ISG

NEW ISLINGTON SCHOOL

PRELIMINARY
ACOUSTICS DESIGN REPORT

20 January 2014

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CONTENTS

DOCUMENT STATUS

Revision	Date	Document Details	Author	Checked By
-	3 October 2013	Preliminary Acoustic Design Report	PJK	AGB
A	20 January 2014	Updated design, including first storey	PJK	AGB

1.0 INTRODUCTION

1.1 Acoustic and Engineering Consultants Limited (AEC) has been instructed by ISG to provide an acoustic design review of their proposals for the New Islington School, Manchester.

1.2 This report is based on Stephenson:ISA Studio's drawings for the school building and essentially focuses on the advice presented in the latest version of the Department for Education and Skills document, BB93 '*Acoustic Design of Schools*', which came into force on 1 July 2003.

1.3 Acoustic conditions in schools are incorporated in the latest version of Approved Document E (ADE) '*Resistance to the passage of sound*', which came into force on the 1 July 2003, and deals with the Requirements of Part E of Schedule 1 to the Building Regulations 2000 (as amended by SI 2002/2871).

1.4 In addition to BB93, the requirements to achieve any available BREEAM credits are also discussed, based on available guidance indicated in the 2011 BREEAM New Construction '*Non-Domestic Buildings Technical Manual SD5073 – 2.0:2111*'.

1.5 With regards to the design information in this report, it should be noted that AEC do 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.

1.6 Acoustic terminology used throughout this report is explained in brief in Appendix A.

2.0 DESIGN CRITERIA

General

2.1 BB93 sets criteria for various types of school room including:

- the allowable internal noise level based on break-in noise and mechanical services plant;
- the level of sound insulation required between spaces, depending on the level of noise generated in a space and the tolerance level of the activity of the adjacent space;
- the recommended reverberation time.

2.2 The acoustic design requirements described above, for the various types of accommodation on this site, are discussed separately below.

BREEAM

2.3 In relation to the acoustic design criteria, there are 3 BREEAM credits available under Hea 05 – Acoustic Performance. The criteria for these credits is provided below:

- Achieve the performance standards required by BB93 based on a sample measurement as described in Section 1.3 of BB93 and the ANC Good Practice Guide.
- Rain Noise – For roofs with a mass per unit area less than 150kg/m^2 (lightweight roofs) or any roofs with glazing/rooflights, calculations or laboratory data are required for teaching/learning spaces to demonstrate that the reverberant sound pressure level in these rooms are not more than 20dB above the indoor ambient noise level for the equivalent type of room given in Table 1.1 of BB93 during 'heavy rain'.

- All music accommodation (or multi-purpose halls in primary schools with no music accommodation) is to meet the performance levels set within BB93. Where noise levels are expected to exceed 95dBA (e.g. in the case of amplified music and/or percussion) the design team must demonstrate that the need for higher sound insulation has been designed out through careful space planning.

2.4 In addition, there is 1 BREEAM credit available for Pol 05 – Noise Attenuation, which relates to external noise level limits associated with any proposed mechanical services plant serving the site. In order to achieve the credit, it must be demonstrated that building services plant from the proposed development does not exceed the existing background noise level at the nearest noise sensitive property by no greater than 5dB during the day (0700 to 2300h) and 3dB at night (2300 to 0700h).

Allowable Internal Noise Levels

2.5 Based on BB93, the internal noise levels, presented in Table 1 below, should be achieved to provide good conditions, either for study and work requiring concentration, or listening.

2.6 The noise level limits relate to *the combination of building services plant and external noise levels breaking into the building*. At this stage, any mechanical services plant serving the rooms should be designed to 3dB below the noise levels identified.

2.7 In addition to the limits in Table 1, BB93 indicates that maximum noise levels should not regularly exceed 55$dBL_{A1,30\ min}$ in any spaces used for teaching.

Table 1 – Maximum Allowable Ambient Internal Noise Levels

Area	**Noise Level Limit, $dBL_{Aeq,\ 30mins}$**
BB93 Required	
Immersive Space (SEN)	30
Reception Classroom, Yr 1 to Yr 6 Classrooms	35
Interview Room, Medical Room	
Hall	
IT Suite	40
BB93 Guidance Only	
Staff Room, Offices	40
Circulation and Stairs, Entrance Lobby	45
Kitchen	50

Internal Airborne Sound Insulation Requirements

Sound Insulation of Walls

2.8 Adequate airborne sound insulation is required between adjacent critical spaces to achieve reasonable privacy. Appropriate sound insulation values for party walls to meet the requirements of BB93 are presented in Figure 2, towards the back of this report. BB93 discusses airborne sound insulation performance requirements in terms of the $D_{nT(Tmf,max),w}$ descriptor, which is calculated with reference to the maximum allowable reverberation time for the specific room. For ease of reference, this descriptor will be referred to as D_w. The D_w values shown on Figure 2 include the effect of glazing and other elements in the partitions.

Sound Insulation of Floors

2.9 The airborne sound insulation requirements also apply to the separating floors. Typically the sound insulation performance required between adjacent spaces is 45dBD_w, however, a higher performance of 55dBD_w is required between the kitchen/servery and the immersive space.

2.10 In addition to the airborne sound insulation of the floors, impact sound insulation is also important in a number of areas. The requirement in terms of maximum impact sound pressure level, $L'_{nT(Tmfmax),w}$ in the receiving rooms below would be no greater than 60dB in the noise sensitive rooms.

Sound Insulation of Doors

2.11 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 30dBD_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). The requirements for acoustic doorsets are marked on Figure 2. Again, the requirements for any new doors have also been based on BB93.

2.12 For non noise sensitive rooms e.g. toilets, changing rooms 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 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.

2.13 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 presented in terms of D_w.

Reverberation Times

2.14 To provide good internal conditions, the reverberation time (RT) in various spaces must be controlled. To meet the requirements of BB93, the reverberation times in Table 2, below, are required.

Table 2 – Required Reverberation Times for Unoccupied Spaces for the New Build

Area	Maximum RT, T_{mf} (secs)
BB93 Required	
Immersive Space (SEN)	<0.4
Reception Classroom, Yr 1 to Yr 6 Classrooms	<0.6
Interview Room, Medical Room, IT Suite	<0.8
BB93 Guidance Only	
Staff Room	<1.0
Kitchen	<1.5
Circulation and Stairs, Entrance Lobby	See below

2.15 For corridors, circulation spaces and entrance spaces, there is no specific RT criteria, however BB93 indicates that acoustic absorption should be provided with the objective being the control of noise in these spaces in order that it does not interfere with study activities in adjacent rooms. The methods indicated to provide this absorption are presented below.

- **Method A** – cover an area equal to or greater than the floor area with a class C absorber or better e.g. provide a suspended ceiling having an NRC of 0.6 throughout the space.

- **Method B –** determine the minimum amount of absorptive material using a calculation procedure.

3.0 EXTERNAL ENVELOPE

General

3.1 To achieve the internal noise level limits in Table 1, the measured external noise levels need to be appropriately controlled by the external envelope. This is considered below.

Measured External Noise Levels

3.2 In order to determine the external noise levels, the existing ambient (road traffic), maximum and background noise levels were measured at 1 location on the proposed site, on Thursday 26 September 2013, over the period 0900 to 1000h. The measured data was reasonably consistent over the period and, therefore, the data appears to be representative of longer measurement periods.

3.3 Full details of the noise survey are included in Appendix B with noise level data presented in Table B1.

3.4 As the site is currently unused wasteland, the measured noise level was influenced by noise sources from every direction. However, once the school building has been built the external noise levels affecting the northern and southern elevations would be expected to reduce by around 3dB. Therefore, the external ambient noise level on the northern and southern elevations would not be expected to be greater than 49dB$L_{Aeq.}$

3.5 In relation to maximum noise levels, these would not be expected to exceed 60dBL_{A1} on either the northern or the southern elevations.

Requirements for Glazing and External Walls

3.6 Guidance identified in the World Health Organisation's '*Guidelines to Community Noise'* indicates that windows which are open for ventilation provide an external to internal reduction in noise levels of 10-15dB. Therefore, to achieve an internal noise level of no greater than 35dBL_{Aeq} in classrooms, with windows open for ventilation, the external free-field noise levels should be no greater than 45-50dBL_{Aeq}.

3.7 Taking into account this reduction of between 10-15dB and the measured external noise levels of 49dBL_{Aeq}, it should be possible to provide natural ventilation, through partially open windows, to the classrooms on either the northern or southern elevations.

3.8 In regards to all other external elements of the facades, they should achieve a sound insulation performance in the order of 35dBR'_w, which is not onerous and would readily be achieved by means of a cavity masonry wall, or a carefully designed metal frame system wall incorporating rainscreen cladding and plasterboard internal lining

Classroom External Doors

3.9 The current school design shows doors direct to outside from the classrooms. Ideally, these would need to be specified to achieve a sound insulation performance of around 30dBR_w, in order to adequately control external-to-internal noise levels.

Roof Constructions

3.10 Based on the measured external noise levels, in principle, even a lightweight roof would appropriately control external traffic noise levels breaking into the new school building, however, there will be a requirement to control noise levels due to rainfall which is discussed below.

3.11 Controlling noise levels due to rainfall on a roof is not a strict requirement under the auspices of BB93. However, the document does indicate that rainfall should be considered in the design of the roof. In addition, there is one credit available under BREEAM Hea 05 with regards to this element.

3.12 If a roof construction having a surface weight or 150kg/m^2 or greater is used, this would automatically comply with the rain noise control requirements.

3.13 Based on the use of the multi-purpose hall for assembly, the rain generated impact sound transmission value for the roof should be 49dBL_{IA} to satisfy BB93 and BREEAM. This would be satisfied by the inclusion of a mass damping layer (10kg/m^3) in the build up as follows:

- 0.9mm thick aluminium outer layer
- 200mm thick mineral wool insulation (equivalent to Plus 37) compressed to 190mm
- 10kg/m^2 mass membrane*
- Vapour control layer
- 30mm thick slab Insulation, nominally 60kg/m^3
- Steel trough perforated liner (equivalent to TR 35/200 Kalzip type liner)

3.14 The roof construction above classbases would need to achieve a rain generated impact sound transmission value of about 45dBL_{IA} to satisfy BB93 and BREEAM. The following example of a roof construction would meet the requirements:

- 0.9mm thick aluminium outer layer
- 200mm thick mineral wool insulation (equivalent to Plus 37) compressed to 190mm
- Steel trough solid liner

This together with the acoustically absorbent suspended ceiling similar to the Ecophon Advantage A type, (25.5kg/m^2) would meet the value required.

3.15 This will require further development once the final constructions have been confirmed.

4.0 ASSESSMENT OF INTERNAL SOUND INSULATION

Walls

4.1 To achieve the sound insulation performance requirements identified on Figures 2 and 3 (at the back of this report) appropriate blockwork and plasterboard constructions are presented in Tables 3a and 3b, below.

It is important to note that Figure 1 identify the on-site (dBD_w) sound insulation performance requirement. Manufacturers' generally rate constructions based on the laboratory (dBR_w) performance. For a plasterboard partition, to arrive at a required on-site performance, a construction having a laboratory performance of <u>at least</u> 5dB higher will need to be selected. For blockwork partitions, the laboratory performance typically needs to be around 3dB higher.

Table 3a: Suggested Masonry/Blockwork Wall Types to Achieve the Required Airborne Sound Insulation Values

Sound Insulation, D_w	**Example of Suitable Constructions**
40dB	Any block wall with a surface mass of at least 150kg/m^2
45dB	Any block wall with a surface mass of at least 210kg/m^2 e.g. 140mm thick (1500kg/m^3)
50dB	Any block wall with a surface mass of at least 315kg/m^2 e.g. 210mm thick (1500kg/m^3) **or** a 200kg/m^2 block wall lined using a layer of at least 8kg/m^2 plasterboard on a British Gypsum Gyplyner (or equivalent), forming a cavity of at least 35mm with 25mm thick mineral wool roll in the cavity.
55dB	Lined block wall as for the 50dB wall, but with either two lining layers, or a single lining with a cavity of at least 85mm.

Table 3b - Suggested Dry Lining Wall Types to Achieve the Required Airborne Sound Insulation Values

On-site Requirement, D_w	**<u>Minimum</u> Laboratory Sound Insulation Performance, R_w**	**Suitable Plasterboard Construction (with acoustic quilt)**
40dB	~45dB	Two layers of 12.5mm thick wallboard, at least 8kg/m^2', each side of 70mm metal studs, with 25mm acoustic quilt in cavity.
45dB	52dB	Two layers of 12.5mm thick dense plasterboard, at least 10kg/m^2, each side of 70mm metal studs, with 25mm acoustic quilt in cavity.
50dB	56dB	Two layers of 15mm thick dense plasterboard, at least 12.5kg/m^2, either side of 70mm metal studs, with 50mm acoustic quilt in cavity.
55dB	61dB	200mm thick twin stud partition with two layers of 12.5kg/m^2 plasterboard either side and 50mm acoustic quilt in cavity.

4.2 The above recommendations assume good workmanship and attention to detail, particularly at junctions with other elements, and where the walls/partitions are penetrated by services. These flanking junctions will often need careful detailing, which includes the deflection head detail and the junctions with the external and corridor walls.

Junction Details

4.3 The above recommendations assume good workmanship and attention to detail, particularly at junctions between the various elements. In addition, generally, any elements that run continuous past a separating wall should be avoided. An example of this is a corridor wall that runs continuously between adjacent rooms, i.e. the separating wall should break the corridor wall.

4.4 These potential acoustically weak areas which commonly result in a separating partition not achieving the required sound insulation performance include:

- Deflection head details.
- Areas were separating walls do not extend from slab to soffit.
- Wall junctions with profiled deck soffits where the profiles need to be appropriately sealed.
- Walls or roofs that run continuously between adjacent rooms and bypassing acoustically rated partitions.
- Service penetrations
- Gaps around steelwork

4.5 In addition to the above, it will be necessary to consider the design of any mechanical services ductwork as cross talk silencers may be required in order that the sound insulation performance is not downgraded between noise sensitive areas.

Doors

4.6 With regards to achieving the door sound insulation performances identified on Figure 2, for a sound insulation performance in the order of 30dBR_w doors should be well fitted solid core timber with compressible rubber seals, (i.e. **not** brush seals) to the head, jambs and, in principle, the threshold.

4.7 To achieve a sound insulation performance of at 35dBR_w or greater, doors should typically be obtained as a complete set, including the frames, and seals. A threshold seal is a critical element for a 35dBR_w (or greater) door and again, it is important that the door set is well fitted. Drop-down threshold seals should be avoided for this type of door and it should be noted that these types of doors would typically be supplied as a complete doorset including all frames and seals.

4.8 Unless appropriate meeting stiles are fitted, the sound insulation performance of double doorsets will be significantly reduced when compared to single leaf doorsets.

Floors

4.9 It is understood that the floor is be constructed from concrete on metal decking which would need to have an overall surface weight of at least 250kg/m^2. This floor should provide an airborne sound insulation performance of 45dBD_w and, thus, provide an appropriate level of airborne sound insulation performance between all space excluding the kitchen/servery and the immersive space.

4.10 In order to achieve the airborne sound insulation performance of 55dBD_w, between the kitchen/servery and immersive space a metal frame suspended ceiling would be required in the kitchen/servery.

4.11 Based on the above floor construction, provided that all rooms are fitted with a floor finish that achieves an impact sound insulation performance of around 18dBΔLw, the required impact sound insulation performance figures would be achieved in all areas. An impact sound insulation performance of 18dBΔLw would typically be achieved, for example using a thin carpet or vinyl with appropriate underlay.

4.12 In relation to the separating floor between the kitchen and the immersive room, as the immersive room requires a low internal ambient noise level and there may be extraction plant located in the kitchen, the plant should be appropriately mounted as per requirements identified in Section 6.

5.0 INTERNAL FINISHES

5.1 To provide appropriate internal conditions conducive to communication and comfort, the reverberation times in the various spaces need to be controlled to the times indicated in Table 3. Based on this the required amount of acoustically absorptive material for each space is discussed separately below.

5.2 It is understood that the internal room finishes have not been finalised at this stage, however, based on information provided by Stephenson:ISA Studio we understand that acoustically absorptive ceilings, with a NRC of at least 0.8, will be installed to all spaces. In relation to the floor finishes, it is understood that in the teaching classes the floors will be a 50% mixture of vinyl flooring and carpet, while all other spaces will have carpet only. In the hall we have assumed that it will be finished with parquet flooring will be installed.

5.3 Table 4 below provides the requires the amount of addition acoustic absorption, in the form of sound absorptive wall panels required to meet the required reverberation times, the presented room heights and floors areas is based on the provided drawings. The below table is based on the assumption that a ceiling achieving a sound absorption of NRC 0.8 has been installed in all rooms.

Table 4 – Areas of Additional Wall Panels

Type of Space	Floor area, m^2	Height, m	Floor finish	RT, s	Area of Wall Panels (NRC of 0.9) required, m^2
BB93 Required					
Immersive Space (SEN)	40	3	Carpet	<0.4	10
Reception Yr	73	5.4	Vinyl/Carpet	<0.6	35
Yr1 to Yr6 Classroom	60	5.4	Vinyl/Carpet	<0.6	30
Interview Room, Medical Room	8	3	Carpet	<0.8	-
IT Suite	40	3	Carpet	<0.8	-
Hall	180	7.2	Parquet	0.8-1.2	45
BB93 Guidance Only					
Staffroom	24	3	Carpet	<1.0	-
Corridors	-	-	-		Refer to paragraphs below

5.4 For the Hall, it is critical that a significant area of absorption is provided at low level (i.e. from the ground or around 1m). As such, this will require development.

5.5 In addition to the above, circulation spaces and corridors require an appropriate area of acoustic absorption. Based on a carpeted corridor / circulation space and the proposed ceiling tiles the reverberation time requirements in these spaces would achieved.

5.6 It should be noted that the above is based on primarily drawings and information, the required area of acoustic absorption may need to be revised when the floor and ceiling finishes haven been finalised, therefore, this will require further development.

6.0 BUILDING SERVICES

Internal Requirements

6.1 Any ventilation system will need to ensure that the internal background noise levels presented in Table 1, for each of the rooms where it serves, are achieved. At this stage, mechanical services plant should be designed to at least 3dB below the noise level criteria presented in Table 1.

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

Table 5 – Maximum Ductwork Duct Velocities

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

6.3 In addition to the control of airborne noise, structure-borne noise also needs controlling by effectively isolating plant from the supporting structure, as follows:

- Air handling should be 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;
- 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 the 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.

6.4 Noise control, in the form of in-line attenuators or acoustic louvres, should be applied to the design of the mechanical services.

6.5 Any service penetrations through partition walls will need to be resiliently sealed.

6.6 Cross talk attenuators may be required to control noise levels transferring between adjacent services via the ductwork.

External Plant Noise Emissions

6.7 Based on the on-site noise level measurements, at this stage, noise levels from mechanical services plant should be controlled to no greater than 44dBL_{Aeq} at the nearest noise sensitive properties, or 40dBL_{Aeq} at the nearest classroom window (whichever is the most onerous) during the day. This would meet the requirements of both Manchester City Councils and BREEAM Pol 05.

6.8 It has been assumed that mechanical services plant will only be operational during the daytime periods.

7.0 BREEAM CREDITS

7.1 In relation to demonstrating compliance with the available BREEAM credits in Hea 05, this report has presented methods to achieve the required performance standards presented in BB93 for teaching spaces and the hall. Therefore, based on the information in this report credits 1 and 3, presented in Section 2, shall be achieved. In relation to 2nd credit, calculations will be provided once the construction of the roof has been agreed.

7.2 The building services noise limit presented in section 6 of this report would comply with the BREEAM Pol 05 requirements.

FIGURE 1 – Proposed Site Layout Showing Monitoring Location

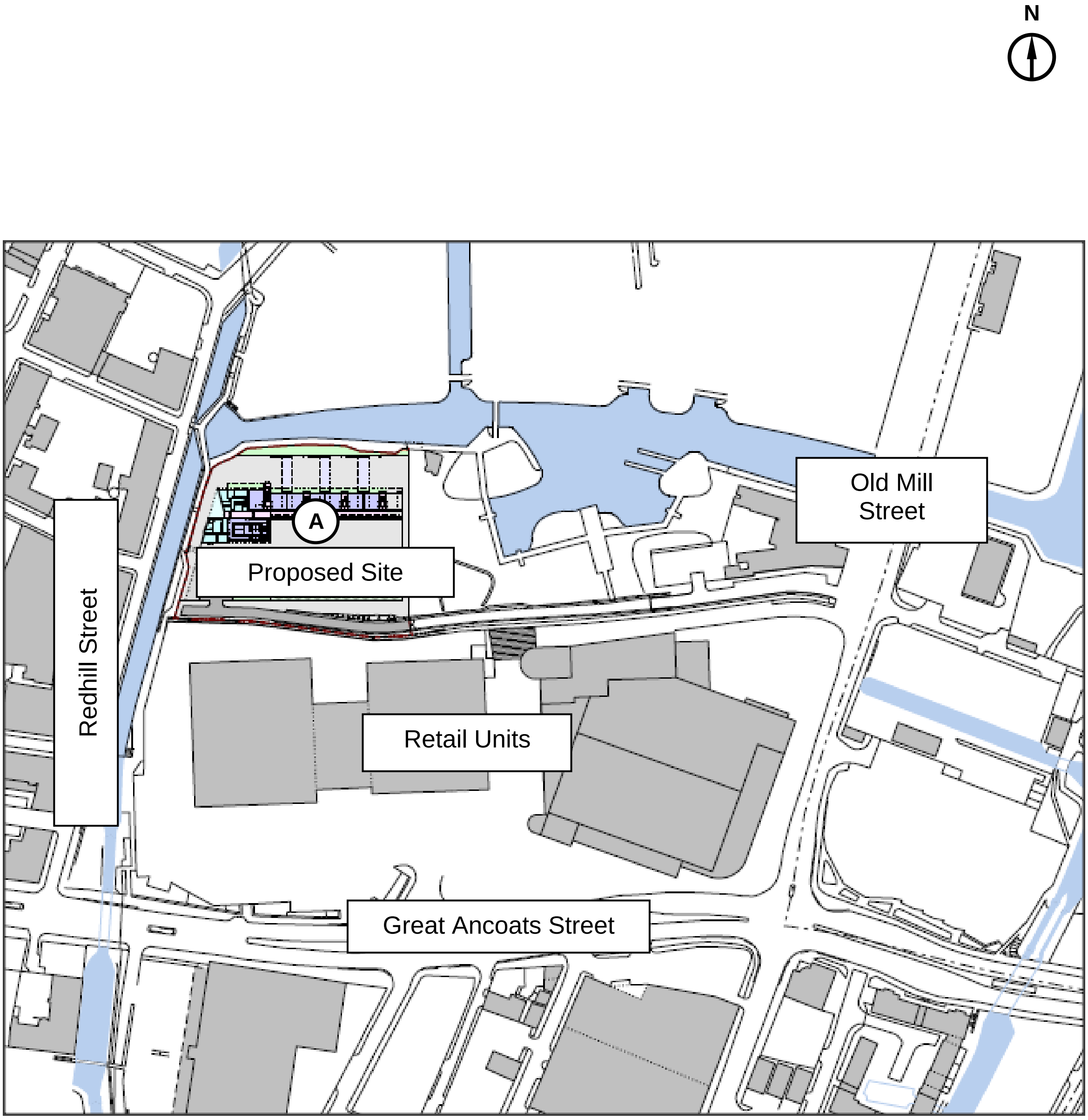


FIGURE 2 – Airborne Sound Insulation Performance Requirements of Ground Floor

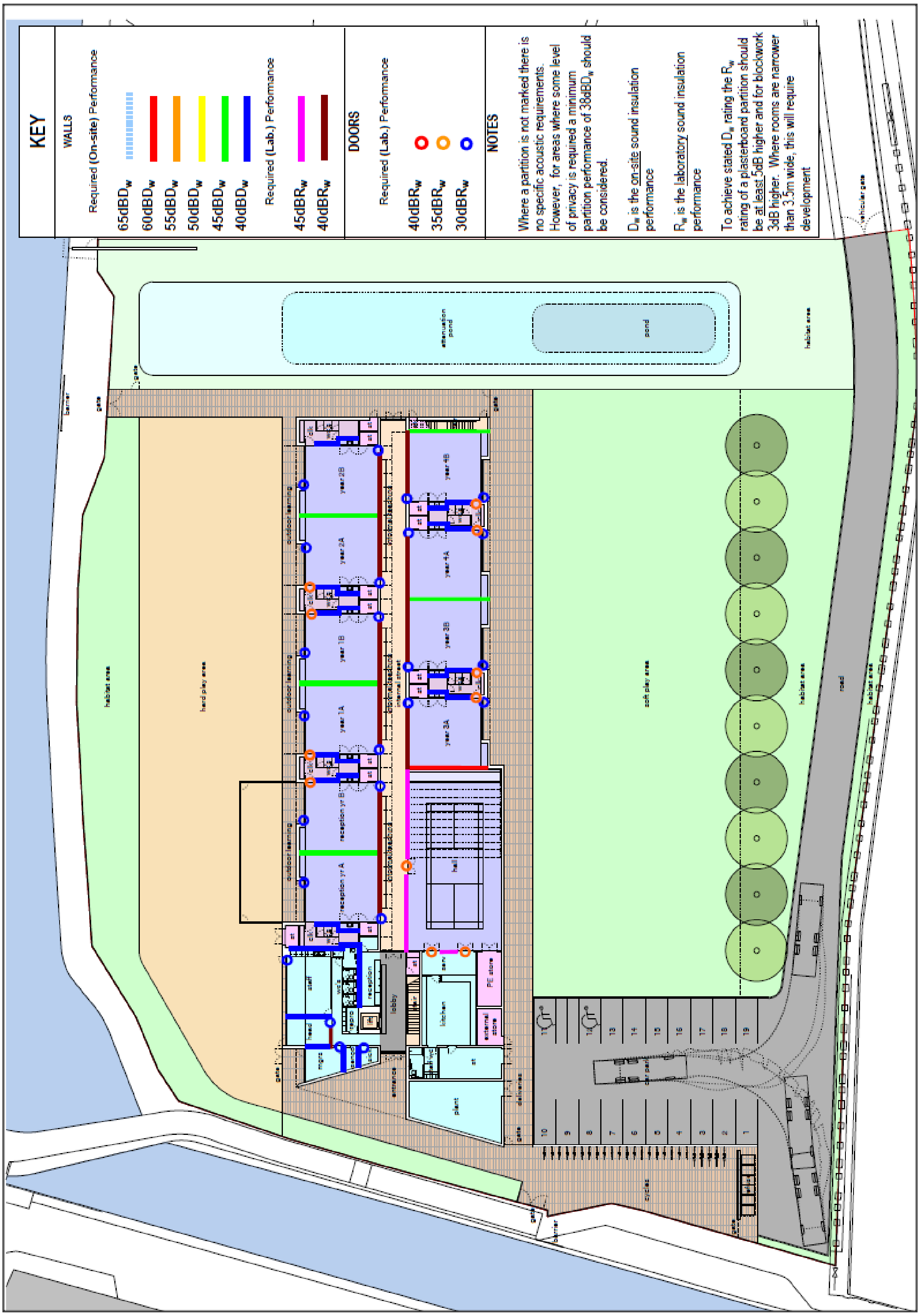
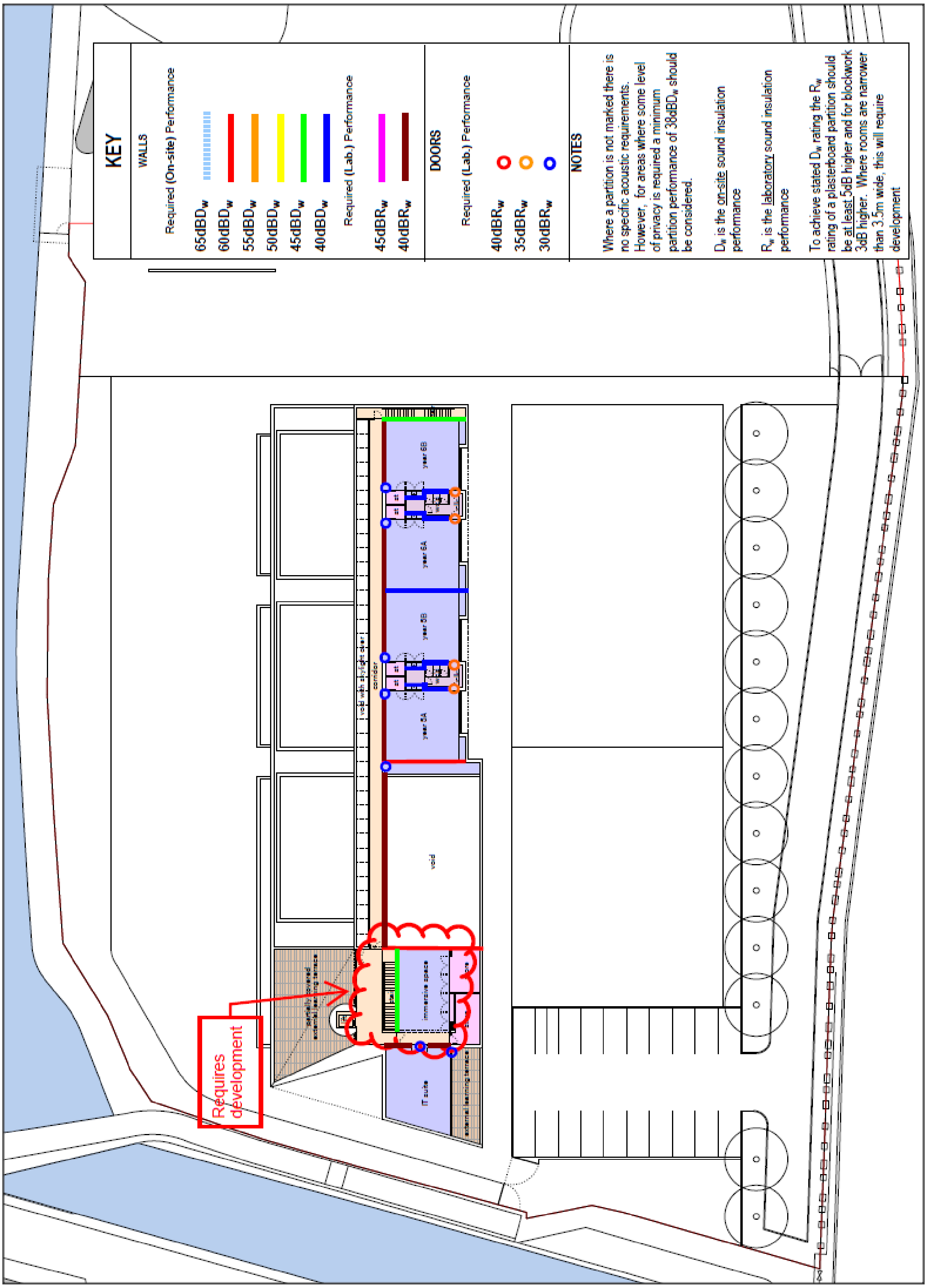


FIGURE 3 – Airborne Sound Insulation Performance Requirements of First Floor



APPENDIX A - Acoustic Terminology in Brief

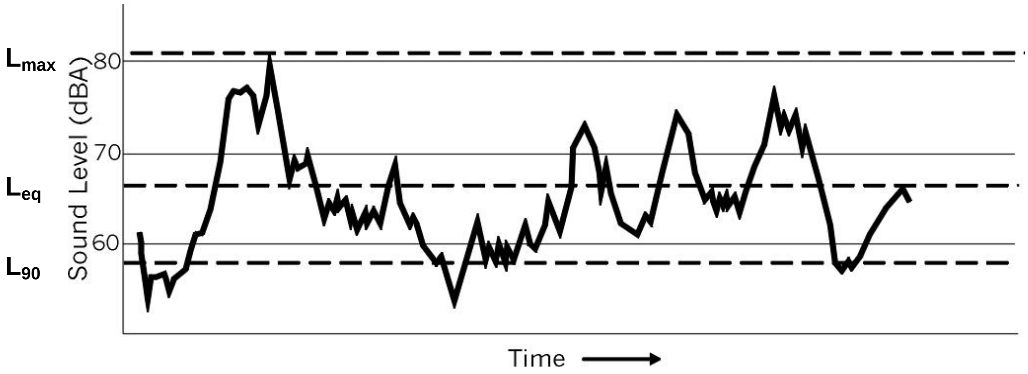
Sound is produced by mechanical vibration of a surface, which sets up rapid pressure fluctuations in the surrounding air. The rate at which the pressure fluctuations occur determines the pitch or *frequency* of the sound. The frequency is expressed in Hertz *(Hz)*, that is, cycles per second. The human 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.



Example of Sound Level Varying With Time

$L_{Aeq,T}$ The equivalent continuous (A-weighted) sound level. It may be thought of as the "average" sound level over a given time, T. It is used for assessing noise from various sources: industrial and commercial premises, construction sites, railways and other intermittent noises and can be considered as the "ambient" noise level.

L_{A1} The (A-weighted) sound level exceeded for 1% of a measurement period. It is the value generally used to indicate a 'typical' maximum noise level.

$L_{A10,T}$ The (A-weighted) sound level exceeded for 10% of a measurement period. It is the value often used to describe traffic noise.

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

L_{Amax} The maximum (A-weighted) sound level measured during a given time. 'Fast' or 'Slow' meter response should be cited.

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

NRC Noise Reduction Coefficient – a single figure number sometimes used to describe the performance of sound absorbing materials based on a combination of its absorption coefficient at various frequencies.

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

$D_{nT(Tmf,max),w}$ A BB93 specific criterion - single number rating used to describe the on-site airborne sound insulation performance properties of a material or building element over a range of frequencies, typically 100-3150Hz, which is calculated in terms of the maximum allowable reverberation time for the specific room. **Referred to in the main body of the report as D_w.**

T_{mf} A BB93-specific reverberation time criterion, taken from Table 1.5 of Section 1 of BB93, for airborne sound insulation in schools and is the average value of the reverberation times one of the frequency range 500Hz–2KHz.

APPENDIX B – Noise Survey Measurement Procedure

Dates & Times of Survey	Thursday 26 September 2012, 0900 to 0945h
Personnel Present	Paul Knowles (AEC)
Equipment Used	B&K 2260 Real Time Analyser (AEC Kit 2)
Weather Conditions	18°C, clear skies, calm.
Measurement Procedure	Ambient and background noise levels were measured at a single location, identified as A on Figure 1 and described below.

A – In the centre of the site.

Location A was selected to measure road traffic, general ambient and background noise levels, which were measured in terms of L_{Aeq}, L_{A10}, $L_{90,}$ L_{A1} and L_{Amax} (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 free field 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 Tables B1.

TABLE B1 –Measured Noise Levels

Location	Period, h	Noise Level, dB					Comments
		L_{Aeq}	L_{A10}	L_{A90}	L_{A1}	$L_{Amax, F}$	
A	0909-0914	51.5	53.0	49.7	55.8	61.5	The ambient noise level was due to distant road traffic. Maximum noise levels were due to road traffic on Redhill Street and from construction works in the area.
	0914-0919	51.4	52.9	49.7	56.3	59.3	
	0919-0924	51.7	53.4	49.9	55.1	57.5	
	0924-0929	50.6	51.9	49.2	55.2	59.0	
	0929-0934	52.3	54.8	49.5	58.9	61.5	
	0934-0939	52.2	53.6	49.6	60.1	64.7	