Intended for
The Hall School Charitable Trust

Document type
Report

Reference
1700003771

Date
March 2019

NOISE SURVEY REPORT
THE HALL SCHOOL

RAMBOLL

Revision	**01**
Date	**04/03/19**
Made by	**Tamasine Leighton-Crawford/Simon Taylor**
Checked by	**Simon Taylor/Rebecca Raby-Smith**
Approved by	**Raf Orlowski/Michael Elliott**
Description	**Noise Survey Report**

Ref 1700003771_Noise Survey Report_1

Ramboll
Terrington House
13-15 Hills Road
Cambridge CB2 1NL
United Kingdom
T +44 (0)1223 321 195
F +44 (0)1223 356 215
www.ramboll.com

CONTENTS

APPENDICES

EXECUTIVE SUMMARY

Ramboll was commissioned to provide a noise survey report in support of a Section 73 minor material amendment planning application in respect of the amendments to the July 2018 permitted development (ref. 2016/6319/P) for the redevelopment of The Hall Senior School in Belsize Park, London.

The content of this report is based on the findings of a baseline noise survey undertaken on 06 September 2016. The baseline noise survey was undertaken at the site of the proposed new building in order to determine the current noise levels around the site and at representative positions of the noise-sensitive receptors during the daytime and late evening. The methodology and results of this noise survey are summarised in this report.

An assessment of the noise levels affecting the proposed development has been made in relation to the internal ambient noise criteria provided in BB93:2015 'Acoustic design of schools: performance standards'[1]. The results have been used to inform the sound insulation requirement of the building envelope and the ventilation strategy. Natural ventilation is suitable for all teaching spaces with limited window openings.

Noise level limits have been recommended for building services plant associated with the development in accordance with London Borough of Camden Local Plan 2017[2] and BS 4142:2014[3]. It is anticipated that this target can be achieved with the provision of standard attenuation measures and no adverse impact is predicted at the nearest noise-sensitive receptors. Meeting these plant noise limits will mean that the requirements of BREEAM credit POL05 are also met.

Construction noise limits at nearby noise sensitive receptors have been recommended based on the methodologies within BS5228[4].

[1] Department for Education (2014), 'Acoustic design of schools: performance standards', Building Bulletin 93.

[2] London Borough of Camden "Camden Local Plan 2017".

[3] BS 4142:2014 'Methods for rating and assessing industrial and commercial sound', BSI Standards Publication.

[4] BS 5228-1:2009+1:2014 'Code of practice for noise and vibration control on construction and open sites. Noise, BSI Standards Publication.

1. INTRODUCTION

Ramboll Environment and Health UK Limited ('Ramboll') was commissioned by The Hall School Charitable Trust ('the Client') to provide a Noise Survey Report in support of a Section 73 minor material amendment planning application ('S73 application') in respect of the amendments to the July 2018 permitted development (ref. 2016/6319/P) for the redevelopment of The Hall Senior School in Belsize Park, London ('the application site').

The proposed development description for the S73 application is as follows:

'Variation of Condition 2 of planning permission 2016/6319/P dated 5th July 2018 for the demolition of the 'Centenary' and 'Wathen Hall' buildings and erection of new four storey building with glazed link to original school building, two storey rear extension with external terrace and enlarged basement replacing the existing Wathen Hall, and enlargement of rear roof storey and insertion of three dormer windows to old school building, all in association with providing additional accommodation for the existing school use (Class D1); NAMELY, to allow minor material design amendments including a reduction in the size of the approved basement, removal of external staircase from Wathen Hall and associated minor external alterations'.

Ramboll carried out a baseline survey of the application site on Tuesday 06 September 2016 ('the 2016 baseline survey'), with the subsequent report ('Ramboll report reference 1620002708-RAM-XX-XX-RP-YA-00002) used to inform the planning application for the 2018 permitted development for the application site (ref. 2016/6319/P). The 2016 baseline noise survey is deemed to be valid for the S73 application and the content of this Noise Survey Report is based on the 2016 baseline noise survey and subsequent report, updated in line with London Borough of Camden Local Plan 2017.

The objective of this Noise Survey Report is to assess the suitability of the site for an extension to the current building, and to set appropriate limits for building services plant noise emissions at nearest noise-sensitive receptors.

The methodology, survey results and assessment are given below.

Acoustic terminology used in this report is presented in Appendix 1.

2. SURVEY DETAILS

2.1 Site description

The application site is located on Crossfield Road, Belsize Park, North London (see Figure 1). The school is in a residential area and there is a preparatory school near the back of the proposed development. The A41 is approximately 300 m to the south west of the application site.

Figure 1: Proposed Development Application Site

2.2 Methodology

The daytime noise survey was conducted by Ramboll. Noise levels were measured at locations representative of the proposed facades of the building and representative of the nearest identified noise-sensitive receptors.

The survey comprised three sets of 10-minute measurements per location during the daytime and three sets of 10 minute measurements per location during the late evening periods. The measurement periods were 14:00 to 16:00 and 21:00 to 22:30.

Measurements were taken at approximately 1.2 metres above ground level and at a distance of at least 3 metres from the façade of any buildings and are considered representative of free-field measurements.

The sound level meter calibration was checked immediately before and after the measurement periods. No significant fluctuation in calibration was detected.

2.3 Weather

During the measurement period, weather conditions were noted as dry with 100 % cloud cover. There was a light breeze at ground level; the wind speed was less than 5 ms^{-1}.

2.4 Measurement locations

The measurement locations are shown in Figure 2.

Figure 2: Noise monitoring locations ST1 and ST2

2.4.1 Location ST1

The measurement location ST1 was 5 m from the current building façade, chosen to be representative of the East façade of the proposed building and the nearest noise-sensitive receptors at the rear of Crossfield Road, Eton Avenue and Strathray Gardens.

Figure 3: Measurement location ST1

2.4.2 Location ST2

The measurement location ST2 was chosen to be representative of the West façade of the building and the nearest noise-sensitive receptors on Crossfield Road.

Figure 4: Measurement location ST2

2.5 Equipment

The following equipment was used to measure noise levels:

- Brüel and Kjær 2250 'Class 1' Sound Level Analyser
- Brüel and Kjær 4231 'Class 1' Sound Level Calibrator
- Rion NA 28 Sound Level Analyser
- Rion NC 74 Sound Level Calibrator

All noise measurement equipment is owned by Ramboll and is subject to annual calibration checks traceable to national standards. Copies of calibration certificates are available on request.

3. NOISE CLIMATE

3.1 Daytime measurements

The dominant noise sources at measurement location ST1 were distant road traffic, voices coming from the school through open windows and birdsong.

The dominant noise sources at measurement location ST2 were road traffic noise on Crossfield Road, road traffic noise on Eton Avenue and voices coming from the school through open windows.

Aircraft noise was occasionally 'just' audible in gaps between the other noise sources.

3.2 Late evening measurements

The dominant noise sources at location ST1 were distant road traffic noise, leaves moving in the trees and occasional voices from nearby residences.

The dominant noise sources at location ST2 were road traffic noise from Eton Avenue and plant noise from the residential building on the opposite side of the road.

4. SURVEY RESULTS

4.1 Noise survey results

A summary of the noise survey results is presented below in Figure 5.

Figure 5: Summary of noise measurement results

Detailed measurement results are provided in Appendix 2.

5. ACOUSTIC DESIGN

The results of the noise survey inform three aspects of the acoustic design for the development:

- The highest measured ambient noise levels affecting the application site determine the site suitability for school development, ventilation strategy and any sound insulation requirements for the external building envelope.
- The representative background noise levels provide a baseline which informs the plant noise emission criteria.
- The measured ambient noise levels at the nearby noise sensitive receptors inform the construction noise assessment.

5.1 Façade sound insulation and ventilation strategy

The building envelope must provide sufficient sound insulation from external noise sources in order to achieve suitable internal ambient noise levels. BB93 sets out indoor ambient noise level (IANL) criteria for different spaces.

These include noise contributions from:

- External noise sources outside the school premises
- Building services noise

The maximum IANLs are summarised in Table 1:

Space	Target limit for internal ambient noise level $L_{Aeq, 30min}$ (dB)	Corresponding limit for building services noise (NR)
Teaching Spaces Main Hall/Multi-purpose hall	**35**	**30**
Meeting rooms Activity Studio Staff room, Offices	**40**	**35**
Dining room Circulation, Stairs Entrance, Reception, Cloak rooms	**45**	**40**
Toilets, Kitchen	**50**	**45**

Table 1: BB93 Indoor ambient noise level criteria

BB93 states that for spaces which are naturally ventilated, the noise level including external noise ingress may exceed the IANL limit by up to 5 dB.

A façade with an open window, limited to no more than 5 % of the floor space, typically provides up to 15 dB attenuation from external noise. Accounting for this attenuation, levels inside the proposed classrooms will be approximately 39 dB L_{Aeq} on the Crossfield Road side of the proposed development and approximately 31 dB L_{Aeq} on the back of the development. Taking the BB93 allowance of +5 dB into account, these levels are within the maximum IANL limit of 40 dB L_{Aeq} for naturally ventilated teaching spaces.
The indoor ambient noise level criteria can be achieved with natural ventilation via partially openable windows.

Most standard façade build-ups will be suitable in terms of achieving the indoor ambient noise level criteria. This includes standard thermal double-glazed windows and any masonry façade or composite façade lined with at least one layer of plasterboard.

5.2 Plant noise emission

BS 4142:2014 'Methods for rating and assessing industrial and commercial sound' describes a method for assessing the impact of the sound levels from fixed plant installations, industrial and manufacturing processes and other activities, on nearby noise sensitive receptors.

The assessment procedure described in BS 4142:2014 is based on the comparison of rating a sound level from industrial sources with the prevailing background sound level at the assessment locations. The assessment of impact is determined using the categories shown in Table 2.

Difference between rating level and background noise level	Impact category
+10 dB or more	Significant adverse impact
+5 dB or more	Adverse impact
0 dB or less	Low impact

Table 2: Classification of industrial noise impacts

LBC Local Plan 2017 states *"Where appropriate and within the scope of the document it is expected that British Standard 4142:2014 'Methods for rating and assessing industrial and commercial sound' (BS 4142) will be used. For such cases a 'Rating Level' of 10 dB below background (15dB if tonal components are present) should be considered as the design criterion)."*

During normal school hours, a noise limit of 31 dB L_{Aeq} is therefore proposed for plant noise emission at nearby residential receptors, which would meet the requirements of the LBC Local Plan and result in low impact according to BS41412:2014.

BS4142:2014 states *that "Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night."*

If the school is used in the evening, as background noise levels are low, an absolute noise limit of 30 dB L_{Aeq} is proposed for plant noise emission at nearby residential receptors, which will result in low impact according to BS41412:2014.

In addition, plant noise must be controlled to no higher than 50 dB L_{Aeq} in external teaching areas and to no more than 45 dB L_{Aeq} outside any windows or facade openings where the ventilation strategy relies upon them being open. Please note, the cumulative plant noise limits should be met with all plant operating at its normal duty.

5.2.1 Mitigation

All proposed plant will be housed within plant rooms inside the building. Inlets and exhausts to air handling units will be ducted to atmosphere.

Plant noise will be controlled by selection of appropriate plant and attenuation, as required, to achieve the above noise emission limit. Full plant specifications are not available at this stage; therefore, it is not possible to specify the exact mitigation measures required.

5.2.2 BREEAM Credit POL05

BREEAM credit POL05 states:

"*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."*

Meeting a plant noise limit of a noise limit of 31 dB L_{Aeq} during normal school hours and 30 dB L_{Aeq} in the evening (as specified in Section 5.2) at the nearby residential receptors will mean that the BREEAM POL05 credit can be awarded by default.

6. CONSTRUCTION NOISE

The exact working methodology and plant to be employed during construction has not been established at this stage in the design.

6.1 Residential receptors

The significance criteria for construction noise levels at residential receptors have been established by reference to ABC method described in BS 5228 (Table 3). The thresholds are determined relative to the pre-existing ambient noise levels at the assessment locations.

Assessment Period	Threshold Value dB $L_{Aeq,T}$		
	Category A	**Category B**	**Category C**
Daytime (07:00-19:00) **Saturday (07:00-13:00)**	65	70	75
Evening (19:00-23:00) Weekend	55	60	65
Night-time (23:00-07:00)	45	50	55

Table 3: Significance Criteria from ABC Method in BS5228

6.1.1 A potential significant noise effect is indicated when the construction noise exceeds the threshold level for the category appropriate to the ambient noise level:

- Threshold values of Category A for construction noise should be used when the pre-existing ambient noise level, when rounded to the nearest 5 dB, is less than those values;
- Threshold values of Category B should be used when pre-existing ambient noise level, when rounded to the nearest 5 dB, is equal to the values in Category A;
- Threshold values of Category C should be used when the pre-existing ambient noise level, when rounded to the nearest 5 dB, is more than the values in Category A.

6.1.2 The ambient noise levels measured around the application site are below 65 dBA, therefore construction noise levels exceeding 65 dBA at the nearest residential receptors would constitute a significant adverse impact.

6.2 Non-residential receptors

Hereward House School, a non-residential receptor is located at the rear of the application site, on Strathray Gardens. The significance criteria for construction noise levels at non-residential receptors have been established by reference to "2 – 5 dB(A) change" method described in BS 5228.

6.2.1 Example method 2 – 5 dB(A) change from BS 5228

Noise levels generated by site activities are deemed to be potentially significant if the total noise (pre-construction ambient plus site noise) exceeds the pre-construction ambient noise by 5 dB or more, subject to lower cut-off values of 65 dB, 55 dB and 45 dB $L_{Aeq,T}$ from site noise alone, for the daytime, evening and night-time periods, respectively; and a duration of one month or more, unless works of a shorter duration are likely to result in significant effect. These evaluative criteria are generally applicable to the following resources:

- residential buildings;
- hotels and hostels;
- buildings in religious use;
- buildings in educational use;
- buildings in health and/or community use.

6.2.2 The ambient noise levels measured around the application site are below 65 dBA, therefore construction noise levels exceeding 65 dBA at the nearest non-residential receptors would constitute a significant adverse impact.

7. CONCLUSION

A noise survey was undertaken at the application site at The Hall Senior School, Belsize Park, North London to establish the existing noise climate. The results of the noise survey undertaken by Ramboll in 2016 have been used to set the sound insulation of the building envelope and noise emission limits.

The measurements have been used to inform the design of the building envelope of the proposed new building to ensure the internal ambient noise level requirements are achieved. The measurements show that the internal ambient noise levels as specified in BB93 can be achieved with natural ventilation.

Background noise levels were measured at representative positions of the nearest noise-sensitive receptors. The results of these measurements are considered suitable to set noise emission limits from any plant associated with the new building at these locations. A noise emission limit of the existing background noise level is considered suitable with a resultant level of 31 dB L_{Aeq} during normal school hours and 30 dB L_{Aeq} in the evening. If noise emission limits are adhered to, no adverse impact is anticipated and BREEAM credit POL05 can be awarded.

APPENDIX 1
ACOUSTIC TERMINOLOGY

A.1 DECIBEL

The ratio of sound pressures which we can hear is a ratio of 10^6 (one million:one). For convenience, therefore, a logarithmic measurement scale is used. The resulting parameter is called the 'sound pressure level' (L_p) and the associated measurement unit is the decibel (dB). As the decibel is a logarithmic ratio, the laws of logarithmic addition and subtraction apply.

A.2 A-WEIGHTED DECIBEL

The unit generally used for measuring environmental, traffic or industrial noise is the A-weighted sound pressure level in decibels, denoted dB(A). An A-weighting network can be built into a sound level measuring instrument such that sound levels in dB(A) can be read directly from a meter. The weighting is based on the frequency response of the human ear and has been found to correlate well with human subjective reactions to various sounds. It is worth noting that an increase or decrease of approximately 10 dB corresponds to a subjective doubling or halving of the loudness of a noise, and a change of 2 to 3 dB is subjectively barely perceptible.

A.3 EQUIVALENT CONTINUOUS SOUND LEVEL

Another index for assessment for overall noise exposure is the equivalent continuous sound level, L_{eq}. This is a notional steady level which would, over a given period of time, deliver the same sound energy as the actual time-varying sound over the same period. Hence fluctuating levels can be described in terms of a single figure level.

A.4 FREQUENCY

The rate of repetition of a sound wave. The subjective equivalent in music is pitch. The unit of frequency is the Hertz (Hz), which is identical to cycles per second. A thousand hertz is often denoted kHz, e.g. 2 kHz = 2000 Hz. Human hearing ranges approximately from 20 Hz to 20 kHz. For design purposes, the octave bands between 63 Hz to 8 kHz are generally used. The most commonly used frequency bands are octave bands, in which the mid frequency of each band is twice that of the band below it. For more detailed analysis, each octave band may be split into three one-third octave bands or in some cases, narrow frequency bands.

A.5 MAXIMUM NOISE LEVEL

The maximum noise level identified during a measurement period. Experimental data has shown that the human ear does not generally register the full loudness of transient sound events of less than 125 ms in duration. Fast time weighting has an exponential time constant of 125 ms which reflects the ear's response. The maximum level measured with fast time weighting is denoted as $L_{AMax,f}$. Slow time weighting (S) with an exponential time constant of 1s is used to allow more accurate estimation of the average sound level on a visual display.

Impulse (I) time weighting has a fast rise (35ms) and a slow decay and is intended to mimic the ear's response to impulsive sounds.

A.6 STATISTICAL NOISE LEVELS

For levels of noise that vary widely with time, for example road traffic noise, it is necessary to employ an index which allows for this variation. The L_{10}, the level exceeded for ten per cent of the time period under consideration, has historically been adopted in the UK for the assessment of road traffic noise. The L_{90}, the level exceeded for ninety per cent of the time, has been adopted to represent the background noise level. The L_1, the level exceeded for one per cent of the time, is representative of the maximum levels recorded during the sample period. A weighted statistical noise levels are denoted L_{A10},dB L_{A90} etc. The reference time period (T) is normally included, e.g. dB $L_{A10, 5min}$ or dB $L_{A90, 8hr}$.

A.7 TYPICAL NOISE LEVELS

Some typical noise levels are given in the following table.

Noise Level dB(A)	Example
130	Threshold of pain
120	Jet aircraft take-off at 100 m
110	Chain saw at 1 m
100	Inside disco
90	Heavy lorries at 5 m
80	Kerbside of busy street
70	Loud radio (in typical domestic room)
60	Office or restaurant
50	Domestic fan heater at 1m
40	Living room
30	Ventilation Noise in Theatre
20	Remote countryside on still night
10	Sound insulated test chamber
0	Threshold of hearing

Table of Typical Noise Levels

APPENDIX 2
NOISE SURVEY RESULTS

NOISE SURVEY RESULTS

Measurement location	Start time	Duration	L_{Amax}	L_{A90}	L_{A10}	L_{Aeq}	Comments
ST1	14:11	10:00	56	41	49	46	Birdsong, voices from school, aircraft
	14:47	10:00	61	41	47	45	Birdsong, voices from school, aircraft
	15:18	10:00	58	43	48	46	Birdsong, children playing outside at school nearby, aircraft
	21:12	10:00	66	36	49	49	Distant road traffic noise, aircraft
	21:40	10:00	58	34	41	38	Distant traffic noise, leaves in trees, voices, aircraft
	22:10	10:00	61	37	45	43	Distant traffic noise, leaves in trees, aircraft
ST2	14:26	10:00	74	45	53	53	Voices from school, traffic noise Crossfield Rd/Adamson Rd
	15:02	10:00	74	44	54	54	Voices from school, hoover in flat opposite, traffic noise Crossfield Rd/Adamson Rd
	15:29	10:00	76	45	55	54	Voices, traffic noise Crossfield Rd/Adamson Rd
	21:00	10:00	77	39	49	53	Traffic noise Eton Ave, plant noise building opposite, aircraft noise
	21:25	10:00	70	40	52	53	Voices, road traffic noise Eton Ave, leaves in trees, aircraft noise
	21:55	10:00	74	39	50	52	Traffic noise Eton Ave, leaves in trees, aircraft noise