

MMU Library

Acoustics Planning Report

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Glossary

Term	Definition
Ambient Noise (as defined in BS 4142:2014+A1 2019)	Totally encompassing noise in a given situation at a given time; it is usually composed of noise from many sources, near and far.
Background Noise (as defined in BS 4142:2014+A1 2019)	A-weighted sound pressure level of the residual noise at the assessment position that is exceeded for 90% of a given time interval, T, measured using the Fast time weighting and quoted to the nearest whole number of decibels.
C_{tr}	Spectrum adaptation term calculated using traffic noise as described in BS EN ISO 717-1:2020. This term is provided with weighted single values such as $D_{nT,w}$ or R_w to match with particular requirements (building acoustic or traffic noise spectrum).
Decibel, dB	Decibel (dB) is a dimensionless unit commonly used to demonstrate sound levels. It is derived from the logarithm of the ratio between the measured level and the reference value. For sound pressure level (L_p) the reference value is 2×10^{-5} pascals. For sound power (L_w) reference value is 1×10^{-12} Watts.
Frequency	Number of cycles per second, measured in hertz (Hz), related to sound pitch.
IANL	Indoor Ambient Noise Level. For schools Table 1 in BB93 (2015) specifies the upper limit for indoor ambient noise levels within teaching areas. The design criteria is set for a 30-minute average level (i.e. $L_{Aeq,30mins}$). However, where there is negligible change in the noise level, BB93 states that a much shorter time period (e.g. $L_{Aeq,5min}$) can be used. BB93 also states that for rooms identified having limits of $L_{eq,30min}$ 35 dBA or less, the noise should not regularly exceed $L_{1,30min}$ 55 dBA.
$L_{90,T}$ ($L_{A90,T}$)	Sound pressure level exceeded for 90% of the measurement period. Referred to as background noise level.
$L_{A,r,Tr}$	Rating Noise Level (as defined in BS 4142:2014+A12019), the specific noise level plus any adjustment for the characteristic features of the noise.
$L_{eq,T}$ ($L_{Aeq,T}$)	The equivalent continuous noise level of a time-varying noise. It is the steady noise level that, over the period under consideration, contains the same amount of sound energy as the time-varying noise over the same period.
$L_{Fmax,T}$ ($L_{AFmax,T}$)	The maximum sound pressure level measured during the measurement period T using the fast time constant.
L_p	The sound pressure level, in decibels, of a sound is 20 times the logarithm to the base of 10 of the ratio of the sound pressure to the reference pressure (2×10^{-5} pascals). The reference pressure shall be explicitly stated and is defined by standard.
Noise Rating (NR)	Curves developed by the International Organization for Standardization (ISO) to determine the acceptable indoor environment for hearing preservation, speech communication and annoyance. These can be compared to NC curves and also can be approximated to equivalent dBA levels.
Reverberation Time (RT)	Time required for the steady sound pressure level in an enclosed space to decay by 60 dB, measured from the moment the sound source is switched off. Reverberation time is described in ISO 354:2003.
R_w (C , C_{tr})	Weighted Sound Reduction Index: Single-figure value of sound reduction according to BS EN ISO 10140-2:2021 used for rating partition systems, door-sets or glazing, based on the values of sound reduction index R at different frequencies. The higher the R_w the better the performance.

Term	Definition
Specific Noise Level (as defined in BS 4142:2014+A1 2019)	The equivalent continuous A-weighted sound pressure level at the assessment position produced by the specific noise source over a given reference time interval.
Weightings (as defined in BS EN 61672:2013):	A-Weighting: Frequency weighting devised to attempt to take into account the fact that human response to sound is not equally sensitive to all frequencies; it consists of an electronic filter in a sound level meter, which attempts to build in this variability into the indicated noise level reading so that it will correlate, approximately, with human response.). C-Weighting: One of the frequency weightings corresponding to the 100-phon contour and the closest to the linear or un-weighted value.

1 Introduction

1.1 Overview

Buro Happold Acoustics have been commissioned to complete a Noise Impact Assessment (NIA) to support a Planning Application for the proposed reconfiguration of the Manchester Metropolitan University Library.

It is understood that the building is to be part refurbishment and part new build. It is understood that the space is to be reconfigured to form various large open-plan spaces and smaller break-out spaces.

Figure 1—1 presents a graphical rendering of the proposed MMU Library.

Figure 1—2 presents a typical floorplate for the proposed MMU Library, provided by Hawkins\Brown & Schmidt/Hammer/Lassen/architects (SHL).

1.2 Scope & Contents

The scope of this report is to provide information to the Local Planning Authority (Manchester City Council) concerning the acoustic design of the scheme.

Assessment of operational noise levels has also been undertaken to see that the impact of plant installations at the site should not negatively affect Noise Sensitive Receptors (NSRs).

This noise impact assessment considers the following:

- Pertinent acoustic criteria
- External noise levels/survey results
- Noise break-in
- Noise break-out
- Conclusions.

1.3 Reference to Products or Manufacturers

Wherever this report refers to a specific product or manufacturer, this can be taken to mean *“any equal approved product providing the same or better level of acoustic performance”*. Buro Happold have no vested interest in any one product or manufacturer.



Figure 1—1 Graphical render of the proposed Library (Source: Hawkins Brown / SHL)

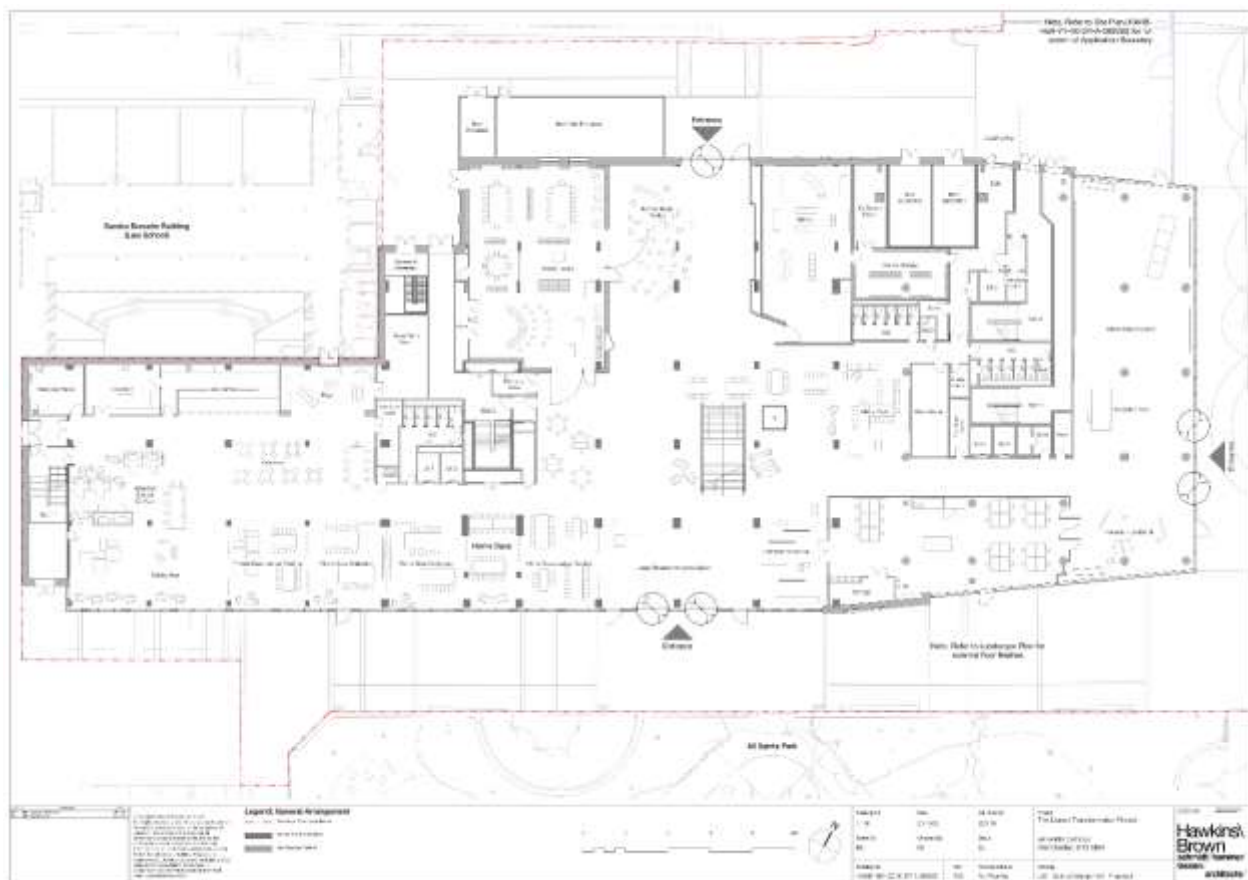


Figure 1—2 Typical floorplate of the MMU Library (Source: Hawkins Brown / SHL)

2 Acoustic Design Criteria

2.1 Relevant Guidance Documentation

This report is informed by the following standards and guidelines:

- The National Planning Policy Framework, 2021 (NPPF)
- The Noise Policy Statement for England, 2010 (NPSE)
- Planning Practice Guidance, 2021
- Manchester City Council - Planning and Noise Technical Guidance (October 2022)
- British Standard (BS) 8233:2014 – Guidance on sound insulation and noise reduction for buildings
- BREEAM New Construction 2018 (Education Building)
 - Hea 05 – Acoustic performance
 - Pol 05 – Reduction of noise pollution.
- WELL 2.0 – Q3 2022
- BS 4142:2014+A1:2019 – Methods for rating and assessing commercial and industrial sound
- World Health Organisation (WHO) – Guidelines for community noise.

2.3 English Planning Policy on Noise Impact – The NPPF and NPSE

The NPPF is the overarching Planning Policy document that applies to all new developments in England. The guidance and assessment criteria given (or referred to) in this document can, therefore, be applied to all other standards in terms of assessing the suitability of granting Planning Permission concerning noise impact.

The NPPF states that planning policies and decisions should aim to:

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

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

With specific reference to noise impact, the NPPF document refers to the Noise Policy Statement for England (NPSE). The NPSE provides guidance, which enables decisions to be made regarding the acceptable noise burden to place on society, using three key phrases:

- No Observed Effect Level (NOEL)
- Lowest Observed Adverse Effect Level (LOAEL)
- Significant Observed Adverse Effect Level (SOAEL)

To provide a consistent frame of reference (and to allow a view to be taken on the suitability of the application regarding the relevant planning guidance), the levels or criteria given in other relevant documents used in the assessment can be re-framed, as shown in Table 2—1.

Table 2—1 NOAEL, LOAEL and SOAEL

Effect Level	Description
NOEL	The NOEL is the level of noise impact below which no effect can be detected, and there would be no discernible negative effect on health or quality of life.
LOAEL	The LOAEL is the lowest level of noise impact above which adverse effects on health or quality of life can be detected. Designing noise impacts to be equal-to-or-less-than, the LOAEL should see that any adverse effects on health or quality of life are negligible.
SOAEL	The SOAEL is the level above which significant adverse effects on health and quality of life occur. Designs should always seek to avoid a noise impact, which would be categorised as a SOAEL.

2.4 Planning Practice Guidance (2021)

The National Planning Practice Guidance (PPG) “advises on how planning can manage potential noise impacts in the new development” and provides guidelines that are in line with the NPPF.

The PPG states that local planning authorities should take account of the acoustic environment and in doing so consider:

- whether or not a significant adverse effect is occurring or likely to occur
- whether or not an adverse effect is occurring or likely to occur
- whether or not a good standard of amenity can be achieved.

This guidance introduced the additional concepts of NOAEL (No Observed Adverse Effect Level), and UAEL (Unacceptable Adverse Effect Level), presented in Table 2—2.

Factors to be considered in determining whether noise is a concern are identified, including the absolute noise level of the source, the existing ambient noise climate, time of day, frequency of occurrence, duration, the character of the noise, and cumulative effects.

Table 2—2 Planning Practice Guidance (PPG 2021)

Perception	Example Outcomes	Increasing Effect Level	Action
No Observed Effect Level			
Not present	No Effect	No Observed Effect	No specific measures required
No Observed Adverse Effect Level			
Present and not intrusive	Noise can be heard but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not so much that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Present and intrusive	Noise can be heard and causes small changes in the behaviour and/or attitude. E.g. turning up volume of television; speaking more loudly; where there is no alternative means of ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Present and disruptive	The noise causes a material change in the behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in the acoustic character of the area	Significant Observed Adverse Effect	Avoid through the use of appropriate mitigation whilst taking into account the social and economic benefit
Present and very disruptive	Extensive and regular changes in the behaviour and/or inability to mitigate the effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant medically definable harm, e.g. auditory and non-auditory.	Unacceptable Adverse Effect	Prevent through use of appropriate mitigation

3 Noise Survey

3.1 Introduction

Environmental noise survey was undertaken between 09:00 on Wednesday 14th December, and 09:00 on Monday 19th December 2022 at a single position in the immediate vicinity of the All Saints library building to capture ambient sound levels. An additional noise survey was undertaken between 20th and 25th July 2023 to capture background sound levels. The noise data collected during the survey will be used to establish the baseline noise levels, and determine the sound insulation performance for the building façade and to quantify rating sound limits for services plant.

The prevailing noise level to the North and East façade of the library was dominated by traffic passing along the A57, and to a lesser extent, Oxford Road. The noise contribution from the A57 is significantly reduced to the South of the library where the background noise levels are noticeably lower.

The two measurement locations are presented below.



Figure 3—1 Background noise level measurement locations

3.3 Ambient Noise Level Survey – For the Façade Sound Insulation Design

3.3.1 Survey methodology

For the ambient sound level survey, conditions were dry with average wind speeds of 3 m/s and temperature of 7 °C. Measurements were taken at a height of approximately 1.5 m in free-field conditions. The approximate measurement location is identified in , with descriptions presented in Table 3—1.

The sound level meter used on the rooftop was a SoundExpert® LxT with Serial Number 0007081. The associated preamplifier was a PRMLxT1L.

Table 3—1 Description of noise survey locations

Measurement position	Description	Notes
1	Rooftop	Unattended measurement position on the North end of the All Saints building roof. Ambient noise levels at this position were dominated by road traffic noise from the A57.

A photograph of the rooftop measurement location is presented in Figure 3—2.



Figure 3—2 Measurement Location 1

3.3.2 External ambient noise levels

Explanations of the measurement indices are as follows:

- **$L_{Aeq,T}$** – the average A-weighted sound pressure level within a measurement period. Typically thought of as the average ambient noise level at a particular time and likely to be due to a combination of various noise sources, near and far
- **$L_{AF,max}$** – the maximum instantaneous A-weighted sound pressure level. Typically corresponding to a short-duration event with a very high sound pressure level (SPL), for example, motorbike passing by, car horn etc.

The measured baseline noise level data has been processed to determine the typical ambient and maximum noise levels. These values shall form the basis of the acoustic design of the façade. As Location 1 is considered to represent a measurement location as a robust worst case in terms of design. Results are presented in Table 3—2.

It's key to consider that the road is elevated, on this basis it is considered that the ambient sound levels across the northern elevation would be relatively consistent across the entirety of the northern elevation.

Table 3—2 Noise data summary

Position	Acoustic parameter	dB(A)	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
1	$L_{eq,07:00-23:00}$	71	62	62	63	69	64	53
	L_{Fmax^*}	86	82	79	76	82	81	73

* This is based on the 90th percentile of the recorded L_{max} to represent regularly occurring events

3.3.3 Discussion

As can be seen from the measurement sound levels above the sound levels across the site are dominated by road traffic movements on Mancunian Way to the north. Noise levels are generally high and constant due to the busy motorway to the north.

Building screening means that the sound levels to the south of the site are lower than those to the north.

A background sound level measurement has been captured on the rooftop of the library building considered representative of the background sound level at the nearby sensitive receptors. This sound level has been processed below to provide limiting criteria for plant.

3.4 Background Sound Level Survey – To Set Operational Noise Limits At Noise Sensitive Receptors

3.4.1 Overview

To identify the typical background sound level at the nearby sensitive receptors, an additional background sound level survey was undertaken between 20th and 25th July 2023.

A single noise survey location was adopted on the rooftop of the MMU library.

Table 3—3 Description of noise survey locations

Measurement position	Description	Notes
2	Rooftop	Unattended measurement position to the South end of the All Saints building. Background sound levels were captured here, intended for use to set limiting plant noise levels (see Section 3.4).

3.4.2 Noise survey equipment used

A list of equipment used during the noise survey is presented in Table 3—4.

The sound level meter was calibrated before and after background sound level survey was carried out. No significant drift in calibration level was witnessed (≤ 0.5 dB). Calibration certificates for all items of equipment detailed above are available upon request.

Table 3—4 Environmental noise survey equipment

Item	Manufacturer	Serial Number
Sound Level Meter	Bruel & Kjaer 2250	2506362
Pre-amplifier	Bruel & Kjaer 0032	18030
Microphone capsule	Bruel & Kjaer 4189	2198156
Site Calibrator	Bruel & Kjaer 4231	2327011

3.4.3 Weather conditions

Weather conditions during the noise survey were generally appropriate. No heavy rain was noted and periods where wind speeds ≥ 5 m/s were observed, were excluded from the survey. Weather observed for the noise survey period can be found online on the website <https://www.timeanddate.com/weather/uk/manchester/historic>.

3.4.4 Identifying the typical background sound level

A methodology to identify a typical background sound level is presented in the document “*Planning and Noise – Technical Guidance (October 2022)*” published by Manchester City Council.

An example is presented in Appendix A of the document and is reproduced in Figure 3—3.

Fundamentally:

- The arithmetic average of a 15-minute time slot is taken, for example, row shown in green, the $L_{A90,15\text{minutes}}$ dB values at 3:33 am across the dates 8-21 October are arithmetically averaged in Column P
- The lowest value of Column P is then adopted as the typical background sound level.

This method has been followed by Buro Happold.

APPENDIX A															
EXAMPLE															
BS4142 ‘Typical’ background noise level calculation															
Time	Measured L_{A90} levels														P arithmetic average
	8-9 Oct	9 to 10 Oct	10 to 11 Oct	11 to 12 Oct	12 to 13 Oct	13 to 14 Oct	14 to 15 Oct	15 to 16 Oct	16 to 17 Oct	17 to 18 Oct	18 to 19 Oct	19 to 20 Oct	20 to 21 Oct		
23:03	43.1	50.8	53.9	52.7	41.5	44.7	38.7	39.9	51.2	48.1	51.0	42.9	44.4	46.4	Arithmetic Average of Column P 44.6
23:18	43.3	54.8	56.3	55.8	40.2	46.5	38.3	39.6	58.8	52.6	50.3	43.5	46.6	48.2	Minimum value column P 41.3
23:33	43.6	58.9	58.4	62.8	39.1	50.0	38.0	39.0	64.0	51.3	48.2	43.6	50.4	49.8	Maximum value column P 50.0
23:48	43.7	62.1	59.6	62.8	37.8	47.4	37.2	38.2	61.8	52.0	50.1	44.9	51.9	50.0	
00:03	42.5	52.8	51.1	54.4	38.3	46.6	35.3	38.9	48.7	48.0	48.8	45.2	46.4	45.9	Mean value of full data set 44.6
00:18	41.8	50.0	47.3	46.7	39.7	46.0	34.7	37.1	45.4	47.3	45.8	42.1	45.5	43.8	Minimum value full data set 32.0
00:33	40.5	47.7	48.0	44.0	37.4	46.1	35.3	36.5	47.1	47.4	45.9	40.4	42.4	43.0	Maximum value full data set 64.0
00:48	40.9	48.5	46.4	44.1	36.9	44.5	34.3	36.4	49.1	48.5	46.5	41.6	45.0	43.3	
01:03	39.2	48.0	45.6	47.2	36.9	44.8	33.6	34.4	51.0	44.4	45.5	41.2	45.8	42.9	
01:18	39.8	53.7	43.4	44.7	36.0	48.0	32.7	34.3	52.6	45.7	47.0	40.7	47.5	43.5	
01:33	40.5	49.8	45.6	45.7	35.7	49.9	33.0	33.8	56.6	45.4	47.3	40.5	47.2	43.9	
01:48	40.1	55.5	48.2	47.2	35.6	47.0	32.1	36.5	57.5	46.2	47.5	41.4	47.0	44.8	
02:03	39.6	55.9	47.6	46.8	34.4	47.1	34.5	34.0	56.2	49.2	45.8	40.9	50.3	44.8	
02:18	41.1	57.8	49.6	47.7	34.0	49.3	32.1	34.1	58.4	48.6	47.0	40.3	49.4	45.3	
02:33	47.6	57.0	51.1	48.3	33.8	52.3	32.0	34.0	60.8	47.5	49.1	39.4	49.5	46.3	
02:48	43.1	59.3	48.8	47.5	33.1	54.8	32.5	33.3	61.8	49.6	48.5	38.7	54.0	46.5	
03:03	40.4	57.2	48.6	46.4	33.4	51.3	32.8	32.9	54.6	46.4	47.7	39.2	52.8	44.9	
03:18	40.6	44.4	49.8	49.3	34.0	39.7	33.3	33.6	38.1	48.5	47.9	38.1	43.3	41.6	
03:33	40.2	39.1	48.7	51.0	34.0	38.5	32.9	34.6	37.5	51.7	47.6	38.8	41.9	41.3	
03:48	39.6	38.4	52.3	49.7	33.9	40.0	33.8	34.8	38.1	51.4	49.2	38.3	42.3	41.7	
04:03	39.4	39.0	53.8	51.8	35.1	40.7	32.7	35.7	37.8	50.8	51.0	38.4	42.1	42.2	
04:18	39.3	38.6	54.2	54.9	36.7	39.6	34.0	35.0	38.6	48.6	52.4	39.5	43.0	42.6	
04:33	39.9	39.3	52.1	53.1	37.4	38.4	34.9	36.5	38.8	49.6	51.8	40.2	44.6	42.8	
04:48	39.9	40.1	52.7	54.2	37.7	38.3	34.6	37.6	45.3	49.3	55.7	39.8	44.2	43.8	
05:03	40.2	40.0	51.7	58.4	38.4	40.3	36.1	39.3	46.9	48.7	55.6	40.3	43.5	44.6	
05:18	41.1	40.8	53.9	53.6	38.7	40.8	36.6	39.4	47.2	50.5	56.1	43.4	45.4	45.2	
05:33	41.5	42.7	53.7	45.2	42.8	41.7	38.7	39.8	47.4	50.3	43.5	43.1	45.3	44.3	
05:48	43.2	42.9	55.2	42.2	42.7	41.8	38.9	40.8	47.8	48.2	40.8	44.0	48.9	44.4	
06:03	43.8	43.7	55.7	40.2	42.4	43.1	39.3	41.6	48.0	42.3	40.9	44.8	50.2	44.3	
06:18	44.9	45.2	42.7	37.5	44.6	44.5	40.9	43.3	48.2	41.8	40.7	45.4	51.0	43.9	
06:33	46.0	46.1	42.3	36.6	44.6	45.4	43.4	44.5	48.4	42.7	40.9	46.0	52.5	44.6	
06:48	47.6	46.8	43.5	37.3	45.1	46.2	46.1	45.4	49.4	42.1	41.8	47.3	51.8	45.4	

41dB is taken as the typical background as it is the minimum value of the averaged individual 15 minute periods

Figure 3—3 Example method to identify the typical background sound level

3.4.5 Nearby Noise Sensitive Receivers

A summary of the nearby Noise Sensitive Receptors (NSRs) considered in this report is listed below:

- **NSR 1** – Residential dwellings on Oxford Road – Approx. 30 m east of the site boundary

The nearby NSRs are annotated in green in Figure 3—4.

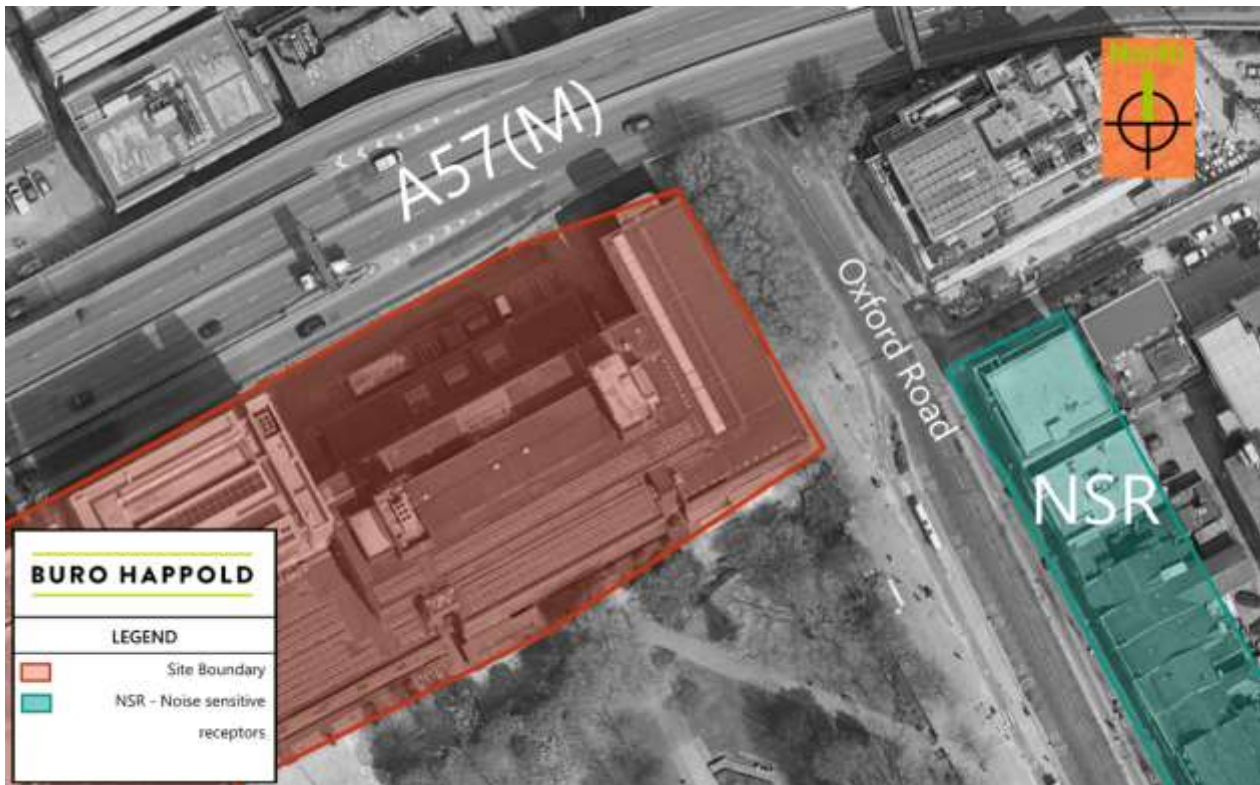


Figure 3—4 Annotated Aerial Image (Source: Google Earth)

3.5.1 Background Sound Levels at NSRs

A summary of background sound levels as measured at NSRs is presented in this section.

Data presented in this sections is in terms of the below:

- **$L_{A90,T}$** – the A-weighted sound pressure level exceeded 90% of the measurement period, i.e. a level which would be perceived as a constant, background noise level. Typically, largely unaffected by local traffic pass-bys or by transient events. More usually attributable to constantly-running building services plant or distant road traffic. What you would hear when there is no local traffic present (or other readily identifiable noise sources)

For reference, the measurement samples are 1-hour during the daytime and 15 minutes at night.

The typical $L_{A90,T}$ dB background sound levels set in line with Manchester City Council Criteria during the daytime and night-time period are shown in Table 3—5.

Table 3—5 Plant rating limits based on measured background sound levels

Measurement Period	Background sound level $L_{A90,T}$ (dB)
Daytime (07:00-23:00 hours)	51
Night-time (23:00-07:00 hours)	50

4 Noise Break-in

The Internal Ambient Noise Level (IANL) should be controlled to within acceptable noise levels to provide suitable internal acoustic amenity.

The IANL is made up of contributions from external noise sources such as road, rail, and air traffic as well as internal building services noise. The aim is to acoustically design the development such that the cumulative noise from external and internal noise sources does not exceed the IANL requirements.

4.1 How façade sound insulation requirements are calculated

4.1.1 Façade design noise levels

Façade design noise levels can be based on the results of the noise survey/mapping.

4.1.2 Methodology

The façade sound insulation requirements are calculated using the façade noise levels and the acceptable internal ambient noise levels established by the various criteria relevant to each space. Façade sound insulation requirements are typically given in terms of R at each octave-band centre frequency and summarised as single figure values in terms of $R_w + C_{tr}$. These are defined as:

- **Sound Reduction Index, R** – is a measure of the sound-insulating properties in a particular frequency band. In this case, the sound reduction index is given at each octave band centre frequency between 125 and 4000 Hz
- **Weighted Sound Reduction Index, R_w** – is a single figure value that describes the standardised performance of partitions when measured in a laboratory
- **Correction Traffic, C_{tr}** – is a single correction value applied that considers the urban traffic noise spectrum.

Calculation procedures follow the “more rigorous calculation method” outlined in BS 8233:2014, based on the equation presented in Figure 4—1.

4.2 Assessment assumptions/variables

Assessment assumptions vary dependent on the type of space. These typically relate to:

- Reverberation time
- Element areas (glazing, opaque façade elements, roof)
- Room volume.

Assessment assumptions/variables should be presented alongside the relevant calculation.

$$L_{eq,2} = L_{eq,ff} + 10 \log_{10} \left(\frac{A_0}{S} 10^{\frac{-D_{ve}}{10}} + \frac{S_{wi}}{S} 10^{\frac{-R_{wi}}{10}} + \frac{S_{ew}}{S} 10^{\frac{-R_{ew}}{10}} + \frac{S_{rr}}{S} 10^{\frac{-R_{rr}}{10}} \right) + 10 \log_{10} \left(\frac{S}{A} \right) + 3$$

$L_{eq,ff}$	is the equivalent continuous sound pressure level outside the room elements under consideration ¹
A_0	is a reference absorption area of 10 m ² and is independent of frequency
S_f	is the total façade area in square metres (m ²) of the room in question
S_{wi}	is the area in square metres (m ²) of the windows of the room
S_{ew}	is the area in square metres (m ²) of the external wall of the room
S_{rr}	is the area in square metres (m ²) of the ceiling of the room
S	is the total area in square metres (m ²) of elements through which sound enters the room, i.e. $S_f + S_{rr}$
$D_{n,e}$	is the insulation of the trickle ventilator measured according to BS EN ISO 10140
R_{wi}	is the sound reduction index (octave band value) of the window
R_{ew}	is the sound reduction index (octave band value) of the external wall
R_{rr}	is the sound reduction index (octave band value) of the roof/ceiling
A	is the equivalent absorption area of the receiving room being considered
3	is a correction factor

Figure 4—1 “more rigorous calculation method” for noise ingress (Source: BS 8233:2014)

¹ It is the free-field sound level (i.e. in the absence of the façade), measured or estimated at the intended position of the element under consideration. It is related to the level $L_{eq,1}$ measured within a few millimetres of the actual façade by the relation $L_{eq,ff} \approx L_{eq,1} - 6$, and to the level $L_{eq,2m}$ measured 2 m away from the façade by the relation $L_{eq,ff} \approx L_{eq,2m} - 3$

4.3 Acoustic Requirements

A summary of internal ambient sound level targets is presented in Table 4—1. These criteria are summarised from WELL and BB 93.

Where the criteria are achieved, the requirements of BREEAM, BB93 and WELL should be achieved.

All “Supported Learning” and “Assisted Learning” spaces have been treated as SEN (special educational needs) rooms as this has more stringent criteria. Clarification is required regarding the use of these spaces, which may result in less stringent requirements required.

Table 4—1 Summary of internal sound level criteria

Room Type	Indoor Ambient Noise Level				Guidance Document
	$L_{eq,T}$ dB(A)	$L_{eq,T}$ dB(C)	$L_{F,Max}$ dB(A)	$L_{F,Max}$ dB(C)	
Enclosed Offices	40	60	50	70	BB93/WELL
Kitchen	50	70	60	80	BB93/WELL
Learning Spaces / Assisted Learning	30	N/A	N/A	N/A	BB93
Meeting Rooms	35	55	45	65	WELL
Open Plan Spaces	40	N/A	N/A	N/A	BB93
Prayer Room	30	N/A	N/A	N/A	Buro Happold Experience

It should be noted that BB93 and by extension, BREEAM Hea 05 criteria refer to indoor ambient noise target criteria in terms of $L_{Aeq,T}$ dB. Where these criteria is met, credit for BREEAM Hea 05 should be awarded. By extension, WELL V2.0 Q3 credits should be awarded by default as described in the WELL section of this report.

4.4 Buro Happold Façade Engineering Glazing Proposals

4.4.1 Introduction

It is understood that an outline specification for the glazed build has been selected by the Buro Happold Façade engineering team.

Coordination has been undertaken between the BH Acoustics and Facades teams to identify if the proposals meet the minimum acoustic requirements.

4.5.1 Glazing

Below, Figure 4—2 presents an image of the proposed glazing system proposed by the Buro Happold facades team. It is understood that the construction is proposed to be formed of 12mm panes of laminated glass with 2 x layers of PVB, on either side of a minimum 12 mm cavity.

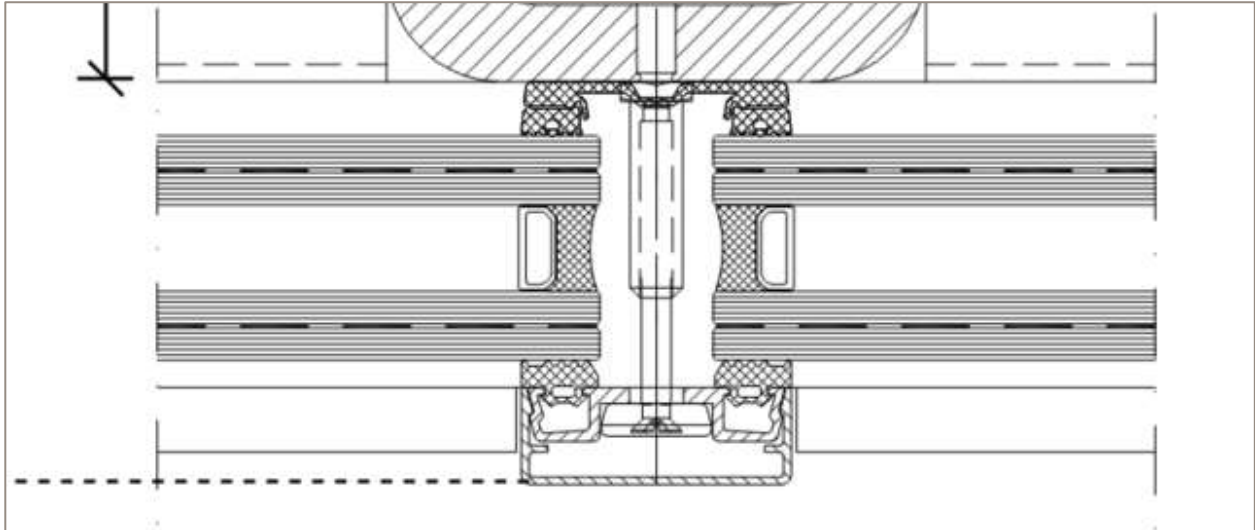


Figure 4—2 Example glazed construction (12mm panes of laminated glass with 2 x layers of PVB, either side of a minimum 12 mm cavity)

4.5.2 Opaque

The proposed façade construction is understood to consist of:

EXTERNAL

- 30 mm precast concrete cladding panel ($\geq 2,500 \text{ kg/m}^3$)
- $\geq 495 \text{ mm}$ void (250 mm mineral wool insulation)
- K10 independent wall lining.

INTERNAL

A drawing of the proposed construction is presented in Figure 4—3.

The independent wall lining appears to have an overall thickness of 12.5 mm, indicating the use of 2x 12.5mm thick plasterboard. This construction should be suitable, however, this lining could be replaced with a 1 x 15 mm sound-resistant plasterboard such as 15 mm thick SoundBloc ($\geq 12.6 \text{ kg/m}^2$). Final façade details will be agreed with Manchester City Council and the project team.

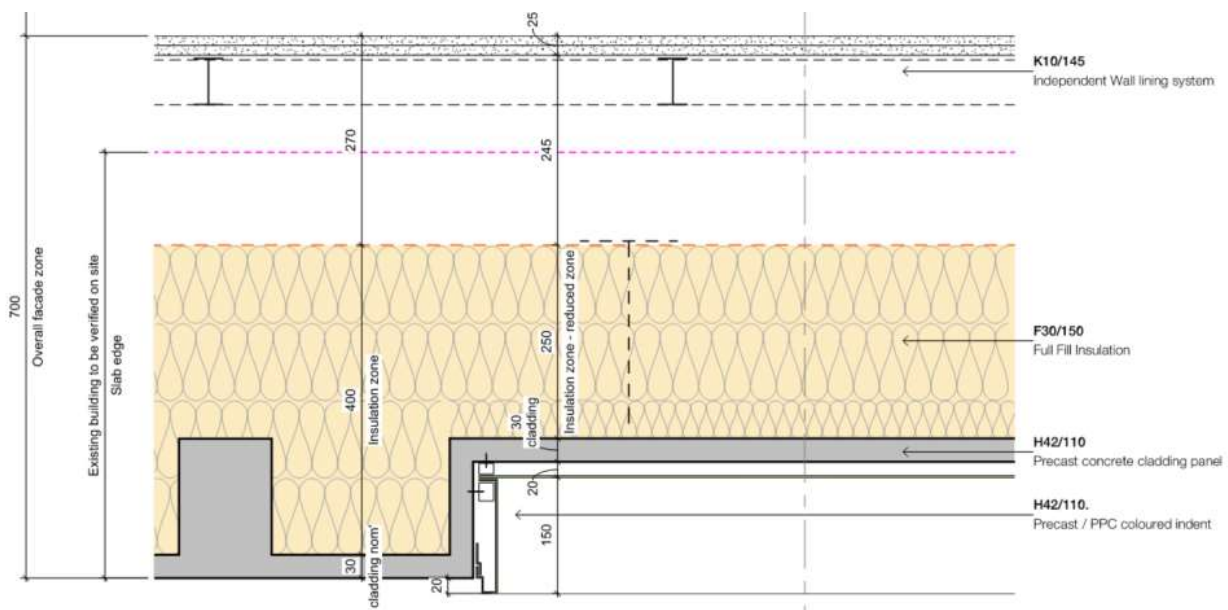


Figure 4—3 Example opaque construction

4.5.4 Summary

INSUL sound insulation performance prediction software along with test data of similar constructions has been used to calculate the likely sound insulation performance of the proposed glazing build-up proposed by the Buro Happold Façades team.

The octave-band centre frequency values from INSUL have been taken for glazing and opaque elements, with a – 3 dB correction applied to each value. This is to account for the calculation error which is stated by the software. These values are presented in .

Table 4—3 and Table 4—4 present summaries of the calculated internal ambient and maximum sound levels respectively.

Table 4—5 and Table 4—6 present the sample rooms selected and used in the calculation and the dimensions and variables used.

Figure 4—4 to Figure 4—7 present noise break-in calculations.

Table 4—2 Minimum octave-band centre frequency sound reduction values for the proposed glazing an opaque façade systems

Frequency (Hz)	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
Glazing Sound Reduction (R dB)	23	32	42	45	50	62
Opaque Sound Reduction (R dB)	54	64	73	72	75	85

Table 4—3 Ambient sound level noise break-in calculation summary

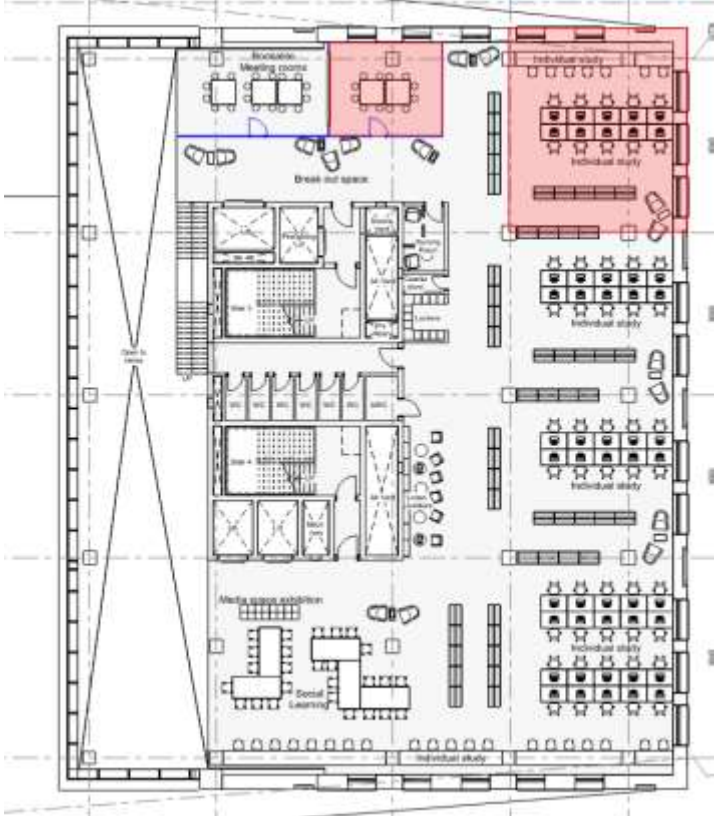
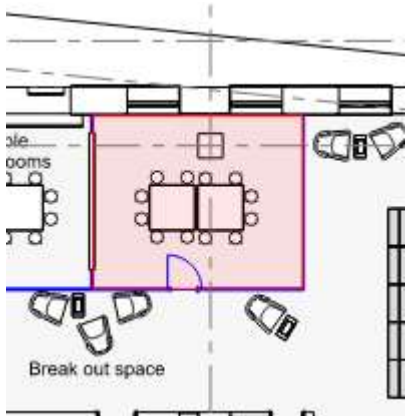
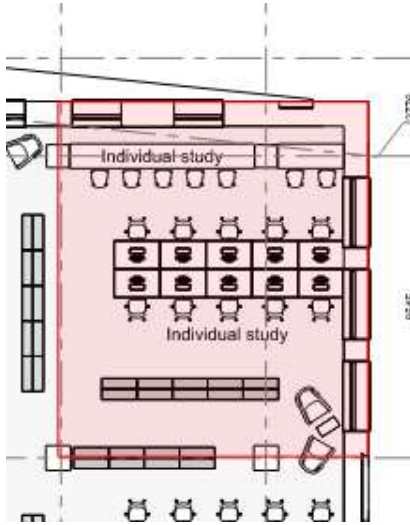
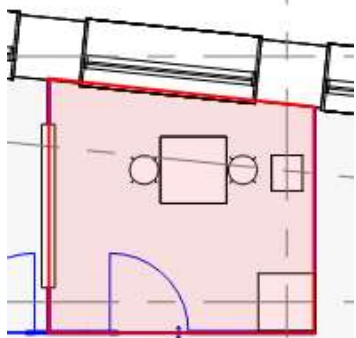
Room	Sound pressure level – dB re 20 µPa At each octave band centre frequency - Hz						L _{Aeq,T} dB		L _{Ceq,T} dB	
	125	250	500	1000	2000	4000	Calculated	IANL Criteria	Calculated	WELL Criteria
Assisted Learning L02	39	30	21	24	14	-	28	30*	40	55
Bookable Room L03	44	35	26	29	19	-	34	40	45	60
Meeting Room L06	43	34	25	28	18	-	32	35	44	55
Open Plan Space L06	44	35	26	29	19	-	33	40*	45	65

*This IANL criteria is based on BB93 as this is more stringent. BB93 does not set out criteria for C-weighted SPL nor L_{F,Max}, therefore all other criteria reference WELL.

Table 4—4 Maximum sound level noise break-in calculation summary

Room	Sound pressure level – dB re 20 µPa At each octave band centre frequency - Hz						L _{AF,max} dB		L _{CF,max} dB	
	125	250	500	1000	2000	4000	Calculated	IANL Criteria	Calculated	WELL Criteria
Assisted Learning L02	56	44	31	34	28	8	43	45	40	65
Bookable Room L03	59	47	34	37	31	11	45	50	45	70
Meeting Room L06	59	47	34	37	31	11	45	45	44	65
Open Plan Space L06	58	46	33	36	30	10	45	55	45	75

Table 4—5 Rooms selected for noise break-in calculations

Elevation	Room
North-West Elevation 	
	
	

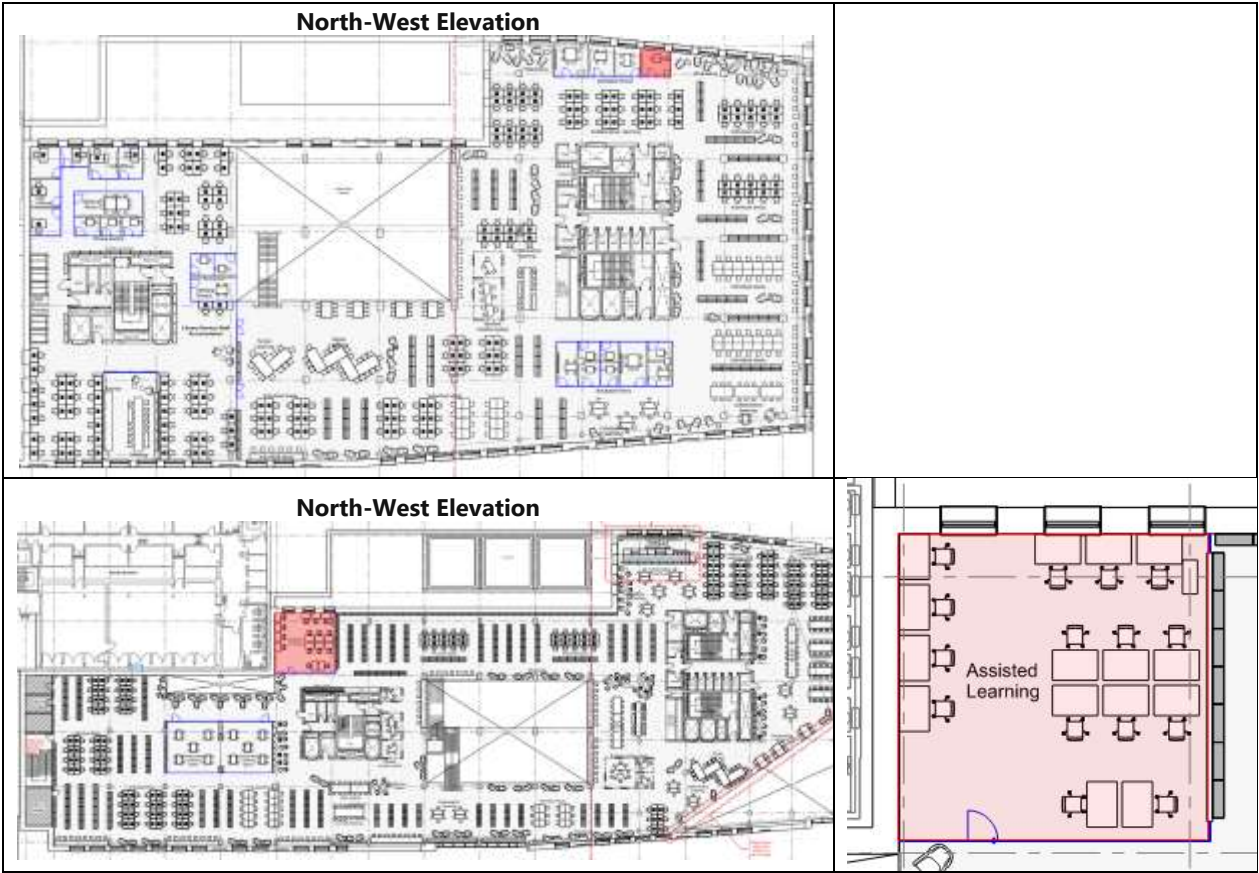
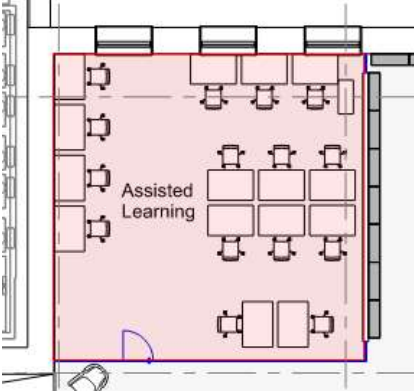
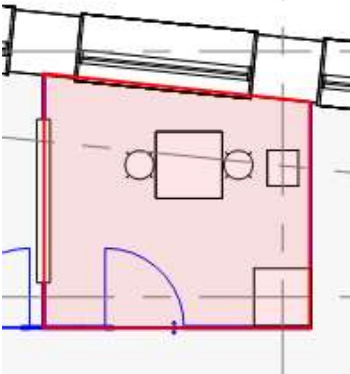
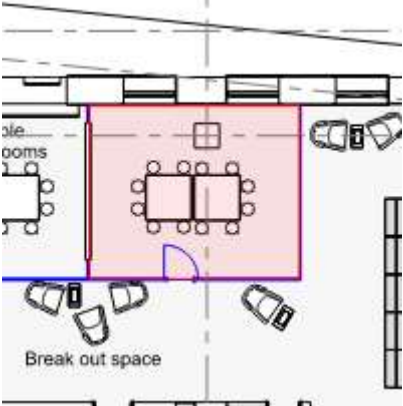
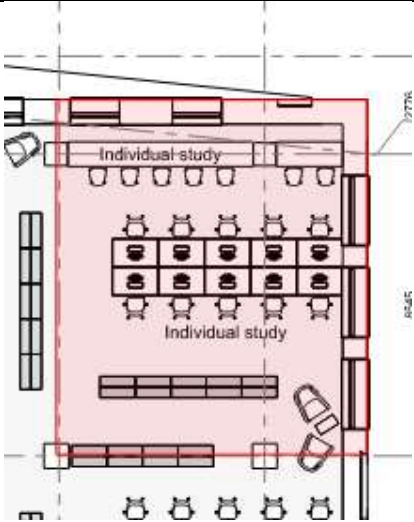


Table 4—6 Room variables used in calculation

Room	Parameters
 Assisted Learning L02	IANL criteria: L_{Aeq} 30 dB, L_{Ceq} 55 dB, L_{Amax} 45 dB, L_{Cmax} 65 dB Design noise level: L_{Aeq} 28 dB, L_{Ceq} 40 dB, L_{Amax} 43 dB, L_{Cmax} 40 dB Room dimensions: 8.1m (d) x 8.2m (w) x 2.9m (h) Reverberation time: 0.6 s Glazing area: 23.8m²
 Bookable Room L04	IANL criteria: L_{Aeq} 40 dB, L_{Ceq} 60 dB, L_{Amax} 50 dB, L_{Cmax} 70 dB Design noise level: L_{Aeq} 34 dB, L_{Ceq} 45 dB, L_{Amax} 45 dB, L_{Cmax} 45 dB Room dimensions: 2.6m (d) x 3m (w) x 2.2m (h) Reverberation time: 0.6 s Glazing area: 7.8m²
 Meeting Room L06	IANL criteria: L_{Aeq} 35 dB, L_{Ceq} 55 dB, L_{Amax} 45 dB, L_{Cmax} 65 dB Design noise level: L_{Aeq} 32 dB, L_{Ceq} 44 dB, L_{Amax} 45 dB, L_{Cmax} 44 dB Room dimensions: 9m (d) x 8m (w) x 3.1m (h) Reverberation time: 1 s Glazing area: 52.7m²

Room	Parameters
 Open Plan Space L06	IANL criteria: L_{Aeq} 40 dB, L_{Ceq} 65 dB, L_{Amax} 55 dB, L_{Cmax} 75 dB Design noise level: L_{Aeq} 33 dB, L_{Ceq} 45 dB, L_{Amax} 45 dB, L_{Cmax} 45 dB Room dimensions: 4.6m (d) x 5.5m (w) x 3.1m (h) Reverberation time: 0.6 s Glazing area: 25.3m²

FAÇADE BREAK-IN CALCULATION									
Project Name	MMU Library								
Room or space	Assisted Learning L02								
Date	230425								
ROOM CONSTANT & FAÇADE AREA									
Façade area (incl. window)	23.8 m ²	Area of the external wall	0 m ²	Room reverberation time (s)					
Area of the louver	0.0 m ²		Tmf	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
Area of the windows	23.8 m ²			0.6	0.6	0.6	0.6	0.6	0.6
Area of the roof/ceiling	66.4 m ²	Area of exposed envelope	90 m ²						
Room Depth (x)	8.1 m		Room Volume	###					
Room Width (y)	8.2 m								
Ceiling height (z)	2.9 m								
DISTANCE ATTENUATION CALCULATION									
Distance correction	No	Calculated Distance Attenuation	-						
Type of distance correction	-								
Distance from source to microphone	-								
Distance from source to receiver	-								
FREE FIELD LEVELS AT 1m FROM THE NOISE SENSITIVE FAÇADE									
LAeq	Free Field Leq in octave bands (dB)	dB(A)	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	
	Resultant Free-Field Leq with distance attenuation (dB(A))	71	62	62	63	69	64	53	
LAmax (if applicable)	Free Field Lfmax in octave bands	dB(A)	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	
	Resultant Free-Field LAmax with distance	86	82	79	76	82	81	73	
SOUND REDUCTION PROPERTIES OF BUILDING ELEMENTS									
		125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	R _w	R _w +C _{tr} (dB)
Window (R _w)	Manual	23	32	42	45	50	62	43	36
Louver (R _w)	No Louver	0	0	0	0	0	0	0	47
External wall Construction (R _w)	Typical external wall construction	46	44	46	54	62	67	52	49
Roof Construction (R _w)	Typical roof construction	99	99	99	99	99	99	99	99
		125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	D _{n,rev} (dB)	
Trickle Vent (D _{n,e,w})	No Vent	200	200	200	200	200	200	-	
	0 Units								
CALCULATED INTERNAL LAeq AND LAF,max LEVELS									
		125Hz	250Hz	500Hz	1kHz	2kHz	4kHz		
Calculated Leq in the receiver room (dB)		39	30	21	24	14	-9		
Calculated Lfmax in the receiver room (dB)		56	44	31	34	28	8		
		L_{eq} (125-4000Hz) 28 dB(A)					L_{Amax} (125-4000Hz) 43 dB(A)		

Figure 4—4 Noise Break-in calculation – Assisted Learning L02

FAÇADE BREAK-IN CALCULATION														
Project Name	MMU Library					BURO HAPPOLD								
Room or space	Bookable Room L03													
Date	230425													
ROOM CONSTANT & FAÇADE AREA														
Façade area (incl. window)	7.8 m2					Area of the external wall	0 m2	Room reverberation time (s)						
Area of the louver	0.0 m2							Tmf	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
Area of the windows	7.8 m2							0.6	0.6	0.6	0.6	0.6	0.6	0.6
Area of the roof/ceiling	7.8 m2					Area of exposed envelope	16 m2							
Room Depth (x)	2.6 m													
Room Width (y)	3.0 m					Room Volume	17 m3							
Ceiling height (z)	2.2 m													
DISTANCE ATTENUATION CALCULATION														
Distance correction	No					Calculated Distance Attenuation	-							
Type of distance correction	-													
Distance from source to microphone	-													
Distance from source to receiver	-													
FREE FIELD LEVELS AT 1m FROM THE NOISE SENSITIVE FAÇADE														
LAeq	Free Field Leq in octave bands (dB)					dB(A)	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz		
	Resultant Free-Field Leq with distance attenuation (dB(A))					71	62	62	63	69	64	53		
LAmx (if applicable)	Free Field Lfmax in octave bands					dB(A)	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz		
	Resultant Free-Field LAmx with distance					86	82	79	76	82	81	73		
SOUND REDUCTION PROPERTIES OF BUILDING ELEMENTS														
						125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	Rw	Rw + CTr (dB)	
Window (Rw)	Manual					23	32	42	45	50	62	43	36	
Louver (Rw)	No Louver					0	0	0	0	0	0	0	47	
External wall Construction (Rw)	Typical external wall construction					46	44	46	54	62	67	52	49	
Roof Construction (Rw)	Typical roof construction					99	99	99	99	99	99	99	99	
						125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	Dn,ew (dB)		
Trickle Vent (Dn,e,w)	No Vent					0 Units		200	200	200	200	200	-	
CALCULATED INTERNAL LAeq AND LAF,max LEVELS														
						125Hz	250Hz	500Hz	1kHz	2kHz	4kHz			
Calculated Leq in the receiver room (dB)						44	35	26	29	19	-4			
Calculated Lfmax in the receiver room (dB)						59	47	34	37	31	11			
						LAeq (125-4000Hz)					LAmx (125-4000Hz)			
						34 dB(A)					45 dB(A)			

Figure 4—5 Noise Break-in calculation –Bookable Room L03

FAÇADE BREAK-IN CALCULATION										
Project Name	MMU Library									
Room or space	Open Plan Space L06									
Date	230425									
ROOM CONSTANT & FAÇADE AREA										
Façade area (incl. window)	52.7 m ²	Area of the external wall	0 m ²	Room reverberation time (s)						
Area of the louver	0.0 m ²			Tmf	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
Area of the windows	52.7 m ²			1.0	1.0	1.0	1.0	1.0	1.0	1.0
Area of the roof/ceiling	72.0 m ²	Area of exposed envelope	####							
Room Depth (x)	9.0 m									
Room Width (y)	8.0 m									
Ceiling height (z)	3.1 m	Room Volume	####							
DISTANCE ATTENUATION CALCULATION										
Distance correction	No	Calculated Distance Attenuation	-							
Type of distance correction	-									
Distance from source to microphone	-									
Distance from source to receiver	-									
FREE FIELD LEVELS AT 1m FROM THE NOISE SENSITIVE FAÇADE										
LAeq	Free Field Leq in octave bands (dB)	dB(A)	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz		
	Resultant Free-Field Leq with distance attenuation (dB(A))	71	62	62	63	69	64	53		
LAmax (if applicable)	Free Field Lfmax in octave bands	dB(A)	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz		
	Resultant Free-Field LAmax with distance	86	82	79	76	82	81	73		
SOUND REDUCTION PROPERTIES OF BUILDING ELEMENTS										
		125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	R _w	R _w +C _{tr} (dB)	
Window (R _w)	Manual	23	32	42	45	50	62	43	36	
Louver (R _w)	No Louver	0	0	0	0	0	0	0	47	
External wall Construction (R _w)	Typical external wall construction	46	44	46	54	62	67	52	49	
Roof Construction (R _w)	Typical roof construction	99	99	99	99	99	99	99	99	
		125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	D _{n,rev} (dB)		
Trickle Vent (D _{n,e,w})	No Vent	200	200	200	200	200	200	-		
CALCULATED INTERNAL LAeq AND LAF,max LEVELS										
		125Hz	250Hz	500Hz	1kHz	2kHz	4kHz			
Calculated Leq in the receiver room (dB)		44	35	26	29	19	-4			
Calculated Lfmax in the receiver room (dB)		58	46	33	36	30	10			
		L_{eq} (125-4000Hz) 33 dB(A)					L_{Amax} (125-4000Hz) 45 dB(A)			

Figure 4—6 Noise Break-in calculation –Open Plan Space L06

FAÇADE BREAK-IN CALCULATION									
Project Name	MMU Library								
Room or space	Meeting Room L06								
Date	230425								
ROOM CONSTANT & FAÇADE AREA									
Façade area (incl. window)	25.3 m ²	Area of the external wall	0 m ²	Room reverberation time (s)					
Area of the louver	0.0 m ²		Tmf	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
Area of the windows	25.3 m ²			0.6	0.6	0.6	0.6	0.6	0.6
Area of the roof/ceiling	25.3 m ²	Area of exposed envelope	51 m ²						
Room Depth (x)	4.6 m		Room Volume	78 m ³					
Room Width (y)	5.5 m								
Ceiling height (z)	3.1 m								
DISTANCE ATTENUATION CALCULATION									
Distance correction	No	Calculated Distance Attenuation	-						
Type of distance correction	-								
Distance from source to microphone	-								
Distance from source to receiver	-								
FREE FIELD LEVELS AT 1m FROM THE NOISE SENSITIVE FAÇADE									
LAeq	Free Field Leq in octave bands (dB)	71	62	62	63	69	64	53	
	Resultant Free-Field Leq with distance attenuation (dB(A))	71	62	62	63	69	64	53	
LAmax (if applicable)	Free Field Lfmax in octave bands	86	82	79	76	82	81	73	
	Resultant Free-Field LAmax with distance	86	82	79	76	82	81	73	
SOUND REDUCTION PROPERTIES OF BUILDING ELEMENTS									
		125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	R _w	R _w +C _{tr} (dB)
Window (R _w)	Manual	23	32	42	45	50	62	43	36
Louver (R _w)	No Louver	0	0	0	0	0	0	0	47
External wall Construction (R _w)	Typical external wall construction	46	44	46	54	62	67	52	49
Roof Construction (R _w)	Typical roof construction	99	99	99	99	99	99	99	99
		125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	D _{n,ew} (dB)	
Trickle Vent (D _{n,e,w})	No Vent	200	200	200	200	200	200	-	
	0 Units								
CALCULATED INTERNAL LAeq AND LAF,max LEVELS									
		125Hz	250Hz	500Hz	1kHz	2kHz	4kHz		
Calculated Leq in the receiver room (dB)		43	34	25	28	18	-5		
Calculated Lfmax in the receiver room (dB)		59	47	34	37	31	11		
		L_{req} (125-4000Hz) 32 dB(A)					L_{Amax} (125-4000Hz) 45 dB(A)		

Figure 4—7 Noise Break-in calculation –Meeting Room L06

5 Noise Break-out

5.1 Introduction

This section details the plant noise limits for controlling noise break-out to nearby NSRs, to see that the acoustic amenity of the surrounding area is not compromised by the operation of newly installed plant.

At this stage, specific plant selections have not been finalised.

Figure 5—1 and Figure 5—2 present limiting plant noise level criteria provided by Manchester City Council and BREEAM Pol 05 respectively.

Both sets of criteria refer to achieving a rating level in line with BS 4142 which is 5 dB below the existing background sound level.

Based on the review, plant rating limits should be set by Buro Happold to be 5 dB below the typical background sound level.

Where the above limit is achieved, plant noise emissions should:

- Not cause a barrier to development
- See that the Pol 05 credit be awarded to the scheme.

5.2 Plant Noise Criteria

Noise and vibration from fixed plant / equipment

Noise from fixed plant, equipment or machinery can be very annoying and disruptive to people living nearby particularly where that item involved emits a noise with impulsive or tonal characteristics.

Many of the complaints Environmental Health receive about noise from plant, equipment and machinery specifically concern the character of the noise emitted. Any noise assessment needs to consider not only the overall level of noise emitted, but also its particular characteristics. The noise assessment should be based on BS 4142, and any application for fixed plant, equipment or machinery must demonstrate that:

'Externally mounted ancillary plant, equipment and servicing shall be selected and/or acoustically treated in accordance with a scheme designed so as to achieve a rating level of 5dB (L_{Aeq}) below the typical background (L_{A90}) level at the nearest noise sensitive location'.

By designing the sound pressure level of any plant items to generate a noise impact of at least 5dB below the existing background level, any plant noise impact should be of a negligible level which should not give rise to complaints from users or occupiers of existing noise-sensitive usages. See Appendix A with regards to the expectation of how to calculate a 'typical' background level.

Past experience has shown that this criterion can be readily achieved. Where available, product specification data for new items should be submitted with the acoustic report. Consultants should be using these to compare with data from the noise survey and propose mitigation where the levels are above those specified in the criterion. Where this information is not available a consultant may choose to measure the noise, levels generated by the equipment in question where the equipment has already been installed elsewhere (and in accordance with BS 4142).

Where fixed plant, equipment or machinery is attached to a building the vibration caused by it can pass through the building structure and cause structure borne noise elsewhere in the building. Where it is to be installed in or on a building containing a noise sensitive use structure borne noise should be considered in the noise assessment and adequate control measures should be proposed. An example of where this would be required is where there is a proposal to install ventilation equipment on the roof of a residential apartment block or it could be an air source heat pump attached to the side of a building.

Figure 5—1 Manchester City Council limiting plant noise level criteria (Source: Manchester City Council - Planning and Noise Technical Guidance)

One credit

- 1 There are no noise-sensitive areas within the assessed building or within 800 m radius of the assessed site.
- OR
- 2 Where there are noise-sensitive areas within the assessed building or noise-sensitive areas within 800 m radius of the assessed site, a noise impact assessment compliant with BS 4142:2014⁽²¹⁸⁾ is commissioned. Noise levels must be measured or determined for:
 - 2.a Existing background noise levels:
 - 2.a.i at the nearest or most exposed noise-sensitive development to the proposed assessed site

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- 2.a.ii including existing plant on a building, where the assessed development is an extension to the building
- 2.b Noise rating level from the assessed building.
- 3 The noise impact assessment must be carried out by a suitably qualified acoustic consultant.
- 4 The noise level from the assessed building, as measured in the locality of the nearest or most exposed noise-sensitive development, must be at least 5dB lower than the background noise throughout the day and night.
- 5 If the noise sources from the assessed building are greater than the levels described in criterion 4, measures have been installed to attenuate the noise at its source to a level where it will comply with the criterion.

Figure 5—2 BREEM Pol 05 Criteria

5.3 Plant Noise Limits

5.3.1 External Plant Noise Limits

Plant noise limits have been established through a noise survey at the site.

The plant noise limits are based on the typical (see Section 0) measured daytime and night-time background sound levels L_{A90} . Table 5—1 presents noise targets.

Compliance with these targets should see that existing residents are protected from undue levels of plant noise impact and amenity is not compromised. Compliance with Local Planning Authority / BREEAM criteria should be achieved.

Table 5—1 Non-emergency plant noise limits at 1 meter from all noise-sensitive receptors adjacent to the proposed development.

Plant Items	Daytime measured background sound level L_{A90} dB (07:00-23:00)	Daytime rating target at 1 meter from sensitive receptors $L_{Aeq,T}$ dB (07:00-23:00)	Night-time measured background sound level L_{A90} dB (23:00-07:00)	Night-time rating limit at 1 meter from sensitive receptors $L_{Aeq,T}$ dB (23:00-07:00)
Non-emergency auxiliary plant and generators	≤ 51	≤ 46	≤ 50	≤ 45

It should be noted that the above are rating limits (in terms of $L_{A_{r,Tr}}$ dB) as defined in BS 4142.

Relevant information regarding the application of penalties (as defined in BS 4142) are included in the sub-sections below.

It is critical that any noise emissions also take into account any potential penalties where an assessment of plant noise is undertaken for the site.

5.3.2 BS 4142 definitions

BS 4142 uses several specific terms to define the various levels used in assessments, as follows:

- **Specific sound** – the commercial/industrial noise source under consideration
- **Residual sound** – the sound level at the noise-sensitive receivers in the absence of the specific sound
- **Ambient sound** – the sound level at the noise-sensitive receivers in the presence of the specific sound (i.e., ambient = residual + specific)
- **Background level** – the sound pressure level which is exceeded by the residual sound for 90% of the measurement period
- **Rating level** – the specific sound, corrected for acoustically distinguishing characteristics.

5.3.2.1 Background level

BS 4142 emphasises that the background level ($L_{A90,T}$) is in fact a range of levels, not one absolute value. Whilst stating that the measurements of background sound should be normally not less than 15 mins, the focus is on obtaining a level for use in assessment that is representative of typical conditions at the noise-sensitive receivers.

An example methodology by which this typical value may be obtained is given in the document. In this example, monitoring of $L_{A90,15mins}$ is undertaken during periods which represent when the specific noise will be operational. After obtaining a sequence of representative contiguous or disaggregated results, it is then proposed that the modal value is representative of the 'typical' background level.

5.3.2.2 Specific sound

BS 4142 requires that the specific sound ($L_{Aeq,T}$) is obtained over a reference period of 1 hour (daytime) and 15 mins (at night). Ideally, measurements would be taken of the ambient sound and residual sound at the assessment location, with these measurements used to accurately calculate the specific sound (ambient – residual = specific).

Where the source (specific sound) is not yet operational, it is permissible to measure the specific sound elsewhere (or to use known manufacturers' or library data) and then model the impact of this against the known background level.

5.3.2.3 Rating level

Once the specific sound level has been determined, this must be corrected in terms of the need to consider the subjective prominence of the impact of the sound at noise-sensitive receivers, and the extent to which acoustically distinctive characteristics will attract attention.

BS 4142 states that this is normally possible to carry out a subjective assessment of characteristics, based on the following correction guidelines:

- **Tonality:** +2 dB for a 'just perceptible' tone, +4 dB for 'clearly perceptible', and rising to +6 dB for 'highly perceptible' tones
- **Impulsivity (rapidity of change and overall chance in level):** +3 dB for 'just perceptible' impulsivity, +6 dB for 'clearly perceptible', rising to +9 dB for 'highly perceptible' impulsivity
- **Intermittency:** if the on/off-time of the specific sound is readily distinctive at the noise-sensitive receivers, +3 dB
- **Other sound characteristics:** (see page 14 or 20 in PDF file of 4142).

It should be noted that where one feature is clearly perceived as dominant, it may be applicable to correct for that feature only. Where multiple features are likely to affect perception and response, each should be added arithmetically.

5.4 Outline Plant Mitigation Proposals

In addition to selecting low-noise plant items, other noise mitigation measures may be necessary to meet the proposed noise limits. These could include, but are not limited to, atmosphere-side attenuators, duct lagging and mass barrier screens, examples of these are shown in Figure 5—3. The selections shall be made at the detailed design stage once the proposed plant is known.

The above can be controlled through the use of an appropriately worded Planning Condition.

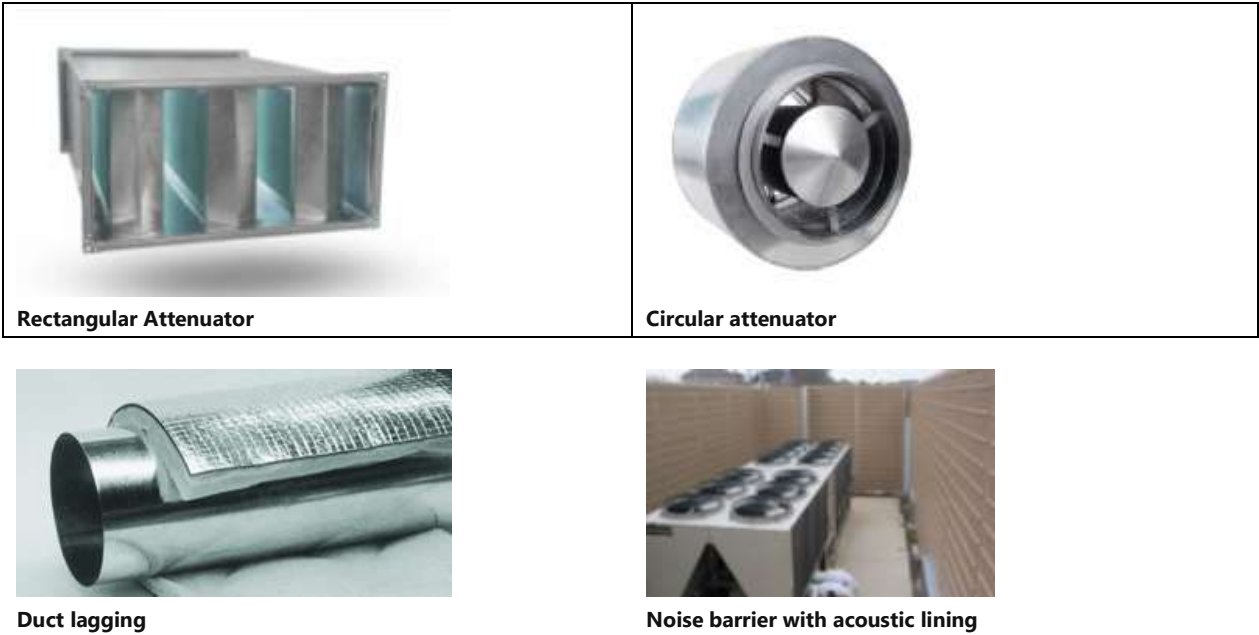


Figure 5—3 Outline plant noise mitigation proposals

6 Conclusions

It is concluded that the proposed development should be suitable in terms of internal acoustic conditions and in terms of the development's noise impact on sensitive receptors.

Environmental noise survey work was conducted to capture survey data on the various noise sources impacting the site.

The required sound insulation performance of external glazing throughout the development has been calculated from noise levels captured during the noise survey model so that suitable internal conditions can be achieved in line with the pertinent guidance documents described in this document.

The report demonstrated that suitable internal noise levels can be attained within the development based on suitable façade sound insulation requirements.

To limit noise break-out from the development (associated with building services plant noise), external noise level criteria are proposed.

Rating limits have been set to control the combined noise from building services to the following under different scenarios:

Where the site-wide plant is operating at typical duty:

- $L_{A,r,T,r}$ 46 dB during daytime periods (07:00 – 23:00 hours)
- $L_{A,r,T,r}$ 45 dB during night-time periods (23:00 – 07:00 hours).

By designing to these Rating level targets, suitable acoustic conditions can be maintained at the surrounding noise-sensitive developments, in line with the pertinent criteria contained within this report.

This noise impact assessment demonstrates that these targets are readily achievable and as such the scheme is considered to be in line with National, Regional and Local Planning Policy and criteria.

Based on the above, noise is not considered to form a barrier to development.

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