MILLER GOODALL
ACOUSTICS AND AIR QUALITY

NOISE ASSESSMENT

on behalf of

HOLBOROW & ORMESHER LTD

for the site at

MOSELY ROAD, MANCHESTER, M14 6NR

REPORT DATE: 10/06/2021

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Summary

This report provides evidence to discharge condition 8 of planning reference 128939/FO/2020. Planning condition no. 8 states:

Prior to the commencement of above ground construction works, a scheme for acoustically insulating the residential dwellings against noise from Moseley Road shall be submitted to and approved in writing by the City Council as local planning authority. The approved noise insulation scheme shall be completed prior to the first occupation of the residential accommodation.

The consented development is a proposed three storey, four-bedroom semi-detached residential dwelling.

Noise measurements have been undertaken at the site to provide sufficient information to address the condition relating to noise.

Calculations of façade performance have been undertaken to determine the glazing and ventilation specifications required to meet the internal criteria described in Condition 8.

The information provided within this report provides sufficient evidence to discharge the planning condition.

Record of changes

Prepared By	Claire Starley AMIOA	Reviewed By	Michael Rickard MIOA
Signed	Claire Starley	Signed	
Date	10/06/2021	Date	10/06/2021

Version	Date	Change	Initials
1	10/06/2021	Initial issue	CS

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Contents

Summary 1
Contents 3
1 Introduction 4
2 Site Description and Consented Development 4
3 Acoustic Standards and Guidance 5
3.1 ProPG: Planning & Noise – Professional Practice Guidance on Planning & Noise – New Residential Development – May 2017 5
3.2 BS 8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings 6
4 Impact of Existing Noise Sources on the Development 8
4.1 Introduction 8
4.2 Mitigation for Achieving Good Acoustic Design 8
4.3 Building Envelope 9
4.4 Consideration of Other Discipline Requirements 10
5 Conclusions 10
6 Health and Safety Information 11
APPENDICES 13
Appendix A - Site Plan and Measurement Position 15
Appendix B - Noise Monitoring 16
Glossary of Terms 26

1 Introduction

1.1 Miller Goodall Ltd has, on behalf of Holborow & Ormesher Ltd, undertaken a noise assessment for a site at Mosely Road, Manchester, M14 6NR.

1.2 The site has planning approval ref 128939/FO/2020 and the conditions relating to noise are detailed below:

1.3 Planning condition no. 8 states:

Prior to the commencement of above ground construction works, a scheme for acoustically insulating the residential dwellings against noise from Moseley Road shall be submitted to and approved in writing by the City Council as local planning authority. The approved noise insulation scheme shall be completed prior to the first occupation of the residential accommodation.

1.4 This assessment aims to provide sufficient information to discharge the noise conditions.

2 Site Description and Consented Development

2.1 The site is located at Mosely Road, Manchester, M14 6NR. The site location is shown outlined in red in Appendix A.

2.2 To the north of the site runs B5093, Mosely Road, from east to west. Beyond the B5093 is the beginnings of the university grounds, Woolton Hall.

2.3 Directly to the east, south and west of the site is further residential property.

2.4 Approximately 100 m to the west of the site there is Bentley's, an active builder's yard which is shielded from direct line of site by several residential properties.

2.5 Approximately 55 m to the south, south-west of the site there is an active timberyard which is shielded from direct line of sight by 1 line of residential properties.

2.6 The planning consent is to develop the site for two, three-storey four bed semi-detached houses.

2.7 The noise survey details are in Appendix B.

3 Acoustic Standards and Guidance

3.1 ProPG: Planning & Noise – Professional Practice Guidance on Planning & Noise – New Residential Development – May 2017

3.1.1 ProPG: Planning and Noise is new guidance with the aim of delivering sustainable development and promoting good health and well-being through the effective management of noise which may impact on new residential developments. The guidance aims to complement the national planning policy and encourages the use of good acoustic design at the earliest phase of the planning process. It builds upon the recommendations of various other guidance documents including NPPF, NPSE and PPG-Noise, BS 8233 and WHO.

3.1.2 The guidance is applicable to new residential developments which would be exposed predominantly to noise from existing transport sources. The ProPG advocates a risk-based approach to noise using a two-stage process:

- Stage 1 – an initial noise risk assessment of the proposed development site; and
- Stage 2 – a systematic consideration of four key elements: –
  - Element 1 – demonstrating a ‘Good Acoustic Design Process’;
  - Element 2 – observing internal ‘Noise Level Guidelines’;
  - Element 3 – undertaking an ‘External Amenity Area Noise Assessment’; and
  - Element 4 – consideration of ‘Other Relevant Issues’.

3.1.3 The ProPG approach is underpinned by the preparation and delivery of an ‘Acoustic Design Statement’ (ADS), whereby the higher the risk for noise at the site, the more detailed the ADS. The ADS should address the following issues:

- Present the initial site noise risk assessment, including the pre-development acoustic conditions prior to development;
- Describe the external noise levels that occur across the site both before and after any necessary mitigation measures have been incorporated. The external noise assessment with mitigation measures in place should use an informed judgement of typical worst-case conditions;
- Demonstrate how good acoustic design is integrated into the overall design and how the proposed acoustic design responds to specific circumstances of the site;
- Confirm how the internal noise level guidelines will be achieved, including full details of the design measures and building envelope specifications;
- A detailed assessment of the potential impact on occupants should be undertaken where individual noise events are expected to exceed 45 dB $L_{AF,max}$ more than 10 times a night inside bedrooms;

- Priority should be given to enable the use of openable windows where practical across the development. Where this is not practical to achieve the internal noise level guidelines with windows open, then full details of the proposed ventilation and thermal comfort arrangements must be provided;
- Present the findings of the external amenity area noise assessment;
- Present the findings of the assessment of other relevant issues;
- Confirm for a low-risk site how adverse impacts of noise will be mitigated and minimised;
- Confirm for a medium or high noise risk site how adverse impacts of noise will be mitigated and minimised and clearly demonstrate that a significant adverse noise impact has been avoided.

3.1.4 ProPG target noise levels are based on existing guidance from BS 8233 and WHO (see below). Table 1 below outlines the guidance noise levels for different room types during day and night times.

Table 1: ProPG guideline indoor ambient noise levels for dwellings

Activity	Location	07:00 to 23:00	23:00 to 07:00
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 $L_{Amax,F}$

3.1.5 The footnotes to this table suggest that internal noise level limits can be relaxed by up to 5 dB where development is considered necessary or desirable, and still represent “reasonable” internal conditions. They also suggest that in such cases, external levels which exceed WHO guidance target levels (see WHO section below) may still be acceptable provided that reasonable internal noise levels are achieved. Although, where the acoustic environment of external amenity areas is intrinsic to the overall design, “noise levels should ideally not be above the range 50 – 55 dB $L_{Aeq,16hr}$”. The wording of ProPG (and BS 8233:2014) is clear that exceedance of guideline noise levels in external areas should not prohibit the development of desirable developments in any event.

3.2 BS 8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings

3.2.1 This standard provides recommended guideline values for internal noise levels within dwellings which are similar in scope to guideline values contained within the World Health Organisation (WHO) document, Guidelines for Community Noise (1999)[1]. These guideline noise levels are shown in Table 2, below.

[1] World Health Organisation Guidelines for Community Noise, 1999

Table 2: BS 8233: 2014 guideline indoor ambient noise levels for dwellings

Location	Activity	07:00 to 23:00	23:00 to 07:00
Living Room	Resting	35 dB $L_{Aeq,16hr}$	-
Dining room/area	Dining	40 dB $L_{Aeq,16hr}$	-
Bedroom	Sleeping (daytime resting)	35 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,8hr}$

3.2.2 BS 8233:2014 advises that:

> *"regular individual noise events…can cause sleep disturbance. A guideline value may be set in terms of SEL[2] or $L_{Amax,F}$ depending on the character and number of events per night. Sporadic noise events could require separate values".*

3.2.3 BS 8233:2014 adopts guideline external noise values provided in WHO for external amenity areas such as gardens and patios. The standard states that it is "desirable" that the external noise does not exceed 50 dB $L_{Aeq,T}$ with an upper guideline value of 55 dB $L_{Aeq,T}$ whilst recognising that development in higher noise areas such as urban areas or those close to the transport network may require a compromise between elevated noise levels and other factors that determine if development in such areas is warranted. In such circumstances, the development should be designed to achieve the lowest practicable noise levels in external amenity areas.

[2] Sound exposure level or L_{AE}

4 Impact of Existing Noise Sources on the Development

4.1 Introduction

4.1.1 Three scenarios were assessed based on the measured noise levels, calculated back to the proposed façade location, using the indicative master plan provided:

- daytime L_{Aeq} noise levels,
- night-time L_{Aeq} noise levels and
- night-time L_{AFmax} noise levels.

4.2 Mitigation for Achieving Good Acoustic Design

4.2.1 In order to assess the potential glazing and ventilation requirements for dwellings, noise ingress calculations were undertaken based on the methodology in BS EN 12354-3[3]. Room and window dimensions were taken from architect drawings.

4.2.2 Noise ingress calculations are summarized in Table 3, below:

Table 3: Predicted internal noise levels.

Description	External Noise Levels		Predicted Internal Noise Levels		BS 8233 Criteria		Exceedance of Criteria		Proposed Glazing and Ventilation
	dB $L_{Aeq,T}$	dB L_{AFmax}	dB $L_{Aeq,T}$	dB L_{AFmax}	dB $L_{Aeq,T}$	dB L_{AFmax}	dB $L_{Aeq,T}$	dB L_{AFmax}	
Living rooms/dining kitchens facing Moseley Road. (daytime)	61	N/A	33	N/A	35	N/A	-2	0	Option 1
Bedrooms facing Moseley Road. (night-time)	57	71	30	45	30	45	0	0	Option 2

- **Option 1** - Glazing with minimum weighted sound reduction index of 27 dB $R_W + C_{tr}$ (e.g. 4/12/4); ventilator with a minimum element normalised sound level difference of 30 dB $D_{ne,W}$.
- **Option 2** - Glazing with minimum weighted sound reduction index of 29 dB $R_W + C_{tr}$ (e.g. 6/12/6); acoustic rated ventilator with a minimum element normalised sound level difference of 41 dB $D_{ne,W}$.

4.2.3 Tables 4 and 5 below provide the minimum requirements for the glazing and ventilation options provided in table 3.

[3] BS EN 12354-3:2000 Building acoustics. Estimation of acoustic performance in buildings from the performance of elements - Airborne sound insulation against outdoor sound

Table 4: Minimum sound reduction indices of glazing

Glazing Option	Sound Reduction Index, R_w in Octave Band Centre Frequency, Hz								R_w	C_{tr}	$R_w + C_{tr}$
	63	125	250	500	1k	2k	4k	8k			
Option 1	18	24	20	25	35	38	35	35	31	-4	27
Option 2	18	24	22	29	39	33	38	38	32	-3	29

Table 5: Minimum ventilation requirements

Ventilation Option	Element normalised sound level difference, *Dne* in Octave Band Centre Frequency, Hz								$D_{ne,W}$	C_{tr}	$D_{ne,W} + C_{tr}$
	63	125	250	500	1k	2k	4k	8k			
Option 1	29	33	32	29	28	30	34	40	30	-1	29
Option 2	33	37	31	35	43	51	50	50	41	-3	38

4.2.4 Trickle ventilator specification is based on 1no trickle vent per room providing the required Part F background ventilation rates. Where 2no trickle vents are required, ventilator ratings must be increased by 3 dB at every octave band.

4.2.5 A coloured mark-up illustrating the location of the glazing and ventilation options proposed is provided in Appendix C.

4.3 Building Envelope

4.3.1 It is recommended that the façade build is:

- External walls: Double leaf 112 mm brickwork, 50 mm cavity, rigid wall ties
- Roof: Tiled/slate roof, 25 mm plasterboard ceiling, 100 mm mineral wool insulation

4.4 Consideration of Other Discipline Requirements

4.4.1 It is recommended that you confirm the suitability of all recommended noise mitigation measures with your architects, structural engineers, building contractors, fire consultants and material manufacturers prior to procurement and field application so that when the recommended noise control measures are implemented on site they will satisfy the requirements of all disciplines, therefore, should not cause any health and safety issues.

5 Conclusions

5.1.1 Conditional planning consent has been granted for a residential development at Mosely Road, Manchester, M14 6NR, planning reference 128939/FO/2020. Condition 8 has been addressed as part of this assessment.

5.1.2 Façade levels have been calculated from measured data for daytime and night-time. Calculated levels have been used to determine specifications for glazing and ventilation to ensure internal criteria for living spaces is achieved.

5.1.3 In conclusion, the noise assessment has provided sufficient information for the discharge of condition 8.

6 Health and Safety Information

The Construction (Design and Management) Regulations (CDM 2015) are the main set of regulations for managing the health, safety and welfare of construction projects. CDM 2015 applies to all building and construction work and includes new build, demolition, refurbishment, extensions, conversions, repair and maintenance in order to reduce injury and ill health.

Under the regulation we are Designers. As a Designer, our decisions can affect the health and safety of workers and others who will construct, maintain, repair, clean, refurbish and eventually demolish or remove the building or structure, as well as those who will use it as a completed workplace. Taking risks arising from the design into account can positively affect the project and make it easier for these risks to be managed by contractors and those who will maintain or use the structure. Our designs must contribute to the safe delivery of a project without risks to health.

As Designers we must:

- understand and be aware of significant risks that workers and users can be exposed to and how these can arise from our design decisions;
- have the right skills, knowledge, and experience and be adequately resourced to address the health and safety issues likely to be involved in the design;
- check that Clients are aware of their duties;
- co-operate with others who have responsibilities, in particular the Principal Designer;
- take into account the general principles of prevention when carrying out our design work;
- provide information about the risks arising from our design;
- co-ordinate our work with that of others in order to improve the way in which risks are managed and controlled.

Our designer's risk assessment for this project and the mitigation work we have recommended is shown in Appendix 4.

APPENDICES

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Appendix A - Site Plan and Measurement Position

Figure A1: Site location and monitoring location

Appendix B - Noise Monitoring

6.1.1 Noise measurements were undertaken at a location consistent with the proposed development in accordance with BS 7445-1: 2003[4] by Reid Malster of Miller Goodall Ltd. The calibration of the sound level meter was checked before and after measurements with negligible deviation (<0.1 dB). Details of the equipment used are shown in Table B1 below.

Table B1:Noise monitoring equipment

Equipment Description	Type Number	Manufacturer	Serial No.	Date Calibrated	Calibration Certification Number
Class 1[5],[6] Integrating Real Time 1/3 Octave Sound Analyser	NOR 140	Norsonic	1407510	13/12/2019	473910536
Microphone	NOR 1225	Norsonic	384687	15/01/2021	N/a*
Class 1 Calibrator[7]	NOR 1251	Norsonic	34123	20/07/2020	04743/2
Outdoor microphone housing	NOR 1217	Norsonic	12175738	N/a	N/a

*No reference number available, but the certificate is available upon request.

6.1.2 Noise monitoring was undertaken at the times specified in Table B2 below. Weather conditions were determined both at the start and on completion of the survey. It is considered that meteorological conditions were appropriate for environmental noise measurements. Measurement locations are shown in Appendix 1.

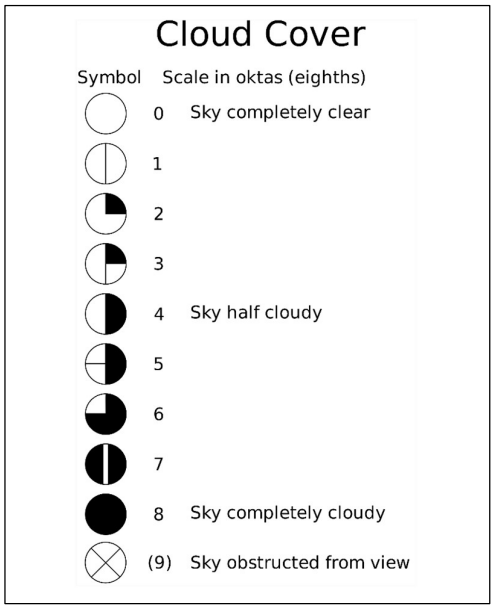
[4] BS 7445-1: 2003 Description and measurement of environmental noise - Part 1: Guide to quantities and procedures

[5] IEC 61672-1 (2002) Electroacoustics – Sound level meters Part 1: Specifications

[6] IEC 61260 (1995) Electroacoustics – Octave-band and fractional-octave-band filters

[7] IEC 60942 (2003) Electroacoustics – Sound calibrators

Table B2: Dates, times and weather conditions during noise measurements

Measurement Location	Date/Time	Weather conditions		
		Description	At Start of Survey	On Completion
P1	19.05.21, to 20.05.21,	Temperature:	14 ºC	12 ºC
		Precipitation:	Dry	Dry
		Cloud cover (oktas – see opposite):	3	7
		Any fog/snow/ice?	No	No
		Any damp roads/wet ground?	No	No
		Wind speed:	4 -5 m/s	4 m/s
		Wind direction:	Variable, generally westerly	
		Any conditions that may cause temp. inversion (e.g. calm nights with no cloud):	No	No

6.1.3 Measurements were taken over a 24hr period. Measurements were made under free-field conditions at a height of 2 m above the ground and with a clear line-of-site to the road traffic on Moseley Road.

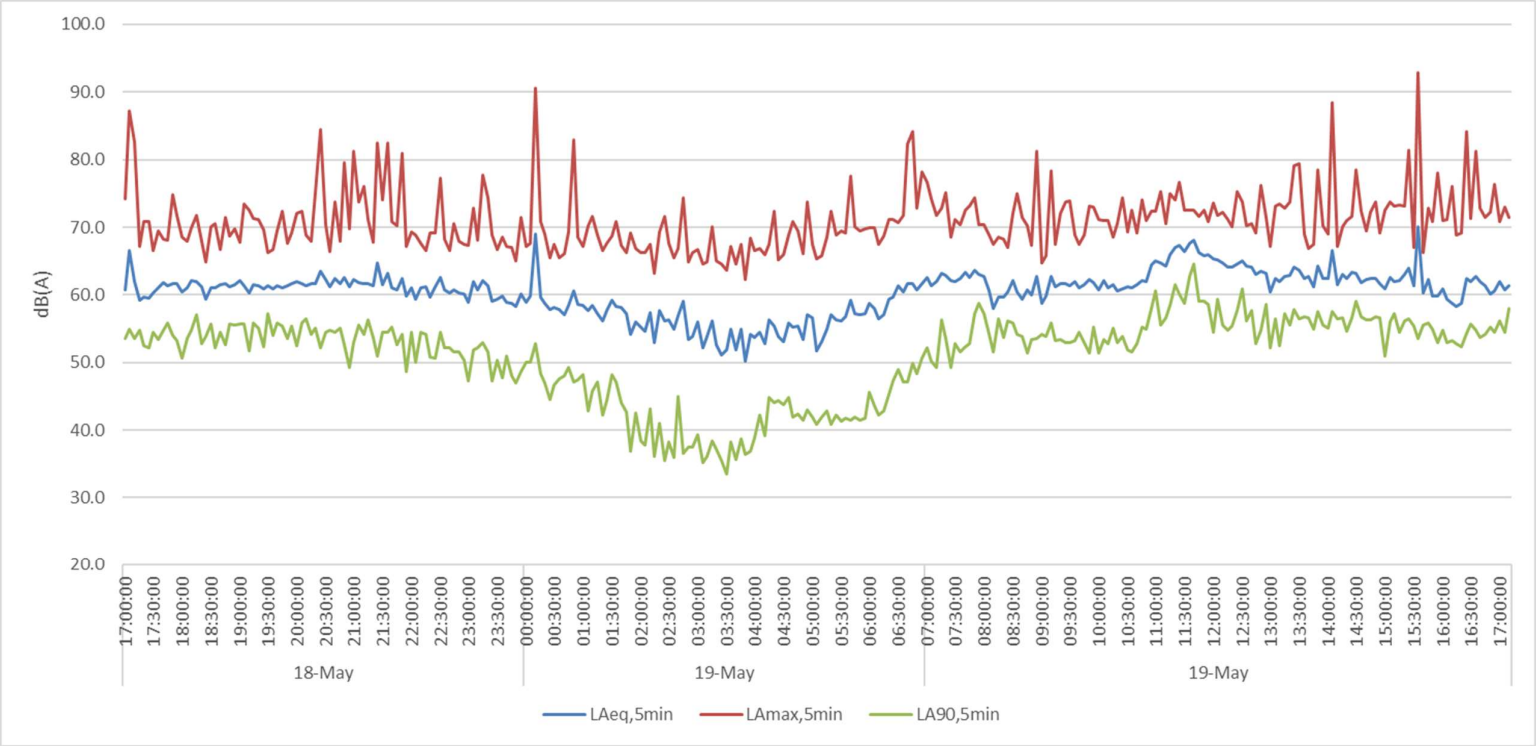
6.1.4 The noise sources within the vicinity of the measurement locations are summarised below:

Table B3: Description of noise sources affecting the site.

Measurement Locations	Noise Sources
P1	Road traffic noise

Monitoring Results

6.1.5 A summary of the broadband measurement data is provided below. All data are sound pressure levels in dB re 20 μPa.

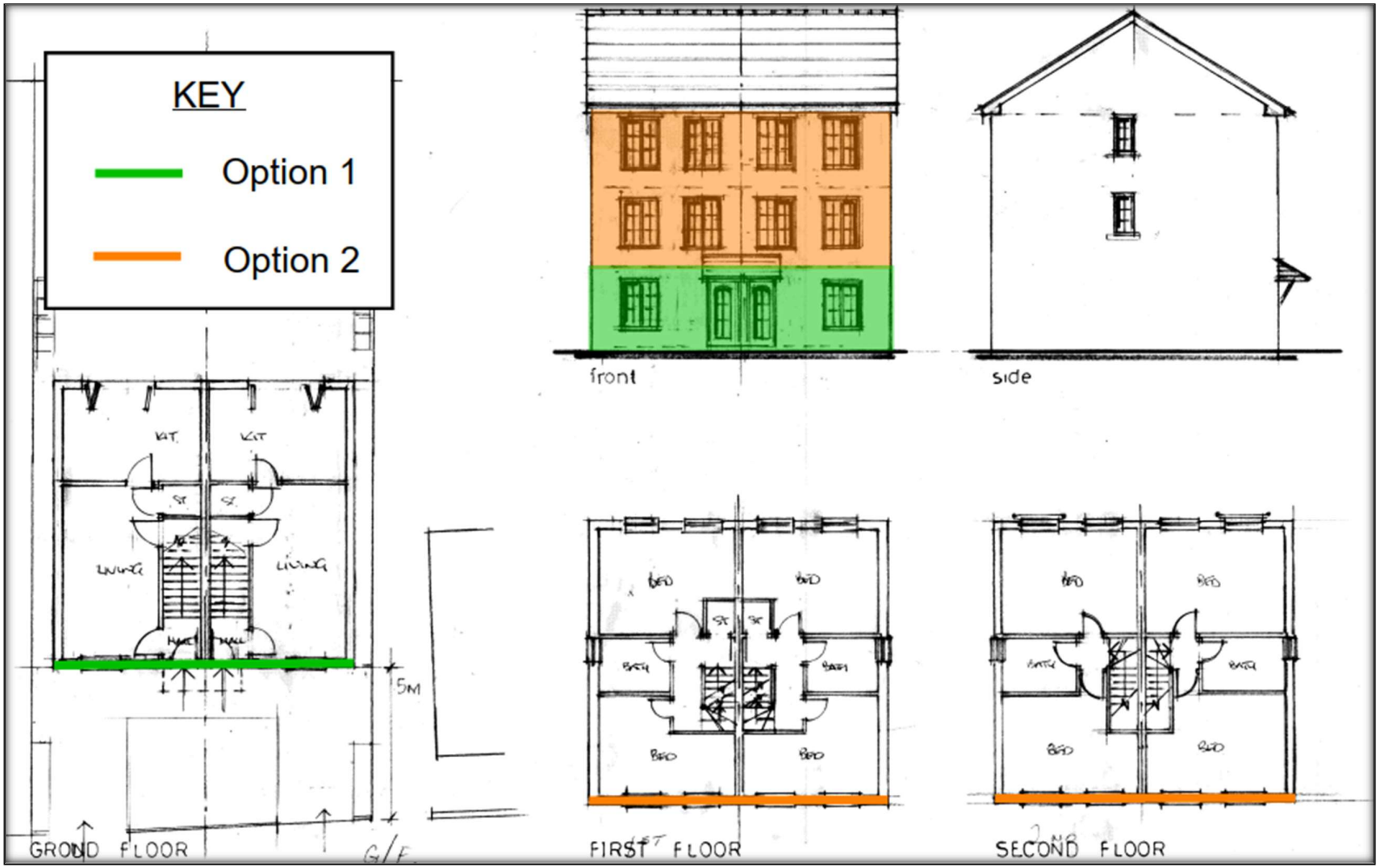


6.1.6 Each measurement period consisted of sequential 5-minute samples which therefore allowed the variation in noise level over time to be assessed. This data was subsequently used to determine a 'typical' L_{AFmax} noise level and octave band spectrum based on the 11th highest measured $L_{AFmax,T}$. This data was subsequently utilised within the noise model.

6.1.7 The 1 second noise levels have not been presented in this report but are kept on file for future reference.

Appendix C - Glazing and ventilation mark-ups

Figure C1: Noise Ingress - Mark-ups. Habitable rooms facing Moseley Road.



Appendix D: DESIGNERS RISK ASSESSMENT

Project:	Former St Lukes School, Eccles New Road, Salford	**Job No.**	102264-2
		By/Date	01/06/2021
		Approved (Acoustic Consultant)	C. Starley

Checklist of potential operations and hazards					
Potential Hazards	**Present**		**Potential Hazards/Operation**	**Present**	
Installing Gyproc planking	YES ☒	NO ☐	Overloading of structures	YES ☒	NO ☐
Noise	YES ☒	NO ☐	Manual handling	YES ☒	NO ☐
Vibration	YES ☒	NO ☐	Electricity	YES ☒	NO ☐
Fall from height	YES ☒	NO ☐	Water	YES ☒	NO ☐
Gas	YES ☐	NO ☒	Services	YES ☒	NO ☐
Falling material	YES ☒	NO ☐	Use of caulking or sealants	YES ☒	NO ☐
Unstable structure	YES ☐	NO ☒	Use of mineral wool	YES ☒	NO ☐
Dust	YES ☒	NO ☐		YES ☐	NO ☐
	YES ☐	NO ☐		YES ☐	NO ☐
	YES ☐	NO ☐		YES ☐	NO ☐
	YES ☐	NO ☐		YES ☐	NO ☐
	YES ☐	NO ☐		YES ☐	NO ☐
	YES ☐	NO ☐		YES ☐	NO ☐
	YES ☐	NO ☐		YES ☐	NO ☐
	YES ☐	NO ☐		YES ☐	NO ☐
	YES ☐	NO ☐		YES ☐	NO ☐
	YES ☐	NO ☐		YES ☐	NO ☐

Project:	Moseley Road, M14 6NR	**Job No.**	102573
		By/Date	10/06/2021
		Approved (Acoustic Consultant)	C. Starley

Stage: Construction		**Sheet 1 of 4**
Hazard	**Action By Designer**	**Residual Hazard**
Installing plasterboard	**1. To eliminate hazard** Cannot eliminate.	
	2. To reduce hazard Advise the main contractor/ builder to undertake a detailed risk assessment and develop a suitable method statement in respect of installing plasterboard, in particular installing plasterboard ceilings at height. Use of board lifters and board handling equipment.	Follow manufacturers recommended safety guidelines during construction. Refer to data sheets from suppliers for more information. Risk of stability and durability issues. Client to seek further guidance from qualified and competent building designers on suitability of plasterboard constructions.
Overloading of structures	**1. To eliminate hazard** Do not exceed the maximum weight and loading restrictions, as advised by an experienced, competent and qualified structural engineer.	
	2. To reduce hazard Keep within recommended guidelines of acoustic design criteria and available construction products to achieve desired design output. Select products with lightest weights that can achieve required acoustic requirements.	Collapse of structure or falling materials through overloading. Client to seek advice and calculations from an experienced, competent and qualified structural engineer to ensure acoustic materials selected will not overload the structure.

Stage: Construction		**Sheet 2 of 4**
Hazard	**Action By Designer**	**Residual Hazard**
Dust	**1. To eliminate hazard** Cannot eliminate.	
	2. To reduce hazard Main contractor/ builder to keep materials in packaging until ready for use. Consider the use of face masks when cutting. See material data sheet for minimum FFP requirement. Operative must be face fit tested. Consider use of EN 166 eye protection to avoid dust in eyes. Carry out CoSHH assessment.	Cutting of Gyproc planking is generally low risk. However, it may be an irritant to skin or respiratory system.
Noise	**1. To eliminate hazard** Cannot eliminate.	
	2. To reduce hazard Manual Handling Main contractor/ builder to undertake a detailed risk assessment and develop a suitable method statement in respect of construction phase noise and impact upon construction workers and surrounding areas. Consider establishing soundproofed areas for cutting and other noisy operations.	Risk of hearing damage. Risk of loss of acoustic amenity to neighbouring areas.
Manual Handling	**1. To eliminate hazard** Cannot eliminate.	
	2. To reduce hazard Main contractor/ builder to undertake a detailed risk assessment and develop a suitable method statement in respect of manual handling during construction. Consider use of smaller sizes of plasterboard to reduce weights.	Risk of musculoskeletal damage.

Stage: Construction		**Sheet 2 of 4**
Hazard	**Action By Designer**	**Residual Hazard**
Vibration	**1. To eliminate hazard** Cannot eliminate.	
	2. To reduce hazard Main contractor/ builder to undertake a detailed risk assessment and develop a suitable method statement in respect of construction phase vibration.	Risk of Hand Arm Vibration Syndrome to workers
Use of caulking or sealants	**1. To eliminate hazard** Cannot eliminate.	
	2. To reduce hazard Main contractor/ builder to undertake a detailed risk assessment and develop a suitable method statement in respect of use of caulking and sealants.	Follow manufacturers recommended safety guidelines during construction. Refer to data sheets from suppliers for more information. Consider wearing gloves
Falls from height	**1. To eliminate hazard** Cannot eliminate.	
	2. To reduce hazard Main contractor/ builder to undertake a detailed risk assessment and develop a suitable method statement in respect of falls from height. Consider the use of scaffolding, suitable work platforms and fall arrest systems.	Risk of injury and death.
Use of Mineral Wool	**1. To eliminate hazard** Cannot eliminate.	
	2. To reduce hazard Main contractor/ builder to undertake a detailed risk assessment and develop a suitable method statement in respect of use of mineral wool. Consider wearing gloves	Follow manufacturers recommended safety guidelines during construction. Refer to data sheets from suppliers for more information.

Stage: Construction		**Sheet 2 of 4**
Hazard	**Action By Designer**	**Residual Hazard**
Falling Material	**1. To eliminate hazard** Cannot eliminate.	
	2. To reduce hazard Main contractor/ builder to undertake a detailed risk assessment and develop a suitable method statement in respect of falling material. Consider use of platforms, scaffold or similar to catch any falling materials.	Risk of injury from falling materials.
Unstable Structure	**1. To eliminate hazard** Cannot eliminate.	
	2. To reduce hazard Competent and qualified structural engineer to undertake calculations and determine if structure is capable of supporting additional weights associated with the acoustic design elements such as plasterboard ceilings to top floor and acoustic rated glazing.	Follow manufacturers recommended safety guidelines during construction. Refer to data sheets from suppliers for more information. Risk of stability and durability issues. Client to seek further guidance from qualified and competent building designers on suitability.

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Glossary of Terms

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

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

$L_{A90,T}$ The A weighted noise level exceeded for 90% of the specified measurement period (*T*). In BS 4142: 2014+A1:2019 it is used to define background noise level.

$L_{Aeq,T}$ The equivalent continuous sound level. The sound level of a notionally steady sound having the same energy as a fluctuating sound over a specified measurement period (*T*). $L_{Aeq,T}$ is used to describe many types of noise and can be measured directly with an integrating sound level meter.

L_{Amax} The highest A weighted noise level recorded during the time period. It is usually used to describe the highest noise level that occurred during the event.

$L_{A10(18\ hour)}$ Often referred to as the UK road traffic noise index, this is the arithmetic average of the values of L_{A10} hourly for each of the 18 one hour periods between 06:00 and 00:00.

L_{day} The A-weighted long-term average sound level as defined in ISO 1996-2: 1987, determined over all the daytime periods (07:00 – 19:00) of a year. Referenced in the Environmental Noise Directive 2002/49/EC.

$L_{evening}$ The A-weighted long-term average sound level as defined in ISO 1996-2: 1987, determined over all the evening periods (19:00 – 23:00) of a year. Referenced in the Environmental Noise Directive 2002/49/EC.

L_{night} The A-weighted long-term average sound level as defined in ISO 1996-2: 1987, determined over all the night-time periods (23:00 – 07:00) of a year. Referenced in the Environmental Noise Directive 2002/49/EC.

L_{den} The equivalent continuous sound pressure level of a notionally steady sound having the same energy as a fluctuating sound over a 24 hour period equivalent to 00:00 to 24:00 but with weightings of 5 dB and 10 dB applied to evening and night-time periods respectively to reflect the greater noise sensitivity of the population at those times. L_{den} is derived using the L_{day}, $L_{evening}$ and L_{night} noise indices and is referenced in the Environmental Noise Directive 2002/49/EC.

NOEL No observed effect level: the level of noise exposure below which no effect at all on health or quality of life can be detected.

LOAEL Lowest observed adverse effect level: the level of noise exposure above which adverse effects on health or quality of life can be detected.

SOAEL Significant observed adverse effect level: the level of noise exposure above which significant adverse effects on health or quality of life can be detected.

R_w Single number rating used to describe the sound insulation of building elements and is defined in BS EN ISO 10140-2: 2010 (formerly BSEN ISO 140-3:1995). It is derived by measurement under laboratory conditions and does not take into account the effects of flanking transmissions.

$D_{nT,w}$ The weighted standardized level difference is a single figure rating used to describe the sound insulation of a construction separating two rooms, for example a wall or floor, and is defined in BS EN ISO 16283-1:2014 (formerly BSEN ISO 140-4:1998). It is derived by measurement of an in-situ construction and therefore takes into account the effects of flanking transmissions, workmanship etc.

$D_{ne,w}$ The weighted element-normalized level difference is a single figure rating used to describe the sound insulation of small elements within a larger construction and is defined in BS EN ISO 10140-2:2010 (BSEN ISO 140-10:1991). It is most often used to rate the sound insulation performance of ventilator units e.g. trickle vents.

C_{tr} A single-number spectrum adaptation term used to characterise the sound insulation rating with respect to urban traffic. It is defined in ISO 717-1:20-13.

NR curves Noise Rating – or NR - curves were developed by the International Organization for Standardization (ISO) to determine the acceptable indoor acoustic environment for hearing preservation, speech communication and annoyance. They are most often used to quantify noise within a building from mechanical and electrical (M&E) systems.

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