	Total Standardized Difference
Room Correction	-1	-1	-1	-1	-1	-1	--	Room Absorption Correction
Sound Level	24	23	14	22	14	2	23	Daytime L _{Aeq,16hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for ground floor and Architect's general arrangement drawing.

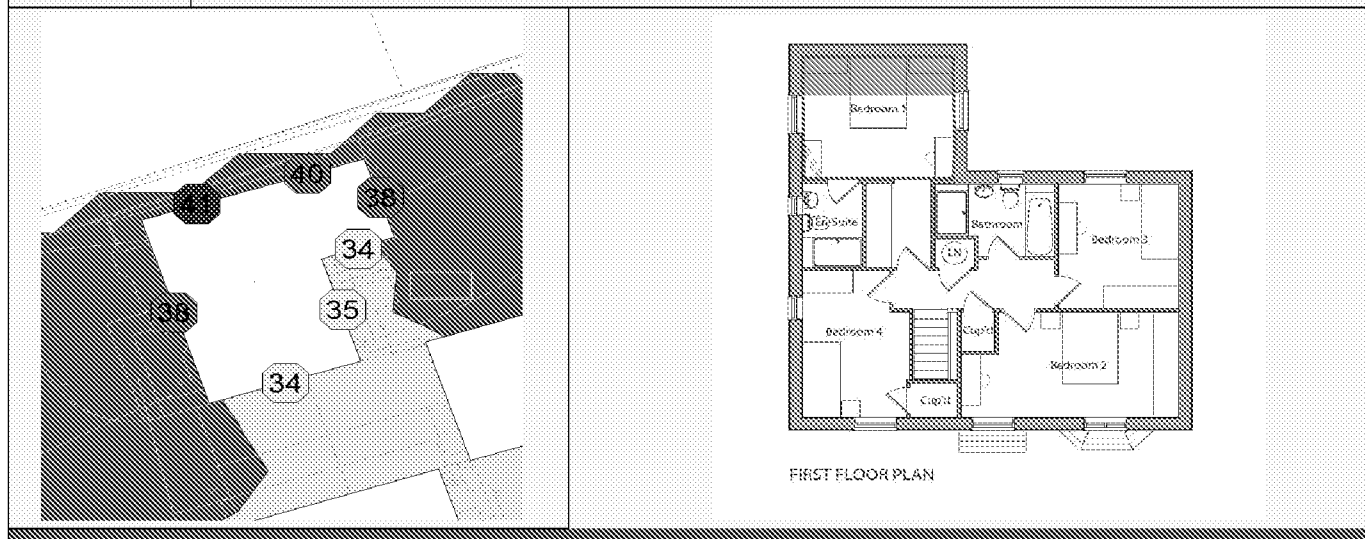


Calculation Sheet	4	Receiver	Plot 19 - 1st Floor		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Area (m ²)	m ²	m ³
Bedroom	4.00	2.20	1.20	10.40	22.88

Term	Description	Units	Value
Sf	Total façade area	m ²	8.8
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	1.2
Sew	External Wall Area	m ²	7.6
V	Volume of receiving room	m ³	22.9
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	7.4

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{min}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq ff, Night-time	41	37	33	37	33	24	40	L _{Aeq,8hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R _w	-28	-25	-30	-26	-30	-32	--	Total Apparent SRI
D _{minT}	-29	-26	-31	-27	-31	-33	--	Total Standardized Difference
Room Correction	1	1	1	1	1	1	--	Room Absorption Correction
Sound Level	17	16	7	14	6	-5	16	Night-time L _{Aeq,8 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for first floor and Architect's general arrangement drawing.



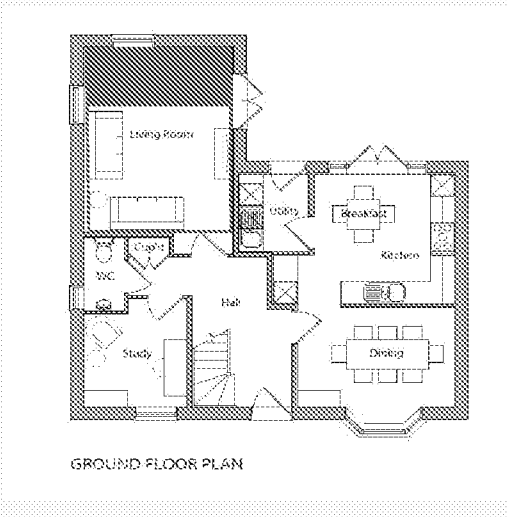
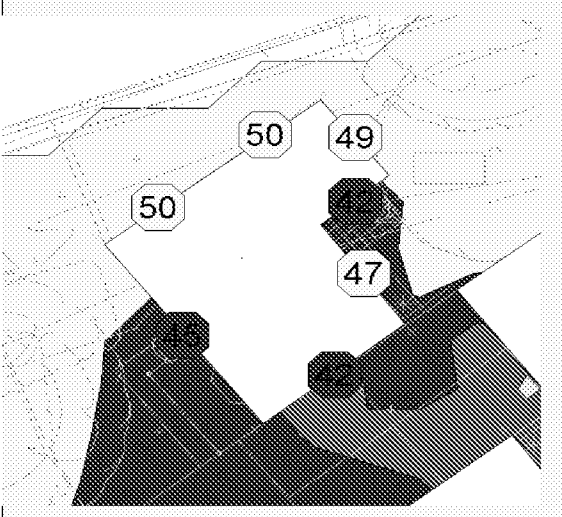
Calculation Sheet		5	Receiver	Plot 32 - Gnd Floor	
Room Type	Facade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Area (m ²)	m ²	m ³
Living Room	4.20	2.60	1.20	17.2	44.7



Term	Description	Units	Value
Sf	Total façade area	m ²	10.9
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	1.2
Sew	External Wall Area	m ²	9.7
V	Volume of receiving room	m ³	44.7
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	14.4

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{snrT}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ft, Daytime	51	47	43	47	43	34	50	L _{Aeq,16hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-29	-26	-31	-27	-31	-33	--	Total Apparent SRI
D _{snrT}	-27	-24	-30	-26	-30	-32	--	Total Standardized Difference
Room Correction	-1	-1	-1	-1	-1	-1	--	Room Absorption Correction
Sound Level	24	23	14	22	14	2	23	Daytime L _{Aeq,16hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for ground floor and Architect's general arrangement drawing.

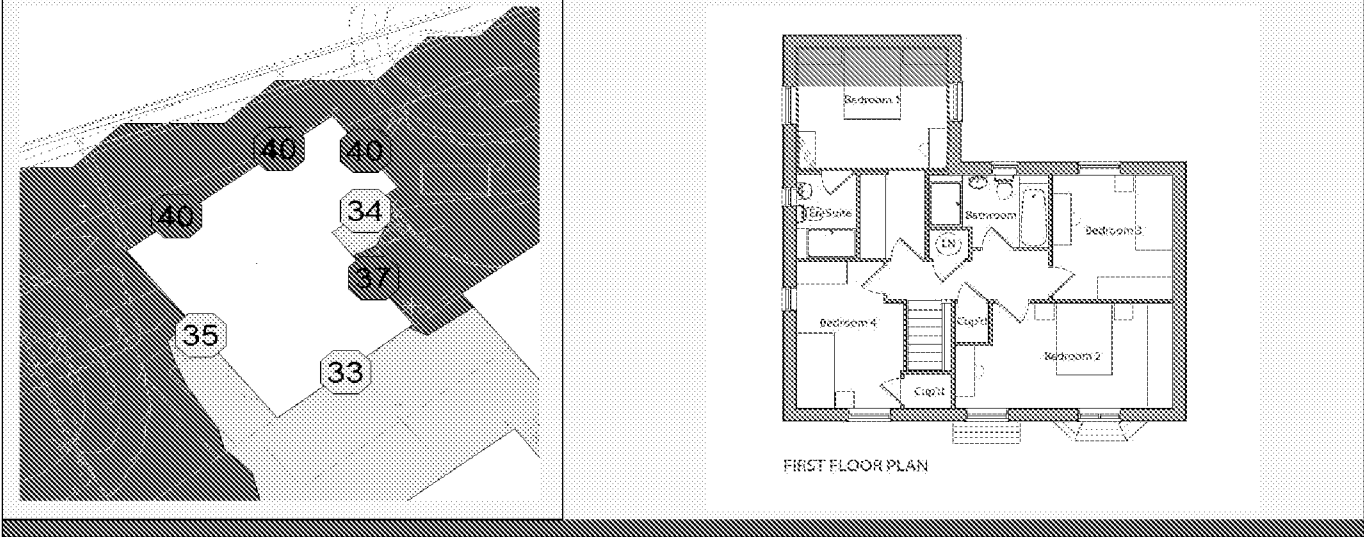


Calculation Sheet	6	Receiver	Plot 32 - 1st Floor		
Room Type	Facade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Area (m ²)	m ²	m ³
Bedroom	4.00	2.20	1.20	10.40	22.88

Term	Description	Units	Values
Sf	Total façade area	m ²	8.8
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	1.2
Sew	External Wall Area	m ²	7.6
V	Volume of receiving room	m ³	22.9
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	7.4

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{snrT}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq ft, Night-time	41	37	33	37	33	24	40	L _{Aeq,8hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R _w	-28	-25	-30	-26	-30	-32	--	Total Apparent SRI
D _{snrT}	-29	-26	-31	-27	-31	-33	--	Total Standardized Difference
Room Correction	1	1	1	1	1	1	--	Room Absorption Correction
Sound Level	17	16	7	14	6	-5	18	Night-time L _{Aeq,8 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for first floor and Architect's general arrangement drawing.

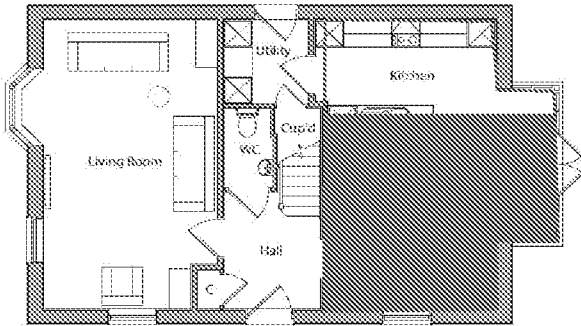
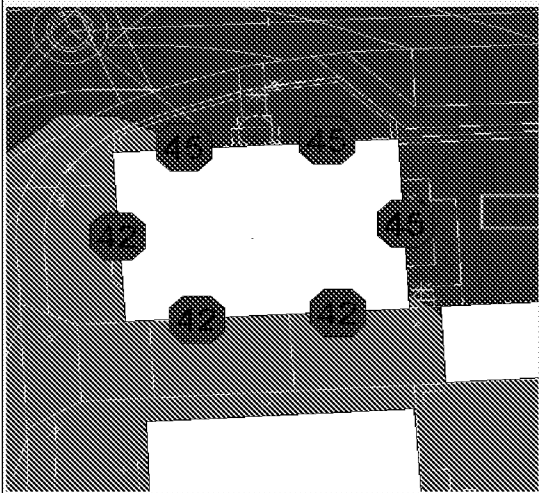


Calculation Sheet	7	Receiver	Plot 44 - Gnd Floor		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Area (m ²)	m ²	m ³
Living Room / Kitchen	7.00	2.70	10.00	20.4	55.1

Term	Description	Units	Values
Sf	Total façade area	m ²	18.9
Svents	Vents Equivalent Open Area	m ²	0.005
Swl	Window Area	m ²	10.0
Sew	External Wall Area	m ²	8.9
V	Volume of receiving room	m ³	55.1
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	17.7

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{snr}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ft, Daytime	46	42	38	42	38	29	45	L _{Aeq,16hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R _w	-24	-20	-27	-29	-33	-32	--	Total Apparent SRI
D _{snr,t}	-24	-20	-27	-29	-33	-32	--	Total Standardized Difference
Room Correction	0	0	0	0	0	0	--	Room Absorption Correction
Sound Level	26	26	14	16	8	0	21	Daytime L _{Aeq,16hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for ground floor and Architect's general arrangement drawing.



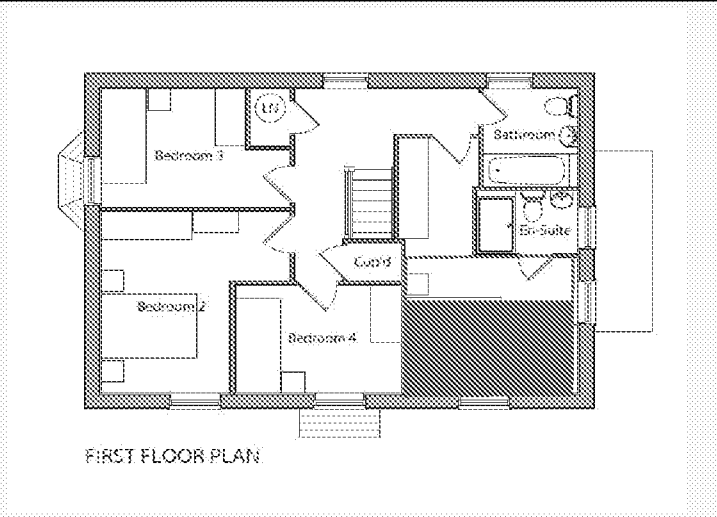
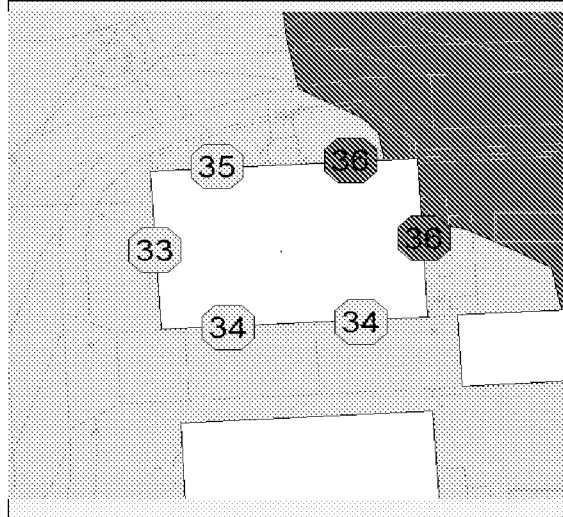
GROUND FLOOR PLAN

Calculation Sheet	8	Receiver	Plot 44 - 1st Floor		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Area (m ²)	m ²	m ³
Bedroom	3.20	2.50	1.20	18.50	46.25

Term	Description	Units	Value
Sf	Total façade area	m ²	8.0
Svents	Vents Equivalent Open Area	m ²	0.005
Swl	Window Area	m ²	1.2
Sew	External Wall Area	m ²	6.8
V	Volume of receiving room	m ³	46.3
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	14.9

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{min}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ff, Night-time	37	33	29	33	29	20	36	L _{Aeq,8hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-28	-25	-30	-26	-30	-32	--	Total Apparent SRI
D _{min,T}	-25	-22	-27	-23	-27	-29	--	Total Standardized Difference
Room Correction	-3	-3	-3	-3	-3	-3	--	Room Absorption Correction
Sound Level	10	9	0	7	-1	-12	9	Night-time L _{Aeq,8 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for ground floor and Architect's general arrangement drawing.

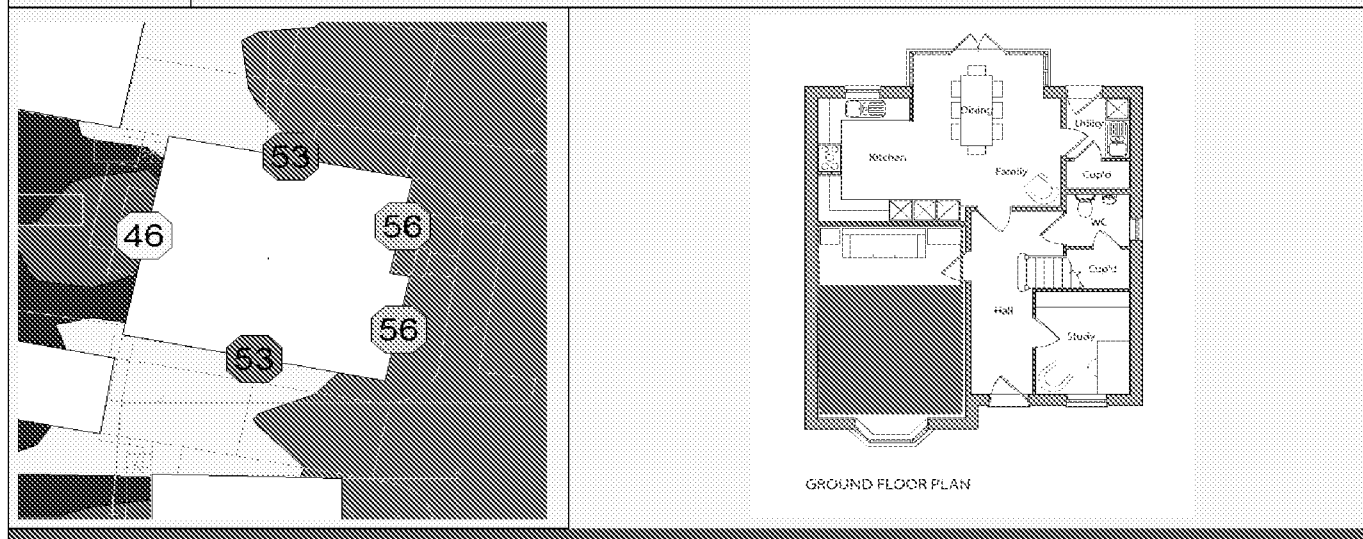


Calculation Sheet	9	Receiver	Plot 62 - Gnd Floor		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Area (m²)	m²	m³
Living	4.20	2.60	4.00	16.7	43.4

Term	Description	Units	Value
Sf	Total façade area	m²	10.9
Svents	Vents Equivalent Open Area	m²	0.005
Swl	Window Area	m²	4.0
Sew	External Wall Area	m²	6.9
V	Volume of receiving room	m³	43.4
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m²	10
A	Equivalent Abs Area (receiving room)	m²	14.0

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{snrT}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ft, Daytime	57	53	49	53	49	40	56	L _{Aeq,16hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R _w	-25	-21	-28	-27	-31	-32	--	Total Apparent SRI
D _{snrT}	-24	-20	-27	-26	-30	-31	--	Total Standardized Difference
Room Correction	-1	-1	-1	-1	-1	-1	--	Room Absorption Correction
Sound Level	34	34	23	28	20	10	31	Daytime L _{Aeq,16hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for ground floor and Architect's general arrangement drawing.

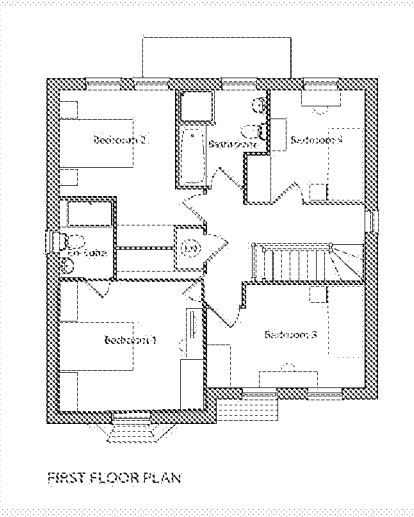


Calculation Sheet	10	Receiver	Plot 62 - 1st Floor		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Area (m ²)	m ²	m ³
Bedroom	4.20	2.60	1.20	9.90	25.74

Term	Description	Units	Value
Sf	Total façade area	m ²	10.9
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	1.2
Sew	External Wall Area	m ²	9.7
V	Volume of receiving room	m ³	25.7
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	8.3

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{snrT}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq ft, Night-time	49	45	41	45	41	32	48	L _{Aeq,8hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R _w	-29	-26	-31	-27	-31	-33	--	Total Apparent SRI
D _{snrT}	-30	-27	-32	-28	-32	-34	--	Total Standardized Difference
Room Correction	1	1	1	1	1	1	--	Room Absorption Correction
Sound Level	24	23	14	22	14	3	24	Night-time L _{Aeq,8 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for first floor and Architect's general arrangement drawing.

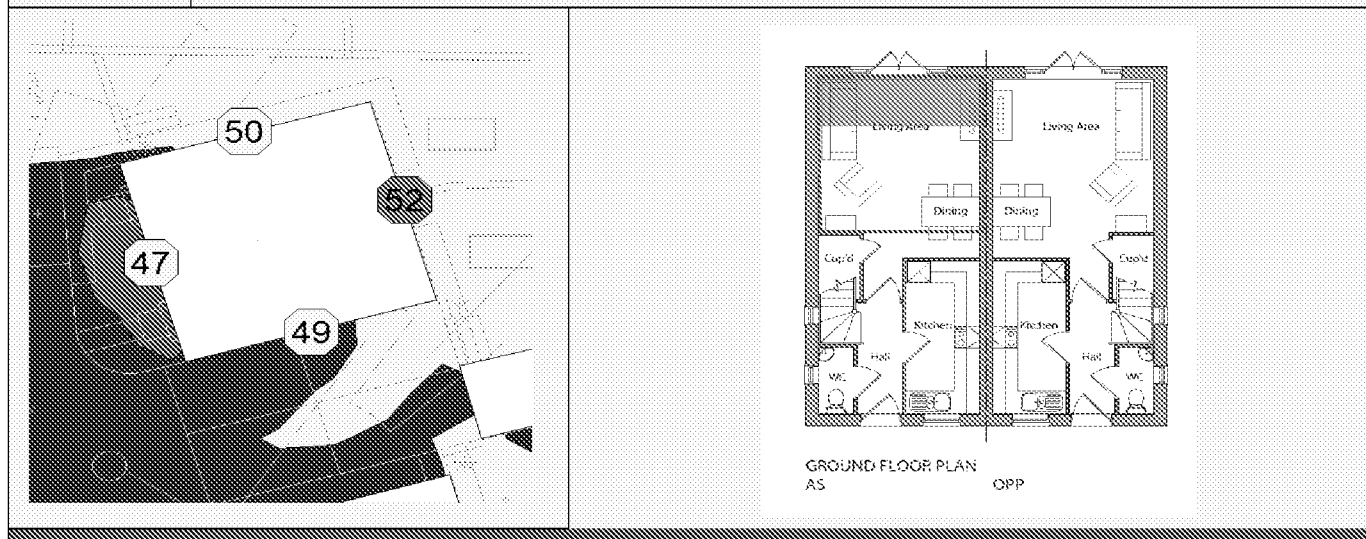


Calculation Sheet	11	Receiver	Plot 67 - Gnd Floor		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Area (m²)	m²	m³
Living Room	4.20	2.60	4.40	17.2	44.7

Term	Description	Units	Values
Sf	Total façade area	m²	10.9
Svents	Vents Equivalent Open Area	m²	0.005
Swl	Window Area	m²	4.4
Sew	External Wall Area	m²	6.5
V	Volume of receiving room	m³	44.7
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m²	10
A	Equivalent Abs Area (receiving room)	m²	14.4

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{snrT}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ft, Daytime	53	49	45	49	45	38	52	L _{Aeq,16hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-24	-21	-28	-27	-31	-32	--	Total Apparent SRI
D _{snrT}	-23	-19	-26	-26	-30	-30	--	Total Standardized Difference
Room Correction	-1	-1	-1	-1	-1	-1	--	Room Absorption Correction
Sound Level	30	30	19	24	16	6	27	Daytime L _{Aeq,16hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for ground floor and Architect's general arrangement drawing.

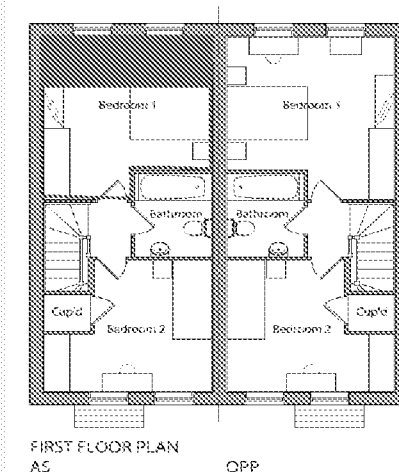
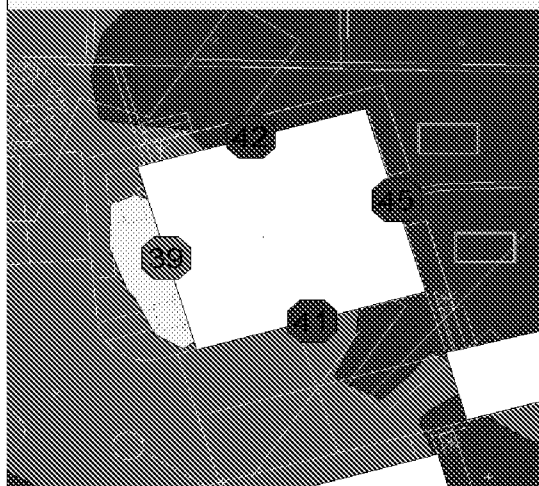


Calculation Sheet	12	Receiver	Plot 67 - 1st Floor		
Room Type	Facade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Area (m ²)	m ²	m ³
Bedroom	4.30	2.20	2.20	10.40	22.88

Term	Description	Units	Values
Sf	Total façade area	m ²	9.5
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	2.2
Sew	External Wall Area	m ²	7.3
V	Volume of receiving room	m ³	22.9
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	7.4

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{min}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq ff, Night-time	46	42	38	42	38	29	45	L _{Aeq,8hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R _w	-26	-23	-29	-27	-31	-32	--	Total Apparent SRI
D _{minT}	-27	-24	-30	-28	-31	-33	--	Total Standardized Difference
Room Correction	1	1	1	1	1	1	--	Room Absorption Correction
Sound Level	24	23	13	19	12	1	22	Night-time L _{Aeq,8 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for first floor and Architect's general arrangement drawing.

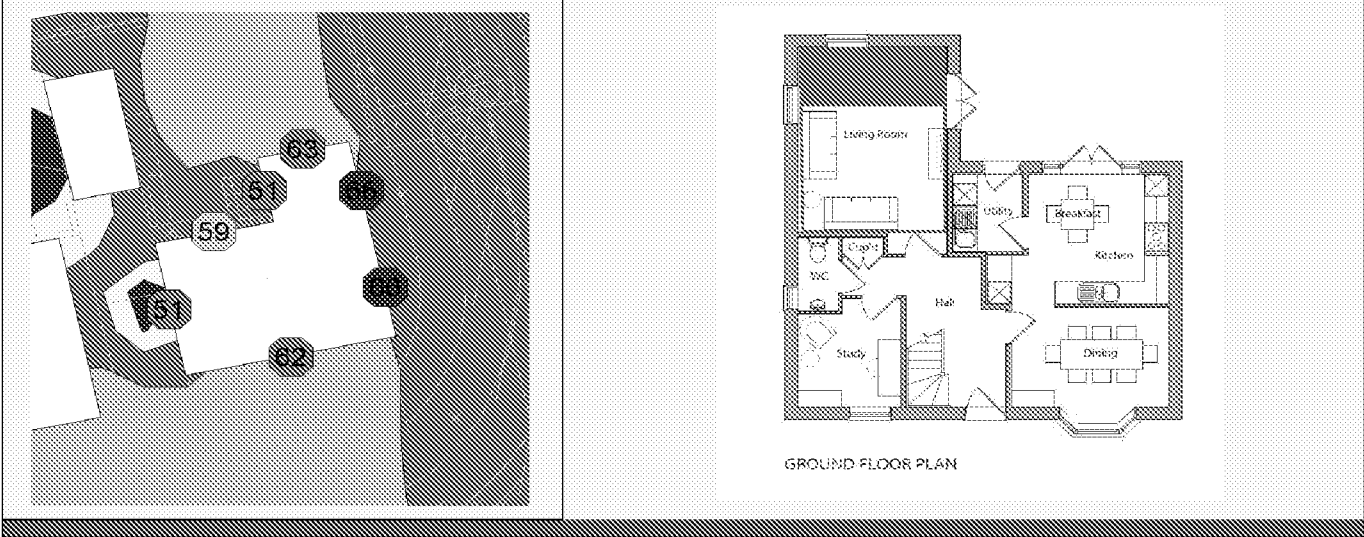


Calculation Sheet	13	Receiver	Plot 72 - Gnd Floor		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Area (m ²)	m ²	m ³
Living Room	4.00	2.60	2.30	17.2	44.7

Term	Description	Units	Value
Sf	Total façade area	m ²	10.4
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	2.3
Sew	External Wall Area	m ²	8.1
V	Volume of receiving room	m ³	44.7
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	14.4

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{snrT}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ft, Daytime	67	63	59	63	59	50	66	L _{Aeq,16hour} value
Ventilator, Dne	40	38	32	47	54	48	41	High Performance Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-27	-23	-29	-40	-43	-37	--	Total Apparent SRI
D _{snrT}	-26	-22	-27	-39	-41	-36	--	Total Standardized Difference
Room Correction	-1	-1	-1	-1	-1	-1	--	Room Absorption Correction
Sound Level	41	41	32	24	18	14	35	Daytime L _{Aeq,16hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for ground floor and Architect's general arrangement drawing.

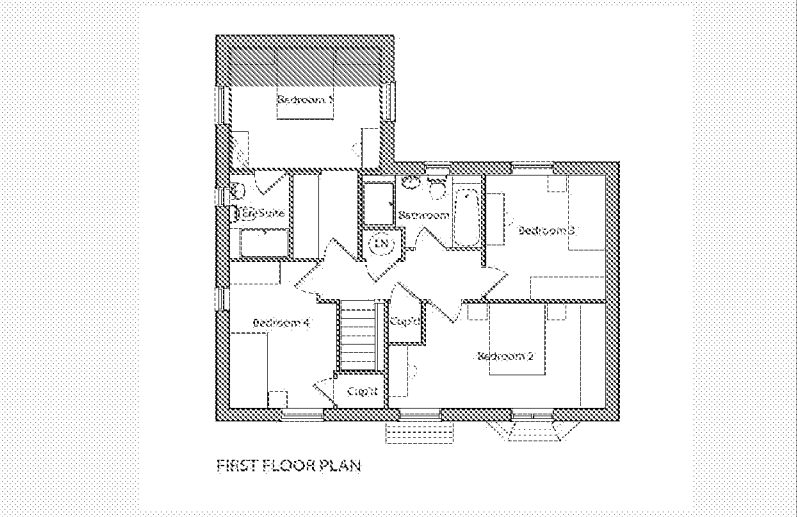
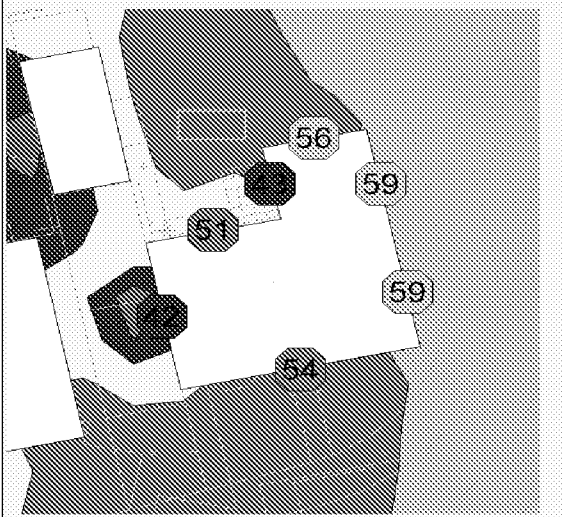


Calculation Sheet	14	Receiver	Plot 72 - 1st Floor		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Area (m ²)	m ²	m ³
Bedroom	4.00	2.20	1.20	10.40	22.88

Term	Description	Units	Value
Sf	Total façade area	m ²	8.8
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	1.2
Sew	External Wall Area	m ²	7.6
V	Volume of receiving room	m ³	22.9
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	7.4

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{min}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq ff, Night-time	60	56	52	56	52	43	59	L _{Aeq,8hour} value
Ventilator, Dne	38	38	33	36	47	49	38	Enhanced Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-29	-25	-30	-35	-43	-39	--	Total Apparent SRI
D _{minT}	-29	-26	-31	-35	-43	-40	--	Total Standardized Difference
Room Correction	1	1	1	1	1	1	--	Room Absorption Correction
Sound Level	35	34	26	25	13	8	30	Night-time L _{Aeq,8 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for first floor and Architect's general arrangement drawing.

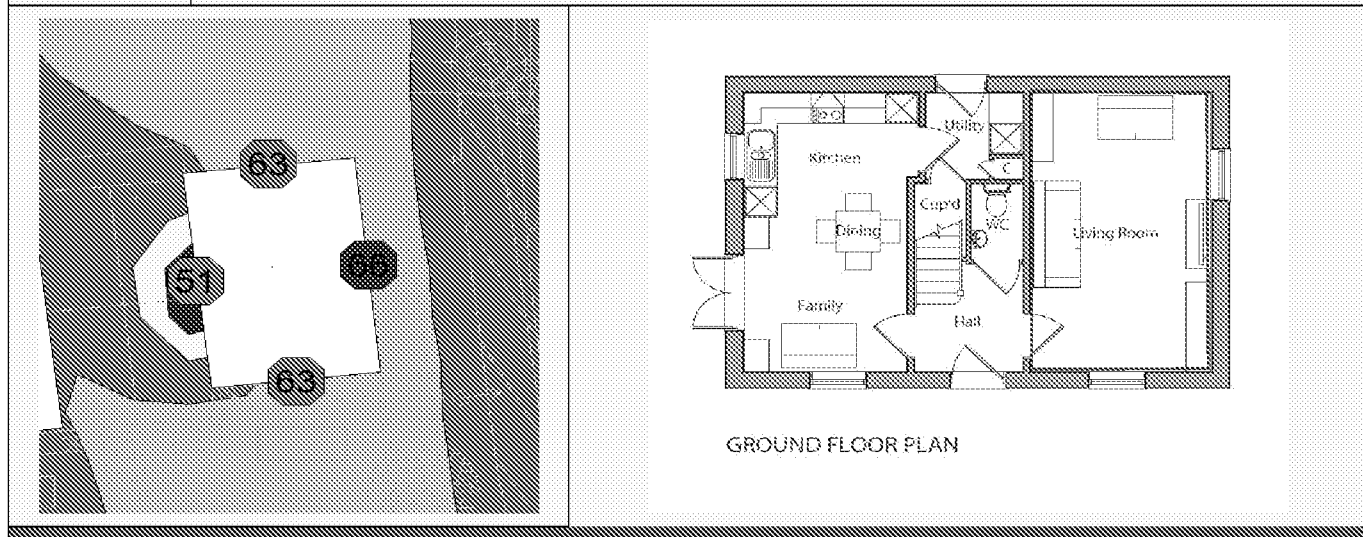


Calculation Sheet	15	Receiver	Plot 77 - Gnd Floor		
Room Type	Facade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Area (m ²)	m ²	m ³
Living	3.70	2.60	1.40	16.7	43.4

Term	Description	Units	Value
Sf	Total façade area	m ²	9.6
Svents	Vents Equivalent Open Area	m ²	0.005
Swl	Window Area	m ²	1.4
Sew	External Wall Area	m ²	8.2
V	Volume of receiving room	m ³	43.4
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	14.0

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{min}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ft, Daytime	67	63	59	63	59	50	66	L _{Aeq,16hour} value
Ventilator, Dne	38	38	33	36	47	49	38	Enhanced Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-29	-25	-30	-35	-43	-39	--	Total Apparent SRI
D _{min} ,T	-27	-23	-26	-33	-41	-37	--	Total Standardized Difference
Room Correction	-2	-2	-2	-2	-2	-2	--	Room Absorption Correction
Sound Level	40	39	30	29	18	13	34	Daytime L _{Aeq,16hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for ground floor and Architect's general arrangement drawing.



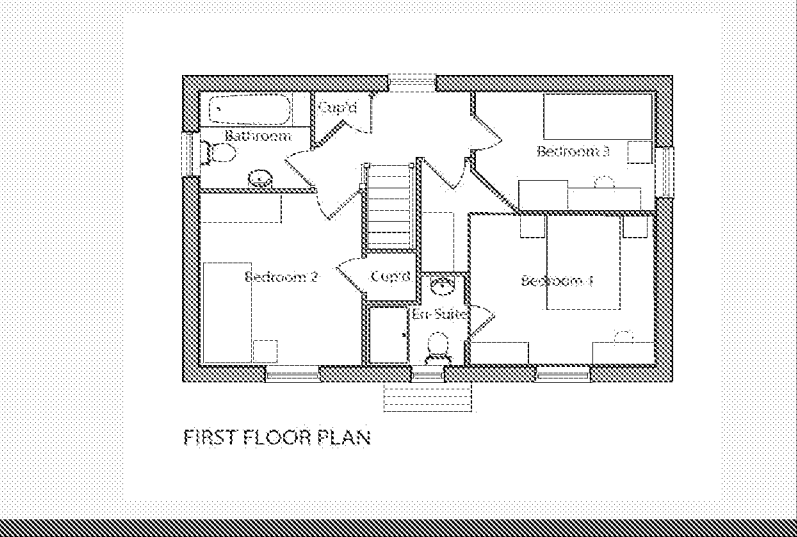
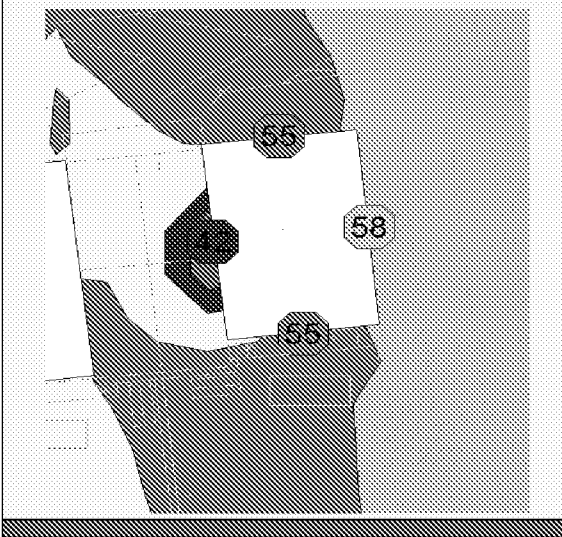
Calculation Sheet		16	Receiver	Plot 77 - 1st Floor	
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Area (m ²)	m ²	m ³
Bedroom	3.70	2.60	1.20	9.90	25.74



Term	Description	Units	Value
Sf	Total façade area	m ²	9.6
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	1.2
Sew	External Wall Area	m ²	8.4
V	Volume of receiving room	m ³	25.7
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	8.3

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{min}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq ft, Night-time	59	55	51	55	51	42	58	L _{Aeq,8hour} value
Ventilator, Dne	38	38	33	36	47	49	38	Enhanced Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R _w	-29	-26	-30	-35	-43	-39	--	Total Apparent SRI
D _{min,T}	-30	-26	-31	-36	-44	-40	--	Total Standardized Difference
Room Correction	1	1	1	1	1	1	--	Room Absorption Correction
Sound Level	34	33	24	24	11	6	28	Night-time L _{Aeq,8 hour} Value

Index	Description
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for first floor and Architect's general arrangement drawing.

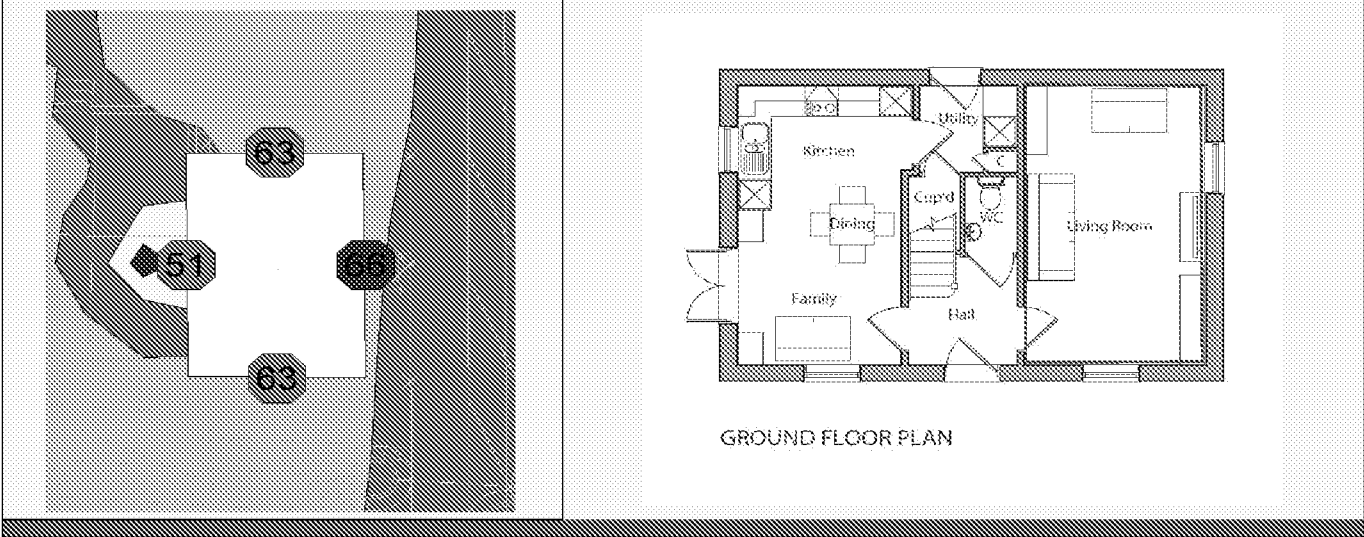


Calculation Sheet	17	Receiver	Plot 95 - Gnd Floor		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Area (m²)	m²	m³
Living	3.70	2.60	1.40	16.7	43.4

Term	Description	Units	Value
Sf	Total façade area	m²	9.6
Svents	Vents Equivalent Open Area	m²	0.005
Swl	Window Area	m²	1.4
Sew	External Wall Area	m²	8.2
V	Volume of receiving room	m³	43.4
T	Rev. Time of Receiving room (residential room ISO 140)	sec	0.5
A ₀	Reference Abs Area	m²	10
A	Equivalent Abs Area (receiving room)	m²	14.0

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{min}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ft, Daytime	67	63	59	63	59	50	66	L _{Aeq,16hour} value
Ventilator, Dne	38	38	33	36	47	49	38	Enhanced Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R _w	-29	-25	-30	-35	-43	-39	--	Total Apparent SRI
D _{min,T}	-27	-23	-26	-33	-41	-37	--	Total Standardized Difference
Room Correction	-2	-2	-2	-2	-2	-2	--	Room Absorption Correction
Sound Level	40	39	30	29	18	13	34	Daytime L _{Aeq,16hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for ground floor and Architect's general arrangement drawing.

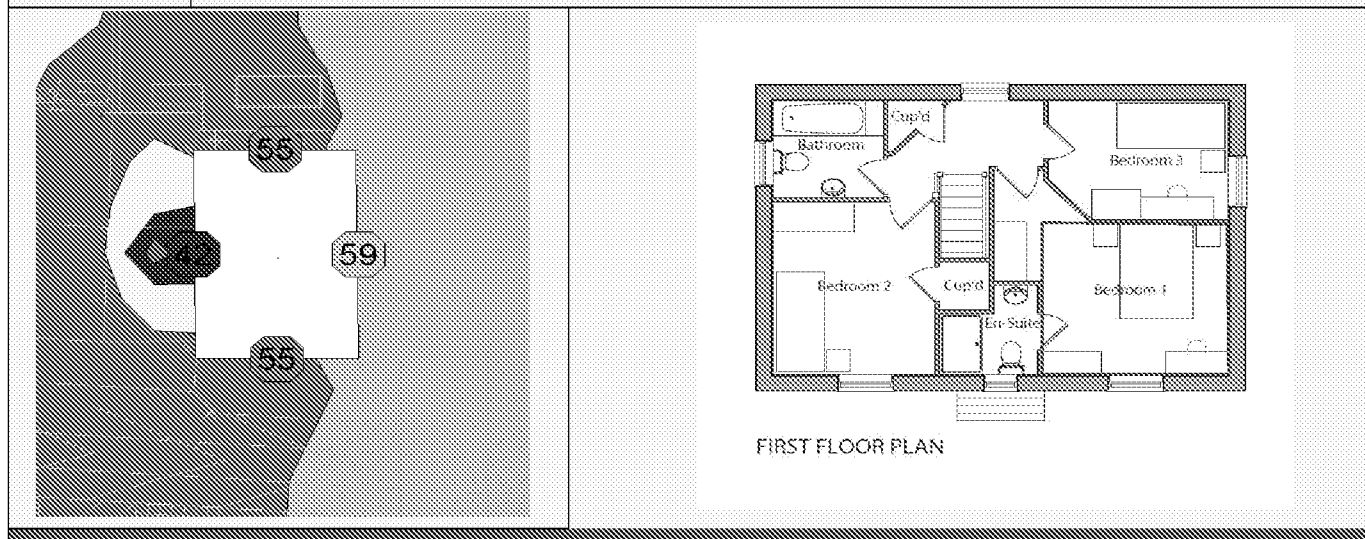


Calculation Sheet	18	Receiver	Plot 95 - 1st Floor		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Area (m ²)	m ²	m ³
Bedroom	3.70	2.60	1.20	9.90	25.74

Term	Description	Units	Values
Sf	Total façade area	m ²	9.6
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	1.2
Sew	External Wall Area	m ²	8.4
V	Volume of receiving room	m ³	25.7
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	8.3

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{min}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq ft, Night-time	56	52	48	52	48	39	55	L _{Aeq,8hour} value
Ventilator, Dne	38	38	33	36	47	49	38	Enhanced Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R _w	-29	-26	-30	-35	-43	-39	--	Total Apparent SRI
D _{min,T}	-30	-26	-31	-36	-44	-40	--	Total Standardized Difference
Room Correction	1	1	1	1	1	1	--	Room Absorption Correction
Sound Level	31	30	21	21	8	3	25	Night-time L _{Aeq,8 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for first floor and Architect's general arrangement drawing.

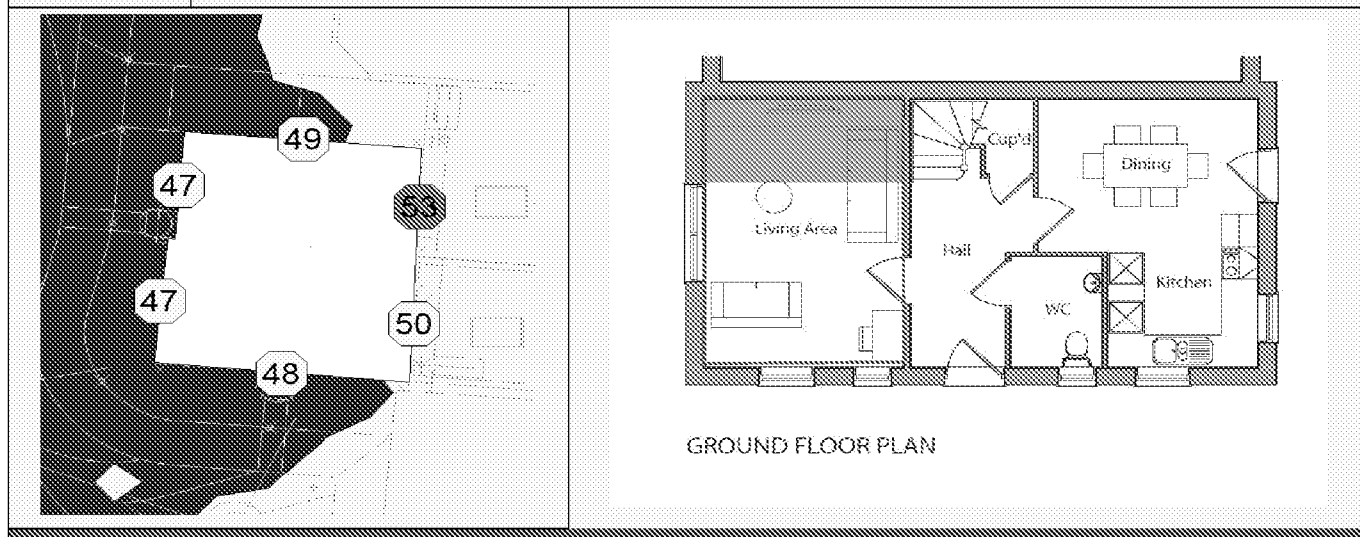


Calculation Sheet	19	Receiver	Plot 115 - Gnd Floor		
Room Type	Facade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Area (m ²)	m ²	m ³
Living Room	3.00	2.50	3.00	17.2	43.0

Term	Description	Units	Value
Sf	Total façade area	m ²	7.5
Svents	Vents Equivalent Open Area	m ²	0.005
Swl	Window Area	m ²	3.0
Sew	External Wall Area	m ²	4.5
V	Volume of receiving room	m ³	43.0
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	13.8

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{min}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ft, Daytime	54	50	46	50	46	37	53	L _{Aeq,16hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R _w	-24	-21	-27	-26	-29	-31	--	Total Apparent SRI
D _{min,T}	-21	-18	-24	-23	-27	-28	--	Total Standardized Difference
Room Correction	-3	-3	-3	-3	-3	-3	--	Room Absorption Correction
Sound Level	30	30	19	25	17	7	27	Daytime L _{Aeq,16hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for ground floor and Architect's general arrangement drawing.

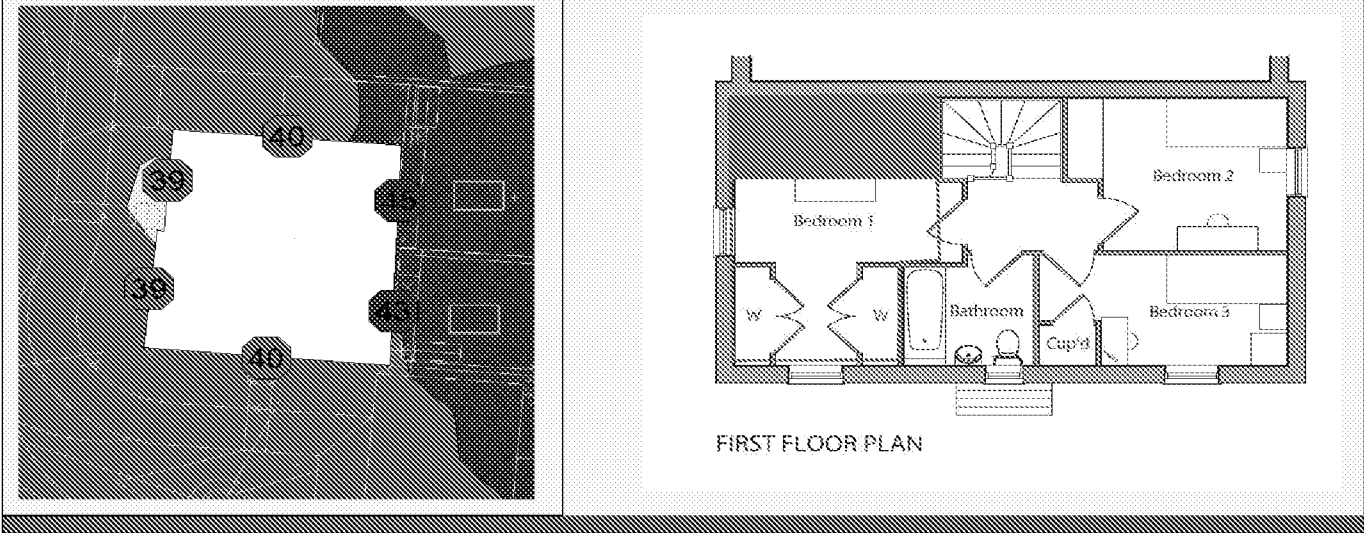


Calculation Sheet	20	Receiver	Plot 115 - 1st Floor		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Area (m ²)	m ²	m ³
Bedroom	3.00	2.30	1.20	13.40	30.82

Term	Description	Units	Value
Sf	Total façade area	m ²	6.9
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	1.2
Sew	External Wall Area	m ²	5.7
V	Volume of receiving room	m ³	30.8
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	9.9

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{min}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq ff, Night-time	46	42	38	42	38	29	45	L _{Aeq,8hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R _w	-27	-24	-29	-25	-29	-31	--	Total Apparent SRI
D _{minT}	-25	-22	-27	-24	-28	-30	--	Total Standardized Difference
Room Correction	-2	-2	-2	-2	-2	-2	--	Room Absorption Correction
Sound Level	20	20	11	18	10	-1	20	Night-time L _{Aeq,8 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for first floor and Architect's general arrangement drawing.



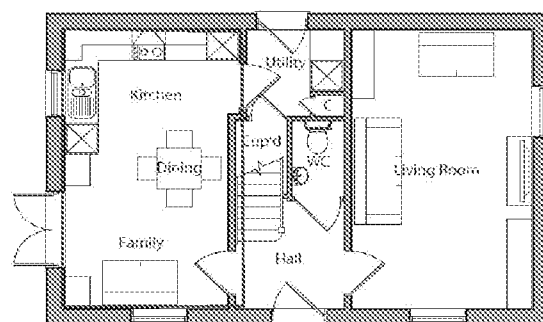
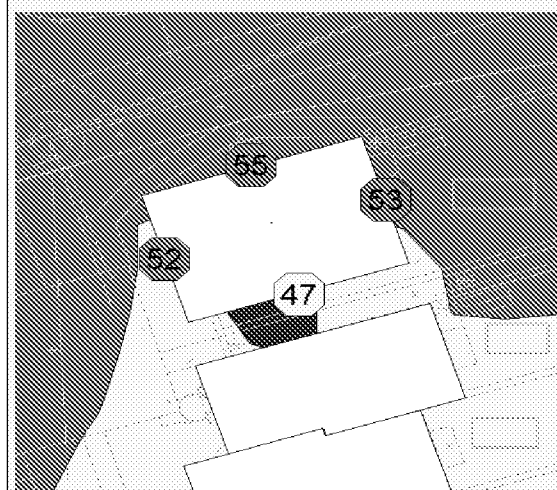
Calculation Sheet		21	Receiver	Plot 143 - Gnd Floor	
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Area (m ²)	m ²	m ³
Living	6.00	2.60	5.00	16.7	43.4



Term	Description	Units	Value
Sf	Total façade area	m ²	15.6
Svents	Vents Equivalent Open Area	m ²	0.005
Swl	Window Area	m ²	5.0
Sew	External Wall Area	m ²	10.6
V	Volume of receiving room	m ³	43.4
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	14.0

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{snrT}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ft, Daytime	56	52	48	52	48	39	55	L _{Aeq,16hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R _w	-25	-22	-29	-29	-32	-33	--	Total Apparent SRI
D _{snrT}	-26	-22	-29	-29	-33	-33	--	Total Standardized Difference
Room Correction	0	0	0	0	0	0	--	Room Absorption Correction
Sound Level	34	34	23	27	19	10	30	Daytime L _{Aeq,16hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for ground floor and Architect's general arrangement drawing.



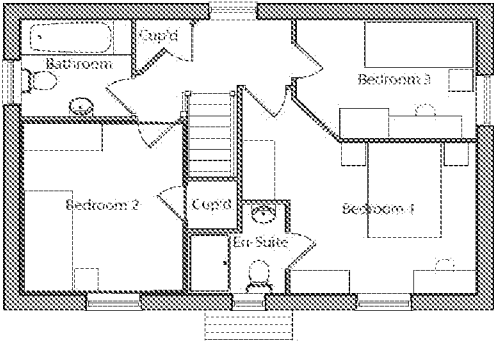
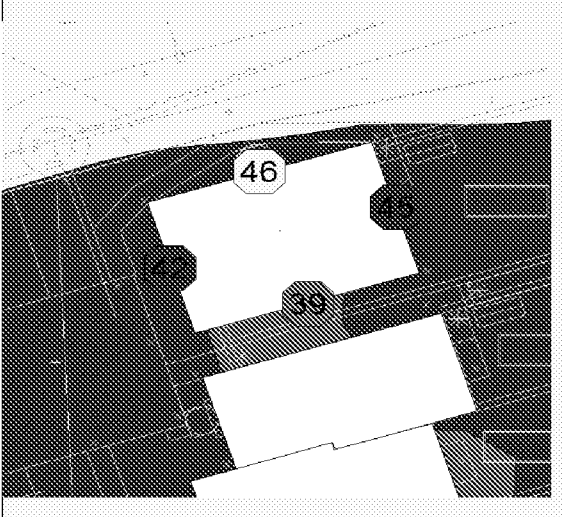
GROUND FLOOR PLAN

Calculation Sheet	22	Receiver	Plot 143 - 1st Floor		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Area (m ²)	m ²	m ³
Bedroom	3.30	2.60	1.20	9.90	25.74

Term	Description	Units	Value
Sf	Total façade area	m ²	8.6
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	1.2
Sew	External Wall Area	m ²	7.4
V	Volume of receiving room	m ³	25.7
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	8.3

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{min}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq ft, Night-time	47	43	39	43	39	30	46	L _{Aeq,8hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R _w	-28	-25	-30	-26	-30	-32	--	Total Apparent SRI
D _{minT}	-28	-25	-30	-26	-30	-32	--	Total Standardized Difference
Room Correction	0	0	0	0	0	0	--	Room Absorption Correction
Sound Level	22	21	12	20	12	1	22	Night-time L _{Aeq,8 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for first floor and Architect's general arrangement drawing.



FIRST FLOOR PLAN

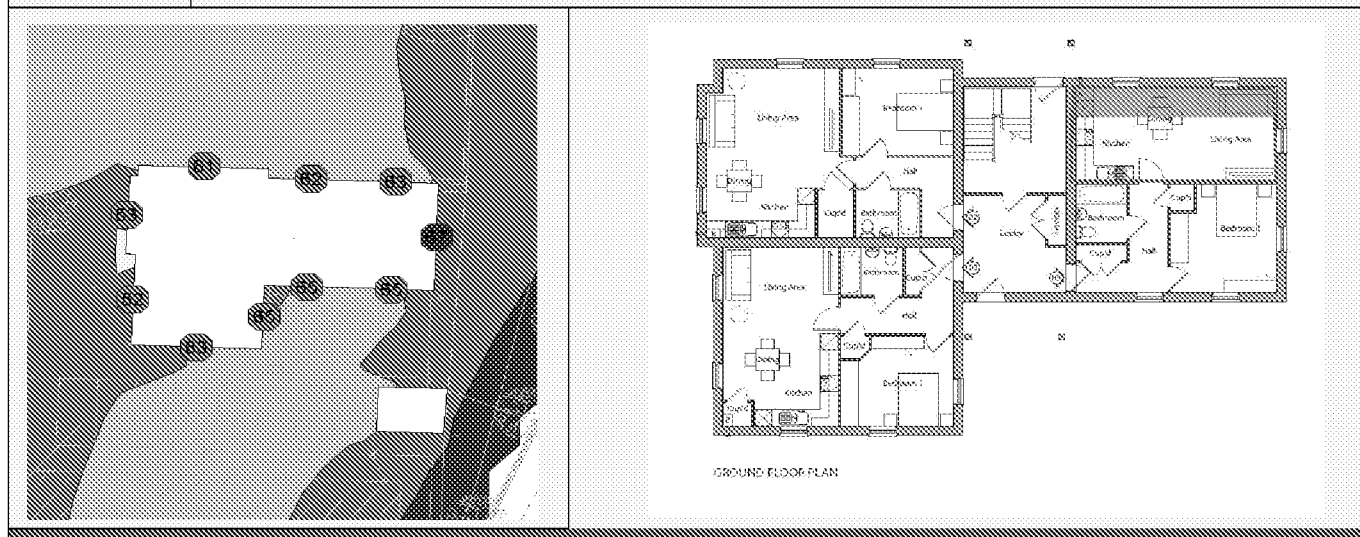
Calculation Sheet		23	Receiver	Plot 159-167 - Gnd Floor	
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Area (m ²)	m ²	m ³
Living Room / Kitchen	3.50	2.40	1.20	20.4	49.0



Term	Description	Units	Value
Sf	Total façade area	m ²	8.4
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	1.2
Sew	External Wall Area	m ²	7.2
V	Volume of receiving room	m ³	49.0
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	15.8

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{min}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ft, Daytime	68	64	60	64	60	51	67	L _{Aeq,16hour} value
Ventilator, Dne	38	38	33	36	47	49	38	Enhanced Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R _w	-29	-25	-30	-35	-43	-39	--	Total Apparent SRI
D _{min,T}	-26	-22	-27	-32	-40	-36	--	Total Standardized Difference
Room Correction	-3	-3	-3	-3	-3	-3	--	Room Absorption Correction
Sound Level	40	39	31	30	18	12	35	Daytime L _{Aeq,16hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for ground floor and Architect's general arrangement drawing.



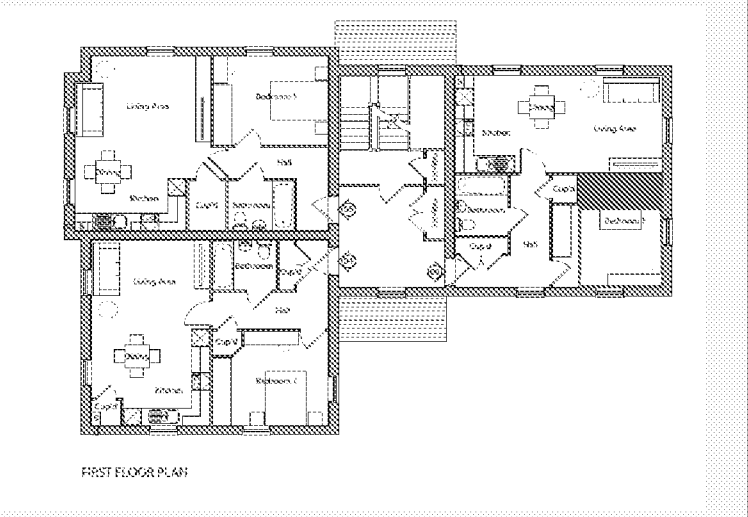
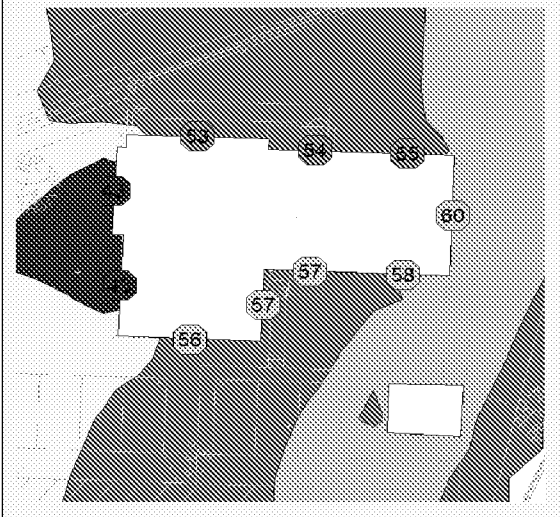
Calculation Sheet		24	Receiver	Plot 159-167 - 1st Floor	
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Area (m ²)	m ²	m ³
Bedroom	4.30	2.50	1.20	18.50	46.25



Term	Description	Units	Value
Sf	Total façade area	m ²	10.8
Svents	Vents Equivalent Open Area	m ²	0.005
Swl	Window Area	m ²	1.2
Sew	External Wall Area	m ²	9.6
V	Volume of receiving room	m ³	46.3
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	14.9

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{min}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ff, Night-time	61	57	53	57	53	44	60	L _{Aeq,8hour} value
Ventilator, Dne	38	38	33	36	47	49	38	Enhanced Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-30	-26	-31	-36	-44	-40	--	Total Apparent SRI
D _{min,T}	-26	-25	-29	-34	-42	-38	--	Total Standardized Difference
Room Correction	-1	-1	-1	-1	-1	-1	--	Room Absorption Correction
Sound Level	33	32	24	23	11	6	28	Night-time L _{Aeq,8 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for ground floor and Architect's general arrangement drawing.



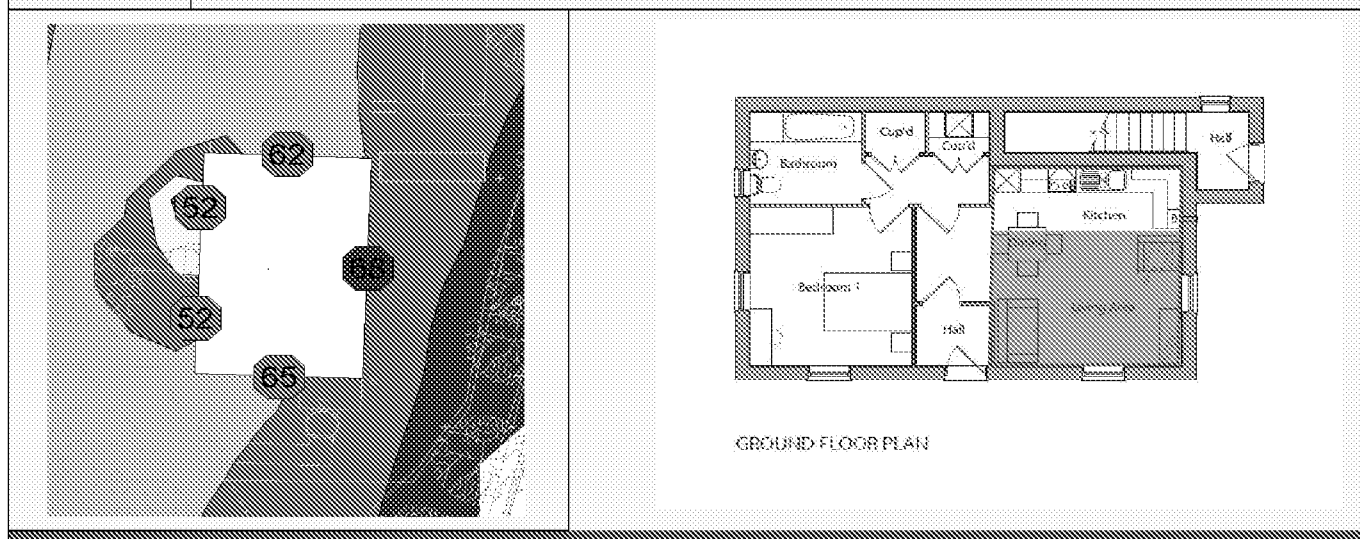
Calculation Sheet		25	Receiver	Plot 174 - Gnd Floor	
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Area (m ²)	m ²	m ³
Kitchen/Dining	4.00	2.60	1.20	18.7	48.6



Term	Description	Units	Value
Sf	Total façade area	m ²	10.4
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	1.2
Sew	External Wall Area	m ²	9.2
V	Volume of receiving room	m ³	48.6
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	15.7

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{min}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ft, Daytime	66	62	58	62	58	49	65	L _{Aeq,16hour} value
Ventilator, Dne	38	38	33	36	47	49	38	Enhanced Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-29	-26	-31	-35	-43	-40	--	Total Apparent SRI
D _{min,T}	-26	-24	-29	-33	-42	-38	--	Total Standardized Difference
Room Correction	-2	-2	-2	-2	-2	-2	--	Room Absorption Correction
Sound Level	38	37	29	28	16	10	33	Daytime L _{Aeq,16hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for ground floor and Architect's general arrangement drawing.



Calculation Sheet		26	Receiver	Plot 174 - 1st Floor	
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Area (m ²)	m ²	m ³
Bedroom	3.40	2.50	1.20	11.50	28.75



Term	Description	Units	Value
Sf	Total façade area	m ²	8.5
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	1.2
Sew	External Wall Area	m ²	7.3
V	Volume of receiving room	m ³	28.8
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	9.3

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{min}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq ft, Night-time	61	57	53	57	53	44	60	L _{Aeq,8hour} value
Ventilator, Dne	38	38	33	36	47	49	38	Enhanced Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R _w	-29	-25	-30	-35	-43	-39	--	Total Apparent SRI
D _{min,T}	-26	-25	-29	-34	-42	-38	--	Total Standardized Difference
Room Correction	0	0	0	0	0	0	--	Room Absorption Correction
Sound Level	35	34	26	25	13	8	30	Night-time L _{Aeq,8 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for first floor and Architect's general arrangement drawing.

