Consultants in Acoustics, Noise & Vibration

024495-R01-A

11 April 2024

The Honourable Society of Lincoln's Inn – Strong Rooms

Noise survey and plant noise egress limits

London, Manchester, Edinburgh, Birmingham, Belfast, Leeds

post@sandybrown.com www.sandybrown.com

Sandy Brown Ltd Registered in England & Wales No. 13227735

Registered Office: 55 Charterhouse Street, London EC1M 6HA

Consultants in Acoustics, Noise & Vibration

Version	Date Comments		Author	Reviewer		
А	11 Apr 24		Paul Monaghan	Steven Wheeler		

Disclaimer

This report has been prepared for the sole benefit and use of our client based on their instructions and requirements. Sandy Brown Ltd extends no liability in respect of the information contained in the report to any third party.

Consultants in Acoustics, Noise & Vibration

Summary

Sandy Brown has been commissioned to provide acoustic advice in relation to proposed works at the Great Hall, the Honourable Society of Lincoln's Inn, London WC2A 3TL. The works involve the replacement of two rooftop chiller units.

An environmental noise survey has been carried out to determine the existing sound levels in the area. The noise survey was performed between 11:00 on 22 March 2024 and 10:15 on 26 March 2024.

The representative background sound levels measured during the survey were $L_{A90,15min}$ 45 dB during the day and $L_{A90,15min}$ 42 dB at night.

Based on the requirements of the Local Authority and on the results of the noise survey, all plant must be designed such that the cumulative noise level at 1 m from the worst affected windows of the nearby noise sensitive premises does not exceed $L_{Aeq,15min}$ 38 dB during the day, and $L_{Aeq,15min}$ 35 dB during the night. These have been corrected relative to the measured free-field background sound levels by the addition of 3 dB (as per the guidance provided in BS 8233:2014 Section G.2.1).

These limits are cumulative, and apply with all plant operating under normal conditions. If plant items contain tonal or attention catching features, a penalty based on the type and impact of those features will be applied, and the limits will be more stringent than those set.

An assessment of the replacement plant items associated with the project has been carried out. The proposed replacement plant items are expected to comply with the relevant noise limits.

Consultants in Acoustics, Noise & Vibration

Contents

1	Introduction	5
2	Site description	5
3	Development proposals	6
4	Building services noise egress criteria	6
5	Noise survey method	7
6	Noise survey results	8
7	Plant noise assessment	10
8	Conclusion	12
Ap	pendix A	13
	Survey details	13
Ap	pendix B	16
	Results of unattended measurements at Location 'L'	16
Ap	pendix D	18
	Plant assessment calculation	18
Ap	pendix C	20
	BS 4142 corrections for attention catching features	20

1 Introduction

Sandy Brown has been commissioned to provide acoustic advice in relation to proposed works at the Great Hall, the Honourable Society of Lincoln's Inn (HSLI), London WC2A 3TL. The works involve the replacement of two rooftop chiller units.

As part of this, an environmental noise survey is required to establish the existing background sound levels in the vicinity of nearby noise sensitive premises and to set appropriate limits for noise egress from building services plant.

This report presents the survey method and results, and a discussion of acceptable limits for noise emissions from building services plant. An environmental noise egress assessment of the proposed replacement plant items is also included.

2 Site description

2.1 The site and its surrounding

The site location in relation to its surroundings is shown in Figure 1.



Figure 1 Aerial view of site (courtesy of Google Earth Pro)

Lincoln's Inn is a society of lawyers with a very long history situated in a tranquil enclave of around 11 acres. 'Lincoln's Inn' thus refers both to the Society and the place.

As well as housing the Society's own facilities, Lincoln's Inn is the location of many barristers' chambers and some solicitors' offices. It faces the Royal Courts of Justice and the Lincoln's Inn Fields across the road to the west.

As well as the Inn's general facilities, there are also residences located within the boundary of the site, the nearest are within Old Buildings and New Square.

The Great Hall is located on the western perimeter of the Lincoln's Inn estate. Lincoln's Inn Fields (road and public park) is located directly to the west.

The site lies within the jurisdiction of the London Borough of Camden (LBC).

2.2 Adjacent noise sensitive premises

The nearest noise sensitive receptors to the Great Hall are:

- Old Buildings, as indicated by the letter 'A' in Figure 1
- New Square Chambers, as indicated by the letter 'B' in Figure 1.

The nearest and worst-affected of these is Old Buildings. As such, this receptor has been assessed herein.

3 Development proposals

Two new plant items are proposed to replace two existing units located on the roof of the Great Hall. An environmental noise survey and plant noise assessment has been carried out to support the planning application for this. It is understood the application has recently been submitted. Sandy Brown have previously been involved in noise surveys and plant noise assessments associated with the Great Hall and other related buildings in the area.

4 Building services noise egress criteria

4.1 Standard guidance

BS 4142:2014:+A1:2019 *Methods for rating and assessing industrial and commercial sound* (BS 4142) provides a method for assessing noise from items such as building services plant against the existing background sound levels at nearby noise sensitive premises.

BS 4142 suggests that if the noise level is 10 dB or more higher than the existing background sound level, it is likely to be an indication of a significant adverse impact. If the level is 5 dB above the existing background sound level, it is likely to be an indication of an adverse impact. If the level does not exceed the background sound level, it is an indication of having a low impact.

If the noise contains 'attention catching features' such as tones, bangs etc, a penalty, based on the type and impact of those features, is applied.

4.2 Local Authority criteria

LBC considers residential spaces, schools and hospitals to be noise sensitive. Appendix 3 of London Borough of Camden Local Plan (2017) states that:

'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.'

5 Noise survey method

5.1 Unattended measurements

Unattended noise monitoring was undertaken at the site over five days.

Details of the equipment used and the noise indices measured are provided in Appendix A.

The unattended measurements were taken over 15-minute periods between 11:00 on 22 March 2024 and 10:15 on 26 March 2024.

The measurement position used during the survey is indicated in Figure 1, denoted by the letter 'L'. A photograph showing the measurement location is provided in Figure 2.



Figure 2 Photograph of the noise monitoring equipment at location 'L'

This location was chosen to be reasonably representative of noise levels at the site and outside the nearest noise sensitive premises.

5.2 Weather conditions

Weather conditions during the survey are described in Appendix A.

6 Noise survey results

6.1 Observations

The dominant noise sources observed at the site during the survey were from fountains on the HSLI estate to the south and intermittent passing pedestrians and road traffic through the site. Some intermittent construction noise (ie, drilling to the northwest) was also observed.

Less significant noise sources included wind and wildlife (eg, birds). Plant on the existing rooftop was slightly audible, despite being completely screened from the microphone.

6.2 Noise measurement results

A graph showing the results of the unattended measurements is provided in Appendix B.

Ambient noise levels measured during the unattended survey are presented in Table 1.

Measured minimum background sound levels are given in Table 2.

Table 1 Ambient noise levels measured during the unattended survey

Date	Day (07:00 – 23:00)	Night (23:00 – 07:00)			
	L _{Aeq,16h} (dB)	L _{Aeq,8h} (dB)			
Friday 22 March 2024	-	46			
Saturday 23 March 2024	50	46			
Sunday 24 March 2024	49	47			
Monday 25 March 2024	52	46			
Average	50	46			

Consultants in Acoustics, Noise & Vibration

Date	Day (07:00 – 23:00)	Night (23:00 – 07:00)		
	L _{A90,15min} (dB)	L _{A90,15min} (dB)		
Friday 22 March 2024	43 ^[1]	42		
Saturday 23 March 2024	44	42		
Sunday 24 March 2024	42	41		
Monday 25 March 2024	43	41		
Tuesday 26 March 2024	45 ^[1]	-		

Table 2 Minimum background sound levels measured during the unattended survey

^[1] Measurement not made over full period due to monitoring start and end time.

The lowest background sound levels measured during the survey were $L_{A90,15min}$ 42 dB during the day and $L_{A90,15min}$ 41 dB at night.

In line with BS 4142:2014+A1:2019, representative background sound levels have been determined using statistical analysis of the continuous measurements.

Day and night statistical analysis of representative values for the site are given in Figure 3.



Figure 3 Statistical analyses of the representative noise levels at location 'L'

From this analysis, the representative background sound levels measured during the survey were $L_{A90,15min}$ 45 dB during the day and $L_{A90,15min}$ 42 dB at night.

7 Plant noise assessment

7.1 Basic limits

Based on the above criteria and the measurement results, the cumulative noise level from the operation of all new plant should not exceed the limits set out in Table 3.

The limits apply at 1 m from the worst affected windows of the nearest noise sensitive premises and are presented as facade levels. These have been corrected relative to the measured free-field background sound levels by the addition of 3 dB (as per the guidance provided in BS 8233:2014 Section G.2.1). In this case these limits would apply at location 'R' indicated in Table 3.

Time of day	Maximum sound pressure level at 1 m from noise sensitive premises, $L_{Aeq,15min}$ (dB)
Day (07:00-23:00)	38
Night (23:00-07:00)	35

Table 3 Plant noise limits at 1 m from the nearest noise sensitive premises

^[1] The limits set out in Table 3 do not include any attention catching features. Penalty corrections for attention catching features may be significant and will need to be considered as the building services design progresses. This is discussed in Appendix D.

All building services plant will be designed to achieve the noise limits set out above, including any corrections for attention catching features.

A plant assessment has been carried out to determine whether the newly proposed plant items will meet these noise limits. It is understood that the proposed plant items are to replace the existing items and will be installed in the same location.

7.2 Proposed plant items

A drawing showing the locations of the proposed plant items is presented in Figure 4.

There is a Daikin VRV condenser unit on the roof that it being retained.

The proposed plant items include 2 No Aermec ANL040 air to water chiller units. These are understood to be replacing the 2 No existing Aermec ANLI070HX air to water chiller units. The new units will be installed in the same location as the existing. This is essentially a like-for-like replacement, with the new units being slightly quieter.

Consultants in Acoustics, Noise & Vibration



Figure 4 Scale drawing showing the locations of the proposed plant items

Sound power level data for the units has been provided by the building services engineer (Tim Spouge, Ingleton Wood LLP) and is presented in Table 4.

Table 4 Sound power level data for each unit

Unit	Sound power level (dB)							
	Octave band centre frequency (Hz)							
	125	250	500	1000	2000	4000	8000	dBA
Existing: Aermec ANLI070HX air to water chiller	-	-	-	-	-	-	-	69
Replacement: Aermec ANL040 air to water chiller	75	70	64	64	57	51	45	68

Consultants in Acoustics, Noise & Vibration

7.3 Assessment

Based on the data provided, an assessment of the sound pressure level at Location 'A' (Old Buildings) has been carried out, taking into account distance attenuation.

Based on this, the predicted sound pressure level 1 m from the nearest facade of Old Square is presented in Table 5.

The full calculation is included in Appendix C.

Table 5 Predicted sound pressure level at Location 'R'

Receptor	Predicted sound pressure level (dB)				
Old Buildings	32				

The predicted noise level at Old Buildings complies with the noise limits for the day and night periods.

8 Conclusion

The representative background sound levels from the noise survey were $L_{A90,15min}$ 45 dB during the day, and $L_{A90,15min}$ 42 dB during the night.

Based on the requirements of the Local Authority, the relevant plant noise limits at the worst affected existing noise sensitive premises are L_{Aeq} 38 dB during the day, and L_{Aeq} 35 dB during the night. These have been corrected relative to the measured free-field background sound levels by the addition of 3 dB (as per the guidance provided in BS 8233:2014 Section G.2.1).

These limits are cumulative, and apply with all plant operating under normal conditions. If plant items contain tonal or attention catching features, the limits will be more stringent than those set out above. If plant items contain tonal or attention catching features, a penalty based on the type and impact of those features will be applied.

An assessment of the proposed replacement plant items associated with the development has been carried out. The proposed plant items are expected to comply with the relevant noise limits.

Appendix A

Survey details

Consultants in Acoustics, Noise & Vibration

Equipment

The noise measurements were taken using a Rion NL-52 sound level meter.

Calibration details for the equipment used during the survey are provided in Table A1.

Equipment description	Type/serial number	Manufacturer	Calibration expiry	Calibration certification number
Sound level meter	NL- 52/00264531	Rion	15 Dec 25	TCRT23/1926
Microphone	UC-59/09678	Rion	15 Dec 25	TCRT23/1926
Pre-amp	NH-25/64656	Rion	15 Dec 25	TCRT23/1926
Calibrator	NC- 75/35013664	Rion	14 Dec 25	TCRT23/1925

Table A1 Equipment calibration data

^[1] Calibration of the meters used for the measurements is traceable to national standards. Calibration certificates for the sound level meter used in this survey are available upon request.

Calibration checks were carried out on the meters and their measurement chains at the beginning and end of the survey. No significant calibration deviation occurred.

Noise indices

Noise indices recorded included the following:

- *L*_{Aeq,*T*} The A-weighted equivalent continuous sound pressure level over a period of time, T.
- $L_{AFmax,T}$ The A-weighted maximum sound pressure level that occurred during a given period, T, with a fast time weighting.
- $L_{A90,T}$ The A-weighted sound pressure level exceeded for 90% of the measurement period. Indicative of the background sound level.

Sound pressure level measurements are normally taken with an A-weighting (denoted by a subscript 'A', eg, L_{A90}) to approximate the frequency response of the human ear.

A more detailed explanation of these quantities can be found in BS 7445: Part 1: 2003 *Description and measurement of environmental noise, Part 1. Guide to quantities and procedures.*

Consultants in Acoustics, Noise & Vibration

Weather conditions

During the unattended noise measurements, weather reports for the area indicated that temperatures varied between 4°C at night and 15C during the day, and the wind speed was less than8 m/s.

These weather conditions are considered suitable for obtaining representative measurements.

Appendix B

Results of unattended measurements at Location 'L'

Consultants in Acoustics, Noise & Vibration



A-weighted sound pressure level (dB)

Appendix D

Plant assessment calculation

Consultants in Acoustics, Noise & Vibration

Project number	024495	Project name HSLI - Stro	ng Rooms	
Calculation revision	А			
Calculation by	Paul Monaghan		Date created	10/04/2024
Checked by	Steven Wheeler		Date checked	11/04/2024
Calculation description	Predicted noise	egress to Old Buildings		

Comments Octave band centre frequency (Hz)									
	63	125	250	500	1000	2000	4000	8000	dBA
Aermec ANL040									
Sound power level		53	53	60	60	61	61	61	68
Correction for 2 units	3	3	3	3	3	3	3	3	
Additional source directivity; Q = 4	6	6	6	6	6	6	6	6	
Total sound power level	9	62	62	69	69	70	70	70	77
Losses									
Distance attenuation - Point source, r=67m	47.5	47.5	47.5	47.5	47.5	47.5	47.5	47.5	
Total losses	48	48	48	48	48	48	48	48	
Sound pressure level after losses	-38	15	15	22	22	23	23	23	29
Facade correction	3	3	3	3	3	3	3	3	
Total facade sound pressure level at receptor	-35	18	18	25	25	26	26	26	32
Criteria									
Criteria - Night time									35

Criteria - Night time Difference

-3

Appendix C

BS 4142 corrections for attention catching features

The following applies where plant noise is assessed in accordance with BS 4142:2014+A1:2019.

If the proposed plant noise contains attention catching features (such as tonal elements, whines, whistles, bangs etc), penalty corrections should be applied based on the type and impact of the features.

If appropriate, a subjective assessment of the plant features can be adopted. Where the plant noise contains tonal elements, the following corrections can be made depending on how perceptible the tone is at the noise receptor:

- 0 dB where the tone is not perceptible
- 2 dB where the tone is just perceptible
- 4 dB where the tone is clearly perceptible
- 6 dB where the tone is highly perceptible.

Where the plant noise is impulsive, the following corrections can be made depending on how perceptible the impulsivity is at the noise receptor:

- 0 dB where the impulse is not perceptible
- 3 dB where the impulse is just perceptible
- 6 dB where the impulse is clearly perceptible
- 9 dB where the impulse is highly perceptible.

For noise which is equally both impulsive and tonal, then both features can be accounted for by linearly summing the corrections for both characteristics.

If the plant has other distinctive characteristics, such as intermittency, then a 3 dB correction can be made.

If a subjective assessment of tonality is not appropriate, an objective assessment can be made by analysis of time-averaged, third-octave band sound pressure levels. A noise source is deemed to be tonal if the level in a third-octave band exceeds the level in adjacent thirdoctave bands by the level differences given below:

- 15 dB in the low frequency third-octave bands (25 Hz to 125 Hz)
- 8 dB in the mid frequency third-octave bands (160 Hz to 400 Hz)
- 5 dB in the high frequency third-octave bands (500 Hz to 10000 Hz).

If an objective assessment identifies the plant noise to be tonal then a 6 dB correction must be made.