ISG PLC

MANCHESTER CREATIVE STUDIO
ACOUSTIC DESIGN REPORT

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1.0 INTRODUCTION

1.1 Acoustic & Engineering Consultants Ltd (AEC) has been instructed by ISG PLC to undertake an acoustic design review of the proposals for the Manchester Creative Studio.

1.2 The development comprises a five storey refurbished building, housing open plan teaching spaces, enclosed teaching spaces, a dining/teaching area, exam spaces and ancillary spaces such as offices, meeting rooms and a management suite.

1.3 This report has been prepared with reference to the Fairhurst Design Group drawing numbers 7236 02 – 10 to 17 & 20, all revision B, and the Northwest Construction Hub Framework agreement that was provide by ISG in PDF format.

1.4 As part of the assessment, noise surveys were undertaken to ascertain existing ambient and background noise levels in the area. A full measurement procedure is provided in Appendix A, and a brief guide to acoustic terminology used is detailed in Appendix B.

1.5 The report suggests appropriate guidance based on Building Bulletin 93 '*Acoustic Design of Schools'* (BB93) and 8233:1999 *'Sound insulation and noise reduction for buildings – Code of Practice',* presents the results of external noise measurements and provides an assessment of the construction of the main building elements required to achieve the suggested criteria.

1.6 It should be noted that AEC does not make recommendations on specific products to be used, although the report may make reference to products that could meet the relevant acoustic parameters. It is assumed that the health and safety requirements for any inferred products are inspected and adhered to, prior to use during the construction period.

2.0 ACOUSTIC CRITERIA

2.1 In terms of the acoustic criteria, AEC has primarily based this report on the advice presented in the latest version of the Department for Education and Skills document, Building Bulletin 93 '*Acoustic Design of Schools'* (BB93). In addition to BB93, the requirements of BS8233 have also been considered. It is important to note that as this building is a refurbishment and a college, the requirements of BB93 are not a building control although, the scope of BB93 does indicate that the standards included can be used as the basis for the acoustic design of further and higher education buildings

2.2 The acoustic criteria considered are as follows:

- the allowable level of internal noise including break-in noise and noise from M & E plant.
- the level of airborne sound insulation required by a wall or a partition between spaces, which depends on the level of noise generated in a space and the tolerance level of the activity of the adjacent space;
- the required impact sound insulation of a party floor depending on the receiving room type;
- the recommended reverberation time in the various spaces to provide good internal acoustic conditions.

2.3 These elements are described in more detail below.

Internal Ambient Noise Levels

2.4 The internal ambient noise levels would be a combination of noise breaking in from outside, and the noise from any mechanical services, if present. The noise levels detailed in Table 1 below are proposed.

Table 1 – Proposed Internal Ambient Noise Levels

Room Type	Maximum Internal Ambient Noise Level, dBL_{Aeq}
Enclosed Teaching	35-40*
Meeting Room	40
Open Plan Teaching / Exam Spaces / Dining (teaching)	40
Break-out / resource	40
Staff Room / Offices	40
Management Suite	45
Circulation	45
WCs	50

***40dBL_{Aeq} would comply with BS8233 requirements for reasonable conditions in a classroom**

2.5 Additionally, maximum noise levels, due to external sources, should not, ideally, regularly exceed $55dBL_{A1,\ 30\ minutes}$ in teaching rooms. L_{A1} measurements can generally be considered as a typical maximum noise level.

Internal Sound Insulation

Airborne

2.6 BB93 discusses airborne sound insulation performance requirements in terms of the $D_{nT(Tmf,max),w}$ descriptor, which is calculated in terms of the maximum allowable reverberation time for the specific room. For ease of reference, this descriptor will be referred to as D_w for the remainder of this report.

2.7 It has been noted that development is mainly open plan teaching and resource areas, however, there are a number of enclosed spaces and to achieve the suggested requirements of BB93, the sound insulation performances are presented in Table 2, below.

Table 2 – Proposed Internal Sound Insulation Performance Requirements

Source Room	Adjacent Space	Required Sound Insulation Performance, dBD_w
Meeting	Stairwell	45
Management	Stairwell	
Teaching	Teaching	
Exam Space	Teaching	
Enclosed Teaching	Teaching	

2.2 As identified in Table 2, all walls (that don't contain a doorset) should ideally achieve a sound insulation performance of at least $45dBD_w$. This sound insulation performance also

applies as a minimum performance for all floors, although in addition, the floor between the dining area and the first floor teaching spaces should provide a sound insulation performance of at least 50dBD_w if the dining room could be noisy when teaching is occurring on the first floor.

2.3 Doors between circulation spaces and any other spaces used by students (teaching spaces, learning resource spaces, etc.) need to achieve a minimum sound insulation performance of 30dBR_w. As a general rule, the partition containing a 30dBR_w door should have a sound insulation performance of at least 40dBR_w (including and glazing that may be required in the wall build-up).

2.4 Further to the above, consideration should be given to providing doors with a sound insulation performance of 35dBR_w to the enclosed classroom spaces with walls that achieve a performance of 45dBD_w. This is due to a single doorset separating these spaces and the open plan spaces.

2.5 For non noise sensitive rooms e.g. toilets or rooms not used by students, such as offices and staffrooms, doors do not need to achieve the 30dBR_w requirement. However, should the client highlight any concerns in relation to confidentiality requirements or noise sensitivity of a particular space, consideration should be given to installing an entrance door with a sound insulation performance of at least 30dBR_w.

2.8 It should be noted that the R_w rating relates to a laboratory measurement of sound insulation, rather than the on-site performance, which is typically given in terms of D_w.

2.9 As indicated above, in terms of impact noise, based on BB93, a level of no higher than 60dB$L'_{nT(Tmf,max),w}$ in all teaching spaces, and 65dB$L'_{nT(Tmf,max),w}$ or lower is required for all noise sensitive rooms. For simplicity, this parameter is almost equivalent to, and will be referred to as $L'_{nT,w}$ in this report.

Reverberation Times

2.10 To comply with BB93, the reverberation times in the various spaces would need to be controlled to the values shown in Table 3 below.

Table 3 – Required Maximum Reverberation Times to Comply with BB93

Room Type	Maximum Reverberation Time, T_{mf}, s
All teaching spaces	<0.8
Exam Spaces	<0.8
Ground Floor Dining-Teaching	<0.8
Meeting Room	<1.0s
Offices / Management Suite	<1.0s
Toilets	<1.5

Rain Noise

2.11 Although BB93 does not include specific criteria with regards to controlling noise from rainfall on roofs, the document does indicate that controlling rain noise should considered in the design of lightweight roofs and rooflights, as it can significantly increase the indoor ambient noise level in the spaces below.

2.12 In order to assist with the design of roofs to adequately control rain noise levels, the Building Research Establishment (BRE) developed IP 2/06 *'Rain noise from glazed and lightweight*

roofing' dated January 2006, which suggests that, as a rule of thumb, the calculated reverberant sound pressure level in a space, due to 'Heavy Rain', should not be more than 20dB above the maximum allowable indoor noise level, as defined in Table 1.1 of BB93.

2.13 Achieving the BRE rain noise levels limits are generally accepted as an appropriate method of demonstrating that lightweight roofs have been appropriately designed in order to control rain noise.

Noise to Adjacent Residential

2.14 It has been noted that residential units are being constructed directly adjacent to the building. On the understanding that the external walls to the two buildings are not directly coupled and assuming a solid masonry external wall to the school building, the anticipated sound insulation performance between the adjacent buildings will be at least 60dBD_w which will be appropriate for all normal teaching activities. As such, this element is not considered further.

3.0 NOISE MEASUREMENTS

3.1 In order to understand the existing noise climate daytime late evening noise surveys were undertaken by AEC on Tuesday 12 and Tuesday 19 November 2013 respectively.

3.2 Full details of the measurements are provided in Appendix A, but in summary, noise levels in the area are dominated by traffic on Henry Street, traffic on Blossom Street and traffic on Great Ancoats Street.

3.3 Based on the external measurements, free-field noise levels incident upon the building façade were between 60 and 65dBL_{Aeq} and maximum noise levels due to single car passbys were in the order of 75dBL_{A1}.

4.0 EXTERNAL ENVELOPE

Glazing and Ventilation

4.1 BS 8233 '*Sound insulation and noise reduction for buildings – Code of practice*' gives a sound insulation performance of a partially open window of around 15dB. World Health Organisation's '*Guidelines for Community Noise*' also indicates a reduction in external to internal noise levels of about 15dB should be achieved across a partially opened window.

4.2 Therefore, as the external noise levels affecting the building facades will be in the order of 60-65dBL_{Aeq}, internal noise levels will be in the order of 45-50dBL_{Aeq} with windows partially open for ventilation purposes. Based on this, to achieve internal noise levels compliant with BB93 and/or BS8233, windows would need to remain closed at all times and alternative means of ventilation provided.

4.3 Alternative means of ventilation could be in the form of acoustically attenuated natural means or mechanical ventilation. In addition to this, consideration could be given to installing secondary windows and incorporating a 'hit and miss' window opening i.e. the outer glazing opens at the top of the window and the inner glazing opens at the bottom. However, it is unlikely that the ideal noise level limit of 35dBL_{Aeq} would be achieved for enclosed teaching spaces but it should be possible to control noise levels to 40dBL_{Aeq} using this method, which is in line with a 'reasonable' standard in BS8233.

4.4 Calculations (based on the 'worst case' noise levels measured) show that a good standard of trickle vent (around 36dB$D_{n,e,w}$) used in conjunction with standard thermal glazing, would

achieve the required internal noise levels in all rooms. However, this method of ventilation would not provide the required rapid ventilation.

4.5 Alternatively, if mechanical ventilation is proposed, it should be controlled to the figures detailed in Table 6, below.

Walls

4.6 Other external elements would subsequently only need to achieve a minimum sound insulation performance of around 45dBR_w. This would be achieved by the existing masonry walls and slate tiled roof.

Roof

4.7 It has been noted that there are glazed rooflights on the top floor. Assuming that these are double glazed units, calculations indicate that appropriate noise levels should be achieved in the rooms below.

5.0 INTERNAL ACOUSTICS

Sound Insulation

Walls

5.1 The suggested on-site minimum sound insulation performance of 45dBD_w would be achieved with the existing masonry walls to the stairs.

5.2 With regards to internal partitions that create enclosed teaching spaces, ideally, these would achieve a minimum performance of 45dBD_w also, with 35dBR_w doors installed. However, it has been noted that these partitions are generally glazed and as such this performance may not be practically achievable without a secondary glazed system. If this is the case, as a minimum, the glazing should achieve a sound insulation performance of 40dBR_w with doors having a minimum performance of 30dBR_w. The plasterboard sections of these partitions should achieve a laboratory performance of 50dBR_w if 45dBR_w glazing is installed and 45dBR_w if 40dBR_w glazing is used.

5.3 There is no acoustic requirement where partitions do not fully enclose a space.

Curtains

5.4 It has been noted that there are curtains proposed around open plan teaching spaces in some areas. If very heavy curtains are selected and they extend from floor to soffit with no gaps, in principle, they could provide some level of attenuation between the separate areas and will also assist with the control of reverberation time in the space.

5.5 However, it must be noted that the noise reduction afforded between adjacent areas will not be significant and, with regards to acoustics, they should not be considered a substitution for partitions in any way.

Flanking Paths and other Potentially Weak Elements

5.6 The above recommendations assume good workmanship and attention to detail, particularly at junctions between the various elements.

5.7 Potential acoustically weak areas are typically termed 'flanking transmission paths'. Examples of flanking noise paths which commonly result in a separating partition not achieving the required sound insulation performance include:

- Lightweight walls or roofs or floating screeds that run continuously (i.e. unbroken) between adjacent rooms past acoustically rated partitions.
- Heavyweight floors, walls and roofs that run continuously across acoustically rated partitions and where a high level of sound insulation performance is required.
- Continuous steelwork between rooms.
- Mechanical Services Ductwork (crosstalk silencers may be required).

5.8 Where an acoustically rated partition (45dBD_w or higher) adjoins a corridor wall or an external wall, the inner leaf of the external or corridor wall would need to be broken.

5.9 Other potentially weak areas in partitions include:

- Deflection head details;
- Areas where separating walls do not extend from slab to soffit. (i.e. weaknesses above suspended ceilings and below raised access floors);
- Junctions between walls and floors / roof that incorporate profiled steel decks, where the profile gaps need to be appropriately sealed.

5.10 These elements require development.

Doors

5.11 Doors to rooms which are considered noise sensitive should achieve a minimum of 30dBR_w, with the surrounding wall achieving around 10dBR_w higher than the performance of the door.

5.12 30dBR_w can be achieved using a solid core timber door, with seals to the head, jambs and threshold.

5.13 It should be noted that it is difficult to achieve high acoustic performance from double leaf doors as it is difficult to ensure a good seal where the leaves meet, and is likely to require rebated meeting stiles.

5.14 It should also be noted that there are areas where a single doorset will separate teaching spaces. This is not ideal, acoustically, and consideration should be given to providing these rooms with a higher performing acoustically rated door; 35dBR_w as a minimum. However, it is also worth highlighting that the scheme incorporates a large number of open plan teaching spaces and even a 30dBR_w door and 40dBR_w partition will be a significant improvement when compared to spaces that are open to each other.

Floors

5.15 The separating floors are existing timber joists with timber floorboards. In order to achieve an appropriate level of airborne and impact sound insulation performance, these floors will need to be underlined with 2 layers of 12.5mm thick Soundbloc (or any board with an equivalent weight) suspended on an MF system via an acoustic hanger, forming a cavity of at least 250mm with 50mm thick mineral wool laid on top of the Soundbloc.

5.16 The above floor construction should provide an airborne sound insulation performance of around 50dBD_w and an impact sound insulation performance of 60dB$L'_{nT,w}$ which will be appropriate in all instances.

5.17 If the existing floors have a ceiling already installed, it may be possible to reduce the required number of plasterboard layers on the new MF ceiling. However, this will require further development when full details of the floor have been provided.

Reverberation Times

5.18 To control reverberation times in order to comply with BB93 requirements, all teaching spaces, meeting rooms, offices and exam rooms should be fitted with an area of acoustically absorbent panels (NRC 0.9 or greater) equivalent to 60% of the floor area for that space. For example, the closed off teaching spaces on the second and third floors will require at least 23m^2 of acoustic absorption, based on a floor area of around 39m^2.

5.19 To assist with controlling the transfer of noise between open plan teaching spaces ideally, the acoustic absorption should be provided as rafts at ceiling level.

5.20 The above assumes a timber or other acoustically reflective floor finish and a floor to soffit height of 3.2m.

5.21 If carpets are installed, the required acoustically absorbent panels required can be reduced to approximately 40% of the floor area.

5.22 Toilets would not require absorption but, ideally, stairwells would have around 7m^2 of absorption for each level. I.e. for ground to 5th floor this would be 42m^2 of absorption evenly distributed around the stairwell.

6.0 BUILDING SERVICES NOISE

Internal Requirements

6.1 In order to achieve the noise levels specified in Table 1 above, for any rooms that are mechanically ventilated, the NR levels detailed in Table 4 below would need to be achieved.

Table 4 – Required M&E NR Levels to Achieve Internal Ambient Noise Levels

Room Type	Maximum Internal Ambient Noise Level, dBL_{Aeq}	Maximum Plant Noise Level, NR
Enclosed Teaching	35-40*	30-35
Meeting Room	40	35
Open Plan Teaching / Exam Spaces / Dining (teaching)	40	35
Break-out / resource	40	35
Staff Room / Offices	40	35
Management Suite	45	40
Circulation	45	40
WCs	50	45

***40dBL_{Aeq} would comply with BS8233 requirements for reasonable conditions in a classroom**

6.2 In order to achieve these levels, noise control, in the form of in-line attenuators or acoustic louvres, are likely to be required for the air conditioning.

6.3 To control airflow generated noise in ductwork systems the duct velocities identified in Table 5, below, should not be exceeded:

Table 5: Maximum Duct Velocities

Room Criteria dBL_{Aeq}	Duct Velocity, m/s		
	Main Duct	Branch Duct	Final Runout
30	5.5	4.5	2.5
35	6.5	5.5	3.25
40	7.5	6	4
45+	9	7	5

6.4 It will also be necessary to control structure-borne noise by effectively isolating plant from the supporting structure. As a guide, the following are recommended:

- Air handling plant installed such that it is supported 150-200mm above the floor slab;
- The support arrangement of air handling plant should include neoprene pads or similar achieving a minimum static deflection of, nominally, 2mm under applied load;
- The fans and motor assemblies inside air handling unit plant should be supported off open spring isolation mounts achieving, nominally, 25mm minimum static deflection under applied load;
- Connecting ductwork should be effectively isolated from air handling units using flexible connections with a minimum operating length of 150mm;
- In-line pumpsets, should include isolation in the supports.
- The supporting systems of large pumpsets, where applicable, should include open spring isolation mounts achieving at least 25mm minimum static deflection under applied load. The system would need to be installed on an inertia base;
- The supporting system of any chillers should include isolation mounts achieving at least 25mm minimum static deflection under applied load. The system would need to be installed on an inertia base;
- Connecting pipework to any large pumpsets should be isolated from the supporting structure by vibration isolators achieving at least 10mm static deflection under applied load.

6.5 Any air conditioning system must take account of not just fan/air-generated noise but also cross talk between spaces, particularly those where noise levels may be higher, the information is private, or the receiving room is particularly noise sensitive e.g. studios and music practice. Hence cross talk silencers need to be considered depending upon the arrangement of the ductwork.

6.6 In addition to this it should be noted fresh air should not be supplied to any noise sensitive rooms via transfer grilles fitted in either the doors or the walls, as this will significantly reduce the sound insulation performance of the partition.

External Requirements

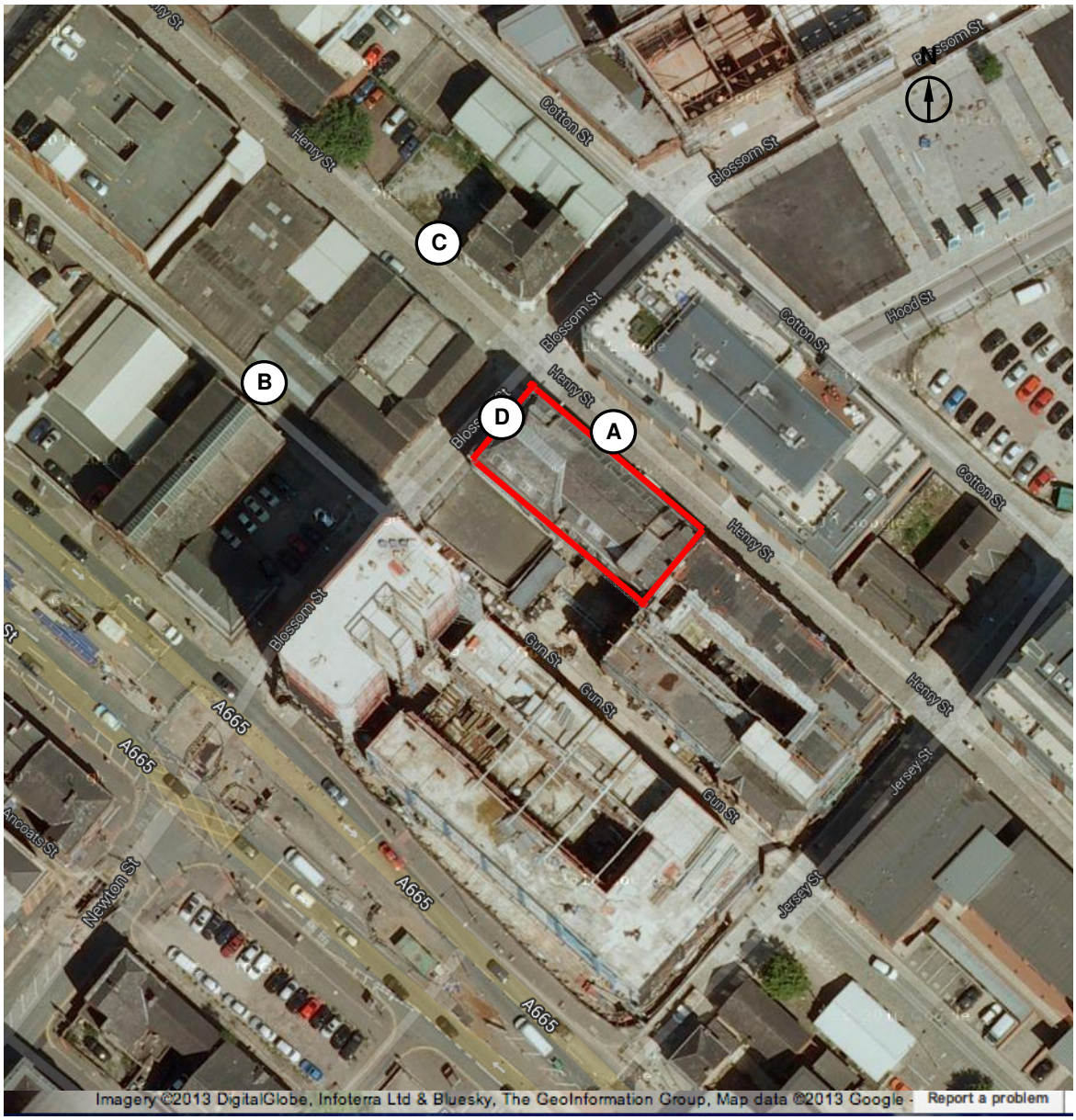
6.7 To comply with the requirements of Manchester City Council, externally mechanical services noise should be controlled to at least 5dB below the lowest measured background noise level at the nearest affected building.

6.8 The lowest measured background noise levels in the area up to around 2200h (when it is assumed the building will be open until), were in the order of 47dBL_{A90}. As such, plant noise levels will need to be controlled to no greater than 42dBL_{Aeq} (assuming no noise character) at the facades of the nearest residential buildings, situated directly opposite the site on Henry Street and Gun Street.

6.9 When further details of the plant are known, a noise level limit at 3m for each item can be set in order to achieve the required 42dBL_{Aeq} at the nearest residential.

Andy Burke

FIGURE 1 – Site Location Plan Showing Monitoring Locations



APPENDIX A – Measurement Procedure

Dates & Times of Survey	Night-time: Tuesday 12/11/13 Daytime: Tuesday 19/11/13
Personnel Present	Andy Burke (AEC)
Equipment Used	B&K 2260 Real Time Analyser (AEC Kit 1)
Weather Conditions	Night-time: 7°C, overcast, dry, little or no wind1-2ms^{-1}. Daytime 3°C, clear skies, dry, sunny, winds around 1-2ms^{-1}.
Measurement Procedure	Ambient and background noise levels were measured at four locations, identified as A to D on Figure 1, and described below. A – On Henry Street, central to and 1m from the Henry Street façade of the building. B – On Gun Street Approximately 20m from Blossom Street, free field. C – Spot check measurement on Henry Street, free-field, some 2.5m from the carriageway. D – Blossom Street, central to and 1m from the building façade. All locations were selected to measure general ambient and background noise levels, which were measured in terms of L_{Aeq}, L_{A90} and L_{A1} (fast response) typically over 5 to 15 minute periods. All the measurements were taken at a height of 1.5m above ground unless stated and all were facade measurements. The sound level analyser, which conforms to BS EN 61672-12003 *'Electro acoustics – sound level meters - Part1Specifications'* for Class 1 Type Z meters, was in calibration and check calibrated before and after the measurement periods using a Brüel & Kjær type 4231 (94dB) calibrator. There was no significant drift of calibration.
Measured Data	A summary of the results are presented in Table A1.

TABLE A1 –Measured Noise Levels

Location	Period, h	Noise Level, dB			Comments
		L_{Aeq}		L_{A1}	
Night-time					
A	2114-2119	63.4	49.2	76.1	7 local cars, distant traffic
	2127-2132	54.7	47.2	64.0	2 local cars, distant traffic
	2143-4148	63.4	46.6	77.7	8 local cars, distant traffic
	2150-2155	54.9	47.5	62.4	1 local car, distant traffic
B	2121-2126	58.1	50.5	65.5	Traffic on Great Ancoats
	2134-2139	56.1	48.7	64.2	Traffic on Great Ancoats
	2157-2202	57.7	46.5	72.6	1 local car, traffic on Great Ancoats Street
	2203-2209	57.0	50.3	64.2	Traffic on Great Ancoats
Daytime					
A	0944-0954	65.3	54.0	77.3	7 local cars, distant road traffic.
	1046-1059	67.0	55.0	77.6	7 local cars, 2 HGV
B	1000-1013	64.9	53.8	76.7	3 local cars, 1 HGV
	1059-1112	66.2	58.9	76.5	4 local cars, 2 HGV
C	1014-1029	60.2	49.8	73.9	5 local cars, free field measurement.

APPENDIX B - Acoustic Terminology in Brief

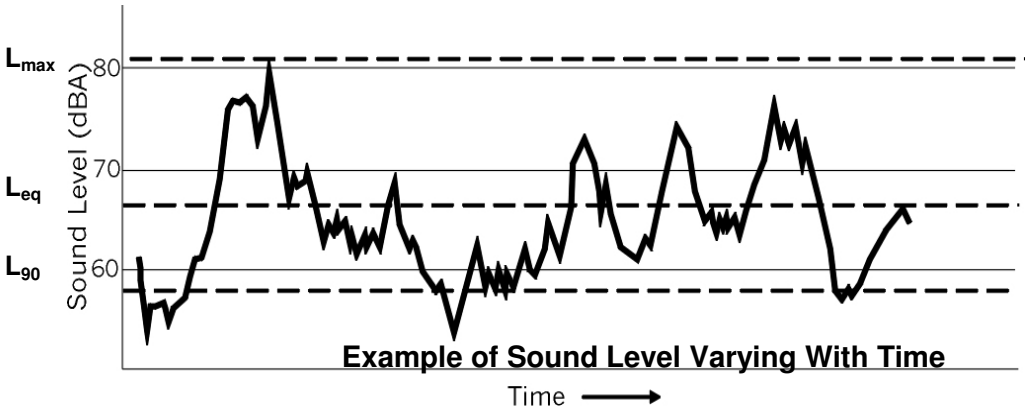
Sound is produced by mechanical vibration of a surface, which sets up rapid pressure fluctuations in the surrounding air. The rate at which the pressure fluctuations occur determines the pitch or *frequency* of the sound. The frequency is expressed in Hertz *(Hz)*, that is, cycles per second. The human ear is sensitive to sounds from about 20 Hertz to 20,000 Hertz. Although sound can be of one discreet frequency - a 'pure tone' - most noise is made up of many different frequencies.

The human ear is more sensitive to some frequencies than others, and modern instruments can measure sound in the same subjective way. This is the basis of the A-weighted sound pressure level *dBA,* normally used to assess the effect of noise on people. The dBA weighting emphasises or reduces the importance of certain frequencies within the audible range.

Noise Units

In order to assess environmental noise, measurements are carried out by sampling over specific periods of time, such as fifteen minutes or one hour, the statistically determined results being used to quantify various aspects of the noise.

The figure below shows an example of sound level varying with time. Because of this time variation the same period of noise can be described by several different levels. The most common of these are described below.



$L_{Aeq,T}$ The equivalent continuous (A-weighted) sound level may be considered as the "average" sound level over a given time, T. It is used for assessing noise from various sources including transportation, industrial and construction sources and can be considered as the "ambient" noise level.

L_{A90} The (A-weighted) sound level exceeded for 90% of a measurement period. It is the value used to describe the "background" noise.

L_{Amax} The maximum (A-weighted) sound level during a measurement period.

Free-field Level This refers to the sound level measured outside, away from reflecting surfaces.

R_w Single number rating used to describe the airborne sound insulation properties of a material or building element over a range of frequencies, typically 100-3150Hz, when measured in a laboratory.

$D_{nT,w}$ Single number rating used to describe the airborne sound insulation properties of a building element over a range of frequencies, when measured on site. Typically, to achieve a performance on site from a plasterboard partition, the partition in the laboratory should achieve a sound insulation performance at

least 5dB greater, i.e. to achieve 50dB$D_{nT,w}$ the partition should be selected to achieve 55dBR_w as a minimum.

NR Noise rating is a single number used to describe building services noise in a space over a range of frequencies based on CIBSE guidance, where BS8233 "*Sound insulation and noise reduction for buildings - Code of practice*" suggests that NR levels are equivalent to dBA levels +6, i.e. NR30 is approximately equivalent to 36dBA.

NRC Noise Reduction Coefficient – a single figure number used to describe the acoustic absorption performance of materials based on the average of its absorption coefficients over the frequency range of 250 to 2kHz.