ArupAcoustics

Buro 4

Boldrewood Campus Refurbishment

Baseline Noise Survey

Report ref
AAc/122593/R01

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Baseline Noise Survey

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Contents

Appendices

Executive Summary

Ambient noise levels have been measured over a 24-hour period at the Boldrewood Campus site. The noise climate is dominated by road traffic near to the site, especially from vehicles using Burgess Road and Basset Avenue. Following assessment of the measured levels, it is recommended that residential accommodation is located so that bedroom facades are not directly exposed to noise from Burgess Road or Basset Avenue. Teaching or office accommodation should not be naturally ventilated via facades that face towards Burgess Road or Basset Avenue. Subject to further design work, it is anticipated that teaching or office accommodation may be naturally ventilated via facades that overlook Basset Crescent East or are otherwise shielded from road traffic noise from Burgess Road or Basset Avenue.

1 Introduction

Arup Acoustics (AAc) carried out ambient noise measurements at the University of Southampton's Boldrewood Campus on 19 and 20 April 2007. Attended, sample measurements were taken at locations around the site in order to assess the main noise sources and to gauge typical noise levels on site and at surrounding residential properties.

It is understood that the site will be developed for residential (hall of residence), teaching and office accommodation uses.

Appendix A provides an explanation of the technical terms used in this report.

1.1 Site Description

Boldrewood Campus is situated in the Bassett area of Southampton, on the northern side of the city. The site is located at the corner of Burgess Road, the A35, and Bassett Avenue, the A33. Several residential properties lie nearby most notably on Oaklands Way to the north of the site and The Cloisters, immediately south-east of the main campus building. The site is shown in Figure 1.

2 Survey Methodology

Measurements were made at various locations on and around site (described below) during daytime hours, 1500-1830, and late evening, 2100-2330 on 19 April. Night-time, 0200-0400, and morning, 0900-1130, measurements were made on 20 April. These were in the form of attended, ten minute measurements. The survey was carried out by Arup Acoustics' engineer Daniel Howells.

For each noise measurement, the sound level meter used, noise climate, wind speed and direction, and the precise measured noise levels were noted. The detailed procedure and results are reported below.

2.1 Measurement Procedure

The sound level meter was mounted on a tripod, with the microphone set approximately 1.2-1.5m above ground level. A windshield was fitted to the microphone at all times to minimise the effects of wind induced noise across the microphone diaphragm.

All measurements were taken in an acoustically 'free field' condition at least 3.5m away from any vertical reflective surfaces. The measurement locations were chosen to provide a representative indication of the typical ambient noise level at noise sensitive receivers surrounding the area proposed for development and to indicate the level of noise entering the site.

2.1.1 Weather

Conditions were clear and dry throughout with winds generally from the south east measured at $0.5ms^{-1}$-$1.5ms^{-1}$.

2.1.2 Instrumentation

The instrumentation used to carry out the noise survey was as follows:

- Brüel & Kjær 2260 type 1 precision sound level meter (SLM)
- Brüel & Kjær type 4231 calibrator
- Kestrel 1000 Anemometer
- Compass

Immediately before and after each series of measurements was carried out, each SLM's calibration was checked using the SPL calibrator.

All noise measuring instrumentation owned and used by Arup Acoustics is checked for correct calibration to traceable national and international standards on an annual basis. Routine 'in-house' spot checks are also conducted as part of Arup Acoustics' QA policy.

2.2 Measurement Locations

The measurement locations used were dependent on the time of day they were conducted. The locations used for morning and daytime measurements (preceded by the letter 'D') differed from those used at late evening and night time hours (preceded by the letter 'N'). Morning and daytime locations were chosen to ascertain typical noise entering the site while late evening and night time locations were used to measure typical noise levels at potentially sensitive receivers nearby that might be affected by noise from the new building and the construction process.

Sections 2.2.1 to 2.2.9 describe the measurement positions and the main noise sources at each location. The locations are also summarised in Figure 1.

2.2.1 Location D1 – Burgess Road

The SLM was sited near the southern site boundary approximately 20m from Burgess Road.

Traffic noise dominated the noise climate at all times. The L_{eq} was dominated by traffic passing on Burgess Road and more distant traffic dominated the background L_{90} levels.

2.2.2 Location D2 – Current Campus Entry Road

Access to the Boldrewood Campus was gained via the entry road from Bassett Crescent East towards the north-east corner of the site. The SLM was sited on the traffic island at the Campus entrance to assess noise entering the site at this area.

Traffic noise from Burgess Road and Bassett Avenue dominated background noise levels. Traffic on Bassett Crescent East to the north-east was very occasional throughout the measurements.

2.2.3 Location D3 – Bassett Avenue

Bassett Avenue runs north-south along the eastern site boundary. The SLM was sited approximately 30m from the road.

Traffic on Bassett Avenue dominated the noise climate with contributions to background levels from traffic on Burgess Road to the south-east.

2.2.4 Location D4 – Corner of Burgess Road and Bassett Avenue

Burgess Road and Bassett Avenue meet at the south-west corner of the site. Due to signalling at this junction there remained a constant presence of traffic. This location was used to determine the subsequent effect of this on noise ingress to the site.

Traffic noise clearly dominated the noise climate. Due to the high number of engines idling during red lights the background noise level at this location was also high.

2.2.5 Location N1 – Western End of Oaklands Way

Several residential properties lie in close proximity to the main campus building on Oaklands Way to the north of the site. The SLM was sited approximately 20m from the western end of Oaklands Way where the road meets Bassett Avenue. This location was chosen to estimate the noise incident on the façade of the western most property on Oakland's Way.

L_{eq} levels were dominated by traffic passing on Bassett Avenue although traffic numbers fell at later times. Plant noise from the current campus buildings dominated background noise levels with contributions from distant traffic noise. The plant noise became subjectively more apparent at later times due to reduced traffic.

2.2.6 Location N2 – Residential Property, Rear Façade on Campus Grounds

Approximately 50m to the north-east of the main campus building lies a residential property whose rear façade backs directly onto the site. The SLM was sited 5m from the boundary fence at this position.

Plant noise from the current campus buildings dominated the background noise levels with contributions from distant traffic at earlier times. Traffic passing on Bassett Avenue was audible at this location although, as at Location N2, there was less traffic at later times and this became a less notable source.

2.2.7 Location N3 – The Cloisters

Immediately south-east of the site is a residential cul-de-sac called The Cloisters, the rear facades of which are approximately 15m from the campus building their closest.

Traffic dominated the noise climate at this position, both the background noise and L_{eq}, although these fell as traffic numbers reduced during later hours.

2.2.8 Location N4 – Burgess Road

On the opposite side of Burgess Road to Boldrewood Campus are several residential properties approximately 10m from the kerbside. A 2m high brick wall surrounding the properties meant that measurements could not be made here due to the SLM's inevitable close proximity to vertical reflective surfaces. Instead a measurement position was found on site grounds, set back from Burgess Road at a similar distance to those properties where an approximation of the levels likely to be experienced could be obtained. This approach requires an assumption that traffic on Burgess Road was the dominant noise source for both positions.

Distant traffic noise dominated the background level while traffic passing on Burgess Road did indeed dominate L_{eq} levels.

2.2.9 Location N5 – Oaklands Way

A second measurement position on Oaklands way was chosen midway along the road, approximately 75m from the busy Bassett Avenue.

The noise climate was dominated by services noise from the campus building, possibly from the chimney, and also by traffic noise although this became less dominant at later times.

Figure 1 Measurement locations

3 Results

Time	Elapsed Time	L_{90}	L_{10}	L_1	L_{eq}	Comments
09:54	00:10	52	61	63	58	Traffic noise dominates noise climate. Background noise level boosted by engines idling at traffic lights on junction of Burgess Road and Bassett Avenue.
10:46	00:10	53	66	70	62	As previous. Some impact noise from groundwork on site.
15:42	00:10	51	68	73	64	Burgess Road traffic noise dominates ~70 vehicles pass in 5 mins. Planes approaching So'ton Airport audible.
16:39	00:10	53	67	70	64	As above, traffic noise on Burgess Road dominates ~75 vehicles pass in 5 mins. Distant traffic noise dominates background.
17:33	00:10	55	67	71	64	As above. 80-85 cars pass in 5 mins.

Table 1 Measurements made at location D1

Time	Elapsed Time	L_{90}	L_{10}	L_1	L_{eq}	Comments
10:07	00:10	47	53	60	51	Traffic noise dominates background with some contribution from birdsong. Construction on Highfield Campus can heard, impacts/hammering. Traffic on Burgess Road and very occasional traffic on Bassett Crescent contribute to L_{eq}. Meas. paused as vehicles access car park.
15:58	00:10	44	52	59	50	Burgess Road & Bassett Avenue traffic noise dominates. Occasional traffic on Bassett Crescent and very occasional pedestrian activity contributes to L_{eq}
17:18	00:10	44	53	61	51	As above.

Table 2 Measurements made at location D2

Time	Elapsed Time	L_{90}	L_{10}	L_1	L_{eq}	Comments
09:29	00:10	57	68	72	65	Traffic noise dominates both L_{eq} and L_{90} from Bassett Avenue and Burgess Road. Some bird noise audible in background throughout. Planes passing overhead audible, 1 prop powered plane passes, loud.
10:23	00:10	57	69	73	65	As above.
10:59	00:10	57	69	73	65	As previous – traffic levels remained relatively constant throughout am measurement period.
16:15	00:10	57	68	80	68	Traffic on Bassett Avenue dominates. Most traffic queuing on approach to lights southbound but also traffic pulling away from lights northbound. Distant traffic noise dominates.
17:03	00:10	56	66	69	63	As above.
17:56	00:10	56	66	69	62	Bassett Avenue traffic noise dominates with contributions from Burgess Road. Some birdsong audible throughout but not significant.

Table 3 Measurements made at location D3

Time	Elapsed Time	L_{90}	L_{10}	L_1	L_{eq}	Comments
09:41	00:10	52	61	63	58	Traffic noise dominates noise climate. L_{90} affected by engines idling at Burgess Road/Bassett Avenue traffic lights.
10:35	00:10	54	60	64	58	As above.
11:11	00:10	55	60	62	58	As above.
16:27	00:10	56	63	68	61	Traffic noise from Burgess Road dominates, with contributions from Bassett Avenue. Combination of engines idling and revving as they pull away from lights.
16:52	00:10	54	60	66	58	As above.
17:44	00:10	54	61	65	59	As above.

Table 4 Measurements made at location D4

Time	Elapsed Time	L_{90}	L_{10}	L_1	L_{eq}	Comments
21:09	00:10	48	65	69	60	Traffic noise on Bassett Avenue dominates L_{eq}. Some services noise from current campus buildings contribute to background noise along with distant traffic. Particularly noticeable when roads are quiet.
22:11	00:10	46	64	68	59	As above.
02:20	00:10	42	52	66	53	Background noise dominated by plant from campus building. Some contribution from distant traffic noise. Infrequent traffic on Bassett Avenue affect L_{eq}.

Table 5 Measurements made at location N1

Time	Elapsed Time	L_{90}	L_{10}	L_1	L_{eq}	Comments
21:25	00:10	46	49	50	48	Plant noise and distant traffic noise dominate background. Some vehicles passing on Bassett Avenue.
22:42	00:10	45	48	50	47	Noise from plant and distant traffic dominate background. Some traffic on Bassett Avenue and Burgess Road. Measurement paused for 2-3 minutes as staff left car park.
02:50	00:10	40	43	46	42	As previous.

Table 6 Measurements made at location N2

Time	Elapsed Time	L_{90}	L_{10}	L_1	L_{eq}	Comments
21:38	00:10	47	51	52	49	Traffic noise dominates both L_{90} and L_{eq}. Some noise from traffic on Burgess Road.
22:57	00:10	45	49	51	47	As above.
03:02	00:10	37	41	48	42	Distant traffic dominates background noise with some contribution from on-site plant. Traffic on Burgess Road affects L_{eq}.

Table 7 Measurements made at location N3

Time	Elapsed Time	L_{90}	L_{10}	L_1	L_{eq}	Comments
21:52	00:10	50	74	77	69	Traffic on Burgess Road dominates L_{eq}. Distant traffic dominates background. 50-60 vehicles pass in 5 mins.
23:10	00:10	43	70	73	64	~40 cars pass on Burgess Road in 5 mins. Distant traffic noise dominates background.
03:17	00:10	36	50	71	56	Distant traffic noise dominates background while noise from occasional traffic on Burgess Road affects L_{eq}. ~10-15 vehicles pass in 5 mins.

Table 8 Measurements made at location N4

Time	Elapsed Time	L_{90}	L_{10}	L_1	L_{eq}	Comments
22:25	00:10	46	50	52	48	Further down Oaklands Way, background noise dominated by plant from current buildings and distant traffic noise. Relatively frequent traffic on Bassett Avenue.
02:33	00:10	41	44	48	43	As above.

Table 9 Measurements made at location N5

4 Headline Implications of Measured Noise levels

The dominant noise sources are road traffic on Burgess Road and the Basset Avenue. Noise levels from road traffic on Basset Crescent East are relatively low. Initial assessments and recommendations are given below. These will need to be confirmed by further design work and more detailed analysis.

4.1 Residential Buildings

BS8233:1999 Sound insulation and noise reduction for buildings – Code of practice, gives guidance at Section 7.6.12 Design Criteria and provides limits for intrusive external noise:

‘For dwellings, the main criteria are reasonable resting / sleeping conditions in bedrooms and good listening conditions in other rooms’.

This is quantified in Table 5 of BS8233 as:

For good conditions the maximum noise levels in living rooms and in bedrooms should be no more than 30dB$L_{Aeq,T}$; for reasonable conditions the maximum noise level in living rooms should be no more than 40dB$L_{Aeq,T}$ and in bedrooms should be no more than 35dB$L_{Aeq,T}$.

It is estimated that the sound insulation of a partially open window will be between 10dB and 13dB. Therefore the maximum night-time noise level at the facade of a residential building should be <53dB$L_{Aeq,T}$.

Residences should not therefore have bedroom facades that look directly out over Burgess Road or Basset Avenue, because of the noise generated by these roads. Residences with bedroom facades that face toward Basset Crescent East or are otherwise shielded from the noise from Burgess Road and Basset Avenue are likely to achieve reasonable resting / sleeping conditions in accordance with the criterion given in BS8233.

4.2 Educational Buildings

Building Bulletin 93 '*Acoustic Design of Schools'* gives criteria for internal ambient noise levels in teaching spaces that are considered to provide appropriate teaching conditions. The BB93 criteria can be used as a basis for setting noise ingress criteria for teaching spaces at Boldrewood Campus. However, the BB93 criteria could reasonably be relaxed for University teaching accommodation since an adult listener is better at rejecting background noise than a school-age listener.

Based on BB93 criteria and the measured noise levels, it is recommended that teaching spaces with facades that overlook Burgess Road or Basset Avenue should not rely on natural ventilation, because of noise ingress. The initial assessment is that teaching spaces with facades that face toward Basset Crescent East or are otherwise shielded from the noise from Burgess Road and Basset Avenue could be naturally ventilated and be suitable quiet for teaching / lecturing purposes.

4.3 Office Accommodation

Criteria for noise break-in to office accommodation are given in the British Council for Offices (BCO) guidance.

BCO guidance recommends that external noise intrusion levels (whether from road, rail or aircraft sources) should, after attenuation by the composite building envelope, not exceed the following acoustic design criteria:

- Open plan offices NR38 (L_{Aeq})
- Cellular Offices NR35 (L_{Aeq})

BCO also gives guidance that, in the case of naturally ventilated buildings, it may be appropriate or necessary to accept higher external noise intrusion levels.

Based on the BCO guidance and measured noise levels, it is recommended that office spaces with facades that overlook Burgess Road or Basset Avenue should not rely on natural ventilation, because of noise ingress. The initial assessment is that office spaces with facades that face toward Basset Crescent East or are otherwise shielded from the noise from Burgess Road and Basset Avenue could be naturally ventilated and achieve suitable control of noise ingress.

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Appendix A

Acoustic Terminology

A1 Acoustic Terminology

A1.1 dB(A)

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 10dB corresponds to a subjective doubling or halving of the loudness of a noise, and a change of 2 to 3dB is subjectively barely perceptible.

A1.2 Equivalent Continuous Sound Level

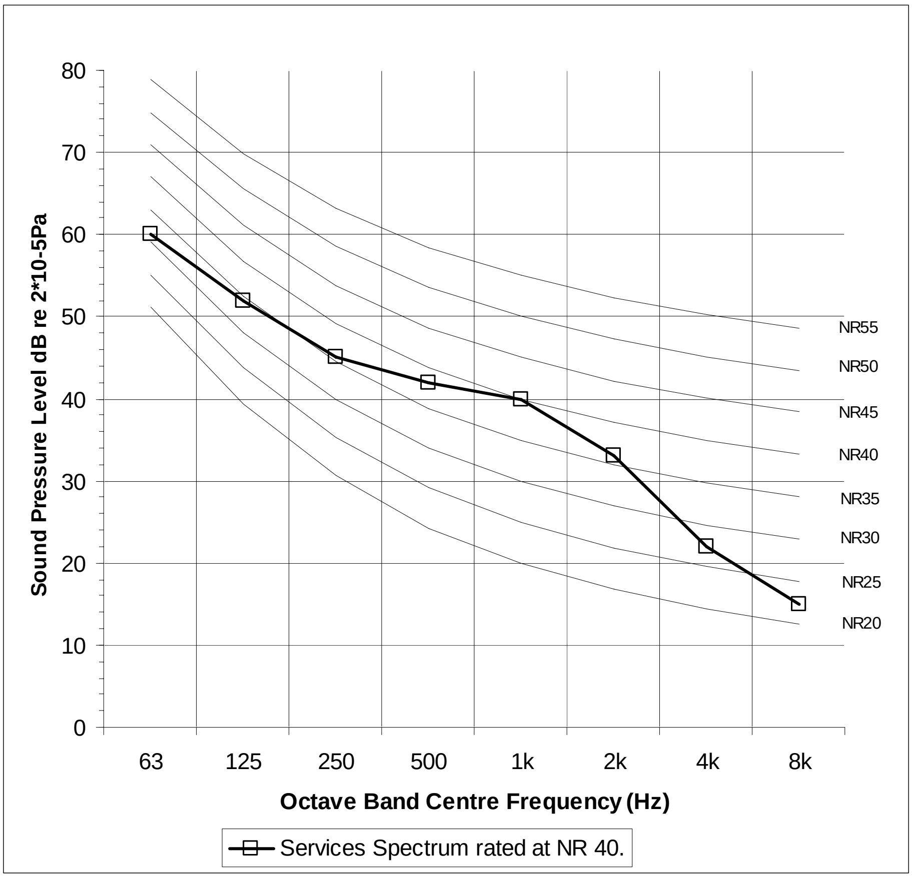
Another index for assessment for overall noise exposure is the equivalent continuous sound level, L_{eq}. This is a notional steady level which would, over a given period of time, deliver the same sound energy as the actual time-varying sound over the same period. Hence fluctuating levels can be described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

A1.3 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 been adopted in this country 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}, dBL_{A90} etc. The reference time period (T) is normally included, eg $dBL_{A10, 5min}$ or $dBL_{A90, 8hr}$.

A1.4 Noise Rating (NR) Curves

Noise rating (NR) curves are a set of internationally-agreed octave band sound pressure level curves, based on the concept of equal loudness. The curves are commonly used to define building services noise limits. The NR value of a noise is obtained by plotting the octave band spectrum on the set of standard curves. The highest value curve which is reached by the spectrum is the NR value. Shown below is a plant noise spectrum that is equivalent to NR40.


80
70
60
50
40
30
20
10
0
Sound Pressure Level dB re 2*10-5Pa
63
125
250
500
1k
2k
4k
8k
Octave Band Centre Frequency (Hz)
NR55
NR50
NR45
NR40
NR35
NR30
NR25
NR20
Services Spectrum rated at NR 40.