

ACOUSTIC SURVEY AND DESIGN SPECIFICATION

YSGOL-YR-HAFOD EXTENSION, JOHNSTOWN

REPORT REFERENCE NO. J003355-5027-RDC-01

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This report has been prepared based upon a scope of works and associated resources agreed between the client and Philip Dunbavin Acoustics Ltd (PDA). This report has been prepared with all reasonable skill, care and diligence and has been based upon the interpretation of data collected. This has been accepted in good faith as being accurate and valid at the time of the collection. This report has been based solely on the specific design assumptions and criteria stated herein.



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1.0 SUMMARY

The acoustic specification for the proposed extension to Ysgol-yr-Hafod Primary School, Johnstown is given in accordance with the current issue of Building Bulletin 93 (Feb 2015) "Acoustic design of schools: performance standards".

An ambient noise survey has been conducted to assess the acoustic climate in the vicinity of the proposed development. Noise levels at the proposed façade are such that the internal noise criteria of BB93 will likely be achievable using a natural ventilation strategy, and purge ventilation / summer overheating ventilation may be provided by fully opened windows.

Performance standards in accordance with BB93 are given for internal unoccupied noise levels, sound insulation between spaces and reverberation times within spaces. The achievement of these standards will also permit the credits of Hea 5 of BREEAM New Construction 2018 to be awarded.

Mechanical services noise limits are given in terms of internal noise levels in classrooms and also in terms of daytime noise levels for external plant at nearby noise sensitive properties during the daytime in order to achieve the requirements of BREEAM Pol 05. We have assumed that external plant will not operate during the night-time.

2.0 BRIEF FOR CONSULTANCY

PDA were engaged to carry out the following work:

A. Noise Survey

We will travel to the site and carry out an ambient environmental noise survey to determine the environmental noise levels incident on the school buildings. The measurement and assessment will include for noise from the adjacent road network, and other local noise sources.

We would propose to undertake manned measurements during periods representative of the normal school day.

We will carry out all noise surveys in accordance with the provisions of BS7445 "Description and Measurement of Environmental Noise". The measurements made will include both dBA and octave band noise levels including L_{eq} , L_1 , and L_{90} parameters.

B. Consulting – Design Specification

We will prepare a design specification indicating the required acoustic performance in terms of unoccupied internal ambient noise level, internal sound insulation and reverberation times for each new and remodelled space in accordance with the recommendations of Building Bulletin 93 - Acoustic Design of Schools.

The design specification will be presented in a short technical report.

3.0 STANDARDS

Requirement E4 of Schedule 1 to the Building Regulations 2010 states;

1. *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.*
2. *For the purposes of this Part – 'school' has the same meaning as in Section 4 of the Education Act 1996[4]; and 'school building' means any building forming a school or part of a school.*

Further to the above, the guidance contained within Section 0.12 of Approved Document E 2010 states;

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 indoor ambient noise which are given in Building Bulletin 93 Acoustic Design of Schools: performance standards, published by the Department for Education and available on the internet at www.gov.uk.

From the above statements it can be seen that compliance with the performance standards of Building Bulletin 93 (BB93) also ensures compliance with the acoustic requirements of the Building Regulations.

3.1 BB93 Acoustic Design of Schools: performance standards (February 2015)

A revised and updated version of BB93 was published in 2014 with the latest revision published in February 2015. BB93 gives standards for unoccupied ambient noise levels, sound insulation between spaces, and reverberation time for schools.

3.1.1 Indoor ambient noise level in unoccupied spaces

BB93 specifies the indoor ambient noise levels in unoccupied teaching spaces in terms of $L_{Aeq,30min}$ which is the 30-minute energy averaged sound pressure level within the unoccupied classroom. The limit applies to noise break-in from ambient noise external to the school and also noise from internal building services, but does not apply to noise generated by the operation of the school itself (i.e. noise from equipment, pupils and staff within or external to the building). A separate standard is given for new-build and refurbished rooms to permit existing rooms to be re-used where practicable without major refurbishment.

Table 1. BB93 specified unoccupied ambient noise levels

Room Type	Upper limit for indoor ambient noise level
	$L_{Aeq,30min}$ [dB]
Nursery School Rooms	35
Primary School Classrooms / Small Group Room	35
Multi-purpose hall (drama, PE, audio/visual presentations, assembly, occasional music)	35
Staff room / Interview Room / Study Room (teacher preparation)	40
Toilets	50

The above noise levels are inclusive of any normal internal mechanical services and must be achieved where a space is mechanically ventilated. In the case where ventilation is provided by a natural or hybrid (natural with mechanical assistance) system, the above noise levels may be increased by 5dB during 'normal' ventilation rates of typically 5l/s/person (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).

For summer cooling or purge / boost ventilation provided by natural means, which is under the control of the teacher, noise levels may be increased to no more than 55 dB. For fully mechanical systems boost or summer cooling must not exceed the values of Table 1 by more than 5 dB.

Automatic actuators for windows and vents etc. should not exceed the values of Table 1 by more than 5 dB to avoid causing disturbance.

3.1.2 Rain noise

BB93 states that lightweight roofs and roof glazing should be designed that calculated noise levels for 'Heavy' rain excitation as defined in BS EN ISO 140-18 should not exceed the values of Table 1 by more than 25 dB.

3.1.3 Airborne Sound insulation between spaces

BB93 specifies the airborne internal sound insulation in terms of $D_{nT,w}$ which is a weighted standardised noise level difference between rooms measured on site. The specified parameter therefore includes both the performance of the separating element and the flanking constructions and is also dependent on correct detailing and quality control on-site. The required sound insulation to BB93 is reproduced in the table below.

Table 2. BB93 specified sound insulation between adjacent rooms

Room Type	Adjacent Area	Airborne Sound Insulation of Party Walls / floors $D_{nT,w}$ [dB]
Nursery / Reception / Primary Classroom	Toilets / Staff Dis WC	45
Nursery / Reception	Nursery (Early Entitlement)	45
Primary Classroom	Staff Room	45

3.1.4 Corridor walls and doors

The sound insulation of corridor walls and doors is specified in BB93 in terms of laboratory R_w values. The specification for primary school classroom corridor walls (without a ventilator in the wall) is that the minimum composite sound insulation of the wall, including any glazing, should meet R_w 40 dB, and the sound insulation of the door-sets should achieve R_w 30 dB.

For the proposed hall extension, any new door-sets leading into the hall should achieve a sound insulation of R_w 35 dB.

Where a corridor wall includes vents, the minimum composite sound insulation of the wall, including any glazing and vents, should meet R_w 33 dB for primary school classroom corridors and 35 dB for the (refurbished) multi-purpose hall corridors.

Unless essential we would recommend that the installation of vents connecting the classrooms and hall to the corridors is avoided.

3.1.5 Reverberation times

BB93 gives the following maximum values of reverberation time for internal spaces relevant to this development;

Table 3. BB93 specified reverberation times for teaching spaces

Room	BB93 specified reverberation times T_{mf} (seconds)
New build nursery School Rooms / Primary School Classrooms / Group rooms	≤ 0.6
Refurbished Primary School Classrooms	≤ 0.8
Multi-purpose hall (refurbishment) ¹	0.8 – 1.5
Library (refurbishment)	≤ 1.0
Interview Room	≤ 0.8
Offices	≤ 1.0
Kitchens (new / refurbished)	$\leq 1.5 / \leq 2.0$
Toilets (new / refurbished)	$\leq 1.5 / \leq 2.0$

Notes:

1. As the reverberation time of the extended hall will be dependent on the construction and finishes of both the new extended portion and the existing hall, the appropriate reverberation target in this case is that for a refurbished hall.

3.1.6 Sound absorption in corridors and circulation spaces

BB93 refers to the method described in Approved Document E of the current Building Regulations for the specification of absorption in corridors and circulation spaces.

Sound absorption in ancillary spaces and circulation areas helps to reduce reverberation time in these areas and hence reduces sound transmission from room to room via connecting circulation spaces. Sound absorption in circulation spaces also helps to reduce noise levels due to people in circulation.

BB93 uses the criteria of Approved Document E of the Building Regulations to specify the absorption required in circulation spaces. This basically requires absorption requirements to be addressed using one of two methods A) or B) below;

- A) For entrance halls, corridors or hallways, cover an area equal to or greater than the floor area, with a Class C absorber or better.
- B) For entrance halls provide a minimum of 0.20 m² total absorption area per cubic metre of the volume.

For corridors or hallways, provide a minimum of 0.25 m² total absorption area per cubic metre of the volume.

We would recommend that Method A) is employed by using a Class C acoustically absorbent ceiling tile to the whole of the circulation space ceilings.

3.2 BREEAM UK New Construction 2018

We understand that the school is to be assessed in accordance with the BREEAM UK New Construction scheme and that the acoustic credits of Hea 05 and Pol 05 are targeted.

Hea 05 essentially requires the school to be designed and tested to be compliant with the requirements of BB93, described in the sections above.

Pol 05 requires the noise due to any external plant and equipment to be assessed in accordance with the methods of BS 4142:2014 such that the Rating Level from external plant and equipment is at least 5dB below the typical pre-existing Background Level (L_{A90}) during the daytime and the night time. The typical pre-existing Background Level was measured as 45 dB(A) and hence plant will need to be limited to a Rating Level of no more than 40 dB(A) at the nearest residences during the daytime when assessed in accordance with BS 4142:2014.

In order to achieve the BREEAM credits the acoustic criteria should be specified and the finished building should be tested by a Suitably Qualified Acoustician. BREEAM defines a Suitably Qualified Acoustician as:

- 1. Has a minimum of three years relevant experience (within the last five years). Such experience must clearly demonstrate a practical understanding of factors affecting acoustics in relation to construction and the built environment; including, acting in an advisory capacity to provide recommendations for suitable acoustic performance levels and mitigation measures.*
- 2. An individual who holds a recognised acoustic qualification and membership of an appropriate professional body. The primary professional body for acoustics in the UK is the Institute of Acoustics.*

4.0 SUITABLY QUALIFIED ACOUSTICIAN

This assessment has been carried out by Dr Richard Cookson of PDA Ltd who has worked as a professional acoustic consultant primarily in building and environmental acoustics for the last 10+ years and is a full corporate member of the Institute of Acoustics. This meets the requirements of the BREEAM scheme for a Suitably Qualified Acoustician (SQA).

5.0 AMBIENT NOISE SURVEY

5.1 Site Description

The proposal is to construct a new build extension to the existing school consisting of an extension to the existing hall, two new classrooms and a new reception / nursery classroom with associated toilets and stores and a new entrance staff room and offices. Some of the existing classrooms are also proposed to be remodelled. The area immediately surrounding the site is largely residential with the exception of a commercial / industrial unit to the rear of the school which is currently disused.

5.2 Survey Times and Personnel

The survey was conducted on the 15th June 2021 between 12:00 and 16:00 hours. All measurements were made and partially attended by Dr Richard Cookson PhD, BSc(Hons), MIOA of PDA Ltd.

5.3 Equipment

The survey was conducted with an NTi XL2 sound level meter. The XL2 sound level meter is a Class 1 accuracy sound level meter in accordance with IEC 61672-1:2002 capable of operating as an integrating sound level meter with frequency analysis and statistical functions.

The sound level meter was set to measure both 'A' weighted sound pressure levels and octave band frequency spectra, using a 'fast' time weighting. Measurements were taken at a single measurement position at the location of the proposed façade of the new extension to the rear of the existing school. The microphone was of the 'free field' type. The meter was field calibrated before and after the survey, during which time no significant calibration drift was observed.

5.4 Weather

During the course of the survey the weather was clear. The temperature was 17 – 23 ° C. Wind speeds varied between 1 and 3 m /s.

5.5 Measurement Positions & Procedure

Measurements were made at a single measurement position in line with the proposed façade at the closest position to Raubon Road.

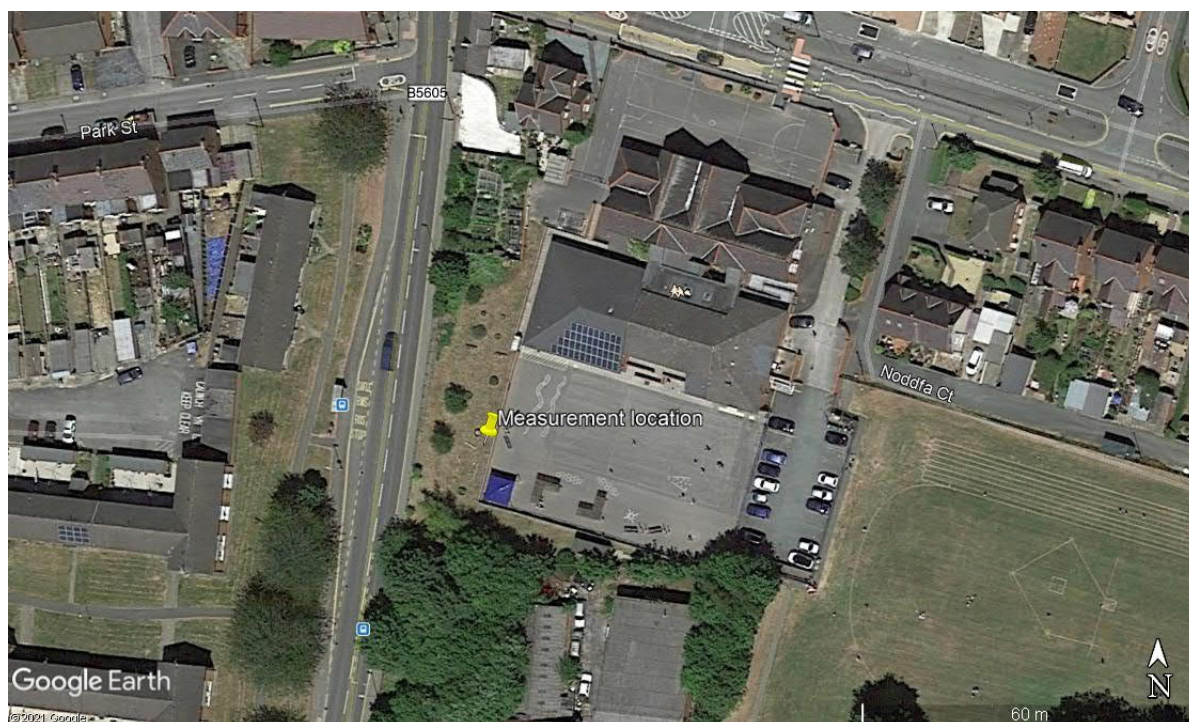


Figure 1. Survey measurement location

The microphone was mounted 1.5m above ground and at least 3.5m from any other reflecting surface. A range of statistical noise indicators were measured, including octave band L_{Aeq} , L_{A90} and L_{A1} .

Definitions of the above terms are listed below:

- L_{Aeq} : The equivalent A-weighted noise level containing the same energy within the measured time period.
- L_{A90} : This is a statistical parameter that is equivalent to the noise level that is exceeded 90% of the measurement period.
- L_{A1} : This is a statistical parameter that is equivalent to the noise level that is exceeded 1% of the measurement period.

5.6 Results

The measured 'A' weighted broadband sound pressure levels are presented in terms of L_{Aeq} , L_{A90} and L_{A1} below. The levels presented in the Table have been rounded to the nearest decibel. Full data is presented at the end of this report.

Table 4 – Summary of Results

Maximum $L_{Aeq,30min}$ [dB]	L_{A90} [dB]	L_{A1} [dB]
52	43 - 45	57 - 59

5.7 Discussion of external noise levels

BB93 states that for single sided natural ventilation the internal criteria can normally be achieved where the external noise levels do not exceed the internal noise criterion by more than 16 dB, and for cross ventilated or roof ventilated buildings the internal criteria can normally be achieved where the external noise levels do not exceed the internal noise criterion by more than 20dB.

In this case, for natural ventilation, the internal noise criterion in the most sensitive classrooms and hall is 40 dB(A) [35 dB(A) + 5]. This suggests that the internal criterion will be achievable using single sided natural ventilation as the external noise level is not greater than 56 dB(A) [40 dB(A) + 16].

With regards to L_{A1} BB93 states that: “In order to protect students from regular discrete noise events, e.g. aircraft or trains, indoor ambient noise levels should not exceed 60 dB $L_{A1, 30mins}$ ”. It can be seen that as external L_{A1} levels do not exceed 60dB this criteria will also be achieved within the proposed development.

6.0 MECHANICAL SERVICES NOISE

Noise levels from any mechanical services in classrooms should not exceed the unoccupied ambient noise criteria of BB93 [35 dB(A) in classrooms]. For intermittent boost or summertime cooling ventilation under the control of the teacher, mechanical services noise may increase by 5 dB [40 dB(A) in classrooms] for the duration of the boost operation.

We note that the BREEAM Pol 05 credit is targeted and in order to achieve this credit external mechanical services noise should be at least 5dB below the pre-existing background noise level (L_{A90}) at nearby noise sensitive residences when assessed in accordance with BS 4142:2014. The typical pre-existing Background Sound Level measured during the daytime was 45 dB L_{A90} . If new mechanical services plant are proposed to operate during the night-time (23:00 – 07:00 hours) an additional night-time ambient noise survey will be required and a more stringent plant noise limit is likely to be required during the night-time.

7.0 DISCUSSION

The results of the environmental noise survey indicate that the site is suitable for natural ventilation and that internal noise criteria are likely to be met using this ventilation strategy. Further to this fully open windows for summer cooling or purge ventilation under control of the teacher will not exceed the internal noise criteria of BB93.

Sound insulation between all of the new build spaces is required to meet 45 dB $D_{nT,w}$ between classrooms. There are no currently proposed adjacencies which would require a higher sound insulation than the standard requirement between primary school classrooms (assuming no high sound level equipment is proposed for the plant room[s]). Classroom doors should be rated with a sound insulation of 30 dB R_w and new doors to the multi-purpose hall should be rated with a sound insulation of 35 dB R_w .

Required reverberation times are as indicated in Table 3. These will likely require fully absorbent ceiling treatments and carpets to new-build classrooms. For the hall a fully absorbent ceiling will be required and it is likely that some wall absorption will be required also.

The existing classrooms were fitted with absorbent ceiling tiles and reverberation times were measured within those rooms proposed to be remodelled. All of the rooms measured met the reverberation time criteria for refurbishment in their existing condition hence we would recommend that any replacement room finishes in these spaces had similar acoustic absorption properties to the finishes they replace.

The proposed ‘Studio’ is not a defined room type within BB93. It is not clear what this room is to be used for and this should be clarified so that an appropriate set of acoustic performance criteria can be assigned.

We note that an operable wall is proposed between the hall and the studio. A high performing operable wall with careful installation will be required and is not likely to achieve the sound insulation specified in BB93 between adjacent classrooms. This may result in activities in one of the spaces disturbing those in the other if activities are not carefully timetabled. With respect to this situation BB93 states:

Where there is an operable wall or folding partition between a teaching area and a hall, the $D_{nT,w}$ between the spaces should be at least 40 dB. The end user should be made aware that the sound insulation performance of the operable wall may not facilitate simultaneous independent use of the spaces on either side.

As such, the client should be made aware of this limitation.

With respect to the kitchen servery / table store and hatch, it is recommended that the table store can be closed off such that there are at least two shutters between the kitchen and the hall when not in use as a dining hall, otherwise noise from the kitchen can cause disturbance within the hall. BB93 states:

Serving hatches between kitchens and multi-purpose halls used for dining should be avoided where practicable, and serveries placed between kitchens and dining areas wherever possible to avoid noise transfer during meal preparation. Where this is not possible, serving hatches should be designed to have as high a level of sound insulation as practicable (not less than 18 dB R_w) and, if necessary, use of the dining hall space timetabled so that noise sensitive activities, eg exams, do not take place in the hall when the kitchen is in use. Where the space is used solely for dining purposes, a sound insulated serving hatch between kitchen and dining space is not necessary.

We note that in this case, the extension to the hall is indicated with doors to the chair store servery as recommended, however the performance may be limited by any existing opening. An 18 dB R_w serving hatch is also recommended if this falls within the scope of the extension / refurbishment.

8.0 CONCLUSION

The acoustic specification for the proposed extension to Ysgol-yr-Hafod Primary School, Johnstown is given in accordance with the current issue of Building Bulletin 93 (Feb 2015) "Acoustic design of schools: performance standards".

An ambient noise survey has been conducted to assess the acoustic climate in the vicinity of the proposed development. Noise levels at the proposed façade are such that the internal noise criteria of BB93 will likely be achievable using a natural ventilation strategy and purge ventilation / summer overheating ventilation may be provided by fully opened windows.

Performance standards in accordance with BB93 are given for internal unoccupied noise levels, sound insulation between spaces and reverberation times within spaces. The achievement of these standards will also permit the credits of Hea 5 of BREEAM New Construction 2018 to be awarded.

Mechanical services noise limits are given in terms of internal noise levels in classrooms and also in terms of daytime noise levels for external plant at nearby noise sensitive properties during the daytime in order to achieve the requirements of BREEAM Pol 05. We have assumed that external plant will not operate during the night-time.



APPENDIX A – FULL SURVEY RESULTS

Date	Time	L _{Aeq}	L _{A1}	L _{A90}	Notes
15/06/2021	12:07:38	63.2	74.1	48.4	Not used. Affected by children in playground
15/06/2021	12:37:38	69.6	79.7	51.7	Not used. Affected by children in playground
15/06/2021	13:07:38	51.5	58.8	43.1	
15/06/2021	13:37:38	50.5	57.1	44.9	
15/06/2021	14:07:38	57.3	66.9	49.2	Not used. Affected by children in playground
15/06/2021	14:37:38	55.7	65.3	47.4	Not used. Affected by children in playground
15/06/2021	15:07:38	53.5	63.1	44.6	Not used. Affected by children in playground
15/06/2021	15:37:38	51.3	59	44.9	
15/06/2021	16:07:38	51.1	57.9	43.7	

APPENDIX B – DEFINITION OF ACOUSTIC TERMS

The decibel

This is the basic unit of noise, denoted dB.

A Weighting

This is a weighting process which simulates the human ear's different sensitivity at different frequencies. A weighting can be shown two typical ways, 50 dB(A) L_{eq} or 50 dB L_{Aeq} . Both mean the same thing. (See below for a definition of L_{eq}). The dB(A) level can be regarded as the overall level perceived by human beings.

L_{eq} and $L_{eq(s)}$

This is the equivalent continuous noise level which contains the same acoustic energy as the actual time-varying sound. In other words it is a kind of average noise level. It is denoted dB L_{eq} or, for A-weighted figures dB(A) L_{eq} or dB L_{Aeq} . It can also be expressed in terms of frequency analysis (see later). $L_{eq(s)}$ is the sample L_{eq} level.

L_n

This is the level exceeded for n% of the time. It is denoted dB L_n or, for A-weighted figures dB(A) L_n or dB L_{An} . It can be expressed in terms of frequency analysis (see later). L_{90} is the level exceeded for 90% of the time and is a measure of the lowest level typically reached. L_{10} is the level exceeded for 10% of the time and is the highest level typically reached. L_{50} is the level exceeded for 50% of the time and, mathematically, it is the median.

L_{max}

This is the maximum level reached during a measurement period. The "time constant", or the ability of the equipment to respond to impulses is usually expressed along with it, e.g. "Fast", "Slow", etc. It is denoted dB L_{max} or, for A-weighted figures dB(A) L_{max} , dB L_{Amax} , etc. It can also be expressed in terms of frequency analysis.

Frequency Analysis

Whereas dB(A) gives a very useful overall figure, it has its limitations in that it cannot be used to model or predict the effect of noise control and mitigation as this nearly always has radically different performance at different frequencies.

Frequency analysis expresses an overall noise level at each frequency or band of frequencies in the audible range. Octave band analysis divides the audible range into 10 bands from 31.5 Hz to 16 kHz and the noise level in each band can be expressed in any form e.g. L_{eq} , L_{90} , L_{max} etc. One third octave band analysis uses 30 bands.

Narrow band analysis takes the process to resolutions of less than 1 Hz. This is useful for identifying the existence of tones (whines, hums, etc.) and in pin-pointing the sources.