

July 2021

Coleg Cambria, Wrexham, Phase 2

Background Noise survey and External Envelope

Prepared for :-

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1.0 **SUMMARY**

ADC was asked to carry out an independent assessment of the above site for a proposed new phase to the existing college campus.

A survey of the current level of external noise was conducted.

The main source of noise was from road traffic on the A5152, accelerating to and from the round-a-bout.

Calculations have been performed using the measured survey data.

Specifications for suitable glazing performance and external wall build-up have been proposed to ensure that the expected levels of ambient noise within teaching areas comply with the requirements of BB93.



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2.0 INTRODUCTION

ADC was asked to carry out an independent assessment of the above site for a proposed new phase to the existing college campus.

This report begins by summarising assessment standards and, where appropriate, discusses alternative interpretations.

After a brief statement of survey details we discuss basic results and the resulting assessment, along with any mitigation which might be implied. We sum-up and conclude at the end, along with brief recommendations.

3.0 ASSESSMENT STANDARDS

3.1 NPPF, NPSE and NPPG

The National Planning Policy Framework (NPPF), the Noise Policy Statement for England (NPSE) and the National Planning Practice Guidance (NPPG) provide nothing in the way of quantitative criteria but instead provide general policy aims and statements and some guidance on how certain situation can be interpreted.

The NPPF's main statement on noise is to be found in paragraph 180:-

- 180 Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:
- a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life^(footnote here refers to NPSE – see below);
 - b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and
 - c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation.

Paragraph 182 is also relevant:-

- 182 Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed.

The NPPF refers to the NPSE which sets out the following aims:-

1. avoid significant adverse impacts on health and quality of life;
2. mitigate and minimise adverse impacts on health and quality of life; and
3. where possible, contribute to the improvement of health and quality of life.

It also introduces the concepts of:

- NOEL – No Observed Effect Level. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.
- LOAEL – Lowest Observed Adverse Effect Level. This is the level above which adverse effects on health and quality of life can be detected.
- SOAEL – Significant Observed Adverse Effect Level. This is the level above which significant adverse effects on health and quality of life occur.

SOAEL is clearly something the policy seeks to avoid in aim 1. Aim 2 represents situations between SOAEL and LOAEL, and seeks to minimise and mitigate the effects.

The NPPG section on noise adds some further detail, much of it reproducing the NPPF and NPSE, but some useful qualitative guidance is provided in a table as reproduced below.

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
		Lowest Observed Adverse Effect Level	
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
		Significant Observed Adverse Effect Level	

Perception	Examples of Outcomes	Increasing Effect Level	Action
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

It also makes the point that the subjective nature of noise means that there is not a simple relationship between noise levels and the impact on those affected. This will depend on how various factors combine in any particular situation, including the level of the noise in absolute terms and how it might compare with the underlying background noise, the impulsiveness or intermittence pattern of the noise, its spectral content, and the time of day. It discusses in very general terms the issues to consider when introducing noise sources to existing noise sensitive area, new residential development in areas affected by existing noise sources (most of which have their own specific guidance, such as BS 4142, BS 8233, BB93 etc.) and the potential impact on wildlife.

3.2 BB93:- Acoustic Design for Schools

BB 93 was updated in December 2014. Quantitatively, however, the design criteria are little changed – just expressed differently to reduce ambiguity in certain situations.

BB93 states the following requirements for internal ambient noise levels:

Table 1: noise activity and sensitivity levels and upper limits for indoor ambient noise level

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	Refurbishment
Nursery school rooms <i>Primary school:</i> classroom, class base, general teaching area, small group room <i>Secondary school:</i> classroom, general teaching area, seminar room, tutorial room, language laboratory	Average	Medium	35	40

4.0 **GUIDE TO MODELLING**

Full details of calculations are given in Appendix 2. The basic approach is as follows.

1. The external noise break-in is based on the level of external noise just outside the façade(s), the area of the façade(s), the sound insulation properties of the façade(s) and the internal absorption of the room.
2. Measurements were made within to the worst affected façade so, at face value, the measured levels should be reasonably representative of the proposed internal levels. However, we need to find a way of incorporating changes, such as glazing, vents, carpeting, etc.
3. The first input to the calculation process is the area of the exposed façade. Where more than one façade is exposed, then they can all be entered. The room depth is also entered so as to derive the room volume. Where the room is not a straight forward rectangular shape, an “effective depth” is sometimes entered so as to derive the approximate room volume. Judgement may occasionally be used if the room is not simple, such as a very unusual shape or a multi-use room such as a through-kitchen/dining room/living room, or studio-style area.
4. The reverberation time (RT) is entered. Usually this is a standardised 0.8 seconds for a completed and fitted out classroom and represents the absorption properties of the room. For an undeveloped site it is longer due to the absence of carpets and furnishings.
5. Two corrections result from the above inputs. Firstly, we have the Area Correction. Put simply, the greater the exposed area, the more

noise will break in. The correction is $10 \times \log(\text{Effective Area})$ and is usually a positive number. Note that the “Effective Area” takes account of the method of modelling vents – see later. The Room Correction takes account of the room absorption (more absorption reduces the noise) and the room volume (a larger volume disperses, and so reduces, the noise). The correction is $10 \times \log(RT/0.163/\text{Volume})$ and is usually a negative number.

6. These corrections, together with the sound insulation properties of the façade(s) give us the basic outside-to-inside level difference. The sound insulation properties of the façade(s), known as the Sound Reduction Index (SRI or just R) are effectively the sound insulation of 1m^2 of material (apart from vents – see later). Of course, a façade is usually made up of more than one element – windows and walls for instance. The overall SRI or R is referred to as the Composite SRI or composite R and is related to the SRI or R of the individual elements and their respective areas. SRI or R figures are usually based on laboratory tests and therefore somewhat idealised.
7. An additional complication is that performance data for vents is generally standardised to 10m^2 . The area of a vent is therefore usually entered as 10m^2 , even though its actual area will usually be nowhere near that much.
8. So, the composite SRI or R, combined with the areas and room corrections gives us the basic level difference to be expected under perfect (laboratory) conditions. However, actual site conditions are affected by workmanship, which can never be guaranteed to be perfect, and flanking paths (noise paths other than straight through the façade(s)). Here, however, the measured internal noise includes these and so a correction is not usually required.
9. The calculated level difference for the existing rooms is set against the actual measured levels when looking at the proposed rooms so that any changes (glazing, vents, absorption (fit-out), etc.) can be taken into account and used to calculate the proposed internal levels.
10. The process is repeated in octave bands across the frequency range to derive the predicted internal levels.

5.0 SURVEY DETAILS

5.1 Site Times and Personnel

The measurements were carried out by Mark Pickering of ADC Acoustics.

Measurements were carried out on 08/07/2021 during typical school teaching hours.

5.2 Instrumentation

Instrumentation used was a Rion NL-52 sound level meter. This is a Class I sound level meter which holds a current calibration certificate, and which was field calibrated before as necessary with no drift noted. The meter was set up to measure continuous 5-minute samples in terms of dB L_{eq} , dB L_{max} and dB L_{90} in overall A-weighted terms, and in octave bands across the frequency range. See Definition of Acoustic Terms in Appendix 1.

5.3 Measurement Positions

The main measurement positions were as shown on the following plan.



The microphone was 1.5 m above ground.

5.4 Survey Conditions

We have no reason to believe that the conditions we found on the survey were anything other than representative of normal conditions. As the measurements were internal, the weather was not crucial but, for the record, there was no rain and roads were dry, and there was negligible wind:

Weather at measurement position, not forecast. Include day/night	Rain, state of roads	Roads Dry
	Wind Speed and direction	0.4m/s
	% cloud cover	25%
	Temperature	19

6.0 RESULTS AND DISCUSSIONS

The main source of noise was from road traffic on the A5152, accelerating to and from the round-a-bout.

6.1 Basic Results

Results are best presented in a summary table as follows:-

Index	dB(A)	63	125	250	500	1k	2k	4k	8k
Average	60	70	61	59	55	57	51	46	38

6.2 Assessments

The above results give the following assessments, based upon a glazing build up to all teaching areas overlooking the A5152.

In terms of BB93, we are mainly concerned with the dB(A) L_{eq} values, or the dB L_{Aeq} levels. See definition of Acoustic terms in Appendix 1

6.3 Required Glazing Performance

The measured levels appear to suggest that glazing specification will need to be designed to reduce external noise break-in as follows:

125	250	500	1K	2K
26	27	34	40	38

This is typically achieved with a 10mm outer pane, 12mm air gap, 6.4mm laminate glazing unit.

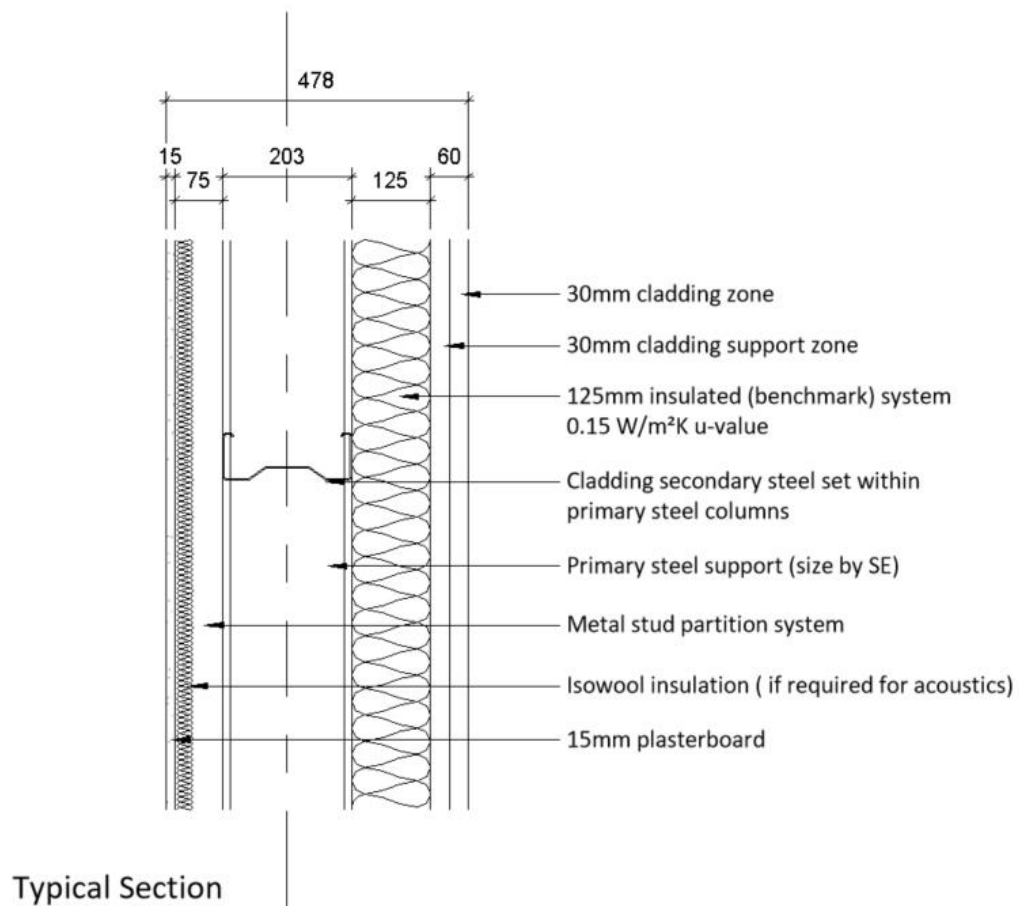
Calculations have been performed and predicted internal classroom noise levels are within the targets set by BB93.

Note that the table provides the acoustic specifications (such as R_w for windows) to meet appropriate criteria. The glazing build-ups and vent models which are also shown are examples and many other options achieving the same acoustic performance are available.

Of course, these assessments are very robust as they use what should be the worst affected rooms. They also leave a small margin for rooms at lower levels where the external noise may be a little higher.

6.4 Proposed External Wall Build-up

The proposed façade build up is proposed :-



6.5 Ventilation

The levels suggested that that windows would need to remain shut on the facades overlooking the main roads to achieve all BB93 criteria.

In order to assume that windows are shut, ventilation will need to be provided which gives occupants the realistic option of doing so. To the façades overlooking the A5152, this is assumed be a full mechanical system.

Note that the table provides the acoustic specifications (such as R_w for windows) to meet appropriate criteria. The glazing build-ups and vent models which are also shown are examples and many other options achieving the same acoustic performance are available. For instance, the existing glazing can be fitted with secondary panes internally, or replaced with a double-glazed unit with the same performance.

Of course, these assessments are very robust as they use what should be the worst affected rooms. They also leave a small margin for rooms at lower levels where the external noise may be a little higher.

7.0 **CONCLUSIONS**

Calculations have been performed using the measured survey data.

Specifications for suitable glazing performance and external wall build up have been proposed to ensure that the expected levels of ambient noise within teaching areas comply with the requirements of BB93.

Appendix 1

Definition of Acoustic Terms

The Decibel

The decibel is the basic unit of noise measurement and is denoted dB. Technically, it is a means of expressing the difference in noise level between the measured noise and a standard level of noise. Most often the threshold of human hearing is used as the standard reference but it really should be stated. The threshold of human hearing is a sound pressure of $20\mu\text{Pa}$ or a sound power of 1pW .

A sound pressure level or SPL should be expressed in dB(re. $20\mu\text{Pa}$). A sound power level or SWL should be expressed in dB(re. 1pW). If the reference levels are omitted, it will often (but not always) be safe to assume that they are referenced to the threshold of human hearing.

A-Weighting and dB(A)

The human hearing system responds differently to different frequencies. The A-weighting system takes account of this by emphasising mid and high frequencies more than low frequencies to given an overall level. An A-Weighted noise level, therefore, reflects the way normal, healthy hearing would perceive the overall level of the noise. The basic unit is dB(A), although other systems of expressing an A-weighted level are discussed below.

Other weighting systems, such as C-Weighting, denoted dB(C), reflect the human hearing system's response at higher noise levels.

Equivalent Continuous Sound Level, L_{eq}

This is a kind of mean noise level.

The unit is dB L_{eq} . For A-weighted levels the unit is dB(A) L_{eq} or, in more modern units, dB L_{Aeq} . The Noise at Work Regulations use $L_{eq(s)}$ which refers to a sample level.

Maximum Level, L_{max}

This is the maximum level reached (usually for a fraction of a second) in the measurement period.

The unit is dB L_{max} . For A-weighted levels the unit is dB(A) L_{max} or, in more modern units, dB L_{Amax} .

Statistical (Percentile) Levels, L_n

During a measurement of fluctuating noise, it is often useful to establish the levels exceeded for a percentage of the time. L_n is the index representing the level exceeded for $n\%$ of the measurement period.

The unit is dB L_n . For A-weighted levels, the unit is dB(A) L_n or, in more modern units, dB L_{An} .

Common examples are as follows :-

dB L_{A90} is the A-weighted level exceeded for 90% of the time and is often used to describe the underlying background noise.

dB L_{A50} is the A-weighted level exceeded for 50% of the time. Mathematically, it is the median, another kind of average.

dB L_{A10} is the A-weighted level exceeded for 10% of the time and has traditionally been used to describe the intermittent highs in the noise climate such as passing cars or aircraft.

Frequency Analysis

Here the audible frequency range is divided up into bands and the noise level is expressed in each frequency band from low pitches to high pitches.

Octave Band analysis is where the frequency range is divided into 8 bands from 63 Hz to 8kHz, or sometimes into 10 bands from 31.5 Hz to 16kHz.

1/3 Octave Band analysis provides more detailed subdivision into 24 bands from 50 Hz to 10kHz, or sometimes into 30 bands from 20Hz to 20kHz.

Narrow Band analysis takes this further with the possibility of many thousands of bands, possibly only 1Hz wide, or even less.

In all types of frequency analysis, the level in each band can be expressed in terms of L_{eq} , L_{max} , L_n , etc. as defined above.

