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REPORT AS8012.141120.NIA

ROYAL HOLLOWAY UNIVERSITY, 11 BEDFORD SQUARE, LONDON

NOISE IMPACT ASSESSMENT

Prepared: 20 November 2014

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List of Attachments

1. INTRODUCTION

Planning approval is being sought for the installation of new cooling plant at Royal Holloway University, 11 Bedford Square, London.

Clarke Saunders Associates has been commissioned by Royal Holloway University to undertake an environmental noise survey in order to measure the prevailing background noise climate at the site. The background noise levels measured will be used to determine daytime and night-time noise emission limits for new building services plant and assessment of plant noise impact at nearby receptor locations, in accordance with the planning requirements of Camden Council.

2. SITE DESCRIPTION

11 Bedford Square is a Grade 1 listed building is an end of terrace bounded by Gower Street to the west, Montague Place to the South and Malet Street Gardens to the east. The adjacent terrace building is understood to be used are office space. There are further office premises across Gower Street and Montague Place with a number of the surrounding buildings being occupied by Royal Holloway University.

The building is used as office and teaching spaces by Royal Holloway University, typically occupied between 09:00hours and 21:00hours.

3. SURVEY PROCEDURE & EQUIPMENT

A survey of the existing background noise levels was undertaken at roof level of the existing building at the location shown in site plan AS8012/SP1. This location was chosen to best represent an acoustic that may be expected at the adjacent premises with a degree of screening from the surrounding noise sources. Measurements of consecutive 5-minute L_{Aeq}, L_{Amax}, L_{A10} and L_{A90} sound pressure levels were taken between 18:00 hours on Monday 17th November and 09:00 hours on Wednesday 19th November 2014.

These measurements will allow suitable noise criteria to be set for the new building services plant, dependent on hours of operation.

The following equipment was used during the course of the survey:

- Rion data logging sound level meter type NA28;

- Rion sound level calibrator type NC-74.

The calibration of the sound level meter was verified before and after use. No significant calibration drift was detected.

The weather during the survey was mostly dry with light winds, which made the conditions suitable for the measurement of environmental noise.

Measurements were made generally in accordance with ISO 1996-2:2007 *Acoustics - Description, measurement and assessment of environmental noise – Part 2: Determination of environmental noise levels*.

Please refer to Appendix A for details of the acoustic terminology used throughout this report.

4. RESULTS

Figures AS8012/TH1-TH2 show the L_{Aeq}, L_{Amax}, L_{A10} and L_{A90} sound pressure levels as time histories at the measurement position.

5. DISCUSSION

The site presents a typical urban acoustic with the background noise climate primarily determined by road traffic noise in the surrounding streets with some noise from plant serving surround buildings.

Measured minimum background noise levels are shown in Table 5.1 below.

Monitoring period	Minimum $L_{A90,10mins}$
07:00 - 23:00 hours	47 dB 20:30-20:35, 17/11/14
23:00 - 07:00 hours	44 dB 02:55 - 03:00 17/11/18
24 hours	44 dB

Table 5.1 - Minimum measured background noise levels **[dB ref. 20µPa]**

6. DESIGN CRITERIA

Table E of the Camden Development Policies 2010-2025, DP28, state that the requirement for planning permission to be granted is that noise levels from plant and machinery at 1 metre external to a sensitive façade do not exceed a level 5dB below the background level, or 10 dB below background level if the noise has any distinguishable character (bangs, clicks, clatters, thumps, whine, hiss, screech or hum).

In addition, the council is understood to request that the background level must not be exceeded by more than 1dB in any octave band between 63Hz and 8kHz.

It is not expected that tonal noise will be generated by the proposed plant units and so the plant noise emissions criteria that should not be exceeded at the nearest noise sensitive receiver should be set to the proposed levels detailed in Table 6.1 and Table 6.2.

Daytime (07:00 – 23:00 hours)	Night-time (23:00 – 07:00 hours)	24 hours
L_{Aeq} 42 dB	L_{Aeq} 39 dB	L_{Aeq} 39 dB

Table 6.1 - Proposed design noise criteria **[dB ref. 20µPa]**

The following spectral criteria have been determined by adding 1dB to each octave band of the frequency spectrum recorded at the time of the minimum L_{A90} value.

Freq (Hz)	63	125	250	500	1k	2k	4k	8k
Criterion	31	36	41	42	43	38	29	19

Table 6.2 - Spectral design criterion

6.2 BS8233: 2014 Guidance on sound insulation and noise reduction for buildings

The guidance in this document indicates 'good' and 'reasonable' noise levels for various activities within various types of buildings.

The relevant sections of this standard are shown in the following table:

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living Room	35 dB $L_{Aeq, 16 hour}$	-
Dining	Dining Room	40 dB $L_{Aeq, 16 hour}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq, 16 hour}$	30 dB $L_{Aeq, 8 hour}$

Table 6.3 - Excerpt from BS8233: 2014 **[dB ref. 20µPa]**

7. PREDICTED NOISE IMPACT

7.1 Proposed plant

The selected plant has been confirmed as:

- 2 no. Mitsubishi Condensing Units Type PUMY P-125 VKM
- 1 no. Mitsubishi Condensing Unit Type MUZ-HJ35VA

The condensing units are to be installed in the vaults below Montague Street at the approximate location of the plant to be installed is shown in site plan AS8012/SP1.

Noise levels generated by the PUMY P-125 VKM condensing units have been confirmed by the manufacturer as follows:

Freq (Hz)	63	125	250	500	1000	2000	4000	8000	dB(A)
L_p @ 1m (dB)	57	53	52	51	46	42	36	30	52
L_p @ 1m (dB) - Low Noise Mode	61	47	46	45	41	36	36	33	47

Table 7.1 - Source noise data for the type PUMY P-125 VKM condenser [dB ref. 20µPa]

No published spectral data for the type MUZ-HJ35VA condensing unit is available. Instead, it has been assumed that the spectral shape of the PUMY P-125 VKM unit has been assumed to be representative and levels have been uniformly changed to match the published A-weighted single value level for the unit:

Freq (Hz)	63	125	250	500	1000	2000	4000	8000	dB(A)
Lp @ 1m (dB)	55	51	50	49	44	40	34	28	50

Table 7.2 - Source noise data for the type MUZ-HJ35VA condenser [dB ref. 20µPa]

7.2 Predicted noise levels

Following an inspection of the site, no surrounding residential premises were identified. The assessment is therefore undertaken to the most affected neighbour, being situated across Montague Place as shown on the indicative site plan AS8012/SP1. This façade is at least 14 metres away from the proposed plant location.

The cumulative noise level at the nearest noise sensitive receiver has been assessed according to the guidelines set out in BS4142:1997 *Method for rating industrial noise affecting mixed residential and industrial areas* as guidance, using the noise data above.

The building services engineer has confirmed that the condensing units will typically only operate during occupancy of the building (09:00-21:00hours) with some capacity for 24hour operation for the server room.

Attenuation due to propagation distance, screening by the pavement and reflections off the backing building façade have been included in this robust calculation.

Assessment Period	Predicted Noise Level	Design Criteria
Daytime (07:00 – 23:00 hours)	27 dB(A)	42 dB(A)
Night-time (23:00 – 07:00 hours)	23 dB(A)	39 dB(A)

Table 7.3 - Predicted noise level and criteria at assessment location [dB ref. 20 µPa]

Freq (Hz)	63	125	250	500	1k	2k	4k	8k
Criterion	31	36	41	42	43	38	29	19
Predicted level at 1m from receiver	34	29	26	22	15	8	2	0

Table 7.4 - Predicted night time noise level and criteria at assessment location [dB ref. 20 µPa]

A summary of the calculations are shown in Appendix B.

All other air handling and extract plant will be fitted with acoustically specified splitter silencers in order that the cumulative noise level does not exceed the 24-hour design noise criterion.

7.3 Comparison to BS8233:2014 Criteria

Table 7.3 clearly shows that the predicted noise levels would meet the recommended internal noise levels of BS8233:2014.

A previous edition of the standard, BS8233:1999 assumes a loss of 10-15dB for a partially open window.

On this basis, assuming a modest loss of 10dB, the external noise level shown in Table 7.3 would result in an internal noise levels that would be below the values recommended in Table 6.3.

8. CONCLUSION

An environmental noise survey has been undertaken at Royal Holloway University, 11 Bedford Square, London by Clarke Saunders Associates between Monday 17th November and Wednesday 19th November 2014.

Measurements have been made to establish the current background noise climate. This has enabled a 24-hour design criterion to be set for the control of plant noise emissions to noise sensitive properties, in accordance with the requirements of Camden Council.

Data for the new Mitsubishi Condensing Units have been used to predict the noise impact of the new plant on neighbouring residential properties.

Compliance with the noise emission design criterion has been demonstrated. No further mitigation measures are required for the control of external plant noise emissions.

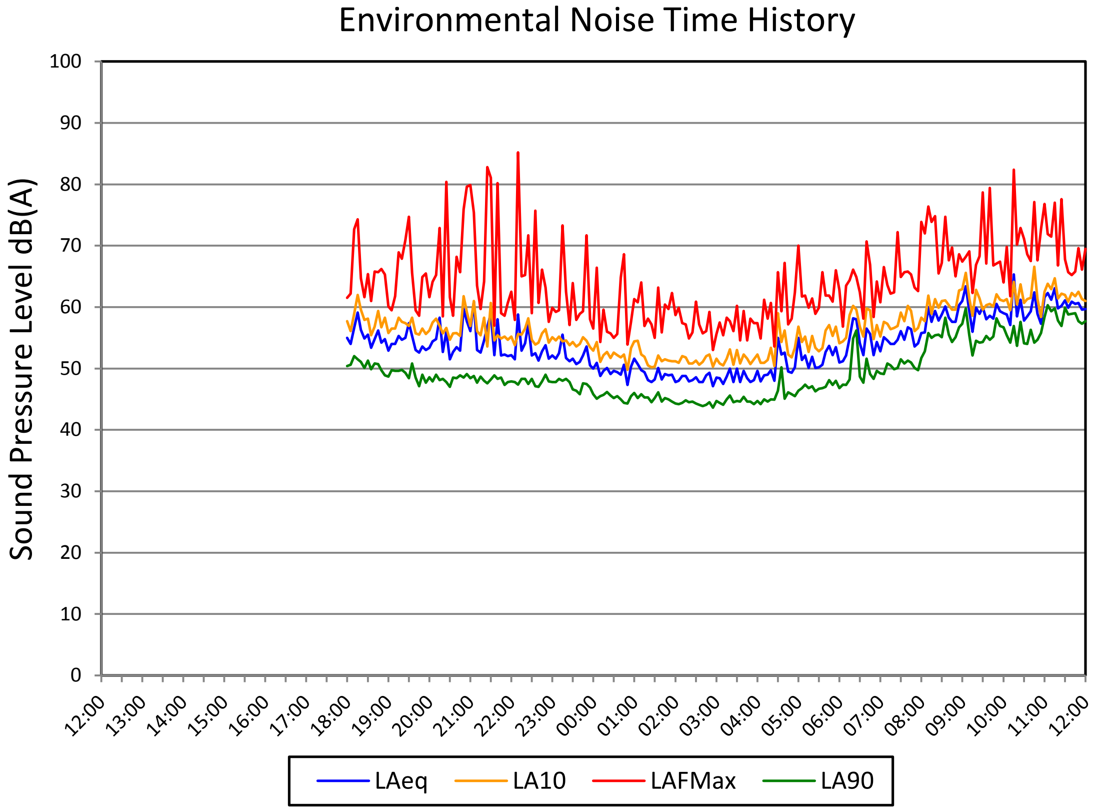
S.Liddell

S.Liddell (Nov 20, 2014)

Steven Liddell MIOA
CLARKE SAUNDERS ASSOCIATES

Figure AS8012/SP1

Royal Holloway University, 11 Bedford Square



Monday 17 November to Tuesday 18 November 2014

Figure AS8012/TH1

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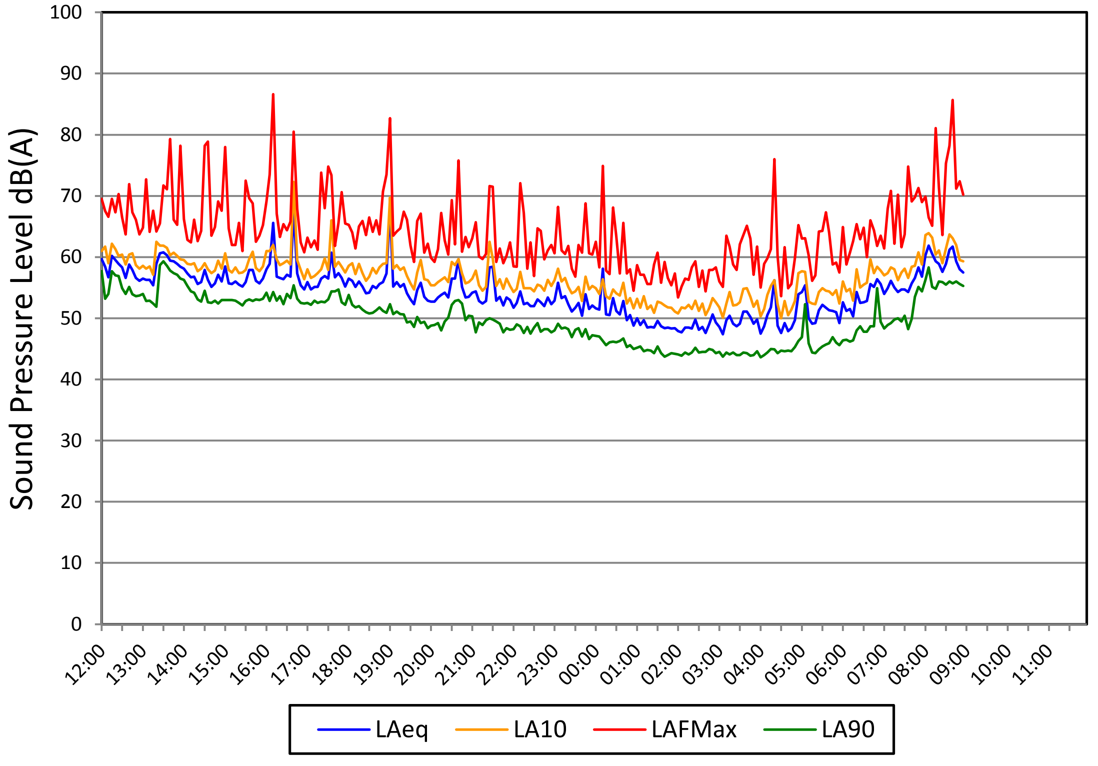
Royal Holloway University, 11 Bedford Square

Environmental Noise Time History



Tuesday 18 November to Wednesday 19 November 2014

Figure AS8012/TH2

APPENDIX A

ACOUSTIC TERMINOLOGY & HUMAN RESPONSE TO BROADBAND NOISE

1.0 ACOUSTIC TERMINOLOGY

The annoyance produced by noise is dependent upon many complex interrelated factors such as 'loudness', its frequency (or pitch) and any variations in its level. In order to have some objective measure of the annoyance, scales have been derived to allow for these subjective factors.

dB (A): The human ear is more susceptible to mid-frequency noise than the high and low frequencies. To take account of this when measuring noise, the 'A' weighting scale is used so that the measured noise corresponds roughly to the overall level of noise that is discerned by the average human. It is also possible to calculate the 'A' weighted noise level by applying certain corrections to an un-weighted spectrum. The measured or calculated 'A' weighted noise level is known as the dB(A) level.

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, as being a high average, it takes into account the increased annoyance that results from the non-steady nature of traffic noise.

L_{eq} : The concept of L_{eq} (equivalent continuous sound level) has up to recently been primarily used in assessing noise in industry but seems now to be finding use in defining many other types of noise, such as aircraft noise, environmental noise and construction noise.

L_{eq} is defined as a notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the actual, fluctuating sound measured over that period (e.g. 8 hour, 1 hour, etc).

The use of digital technology in sound level meters now makes the measurement of L_{eq} very straightforward.

Because L_{eq} is effectively a summation of a number of noise events, it does not in itself limit the magnitude of any individual event, and this is frequently used in conjunction with an absolute noise limit.

L_{max} : L_{max} is the maximum sound pressure level recorded over the period stated. L_{max} is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the L_{eq} noise level.

D The sound insulation performance of a construction is a function of the difference in noise level either side of the construction in the presence of a loud noise source in one of the pair of rooms under test. *D*, is therefore simply the *level difference* in decibels between the two rooms in different frequency bands.

D_w D_w is the *Weighted Level Difference* The level difference is determined as above, but weighted in accordance with the procedures laid down in BS EN ISO 717-1.

$D_{nT,w}$ $D_{nT,w}$ is the *Weighted Standardised Level Difference* as defined in BS EN ISO 717-1 and represents the *weighted level difference*, as described above, corrected for room reverberant characteristics.

C_{tr} C_{tr} is a spectrum adaptation term to be added to a single number quantity such as $D_{nT,w}$, to take account of characteristics of a particular sound.

$L'_{nT,w}$ $L'_{nT,w}$ is the *Weighted Standardised Impact Sound Pressure Level* as defined in BS EN ISO 717-2 and represents the level of sound pressure when measured within room where the floor above is under excitation from a calibrated tapping machine, corrected for the receive room reverberant characteristics.

APPENDIX A

ACOUSTIC TERMINOLOGY & HUMAN RESPONSE TO BROADBAND NOISE

2.0 OCTAVE BAND FREQUENCIES

In order to determine the way in which the energy of sound is distributed across the frequency range, the International Standards Organisation have agreed on "preferred" bands of frequency for sound measurement and analysis. The widest and most commonly used band for frequency measurement and analysis is the Octave Band. In these bands, the upper frequency limit is twice the lower frequency limit, with the band being described by its "centre frequency" which is the average (geometric mean) of the upper and lower limits, eg. 250 Hz octave band runs from 176 Hz to 353 Hz. The most commonly used bands are:

Octave Band Centre Frequency Hz	63	125	250	500	1000	2000	4000	8000

3.0 HUMAN PERCEPTION OF BROADBAND NOISE

Because of the logarithmic nature of the decibel scale, it should be borne in mind that noise levels in dB(A) do not have a simple linear relationship. For example, 100dB(A) is not twice as loud as 50 dB(A) sound level. It has been found experimentally that changes in the average level of fluctuating sound, such as traffic noise, need to be of the order of 3 dB(A) before becoming definitely perceptible to the human ear. Data from other experiments have indicated that a change in sound level of 10 dB(A) is perceived by the average listener as a doubling or halving of loudness. Using this information, a guide to the subjective interpretation of changes in traffic noise level can be given.

INTERPRETATION

Change in Sound Level dB(A)	Subjective Impression	Human Response
0 to 2	Imperceptible change in loudness	Marginal
3 to 5	Perceptible change in loudness	Noticeable
6 to 10	Up to a doubling or halving of loudness	Significant
11 to 15	More than a doubling or halving of loudness	Substantial
16 to 20	Up to a quadrupling or quartering of loudness	Substantial
21 or more	More than a quadrupling or quartering of loudness	Very Substantial

4.0 EARTH BUNDS AND BARRIERS - EFFECTIVE SCREEN HEIGHT

When considering the reduction in noise level of a source provided by a barrier, it is necessary to establish the "effective screen height". For example if a 3 metre high barrier exists between a noise source and a listener, with the barrier close to the listener, the listener will perceive the noise source is louder, if he climbs up a ladder (and is closer to the top of the barrier) than if he were standing at ground level. Equally if he sat on the ground the noise source would seem quieter than it was if he were standing. This may be explained by the fact that the "effective screen height" is changing with the three cases above, the greater the effective screen height, in general, the greater the reduction in noise level.

Where the noise sources are various roads, the attenuation provided by a fixed barrier at a specific property will be greater for roads close to the barrier than for roads further away.

APPENDIX B
AS8012 - Royal Holloway University, 11 Bedford Square
Plant Noise Assessment

To Nearest Most Affected Noise Sensitive Receiver

Daytime Operation (3 units)		63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	dB(A)
PUMY P-125 VKM	Lp @ 2m	57	53	52	51	46	42	36	30	**52**
For Number of Plant	2	60	56	55	54	49	45	39	33	
MUZ-HJ35VA	Lp @ 2m	55	51	50	49	44	40	34	28	**50**
For Number of Plant	1	55	51	50	49	44	40	34	28	
Combined SPL from all plant	Lp @ 2m	61	57	56	55	50	46	40	34	**56**
Distance Loss	To 14m	-19	-19	-19	-19	-19	-19	-19	-19	
Reflection off backing wall	Q=2	3	3	3	3	3	3	3	3	
Screening*		-7	-8	-10	-12	-15	-17	-18	-18	
Specific Noise Level at Receiver	$L_{eq\ 1hr}$	**38**	**33**	**30**	**27**	**19**	**12**	**6**	**0**	**27**

** Screening loss limited to 18dB*

Background Noise Level **47 dB(A)**
Design Criteria **42 dB(A)**

Night time operation (1 unit)		63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	dB(A)
PUMY P-125 VKM	Lp @ 2m	57	53	52	51	46	42	36	30	**52**
Distance Loss	To 14m	-19	-19	-19	-19	-19	-19	-19	-19	
Reflection off backing wall	Q=2	3	3	3	3	3	3	3	3	
Screening*		-7	-8	-10	-12	-15	-17	-18	-18	
Specific Noise Level at Receiver	$L_{eq\ 1hr}$	**34**	**29**	**26**	**22**	**15**	**8**	**2**	**0**	**23**

** Screening loss limited to 18dB*

Background Noise Level **44 dB(A)**
Design Criteria **39 dB(A)**