Acoustic Report

Cambridge Regional College - The Hive
Noise Assessment
June 2010

Halcrow Group Limited

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1 Introduction

Cambridge Regional College has outgrown its current campus facilities. As part of a strategy to expand, the College proposes to build a new campus called 'The Hive' which is dedicated to innovative building technologies, ethical business practice and sustainability.

The new campus will be situated adjacent to the current Kings Hedges Campus. The new site lies close to the A14, to the north of Cambridge City centre, and adjacent to Kings Hedges Road.

Halcrow has been commissioned to undertake a noise assessment at 'The Hive' site in order to ascertain current noise levels and to establish the level of sound insulation required in the new buildings.

Whilst every effort has been made to ensure that this report is easy to read, the content is necessarily technical in nature; to assist the reader, a glossary of terms used in the report is included in Appendix A.

2 Site Description

2.1 *The Hive*

The development site lies south of the A14 and adjacent to Kings Hedges Road.

The A14 is a dual-carriageway with two lanes operating in both directions. To the east of the site is an EDF substation and electricity pylon. To the north of the site is a guided busway, which is currently not operational. The busway is expected to be operational in the near future, once snagging issues have been completed by the contractor. An estimate of the future noise due to the busway at the development site has been predicted using a three-dimensional noise model.

To the north-east of the site is the main Cambridge Regional College campus. To the south and west of the site are residential houses, separated by Kings Hedges Road.

Currently the main source of noise on site is road traffic from the A14. Traffic noise from Kings Hedges Road is clearly audible, but it is considered that the traffic noise from the A14 is the primary noise source.

2.2 *Proposed Development*

The proposed site layout is provided by architectural and urban design practice 5th Studio. It is proposed to situate two separate buildings on The Hive; these will be the SmartLife Low Carbon (CRC/CCC) facility and the Good Business Centre (Citylife).

The closest proposed building, the SmartLife Low Carbon Building, is to be set back 10m from the guided busway.

In addition to these Cambridge Regional College buildings, the Building Research Establishment are developing a proposal to situate experimental 'EcoHomes' or exhibit environmentally sustainable building technologies, within the development site. It is proposed that these could be temporary structures to be changed over time. Few details are known about these buildings at this time.

3 Planning Policy Guidance

3.1 *Planning Policy*

Planning Policy Guidance Note 24: "*Planning and Noise*" (PPG24) sets out the Government's policies on noise-related planning issues in England. The document gives guidance to local authorities in England on the use of their planning powers to minimise the adverse impact of noise without placing unreasonable restrictions on development.

Specifically, PPG 24:

- outlines the considerations to be taken into account when determining planning applications for both noise-sensitive developments and for those activities which will generate noise;
- sets out noise exposure categories (NECs) for residential development, encourages their use and recommends appropriate levels for exposure to different sources of noise; and advises on the use of planning conditions to minimise the impact of noise.

PPG 24 states that developments such as schools will contain buildings and activities which are noise-sensitive. However, these developments are likely to occupy sizeable sites and to contain a proportion of buildings and activities which are less noise-sensitive. PPG24 therefore considers that the NEC principle cannot therefore be sensibly applied to such developments and it will be more appropriate to refer to specific guidance on internal noise standards in respect of each activity. General information can be found in BS 8233, and the Department for Education publishes guidance for schools.

3.2 *BS 8233: 1999*

British Standard 8233: 1999: '*Sound Insulation and Noise Reduction for Buildings – Code of Practice*' provides recommendations for the control of noise in and around buildings. The Standard suggests suitable internal noise levels within different types of buildings, including residential dwellings, offices, libraries and classrooms. The standard suggests the design ranges in Table 1 below;

Criterion	Typical Situations	Design range $L_{Aeq,T}$ dB	
		Good	Reasonable
Reasonable speech or telephone communications	Cafeteria, canteen, kitchen	50	55
	Wash-room, toilet	45	55
	Corridor	45	55
Reasonable conditions for study and work requiring concentration	Library, cellular office, museum	40	50
	Staff room	35	45
	Meeting room, executive office	35	40
Reasonable listening conditions	Classroom	35	40
	Lecture theatre	30	35

Table 1: Indoor Ambient Noise Level in Unoccupied Spaces

3.3 Building Bulletin 93

Building Bulletin 93 provides recommendations for the control of noise in and around school buildings.

Section 1 of Building Bulletin 93 sets out the performance standards for the acoustics of new buildings and describes the normal means of demonstrating compliance with The Building Regulations.

Building Bulletin 93 does not directly apply to colleges of further and higher education. However many of the acoustic specifications are desirable and can be used as a guide to the design of these buildings.

3.4 Local Authority Consultation

Halcrow has formally consulted with South Cambridge District Council to determine the scope of this assessment and to identify any specific concerns they may have regarding the proposed college buildings. It was agreed that a noise assessment should be undertaken at Cambridge Regional College to quantify the noise at the college. It has been agree that the internal noise limits recommended in the BS8233 guidance are appropriate for assessing the noise in the classrooms.

4 Noise Measurements

A baseline noise survey was carried out during a typical school day period to establish noise levels representative of the prevailing noise conditions at the proposed site. The survey commenced at 08.00 on 10 May 2010 and finished at 17.00. The weather during the survey was suitable for noise measurements, being dry and sunny with a very light wind.

4.1 Equipment

Noise measurements were conducted with a 01dB-Stell Solo type 1 integrating sound level meter (serial number 11144), fitted with a 01dB-Stell half inch preamplifier (serial number 11790) and 01dB-Stell half inch microphone (serial number 39616).

The meter was calibrated before measurement using a Larson Davis CAL200 calibrator (serial number 3054). The calibration was checked upon completion of the measurements and no calibration drifts were found to have occurred.

All the equipment had been calibrated to traceable standards by the manufacturer in the 24 months preceding the survey. The calibrator had been calibrated to traceable standards within 12 months of the survey.

4.2 Measurement Location

Ambient noise measurements was conducted at one location in the north East corner of the site, approximately 5m from the bus way and 3m from the boundary of the EDF substation.

The microphone was in a free-field position at a height of 1.5m above ground level.

4.3 Measurement Results

The existing noise climate within the vicinity of the proposed building was dominated by road traffic noise from the A14. Road noise from Kings Hedges Road was also evident.

A summary of the survey results are given in table 1 below.

Period	L_{Aeq} dB	L_{Amax} dB	L_{A90} dB	L_{A10} dB
08.00 – 08.30	60.9	78.8	58.2	62.6
08.30 – 09.00	60.7	67.9	57.3	62.6
09.00 – 09.30	60.0	72.6	56.4	62.1
09.30 – 10.00	59.4	67.8	55.8	61.5
10.00 – 10.30	60.5	74.6	56.8	62.7
10.30 – 11.00	60.0	67.6	56.5	62.0
11.00 – 11.30	59.6	68.9	56.5	61.6
11.30 – 12.00	59.0	65.9	55.6	61.1
12.00 – 12.30	58.4	68.6	54.4	60.6
12.30 – 13.00	57.6	64.5	54.2	59.7
13.00 – 13.30	60.7	67.3	57.3	62.9
13.30 – 14.00	61.3	70.6	57.9	63.2
14.00 – 14.30	61.3	68.0	57.5	63.6
14.30 – 15.00	62.0	75.0	58.8	64.0
15.00 – 15.30	62.6	73.4	59.3	64.5
15.30 – 16.00	62.7	70.9	59.6	64.6
16.00 – 16.30	61.2	74.1	58.3	63.1
16.30 – 17.00	62.0	68.3	59.2	63.8
Overall	60.7	50.0	56.5	75.0

Table 2: Noise levels at measurement position

4.4 Guided Busway Noise

An additional noise survey was carried out to measure typical *Single Event Noise Exposure Level* (SEL) from bus pass-bys, which is of assistance in predicting the future noise from the busway. The measurements were undertaken at 10 metres from a road used primarily by single- and double-decker busses, under conditions where the buses were accelerating after taking a bend in the road.

Due to the position of the exhausts and cooling fans, the noise levels for the double-decker buses were generally lower than those for the single-decker buses. Therefore the results presented in Table 3 below only include the measurements of single-decker buses.

Event	SEL (dB)					Broadband SEL dB(A)
	125Hz	250Hz	500Hz	1kHz	2kHz	
1	88.1	82.4	78.2	75.9	72.8	81.3
2	83.6	79.9	79.5	75.5	72.2	81.0
3	88.8	81.8	81.2	80.0	77.0	84.4
4	83.1	76.0	73.0	71.2	67.9	76.1
5	73.6	67.3	65.5	63.1	60.7	68.8
6	74.4	70.2	70.3	67.8	64.2	72.6
7	87.4	81.4	78.2	78.7	75.4	82.9
8	85.0	84.5	81.3	78.0	74.3	83.2
Average	83.0	77.9	75.9	73.8	70.6	78.8

Table 3: Measured Single Event Noise Levels of Bus Pass-bys

The measured SEL values have been used to validate the computer modelling in which sound power level spectra for heavy vehicles, provided by the Transport Research Laboratory (TRL), have been used as the source data for the guided busway.

The average measured SEL in Table 3 above has been used to calculate the expected noise levels at a position 10m from the busway during a 1-hour period, based on 11 bus pass-bys per hour[1]. The calculated noise levels are shown in Table 4 below:

$L_{eq,1h}$ (dB)					$L_{Aeq,1h}$ dB(A)
125Hz	250Hz	500Hz	1kHz	2kHz	
58.0	52.9	50.9	48.7	45.5	53.8

Table 4: Calculated Noise Levels for 11.3 Bus Pass-bys per hour

Combining the loudest measured ambient daytime measurement with the calculated noise levels for the guided busway gives an ambient noise level of 63.2 dB(A) at 10m from the guided busway, which is where the closest facade of the SmartLife Low Carbon Centre is to be located.

[1] $L_{eq,1h} = SEL-10Log_{10}(3600)+10Log_{10}(11.3)$

5 Internal Noise Levels

BS8233 states how to calculate noise break-in from external noise sources. The method takes into account different elements through which the sound enters the room and the sound reduction index of the different elements as well as the different area of each element.

The exact make-up of the Smart Life Low Carbon Building is not yet known. A typical size class room of 10m x 5m x 3m has been taken to calculate internal noise levels. Standard 4-12-4 double glazing with trickle ventilation and a reverberation time of 0.5s has been used to calculate the break-in noise level. Using these assumptions for the classroom the calculated internal noise level is calculated to be 33.7 dB. This internal noise level is below the 'good' standard as set out in BS8233:1999. However it should be noted that the internal noise levels are only achieved with the windows closed. With the windows open the internal noise level is calculated to be 50.7 dB which exceeds BS8233:1999 'reasonable' standard.

The above calculations demonstrate that a suitable acoustic environment can be achieved within a classroom, library, office, or staff room using standard thermal double glazing in combination with an appropriate acoustic ventilation / cooling strategy. However, it should be noted that quieter environments are recommended for lecture theatres, and a higher standard of glazing may be required to achieve these conditions.

An alternative way of ventilating the classrooms should be sought, that does not rely solely upon open windows. It is possible that a combination of low energy cooling methods such as exposed thermal mass and pre-cooling together with acoustic louvres to provide airflow (mechanically assisted at peak times) may be appropriate. Other potential solutions include provision of an acoustic barrier between the building and the busway, with the air-intakes for the building located at a low level within the acoustic shadow zone of the barrier.

Calculations for the internal noise levels for the BRE innovation park have not been made as the park has not been approved by the Hive board and it is unclear at this stage what the BRE innovation park shall consist of.

6 Conclusions

Cambridge Regional College proposes to build a new campus called 'The Hive' which is a unique campus dedicated to innovative building technologies, ethical business practice and sustainability.

The new campus is next to the current Kings Hedges Campus and is part of the strategy to address the expansion of the current campus.

Halcrow was commissioned to undertake a noise assessment at 'The Hive' in order to ascertain current noise levels and to establish the level of sound insulation required in the new buildings. The internal noise levels have been calculated assuming standard thermal double glazing and have been shown to achieve the 'good' standard stated in BS8233 for classrooms. However it should be noted that the internal noise levels will only be achieved with the windows closed. The internal noise levels are not met with windows open, and therefore an alternative method of ventilating and cooling the building should be sought.

A Acoustic Terminology

Noise is defined as unwanted sound, and the unit of measurement is the decibel (dB). Noise levels range from the threshold of hearing at 0dB to levels of over 130 dB at which point the noise becomes painful.

Sound consists of vibrations transmitted to the ear as rapid variations in air pressure. The more rapid the fluctuation the higher the frequency of the sound. However the sensitivity of the human ear varies with frequency. Therefore most every day noise is measured in dB(A), the (A) suffix indicating that the measured level has been modified to allow for this phenomenon. It has been found that changes in noise level when measured in dB(A) most closely correlate with the changes in subjective reaction.

The range of values of pressure over which the ear can hear is enormous and for convenience the decibel scale, which is logarithmic is used as the resulting numbers correspond, generally, to the noise perceived. A change in noise level of 10dB(A) represents a halving or doubling in perceived loudness.

An indication of the range of sound levels commonly found in the environment is given in the following table.

Sound Level	**Location**
0dB(A)	Threshold of hearing
20 to 30dB(A)	Quiet bedroom at night
30 to 40dB(A)	Living room during the day
40 to 50dB(A)	Typical office
50 to 60dB(A)	Inside a car
60 to 70dB(A)	Typical high street
70 to 90dB(A)	Inside factory
100 to 110dB(A)	Burglar alarm at 1m away
110 to 130dB(A)	Jet aircraft on take off
140dB(A)	Threshold of Pain

Table A1 Typical Sound Levels found in the Environment

A.1 Glossary of Acoustic Terminology

dB (decibel) The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and a reference pressure (2x10-5Pa).

dB(A) A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e. 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.

L_{Aeq} L_{Aeq} is defined as the notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the A - weighted fluctuating sound measured over that period.

L_{Amax} L_{Amax} is the maximum A - weighted sound pressure level recorded over the period stated. L_{Amax} is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.

L_{10} & L_{90} If a non-steady noise is to be described it is necessary to know both its level and the degree of fluctuation. The L_n indices are used for this purpose, and the term refers to the level exceeded for n% of the time. Hence L_{10} is the level exceeded for 10% of the time and as such can be regarded as the 'average maximum level'. Similarly, L_{90} is the 'average minimum level' and is often used to describe the background noise. It is common practice to use the L_{10} index to describe traffic noise.

L_{AR} L_{AR} is the rating level that is the estimated future noise level over a stated period of time due to the activities under consideration (L_{Aeq}) suitably converted by the addition of 5dB for character (whine, hiss, screech, hum etc) where necessary.

Free-field Level A sound field determined at a point away from reflective surfaces other than the level ground with no significant contributions due to sound from other reflective surfaces. Generally as measured outside and away from buildings.

Façade Level Sound field defined 1 metre from a solid, reflecting surface, such as a building. Typically 3 dB higher than a free-field level.