REPORT TITLE:

ABACUS BELSIZE PRIMARY SCHOOL - Environmental Survey Report with Commentary on Natural Ventilation Suitability & BREEAM POL 05 Noise Limiting Criteria

CLIENT DETAILS:

Kier Construction

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1. Introduction

Pace Consult Limited was commissioned by Kier Construction to undertake a noise survey and assessment of the proposed Abacus Belsize Primary School.

The proposed school will be located within an existing three story building including a lower ground floor, and a new build extension, which will contain classrooms, staff rooms and a main hall.

This report contains an assessment of the acoustic requirements for the building envelope based on environmental noise survey data measured at the site, and also considers the noise impact from M&E items on the surrounding area.

This report has been prepared in accordance with national standards such as BREEAM 2014 (Refurbishment and New Construction) Hea 05 and Pol 05, Acoustic design of Schools: Performance Standards Building Bulletin 93, February 2015, and British Standard BS4142: 2014, Method for rating and assessing industrial and commercial sound.

The prevalent noise source affecting the proposed school is road traffic from Rosslyn Hill and Downshire Hill Road.

2. Environmental Methodology

2.1 Perception

Noise is defined as unwanted sound. Human ears are able to respond to sound over the frequency range of about 20 Hz to 20 kHz and over the audible range of 0 dB (the threshold of perception) to 140 dB (the threshold of pain). The ear does not respond equally to different frequencies of the same magnitude, and is more responsive to mid-frequencies than to lower or higher frequencies. To quantify noise in a manner that approximates to the response of the human ear, a weighting mechanism is used. This reduces the importance of lower and higher frequencies, in a similar manner to the human ear. To help understand the range of noise levels which may be encountered, an indication of the level of some common sounds on the dB(A) scale is given in the table below.

Common Sounds on the dB(A) Scale	
dB(A)	Description
140	Threshold of pain
120	Jet take off at 50 metres
100	Maximum noise levels on an underground platform
80	Kerbside of a busy urban street
60	Busy general office
40	Residential area at night
20	Background in a TV and recording studio
0	Threshold of hearing

Furthermore, the perception of noise may be determined by a number of other factors, both acoustic and non-acoustic. In general, the impact of noise depends upon its level, the margin by which it exceeds the background level, its character and its variation over a given period of time.

In addition, the time of day and other acoustic features such as tonality may be important, as may the disposition of the affected individual receptor. Any assessment of noise should give due consideration to all of these factors when assessing the significance of a noise source.

The most widely used weighting mechanism that corresponds to the response of the human ear is the A-weighting scale. This is widely used for environmental noise measurement, and the levels are denoted as dB(A) or L_{Aeq}, L_{A90}, etc., according to the parameter being measured.

The decibel scale is logarithmic rather than linear, and hence a 3 dB increase in sound level represents a doubling of the sound energy present. Judgement of sound is subjective, but as a general guide a 10 dB(A) increase can be taken to represent a doubling of loudness, whilst an increase in the order of 3 dB(A) of a steady source is generally regarded as the minimum difference needed to perceive a change.

2.2 Legislation and Policy

2.2.1 National Planning Policy Framework and the Noise Policy Statement for England

The National Planning Policy Framework (NPPF) sets out the general requirements for gaining planning permission. Comments regarding noise found within the document are as follows. The planning system should prevent 'both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or NOISE pollution' (paragraph 109). It adds to this by saying that 'planning policies and decisions should aim to avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development' (paragraph 123).

The NPPF references the Noise Policy Statement for England (NPSE) which intern references two concepts used by the World Health Organisation (WHO) which can be used to ascertain relevant noise levels for individual sites. The concepts are LOAEL (Lowest Observed Adverse Effect Level) and SOAEL (Significant Observed Adverse Effect Level). The NPPF then gives three aims to adhere to:

Aim 1 – Avoid significant adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.

Aim 2 – Mitigate and minimise adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy of sustainable development.

Aim 3 – Where possible, contribute to the improvement of health and quality of life through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.

To avoid 'significant adverse impacts on health and quality of life', by creating a situation where the impact of noise lies below the SOAEL the guidance contained within Building Bulletin 93 *Acoustic Design of Schools: performance standards*.

2.2.2 Acoustic design of Schools: Performance Standards Building Bulletin 93, February 2015

This document supersedes section 1 of 'Building Bulletin 93' (BB93) published in 2003, and The Acoustic Performance Standard for the Priority School Building Programme (APS), June 2013.

Requirement E4 from Part E of Schedule 1 to the Building Regulations 2010 (as amended by Statutory Instrument, SI 2002/2871) states the following: *"Each room or other space in a school building shall be designed and constructed in such a way that it has the acoustic conditions and the insulation against disturbance by noise appropriate to its intended use."*

Approved Document E in support of the Building Regulations gives the following guidance:
"In the Secretary of State's view the normal way of satisfying Requirement E4 will be to meet the values for sound insulation, reverberation time and internal ambient noise which are given in section 1 of Building Bulletin 93 'The Acoustic Design of Schools', produced by DfES.

The Building Regulations require that all spaces should meet the performance standards for indoor ambient noise level, airborne and impact sound insulation, and reverberation time as specified in tables 1 to 7. These values are for rooms that are finished, furnished for normal use, but unoccupied. Where rooms are to be used without furnishings, the performance standards normally apply in the empty condition. Normal furnishing is not anticipated to have any significant effect on indoor ambient noise levels or sound insulation, but may reduce measured reverberation times by providing diffusion and absorption.

<u>Areas covered by the regulations</u>
Requirement E4 of the Building Regulations applies to teaching and learning spaces. The School Premises Regulations and the Independent School Standards apply to all areas of schools. The Building Regulations are not intended to cover the acoustic conditions in administration and ancillary spaces not used for teaching and learning except where they affect conditions in neighbouring teaching and learning spaces, but do require consideration to be given to adjoining areas, such as corridors, which might have doors, ventilators, or glazing separating them from a teaching or learning space.

New-build, conversion and refurbishment work

The School Premises Regulations and the Independent School Standards apply to refurbishment work, and the acoustic standards for refurbishment works given in this document apply. Where there is a need to upgrade the acoustic performance of an existing building or when refurbishment is undertaken for other reasons, then the refurbished elements should meet, as far as reasonably practicable, the acoustic performance given in these guidelines to satisfy the School Premises Regulations, the Independent School Standards and the Equality Act.

Although Building Regulations do not apply to all alteration and refurbishment work, it is desirable that such work should consider acoustics and incorporate upgrading of the acoustics as appropriate. In addition, Regulation 4 of the Building Regulations requires that any building work on an existing school should not make an existing requirement or contravention any worse than before building work was carried out.

In the case of existing buildings, Part E of the Building Regulations applies to material changes of use as defined in Building Regulations. The tables in section 1 give recommended values for both new buildings and for refurbished elements.

Where there is a material change of use as defined in the Building Regulations, such work should be carried out as is necessary to ensure that the building complies with Requirement E4 of the Building Regulations. In these cases, the ‘refurbishment’ criteria contained within this document apply. The School Premises Regulations and Independent School Standards apply whether or not there is a material change of use.

Indoor ambient noise levels in unoccupied spaces

The objective is to provide suitable indoor ambient noise levels (IANL) for
a) clear communication of speech between teacher and student
b) clear communication between students
c) learning and study activities

The IANL includes noise contributions from:

- external sources outside the school premises (including, but not limited to, noise from road, rail and air traffic, industrial and commercial premises)
- building services (eg, ventilation systems, plant, drainage etc). If a room is naturally ventilated, the IANL is calculated and measured with ventilators or windows open as required to provide ventilation as described in section 1.1.3. If a room is mechanically ventilated or cooled, the plant should be assumed to be running at its normal operating duty.
- actuator and damper noise

The IANL excludes noise contributions from:

- teaching activities within the school premises, including noise from staff, students and equipment within the building or in the playground (noise transmitted from adjacent spaces is addressed by the airborne and impact sound insulation requirements)
- equipment used in the space (eg machine tools, CadCam machines, dust and fume extract equipment, compressors, computers, projectors, fume cupboards) as these noise sources are considered as operational noise.
- rain noise - however, Building Regulation submissions should demonstrate that lightweight roofs and roof glazing have been designed to provide suitable control of rain noise reverberant sound pressure level in a space (calculated using laboratory test data with 'heavy' rain noise excitation as defined in BS EN ISO 140-18). Levels during heavy rain should not be more than 25 dB above the appropriate indoor ambient noise level given in table 1 (for refurbishments, this applies only to new roofing elements and not to repairs to existing roofs) Table 1 (overleaf) specifies upper limits for indoor ambient noise levels in terms of LAeq,30mins during normal teaching hours. Also, Table 1 indicates the room classification for the purpose of airborne sound insulation.

Table 1 (overleaf) specifies upper limits for indoor ambient noise levels in terms of *L*Aeq,30mins during normal teaching hours.

Type of room	Room classification for the purpose of airborne sound insulation in Tables 3a and 3b		Upper limit for the indoor ambient noise level $L_{Aeq,30mins}$ dB	
	Activity noise (Source room)	Noise tolerance (Receiving room)	New build	Refurbish-ment
Nursery school rooms *Primary school:* classroom, class base, general teaching area, small group room *Secondary school:* classroom, general teaching area, seminar room, tutorial room, language laboratory	Average	Medium	35	40
Open plan: (See also section 1.8) Teaching area Resource/breakout area	Average	Medium	40	45
Primary music room	High	Medium	35	40
Secondary music classroom[1] Small and large practice/group room[1] Performance/recital room[1]	Very high	Low	35	40
Performance/recital room[1] Ensemble room [1] Recording studio[1]	Very high	Low	30	35
Control room - for recording[1] Control room - not for recording	High Average	Low Medium	35	40
Lecture room	Average	Medium	35	40
Teaching space intended specifically for students with special hearing and communication needs[2]	Average	Low	30	35
SEN calming room	High	Low	35	35

Type of room	Room classification for the purpose of airborne sound insulation in Tables 3a and 3b		Upper limit for the indoor ambient noise level $L_{Aeq,30mins}$ dB	
	Activity noise (Source room)	Noise tolerance (Receiving room)	New build	Refurbish-ment
Study room (individual study, withdrawal, remedial work, teacher preparation)	Low	Medium	40	45
Libraries: Quiet study area Resource area	 Low Average	 Medium Medium	 40 40	 45 45
Science laboratory	Average	Medium	40	45
Design and technology: Resistant materials, CADCAM area Electronics/control, textiles, food, graphics, design/resource area, ICT room, art	 High Average	 High Medium	 40 40	 45 45
Drama studio, assembly hall, multi-purpose hall (drama, PE, audio/visual presentations, assembly, occasional music)	High	Low	35	40
Atrium, circulation space not intended for teaching and learning	Average	Medium	45	50
Sports hall Dance studio Gymnasium/Activity studio	 High	 Medium	 40	 45
Swimming pool	High	High	50	55
Meeting room, Interviewing/counselling room, video conference room	Low	Medium	40	45
Dining room	High	High	45	50
Administration and ancillary spaces: Kitchen Office, medical room, staff room Corridor, stairwell, coats and locker area Changing area Toilet	 High Low Average High Average	 High Medium High High High	 50 40 45 50 50	 55 45 55 55 55

In order to protect students from regular discrete noise events, eg, aircraft or trains, indoor ambient noise levels should not exceed 60 dB LA1, 30mins. This is achieved by default for spaces with IANLs up to 40 dB *L*Aeq, 30min, but requires assessment in spaces with higher IANL limits, eg, 45 and 50 dB.

Noise from building services under normal conditions should meet the limits for indoor ambient noise levels (IANL) given in table 1.

The design should show that IANLs can be achieved when the ventilation systems are operating in their normal condition; when providing intermittent boost ventilation; and when operating to control summertime overheating. A ventilation strategy may use one type of system for normal operation, and different types of system for intermittent boost and summertime overheating. The tolerances on the IANL limits in Table 1 for different types of ventilation system under different operating conditions are summarised in the table overleaf.

Condition	Ventilation system	Noise level limit
Normal - ventilation for normal teaching and learning activities	Mechanical[1]	Table 1 value
	Natural[2]	Table 1 value + 5 dB[4]
	Hybrid[2]	Mechanical system noise: Table 1 value
		Total noise level: Table 1 value + 5 dB
Summertime[5] - ventilation under local control of teacher to prevent overheating – allowable during the hottest 200 hrs of the year	Mechanical	Table 1 value + 5 dB[4]
	Natural or Hybrid	≤55 dB
Intermittent boost[6] – ventilation under local control of teacher for dilution of fumes during practical activities as in practical spaces for science, art, food technology and design and technology	Mechanical	Table 1 value + 5 dB[4]
	Natural	≤55 dB
Process - extract[3] can be automatic ventilation for safety and/or under local control of teacher	Mechanical and/or natural	See IoA/ANC guide[Ref1] for operational noise levels

Notes: 1 The normal condition for a ventilation system with purely mechanical air supply is defined as when the system is operating to limit the daily average carbon dioxide concentration to no more than 1,000ppm with the maximum concentration not exceeding 1,500ppm for more than 20 consecutive minutes on any day during normal school operating hours. This would normally equate to a minimum ventilation rate of approximately 8l/s per person. Mechanical ventilation in this context refers to systems (or parts of systems) that use mechanical fans to mix or drive the air including those in mechanical, hybrid, mixed mode and natural ventilation systems and in fan convector heaters.

2 The normal condition for a ventilation system in natural or hybrid mode is defined as when the system is operating to limit the daily average carbon dioxide concentration to no more than 1,500ppm with the maximum concentration not exceeding 2,000ppm for more than 20 consecutive minutes on any day. This would normally equate to a minimum ventilation rate of approximately 5l/s per person. For hybrid systems, the mechanical noise excluding external noise break in, should meet the IANL figure in table 1.

The mid-season design condition can be used in simple ventilation calculations and is defined as an outside temperature of 11 °C and an internal air temperature of 20 °C with no external wind effect.

Where there is a hybrid system, any mechanical system components should meet the IANL limits from table 1. The total noise level including external noise ingress may exceed the IANL limit from table 1 by up to 5 dB.

***3** Process extract includes the operational noise from local exhaust ventilation systems and boost ventilation under the local control of the teacher as required for fume and dust extract in design and technology, odour and steam from cookers in food technology, fume cupboard extract and similar process extract systems.*

***4** The +5 dB does not apply to teaching and learning spaces where the Table 1 IANL is greater than or equal to 45 dB.*

***5** Natural, mechanical or hybrid ventilation systems may be used to improve thermal comfort in summer at the expense of higher indoor ambient noise levels. The normal ventilation IANL can be exceeded during the hottest 200 hours in peak summertime conditions and the design should show that IANLs, defined in table 3 can be met under these conditions as well as under normal operation. The ventilation must be under the local control of the teacher so that the noise level can be reduced to normal levels when needed. This does not apply to classrooms intended specifically for students with special hearing and communication needs, or to speech therapy rooms.*

***6** The noise level from locally controlled intermittent boost mechanical ventilation may exceed the IANL by up to 5 dB*

2.2.3 British Standard BS4142: 2014, Methods for rating and assessing industrial and commercial sound.

This British Standard describes methods for rating and assessing sound of and industrial and/or commercial nature, which includes:

a) sound from industrial and manufacturing process; b) sound from fixed installations which comprise mechanical and electrical plant and equipment., c) sound from the loading and unloading of goods and materials at industrial and/or commercial premises; and d) sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes, such as that forklift trucks, or that from train or ship movements on or sound an industrial and/or commercial site.

The procedure contained in BS4142 for assessing the likelihood of complaints is to compare the measured or predicted noise level from the source in question, the 'specific noise level', at the assessment position with the background noise level.

Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background sound level. Where such features are present at the assessment location, addition of correction to the specific sound level to obtain the rating level is justify. This can be approached in three ways: a) subjective method; b) objective method for tonality; c) reference method..

The penalties of the subjective method are as follow:

The rating penalty for tonality is between 0 to 6 dB, for impulsivity a correction of up 9 dB can be applied. Where the specific sound features characteristics that are neither tonal nor impulsive, though otherwise are readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied. Finally, 3 dB penalties can be applied for Intermittency (specific sound has identifiable on/off conditions).

To assess the likelihood of complaints, the measured background noise level is subtracted from the rating noise level. BS4142 states:

'A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.. A difference of around + 5 dB could be an indication of a significant adverse impact, depending on the context. The lower the rating level is relative to the measured background sound level, the less likely it is that there will be an adverse impact.

2.2.4 Building Regulations Establishment Environmental Assessment Method – BREEAM 2014.

BREEAM Refurbishment 2014 Internal ambient noise levels - Hea 05 (Second credit)

The first Hea 05 credit does not apply to this report. The following must be achieved to attain the second credit.

Achieve the indoor ambient noise level standards set out within Section 2 of APS for all room types. For roofs with a mass per unit area less than 150kg/m2 (lightweight roofs) or any roofs with glazing or rooflights, calculations using laboratory data with 'heavy' rain noise excitation as defined in BS EN ISO 140-183 are required (in accordance with the guidance in APS) for teaching/learning spaces to demonstrate that the reverberant sound pressure level in these rooms are not more than 20 dB above the appropriate limits presented within Section 2 of APS, table 1.

Note. APS is superseded by BB93.

Pol 05 (One credit)

The Pol 05 requirements are as follows:

Where a noise impact assessment in compliance with BS 7445 has been carried out and the following noise levels measured/determined:

i. Existing background noise levels at the nearest or most exposed noise-sensitive development to the proposed development or at a location where background conditions can be argued to be similar.

ii. The rating noise level resulting from the new noise source

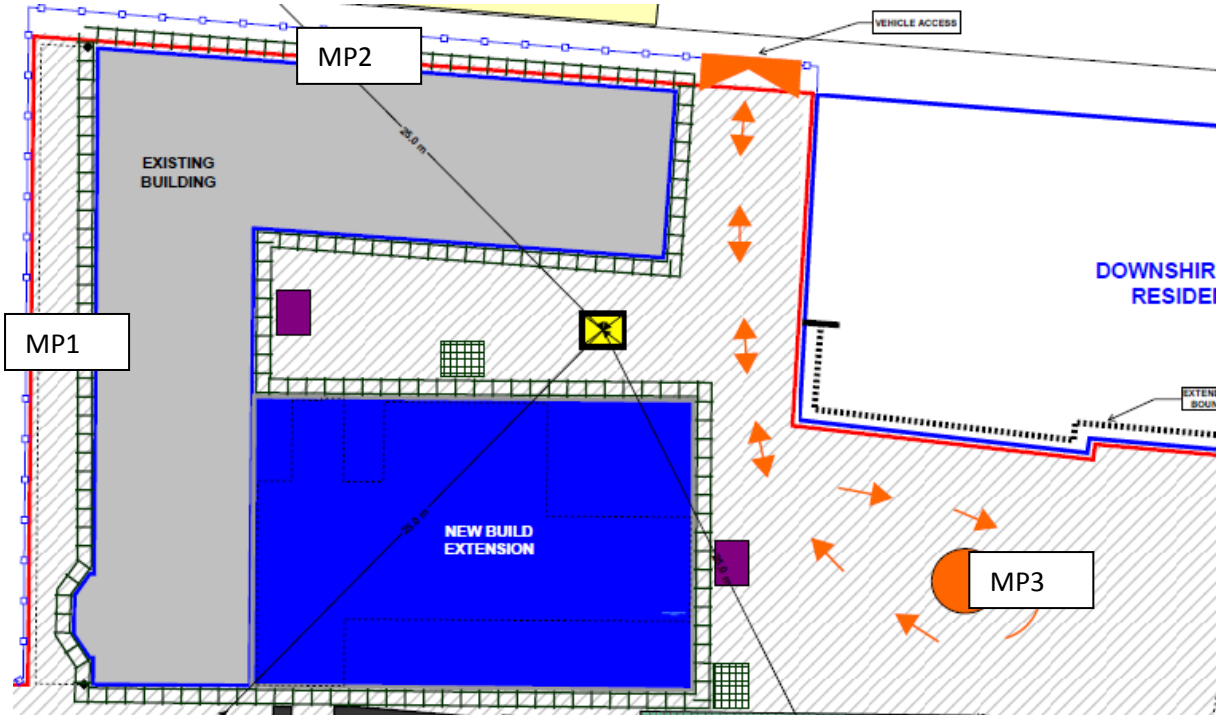
The noise level from the proposed site/building, as measured in the locality of the nearest or most exposed noise-sensitive development, is a difference no greater than +5dB during the day (07:00 to 23:00) and +3dB at night (23:00 to 07:00) compared to the background noise level.

BREEAM 2014 New Construction

BREEAM new construction Hea 05 and Pol 05 requirements are similar to BREEAM 2014 Refurbishment.

3. Noise Survey Details

The noise survey was carried out on site on Monday 16th and Tuesday 17th March 2015. Survey locations (MP1, MP2 and MP3) are indicated on the aerial image below.



The noise levels at the measurement positions MP1 and MP2 are representative of the existing noise climate affecting the proposed school, and measurement position MP3 is representative of the noise climate affecting the nearby nearest noise sensitive properties.

The microphone at position MP1 and MP2 was positioned 1 metre from the existing windows at first floor level. The microphone at MP3 was positioned 1.5 metres above ground level and 3.5 metres away from any reflective surface in accordance with the principles of BS 7445:1997 Parts 1-3, 'Description and Measurement of Environmental Noise',

The climatic conditions during the noise surveys were warm with light winds (< 2m/s).

All measurements were made with calibrated precision grade sound level meters (Svantek: Serial no 34931, 34938, and 34927) which achieve the requirements of BS EN 61672: 2003.

The sound level meters were calibrated before and after the measurement period using a Norsonic calibrator, no significant drift had occurred.

The tables below show the measured data.

Table 2 - Environmental Noise Data MP1			
ID MP	LAeq dB (Log average)	LA1 dB Average	LA90, $_{15\,min}$ dB Lowest measured
Day (07:00-18:00)	66	74	52
Evening (18:00-23:00)	64	72	47
Night (23:00-07:00)	62	73	40

Table 3 - Environmental Noise Data MP2			
ID MP	LAeq dB (Log average)	LA1 dB Average	LA90, $_{15\,min}$ dB Lowest measured
Day (07:00-18:00)	64	71	50
Evening (18:00-23:00)	61	68	45
Night (23:00-07:00)	58	67	39

Table 4 - Environmental Noise Data MP3			
ID MP	LAeq dB (Log average)	LA1 dB Average	LA90, $_{15\,min}$ dB Lowest measured
Day (07:00-18:00)	49	58	40
Evening (18:00-23:00)	48	57	34
Night (23:00-07:00)	47	52	31

Note. The above are 15 minute noise samples recorded during the daytime and night period including peak traffic flow from traffic.

4. Environmental Impact Assessment

4.1 Expected Internal Ambient Noise levels

An estimate of the internal noise level within the proposed School has been made based on a value of sound reduction for open windows (15dBA) which has been taken from BS8233:2014 Guidance on sound insulation and noise reduction for buildings

Internal noise levels during school hours have been calculated for rooms within the proposed school.

Table 5 - Internal Ambient Noise Levels with Open Windows. Rosslyn Hill Facade			
Time	External Noise Level (log average), $L_{Aeq,T}$ (dB)	Sound Insulation of Partially Open Window, dB(A)	Estimated Internal Noise Level, dB(A)
Day	66	15	51

Table 6 - Internal Ambient Noise Levels with Open Windows. Downshire Hill Facade			
Time	External Noise Level (log average), $L_{Aeq,T}$ (dB)	Sound Insulation of Partially Open Window, dB(A)	Estimated Internal Noise Level, dB(A)
Day	64	15	49

It can be seen that rooms located on Rosslyn Hill and Downshire Hill are not expected to comply with the IANLs given in Table 1 of BB93 when the room is natural ventilated via openable windows. Therefore, mechanical ventilation will be required in order to meet the IANLs within the Table 1 of BB93.

The minimum required sound reduction (Rw dB) for the proposed glazing is shown below.

63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
19	20	18	28	38	34	38

However, classrooms located to the North East of the proposed school: Reception classrooms, Main Hall, and Year 6, can be ventilated via openable windows.

4.2 Expected External Ambient Noise Levels

External noise levels in the Soft Play, External Learning, Sensory Garden, and Play are expected to be below LAeq of 50 dB, which is the lowest noise that produces an adverse health effect according to the WHO guidelines for community noise.

5. Noise from mechanical plant

Noise levels generated by mechanical plant and experienced by local receptors depends upon a number of variables, the most significant of which are:

- the noise generated by plant on site, generally expressed as sound power levels (SWL);
- the distance between the noise source and the receptor;
- the attenuation due to ground absorption, atmospheric and barrier effects; and
- the periods of operation of the plant on the site, known as its “on-time”.

It is possible that the proposal will include installations of ventilation and mechanical plant. However, at this stage, no information is available with regard to the fixed installations and mechanical plants that are to be installed as part of the proposed development.

Consequently, it is not possible to present an inclusive assessment of the noise effects of such plant. However, in order to ensure that background noise levels at the nearest noise sensitive receptors do not increase significantly as a result of the development, design noise limits for electrical and mechanical plant have been provided.

The noise limits have been based on achieving 10dB below the quietest background noise level recorded during the noise survey.

Table 7: Summary of the recommended Noise Rating Level dB

Period	Recommended Rating Noise Level $L_{Ar,\,T}$ (dB)
Day	30
Evening	24
Night	21

Note: A noise correction should be applied to the recommended rating noise levels, if the noise source has tonal, impulsive or intermittent content.

There are a number of measures that can be introduced to control noise from the mechanical and fixed plant installation associated with the proposed development. Consideration should be given to reducing noise at point of generation (e.g. by selecting quiet plant) or containment of noise generated (e.g. by insulating buildings which house machinery and/or providing purpose-built barriers around the site).

Generally measures should be proportionate and reasonable and may include practical engineering solutions, site layout and procedural matters. In general plant noise levels should be limited such that any noise impact would be negligible.

If fixed installations and mechanical plant were designed cumulatively to achieve the above mentioned noise limits, specific noise from plant would not lead to an increase in existing background noise level at the nearest proposed residential properties. Therefore, there is a positive indication that complaints are unlikely.

BREEAM (Pol 05) credit will be awarded if the noise from mechanical plant is compliant with the BS4142:2014 assessment.

6. Construction Noise

In order to evaluate the construction noise from the proposed school to the nearest noise sensitive receptors, the guidance outlined by BS5228: Code of practice for noise and vibration control on construction and open sites (part 1&2): 2009 is used.

This British Standard states a practical method of construction noise monitoring, which is the ABC sound levels categories. This suggests that the significance of construction noise impact should be limited by introducing thresholds which are considered appropriate through the consideration of the pre-existing ambient noise conditions in the area.

Annex E of BS5228 details the ABC Method which shows an example of the threshold of significant effect (SOAEL) at dwellings when the total noise level, rounded to the nearest decibel, exceeds the listed value. The table can be used as follows: for the appropriate period (night, evening/weekends or day), the ambient noise level is determined and rounded to the nearest 5 dB. This is then compared with the total noise level, including construction. If the total noise level exceeds the appropriate category value, then a significant effect is deemed to occur.

BS5228-1 Table E.1 Example threshold of significant effect at dwellings			
Assessment category and threshold value period (*L*Aeq)	**Threshold value, in decibels (dB)**		
	Category A [A)]	**Category B** [B)]	**Category C** [C)]
Night-time (23.00–07.00)	45	50	55
Evenings and weekends [D)]	55	60	65
Daytime (07.00–19.00) and Saturdays (07.00–13.00)	65	70	75
NOTE 1:	A significant effect has been deemed to occur if the total L_{Aeq} noise level, including construction, exceeds the threshold level for the Category appropriate to the ambient noise level.		
NOTE 2:	If the ambient noise level exceeds the threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a significant effect is deemed to occur if the total L_{Aeq} noise level for the period increases by more than 3 dB due to construction activity.		
NOTE 3:	Applied to residential receptors only.		
A)	Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.		
B)	Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values		
C)	Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values		
D)	19.00–23.00 weekdays, 13.00–23.00 Saturdays and 07.00–23.00 Sundays.		

Using the commentary for the ABC method which states that significant impact occurs beyond the above threshold values, the conclusion can be drawn that compliance with the above values is an indication that the SOAEL (Significant Observed Adverse Effect Level This is the level above which significant adverse effects on health and quality of life occur) has been avoided, which is in line with the aims of the NPSE (Noise Policy Statement for England).

In order to select an appropriate construction noise criterion (A, B or C) the period values above are averaged below:

Daytime	Evening	Night
49	48	47
Nearest 5dB = 50dB	**Nearest 5dB = 50dB**	**Nearest 5dB = 45dB**

Measured noise data on the site indicates that noise limits for construction noise should be set using category A from BS 5288:2009. This is discussed above.

Noise limits for construction work at dwellings	
Assessment category and threshold value period (L_{Aeq})	Period $L_{Aeq,T}$ Threshold values, in decibels (dB)
Night-time (23.00−07.00)	50 (Category B)
Evenings (19:00-23:00) and weekends	55 (Category A)
Daytime (07.00−19.00) and Saturdays (07.00−13.00)	65 (Category A)

Using the commentary for the ABC method which states that significant impact occurs beyond the above threshold values, the conclusion can be drawn that compliance with the above values is an indication that the SOAEL has been avoided, which is in line with the aims of the NPSE.

The standard also provides guidance on method of measuring vibration and assessing its effects on the environment. It provides guidance on human response to vibration and response limits of building to ground-borne vibration which are detailed in the page overleaf.

BS5228: 2009 (Part 2) Vibration Criteria

BS5228-2 Table B.1 Guidance on the effects of vibration levels	
0.14mm.s^{-1}	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies people are less sensitive to vibration.
0.3 mm.s^{-1}	Vibration might be just perceptible in residential environments
1.0 mm.s^{-1}	It is likely that vibration of this level in residential environments will cause complaints but can be tolerated if prior warning and explanation has been given to residents.
10.0 mm.s^{-1}	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

BS5228-2 Table B.2 Transient vibration guide values for cosmetic damage		
Type of building	Peak component particle velocity in frequency range of predominant pulse	
	4Hz to 15Hz	15Hz and above
Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	50mm/s at 4 Hz and above
Unreinforced or light framed structures Residential or light commercial buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

At the moment of writing this report no information is known about the type and number of machineries which will be operating on site, and therefore no conclusive assessment has been undertaken. Pace Consult can provide an assessment of the construction noise if this assessment will be required.

7. Conclusions

The effects and impact of noise relating to the proposed Abacus Belsize Primary School have been assessed. Throughout, the assessment has been undertaken with reference to BREEAM 2014, BB93, and BS4142:2014.

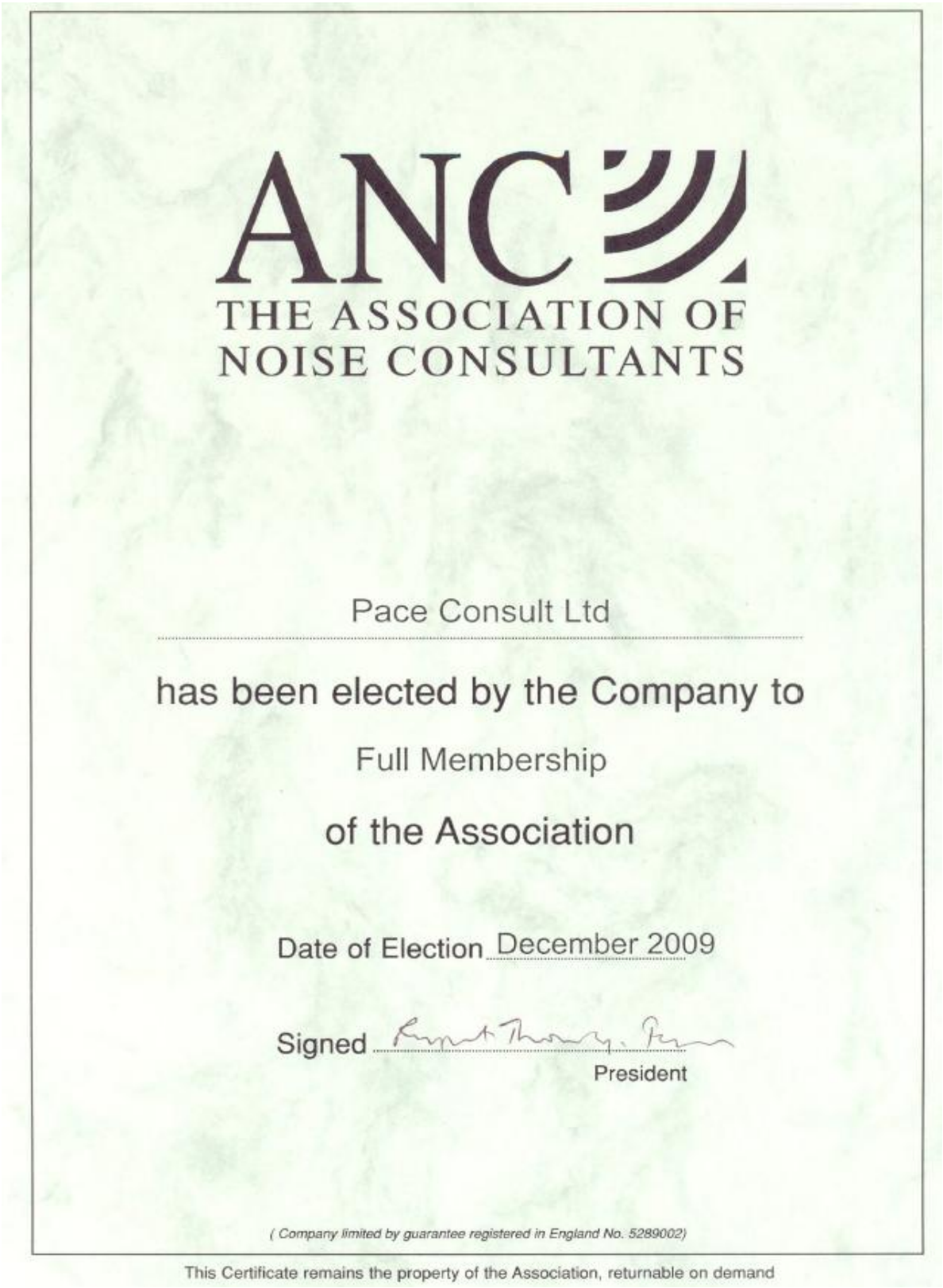
On the basis of the period average noise levels recorded at the proposed site, it is considered that mechanical ventilation will be needed for classrooms exposed to the highest sound levels (Downshire Hill and Rosslyn Hill), classroom located at the back of the proposed school can be natural ventilated.

Road traffic noise affecting the soft play, external learning, sensory garden, and Play area (Play deck) is below LAeq 50 dB, which is the lowest noise level that produces an adverse health effect according to the WHO guidelines for community noise.

To minimise the risk of noise nuisance to the proposed surrounding area plant noise target design levels have been recommended. These will aid the selection of appropriately quiet plant and where necessary enable the design of mitigation measures, such that the residents in the area should not be adversely affected.

Construction noise limiting criteria based on the methodology described in BS5228: 2009 has been proposed if this assessment will be needed.

Appendix 1 – ANC Accreditation



ANC

THE ASSOCIATION OF NOISE CONSULTANTS

Pace Consult Ltd

has been elected by the Company to

Full Membership

of the Association

Date of Election December 2009

Signed

President

(Company limited by guarantee registered in England No. 5289002)

This Certificate remains the property of the Association, returnable on demand