

PROPOSED NEW CLASSROOM BLOCK AT LORETO COLLEGE, MANCHESTER

RIBA STAGE 2: PLANNING NOISE ASSESSMENT

On behalf of:
Loreto Sixth Form College

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1.0 INTRODUCTION

- 1.1 Hepworth Acoustics Ltd was commissioned by '10architects', on behalf of Loreto Sixth Form College, to provide acoustic consultancy services in connection with a proposed new classroom block at their college campus off Chichester Road South, Manchester.
- 1.2 Specifically, this report sets out a RIBA Stage 2 noise assessment in connection with a planning application.
- 1.3 The new classroom block is to be located to the south of the campus at the corner of Chichester Road South and Moss Lane West. The nearest dwellings to the proposed new building are located on Tamworth Street to the west and Maher Gardens to the north. The location of the site is shown in Figure 1.
- 1.4 It is proposed to demolish the former community building currently in-situ and develop a three-storey building with associated car parking and landscaping. An external plant deck is to be located on the second floor roof space to the southwest at the rear of the building. The development layout of the proposed classroom block is shown in Figure 2.
- 1.5 This noise assessment has included:
- An inspection of the site and surrounding area;
 - Carrying out an environmental noise survey to establish the prevailing noise climate at the site;
 - Providing outline advice on the control of break-in of external noise to teaching areas in line with Building Bulletin 93, 'Acoustic Design of Schools' (BB93); and,
 - Recommendation of appropriate noise design limits for any external fixed plant.
- 1.6 All outline recommendations in this report are provided with respect to acoustic performance only and compliance with other requirements (e.g. fire, structural and ventilation etc.) should be checked by others.
- 1.7 The various noise units and indices referred to in this report are described in Appendix I. All noise levels mentioned in the text have been rounded to the nearest decibel, as fractions of decibels are imperceptible.

2.0 RELEVANT DESIGN GUIDANCE

BB93

- 2.1 Loreto college is classified as a sixth form college, and therefore there is no statutory requirement to meet any particular acoustic performance standards. However, BB93:2015 'Acoustic Design of Schools: Performance Standards', which applies to new schools, and which provides useful guidance on acoustic design of education buildings, has been used as design guidance for the purposes of determining appropriate guideline acoustic criteria for this development. The document was published in 2014 but a number of updates were issued in 2015.
- 2.2 The acoustic performance standards of BB93 provide acoustic performance criteria for each room type and are determined by the room usage as shown in Table 1 of this report.

Room Use Designations and Indoor Ambient Noise Level

- 2.3 BB93 states requirements for limiting the level of ambient sound in teaching and other relevant spaces. This is called the 'Indoor Ambient Noise Level' (IANL). The IANL within a space is taken as being the noise level experienced in the completed, unoccupied, unfurnished space due to the break-in of external noise and any noise from building services within the space. Noise from teaching activities or teaching equipment is excluded.
- 2.4 The BB93 upper limit of Indoor Ambient Noise Level under normal conditions for a selection of school spaces (assumed to be mechanically ventilated) are shown in Table 1.

Table 1: Indoor Ambient Noise Limits from Table 1 of BB93 for New Builds

Type of Room	Upper Limit for the indoor ambient noise level dB $L_{Aeq,30\text{ min}}$ (mechanical ventilation provided)
Secondary school: classroom, general teaching area, seminar room, tutorial room, language laboratory	35
Open plan: Teaching area, Resource/breakout area	40
Study room (individual study, withdrawal, remedial work, teacher preparation)	40
Atrium, circulation space not intended for teaching and learning	45
Meeting room, Interviewing/counselling room, video conference room	40
Dining room	45
Administration and ancillary spaces: Kitchen	50

Office, medical room, staff room	40
Corridor, stairwell, coats and locker area	45
Changing area	50
Toilet	50

- 2.5 In order to protect students from regular discrete noise events, e.g. aircraft or trains, BB93 states that IANLs should not exceed 60 dB $L_{A1,30 \text{ min}}$ in teaching spaces.
- 2.6 The IANL criteria exclude noise contribution from rain noise. However, BB93 states that IANL during heavy rain (as defined in BS EN ISO 140-18) should be controlled so as to be no more than 25 dB above the IANL criteria of Table 1.
- 2.7 Where spaces are to be naturally ventilated, or ventilated via a hybrid system, relaxation of the IANL criteria are applicable. The corresponding IANL tolerances are shown in Table 2.

Table 2: Summary of IANL Tolerance/Limits for Hybrid Ventilation System

Condition	Ventilation System	IANL Limit
Normal – Ventilation for normal teaching and learning activities	Mechanical	Table 1 values
	Natural	Table 1 values + 5 dB*
	Hybrid	Mechanical system noise: Table 1 values
		Total noise level: Table 1 value +5 dB
Summertime – ventilation under local control of teacher to prevent overheating	Natural / Hybrid	≤55 dB on hottest 200 days per year
Intermittent Boost - ventilation under local control of teacher to provide dilution of fumes	Natural	Table 1 value +5 dB

* does not apply to teaching and learning spaces where the Table 1 IANL is equal to or greater than 45 dB.

BS 4142

- 2.8 British Standard 4142: 2014 +A1:2019, 'Methods for rating and assessing industrial and commercial sound' is the appropriate guidance for determining appropriate environmental noise limits at residential locations for any new mechanical services plant and equipment.
- 2.9 BS 4142 requires a 'rating' level ($L_{A,r,T}$) calculated from the operation of the noise source to be compared with the background sound level ($L_{A90,T}$) which is measured in the absence of the noise source. The noise is assessed over a 1-hour period for plant operating in the daytime and a 15-minute period for any plant operating at night.

- 2.10 The rating level ($L_{Ar,Tr}$) is based on the 'specific' sound level ($L_{Aeq,T}$) attributed to the operating noise source, with 'character corrections' added for sound sources where 'certain acoustic features can increase the significance of impact'.
- 2.11 The acoustic character correction applied to the specific sound level in order to obtain the rating level can take into account tonality, intermittency, impulsivity and characteristics otherwise distinctive against the prevailing noise climate in the area.
- 2.12 An initial estimate of the potential noise impact from the operating noise source is determined by comparing the difference between the background sound level and the rating level at residential locations.
- 2.13 Regarding the outcome of the initial estimate, BS 4142 states that:
- Typically, the greater this difference, the greater the magnitude of impact;
 - A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context;
 - A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context; and,
 - The lower the rating level is relative to the measured background level, the less likely it is that the operation will have an adverse impact or a significant adverse impact. Where the rating level is does not exceed the background sound level, this is an indication of the specific sound source having low impact, depending on the context.
- 2.14 BS 4142 also states in respect of background sound levels that "it is important to ensure that values are reliable and suitably represent the particular circumstances and periods of interest... the objective is not simply to ascertain a lowest measured background sound level, but rather to quantify what is typical during particular time periods".
- 2.15 BS 4142 states that all pertinent factors must be taken into account regarding the context in which the noise occurs, including but not limited to:
- The absolute level of sound.
 - The character and level of the residual sound compared to the character of the specific sound; and,

- The sensitivity of the receptor and whether dwellings or other premises used for residential purposes will incorporate design measures that ensure good internal and/or outdoor acoustic conditions such as acoustic screening.

2.16 The initial numerical assessment and the context are then both taken into account when determining the potential noise impact at residential locations.

3.0 NOISE SURVEY

- 3.1 An environmental noise survey has been carried out. The purpose of the noise survey was to determine the ambient noise levels at the site to assist with determining the likely noise break-in level to the new classroom block, and also to measure background sound levels representative of the nearest dwellings in order to establish appropriate noise design limits for any new fixed plant installations.
- 3.2 Noise levels were measured at a location in the southern part of the existing campus, which is considered representative of the noise climate for the proposed new building and the nearest dwellings to the site. The measurement location is shown in Figure 1.
- 3.3 The noise measurements were undertaken for a period of over 24 hours by installing an automatic data-logging sound level meter. The survey was carried out in terms of a series of consecutive 15-minute measurements on Thursday/Friday 2/3 March 2023. The noise measurements were taken in 'free-field' conditions and at a microphone height of approximately 1.4m above the ground. Calibration checks were carried out both before and after the measurement periods with no variance in levels noted. Frequency analysis and audio recording (for the identification of noise sources) was also carried out.
- 3.4 The measured 15-minute values are considered to be representative of both the corresponding 1-hour values in line with BS 4142 and the corresponding 30-minute values in line with BB93.
- 3.5 The weather conditions during the noise survey were suitable for the purposes of the survey and subsequent assessment.
- 3.6 The results of the noise survey are summarised in Table 3, and the full results along with details of the equipment used, and the weather conditions during the survey periods, are shown in Appendix II.

Table 3: Summary of Measured Noise Levels (dB)

Period	$L_{Aeq,15\text{ min}}$	$L_{A90,15\text{ min}}$
School hours (i.e. 08:00 – 16:00)*	57 – 60	48 – 53
Out of School hours (i.e. 16:00 – 23:00)	55 – 61	42 – 54
Night-time (i.e. 23:00 – 07:00)	49 – 55	39 – 44

* Excluding extraneous noise such as emergency sirens and vehicles in car park

- 3.7 The noise climate in the area was due to road traffic on the nearby roads.
- 3.8 To allow for the evaluation of noise break-in to the new building, unweighted octave band noise levels are used at the measurement location and are shown in Table 4 in terms of $L_{eq,T}$ and $L_{1,T}$.

Table 4: Ambient Noise Levels (dB)

Description	Octave Band Centre Frequency (Hz)						
	63	125	250	500	1k	2k	4k
$L_{eq,T}$	70	63	59	59	57	54	46
$L_{1,T}$	73	65	61	61	62	58	49

- 3.9 The results of the noise survey have been taken into account in our outline assessment of noise break-in to the rooms within the new classroom block which is set out in Section 4.
- 3.10 For the purposes of assessing noise from new external fixed plant associated with the building we have adopted the mode of the measured $L_{A90,15mins}$ values as the representative background sound levels during evening and night-time periods at the nearest dwellings. The evening value was 45 dB $L_{A90,T}$ and 40 dB $L_{A90,T}$ for the night-time period. The control of noise from external fixed plant is discussed in Section 5.

4.0 CONTROL OF INDOOR AMBIENT NOISE LEVELS (IANL)

- 4.1 As previously stated, the IANL within a space is taken as being the noise level experienced in the completed, unoccupied, unfurnished space due to the break-in of external noise and any noise from building services. Noise from teaching activities or teaching equipment is excluded.
- 4.2 Based on the noise survey results the new classroom block would be exposed to external noise of around 58 dB $L_{Aeq,T}$. Therefore, in general, the resulting noise levels inside teaching spaces and non-teaching spaces away from Chichester Road South and Moss Lane West would meet the relevant BB93 IANL values with windows of standard well-fitted thermal double glazing (4mm glass - 4mm glass) i.e. windows having a typical sound reduction performance of 25 dB $R_w + C_{tr}$ when the windows are closed.
- 4.3 However, for teaching spaces and non-teaching spaces overlooking Chichester Road South and Moss Lane West enhanced acoustic glazing would be necessary. Well fitted windows of minimum 6 mm glass – 12 to 20 mm cavity – 4 mm glass i.e. having a typical sound reduction performance of 29 dB $R_w + C_{tr}$ would control noise break-in to meet the relevant BB93 IANL values.

Natural/Hybrid Ventilation

- 4.4 The internal ambient noise levels within a room with a partially open window will be between 10 – 15 dB below the external noise level. Therefore, where the external noise level exceeds the IANL criterion (with + 5 dB tolerance for natural ventilation) by more than 10 - 15 dB, then it is likely that some alternative means of ventilation will be necessary.
- 4.5 This means that where external noise levels exceed 50 - 55 dB $L_{Aeq,T}$ outside new build teaching areas, and 55 - 60 dB $L_{Aeq,T}$ outside non-teaching spaces, an alternative means of ventilation is likely to be necessary. This may be mechanical ventilation, but equally may be an acoustically attenuated form of natural/passive ventilation.

Mechanical Ventilation

- 4.6 If the outline proposals for a mechanical ventilation strategy are adopted, the lowest (and most onerous) IANL criterion would generally be 35 dB $L_{Aeq,30 \text{ min}}$ (classrooms as indicated in Table 1), except for certain types of music room and also any teaching rooms intended specifically for students with special hearing and communication needs where lower (i.e. more onerous) limits apply.

- 4.7 The resulting internal ambient noise levels in spaces will be due to a combination of ingress of external noise and noise from any building services equipment. As such, where rooms will not be significantly affected by external noise ingress, the M&E noise levels can be specified to meet the adopted internal ambient noise level criteria. Where spaces are potentially affected by external noise ingress, some additional headroom must be provided and lower noise generating equipment will need to be specified to ensure that the IANL criteria in Table 1 are not exceeded.
- 4.8 ‘Noise rating’ is a graphical method for assigning a single-number rating to a noise spectrum. It can be used to specify the maximum acceptable level in each octave band of a frequency spectrum, or to assess the acceptability of a noise spectrum for a particular application. The method was originally proposed for use in assessing environmental noise, but it is now used in the UK mainly for describing noise from mechanical ventilation systems in buildings. Whilst there is no direct relationship between NR and dB(A) values (such as noise levels denoted in terms of $L_{Aeq,T}$), the following approximate relationship applies:

$$\text{dB(A)} \approx \text{NR} + 6$$

- 4.9 On this basis, we therefore recommend that M&E noise levels should be controlled to a value no higher than the NR value that is at least 9 dB below the corresponding adopted internal ambient noise level to consider the influence of road traffic noise. Example M&E noise design limits for relevant spaces are set out in Table 5 below.

Table 5: M&E noise limits (dB)

Room	NR value
Classroom	26
Staffroom	31

Outline Recommendations

- 4.10 Therefore, in order to adequately control noise break-in, we recommend the following:
- Glazed areas of the elevation should be specified to provide a minimum sound insulation performance rating of 30 dB $R_w + C_{tr}$, this could be provided by well-fitted 8 mm glass – 12 to 20 mm cavity – 4 mm glass double glazing, if this meets safety and other requirements;
 - In order to maintain the sound insulation of the building envelope, we recommend that any non-glazed elements should be designed such that they provide a minimum sound insulation of 45 dB $R_w + C_{tr}$.

- Mechanical ventilation systems or an acoustically attenuated form of natural/passive ventilation would be appropriate for the new building, specifications for the adopted strategy should be in line with the recommendations given above.

5.0 ENVIRONMENTAL NOISE LIMITS FOR FIXED PLANT

- 5.1 We understand that an external fixed plant deck is to be located on the second floor roof space to the rear of the building, however, there are no details of the noise emissions from this equipment at this stage.
- 5.2 Using the results of the noise survey (as detailed in Section 3), we have derived appropriate daytime and night-time environmental noise design limits which would need to be considered in the selection and installation of any external plant. To achieve no more than a low noise impact as defined in BS 4142, plant noise design limits at the nearest dwellings are recommended to not exceed the prevailing background noise levels.
- 5.3 On this basis, the recommended cumulative fixed plant/equipment rating sound levels (i.e. rated according to BS 4142) for the new plant are shown in Table 6.

Table 6: Recommended Plant Noise Design Limit at Nearest Dwellings (dB)

Location	Daytime	Night
Outside the nearest dwelling	45	40

- 5.4 Typical measures that can be taken to adequately control noise from new fixed plant and equipment include:
- Specifying low noise equipment;
 - Careful siting of equipment away from dwellings and teaching spaces;
 - Installation of acoustic enclosures around the fixed plant and machinery where necessary;
 - Installation of noise attenuators, acoustic louvres, etc; and
 - Carrying out regular maintenance of equipment to minimise noise emissions.

6.0 SUMMARY

- 6.1 Hepworth Acoustics Ltd was commissioned by '10architects', on behalf of Loreto Sixth Form College, to provide a RIBA Stage 2 noise assessment in support of a planning application in connection with a proposed new classroom block at their college campus off Chichester Road South, Manchester.
- 6.2 Although Loreto is a Sixth Form College, BB93 has been adopted as the acoustic standard for this development as it provides appropriate design criteria for acoustic performance.
- 6.3 A baseline noise survey has been carried out at the site to establish the prevailing noise climate of the area.
- 6.4 Potential ingress of external noise to rooms within the proposed new classroom block has been assessed against the prevailing ambient noise levels in the area in the context of achieving the BB93 criteria for indoor ambient noise levels.
- 6.5 Outline recommendations have been provided for the design of the building envelope to achieve an appropriate standard of acoustic performance.
- 6.6 At this stage there are no details of proposed new externally mounted fixed plant, therefore environmental noise design limits at the nearest dwellings have been specified for any new external building services equipment, in accordance with the requirements of BS 4142: 2014 +A1:2019.



Key:

Not to scale

 - Noise Measurement Position

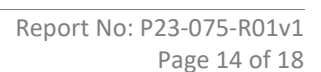
 - Proposed Area for redevelopment



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Title: Figure 1: Site Location & Noise Measurement Position

Project: P23-075



Appendix I: Noise Units & Indices

Sound and the decibel

A sound wave is a small fluctuation of atmospheric pressure. The human ear responds to these variations in pressure, producing the sensation of hearing. The ear can detect a very wide range of pressure variations. In order to cope with this wide range of pressure variations, a logarithmic scale is used to convert the values into manageable numbers. Although it might seem unusual to use a logarithmic scale to measure a physical phenomenon, it has been found that human hearing also responds to sound in an approximately logarithmic fashion. The dB (decibel) is the logarithmic unit used to describe sound (or noise) levels. The usual range of sound pressure levels is from 0 dB (threshold of hearing) to 120dB (threshold of pain).

Due to the logarithmic nature of decibels, when two noises of the same level are combined together, the total noise level is (under normal circumstances) 3 dB(A) higher than each of the individual noise levels e.g. 60 dB(A) plus 60 dB(A) = 63 dB(A). In terms of perceived 'loudness', a 3 dB(A) variation in noise level is a relatively small (but nevertheless just noticeable) change. An increase in noise level of 10 dB(A) generally corresponds to a doubling of perceived loudness. Likewise, a reduction in noise level of 10 dB(A) generally corresponds to a halving of perceived loudness.

The ear is not equally sensitive to sound at all frequencies. It is less sensitive to sound at low and very high frequencies, compared with the frequencies in between. Therefore, when measuring a sound made up of different frequencies, it is often useful to 'weight' each frequency appropriately, so that the measurement correlates better with what a person would actually hear. This is usually achieved by using an electronic filter called the 'A' weighting, which is built into sound level meters. Noise levels measured using the 'A' weighting are denoted dB(A) or dBA.

Frequency and Hertz (Hz)

As well as the loudness of a sound, the frequency content of a sound is also very important. Frequency is a measure of the rate of fluctuation of a sound wave. The unit used is cycles per second, or hertz (Hz). Sometimes large frequency values are written as kiloHertz (kHz), where 1 kHz = 1000 Hz.

Young people with normal hearing can hear frequencies in the range 20 Hz to 20 kHz. However, the upper frequency limit gradually reduces as a person gets older.

Glossary of Terms

When a noise level is constant and does not fluctuate, it can be described adequately by measuring the dB(A) level. However, when the noise level varies with time, the measured dB(A) level will vary as well. In this case it is therefore not possible to represent the noise climate with a simple dB(A) value. In order to describe noise where the level is continuously varying, a number of other indices can be used. The indices used in this report are described below.

- L_w This is the 'Sound Power Level' which is a logarithmic ratio between a sound power quantity and the human threshold of hearing.
- L_{wA} This is the A-weighted 'Sound Power Level', which is the Sound Power Level (L_w) adjusted to account for the average human hearing response at difference frequencies for a given sound power range.
- $L_{Aeq,T}$ This is the A-weighted 'Equivalent Continuous Sound Level' which is an average of the total sound pressure measured over a specified time period. In other words, $L_{Aeq,T}$ is the level of a steady sound which has the same total (A-weighted) sound pressure as the real fluctuating noise, measured over the same time period. It is increasingly being used as the preferred parameter for most forms of environmental noise.
- L_{AFmax} This is the 'Maximum A-weighted Sound Level' that was measured during the monitoring period. L_{Amax} used in this report refers throughout to L_{Amax} measured using the fast time weighting of the sound level meter, L_{AFmax} .
- $L_{A1,T}$ This is the A-weighted noise level exceeded for 1% of the time period. L_{A1} is usually used as a measure of peak noise in the assessment of noise break-in in BB93.
- $L_{A90,T}$ This is the A-weighted sound level exceeded for 90% of a measurement time period. $L_{A90,T}$ is used as a measure of background sound level.
- $L_{A,T}$ This is an A-weighted value most commonly used in BS 4142 assessments, which is the sound level of the noise source under assessment, at the assessment location, evaluated over the reference

assessment period (T_r) and includes numerical adjustments for the characteristic features of the sound.

$D_{n,e}$ This the 'Element Normalised Level Difference', which is a value quantifying the sound insulation performance of a building element, such as an air vent, in a stated frequency band.

$D_{n,e,w}$ This the 'Weighted Element Normalised Level Difference', which is a single figure value quantifying the sound insulation performance of a building element, such as an air vent.

R This is the 'Sound Reduction Index' as measured in a laboratory, which is a measure of the sound insulation properties of a building element (e.g. a wall) in a stated frequency band.

R_w This is the 'Weighted Sound Reduction Index' (R_w), which is a single figure quantity of R , the laboratory measured Sound Reduction Index.

C_{tr} This is a weighted transport noise spectrum, which can be added to $D_{nT,w}$ or R_w in some standards to account for the spectral composition of different sound sources.

D This is the Level Difference and is a field measurement of the airborne sound insulation between adjacent spaces. As well as being field measurement, this term and all other D terms below therefore include on-site conditions other than direction noise transmission through, for example, a wall (flanking transmission).

D_n This is the Normalized Level Difference and is a field measurement of the airborne sound insulation between adjacent spaces.

D_{nT} This is the Standardised Level Difference, which is equivalent to the measured D_n and corrected to a standardised reverberation time of 0.5s.

$D_{nT,w}$ This the Weighted Standardised Level Difference, is a single figure value of D_{nT} , and is the field measurement of airborne sound transmission

$D_{nT,w} + C_{tr}$ This is the Weighted Standardized Level Difference with Spectrum Adaption Term C_{tr}

Appendix II: Noise Survey Results

Date(s):	Thursday/Friday 2/3 March 2023
Equipment	NTi XL2 'Class 1' sound level meters (s/n: A2A-20228-E0) with associated calibrator and environmental outdoor monitoring kit
Weather	Dry, ~9°C, clear skies and calm <3 m/s

All levels in dB(A)

Location : Overlooking Chichester Road South

