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AAD
applied
acoustic
design

THE IMPERIAL HOTEL, LONDON

EXTERNAL BUILDING FABRIC ASSESSMENT

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1.0 Introduction

1.1 Applied Acoustic Design were instructed by Artelia UK to undertake an external building fabric assessment for the proposed refurbishment of the Imperial Hotel in London. All windows to the existing façades are to be replaced.

1.2 A noise survey has been carried out at three locations on the west and south façades and over the canopy to the north east of the site. Measurements were taken to establish typical existing levels of ambient noise, which are used to inform the external building fabric design with respect to hotel accommodation.

1.3 This report outlines the elements of design that have been employed to achieve the standards required.

2.0 Site & Surroundings

2.1 The Imperial Hotel is located on Russell Square. The president Hotel is directly adjacent to the north of the site. Various commercial buildings are located to the south. The noise climate is dominated by continuous road traffic noise on the façade overlooking Russell Square. The other façades are exposed to existing plant noise from surrounding buildings.

2.2 An aerial view of the site, together with the noise survey locations are presented in Appendix A.

3.0 Noise Survey Details

3.1 Instrumentation: Long term unattended measurements of ambient noise were carried out with two NTi sound level meters (Serial No.: 10216 and 13312). The instruments were calibrated before and after the survey with the appropriate calibrator, no significant calibration drift was recorded.

3.2 Location: Unattended long-term measurements were carried at the 7th Floor on the west façade overlooking Russell Square. This location was deemed representative of the highest ambient noise levels incident on the hotel's façades. Unattended long-term measurements were also carried out at 8th Floor on the south façade of the wing building and at 1st Floor over the canopy to the north east of the site.

3.3 Period: Unattended long-term measurements were carried out between 12:00 on Thursday 24th January 2019 and 15:00 on Monday 28th January 2019, and between 12:00 on Wednesday 1st February 2019 and 08:00 on Tuesday 5th February 2019.

3.4 Weather: Weather was overcast and dry during the unattended survey. Wind speeds remained light with calm periods throughout the survey. Weather was overcast and dry during the attended survey. The data collected is deemed valid and representative of the local environment.

3.5 Site Noise Characteristics: Noise levels were dominated by road traffic noise at the 7th Floor location overlooking Russell Square and by plant noise at the two other locations.

3.6 Surveyor: Hasan Hakil MIOA, Alec Higgins AMIOA

3.7 Results: A summary of the noise levels used in the assessment are presented in Table 1. Long-term time histories are presented in Appendix B.

Table 1: Measured Ambient Noise Level – First Floor Location

Measurement Period	octave band centre frequency (Hz)								dBA
	63	125	250	500	1k	2k	4k	8k	
	sound pressure level, dB re $2x10^{-5}$ Pa								
Daytime (07:00-23:00)	47	60	60	63	63	60	53	41	66 ($L_{eq,16h}$)
Night-time (23:00-07:00)	42	52	53	54	55	53	47	40	59 ($L_{eq,8h}$)
Night-time (23:00-07:00)	49	59	60	62	64	63	58	49	68 (L_{max})

Table 2: Measured Ambient Noise Level – 7th Floor Location

Measurement Period	octave band centre frequency (Hz)								dBA
	63	125	250	500	1k	2k	4k	8k	
	sound pressure level, dB re $2x10^{-5}$ Pa								
Daytime (07:00-23:00)	74	67	63	63	65	62	54	47	69 ($L_{eq,16h}$)
Night-time (23:00-07:00)	68	61	59	60	64	61	53	45	67 ($L_{eq,8h}$)
Night-time (23:00-07:00)	65	66	68	71	73	73	70	68	78 (L_{max})

Table 3: Measured Ambient Noise Level – 8th Floor Location

Measurement Period	octave band centre frequency (Hz)								dBA
	63	125	250	500	1k	2k	4k	8k	
	sound pressure level, dB re $2x10^{-5}$ Pa								
Daytime (07:00-23:00)	66	59	59	57	56	54	46	32	61 ($L_{eq,16h}$)
Night-time (23:00-07:00)	67	59	57	56	55	54	45	34	60 ($L_{eq,8h}$)
Night-time (23:00-07:00)	56	57	59	62	64	64	61	59	69 (L_{max})

4.0 External Building Fabric Assessment

4.1 BS8233:2014 provides recommendations on suitable internal noise levels for bedrooms which are summarised below.

Table 4 : Building Envelope Sound Insulation Criteria – Residential Accommodation

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

4.2 In addition to the criteria above, it is desirable to set criteria for $L_{Amax,F}$ during the night-time because regular individual noise events can cause sleep disturbance, as stated in BS8233:2014. An internal noise criterion of 45 dB $L_{Amax,F}$ at night is deemed to be reasonable based on the 1999 version of BS8233.

4.3 It is understood that the existing façade elements are to be retained with the exception of the windows that are to all be replaced. The ventilation strategy is for fully mechanically assisted ventilation. Noise level data presented above was used to assess the window sound insulation performance requirements. Noise levels were assessed as measured for the 1st Floor and the 8th Floor locations. Distance corrections were applied to the data measured at the 7th Floor of the Russell Square façade location to account for higher traffic noise levels at lower floors.

4.4 The existing external wall construction is understood to be a cavity masonry wall and is predicted to provide a laboratory sound insulation performance of 45 dB R_w.

4.5 The existing roof construction is a concrete deck which is estimated to achieve a laboratory sound insulation performance of 47 dB R_w.

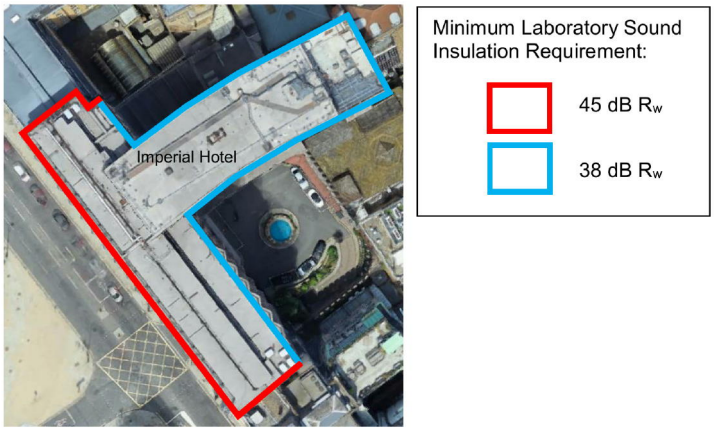
4.6 The external wall and roof fabric described above should provide sufficient sound insulation performance in order not to contribute to internal noise levels. The weakest external building fabric element will be the windows. Table 5 presents the window sound insulation requirements so that the internal noise level criteria for bedrooms can be met.

Table 5 : Windows Sound Insulation Criteria

Façade	Sound Insulation Performance Criteria	Typical Glazing Configuration
Overlooking Russell Square and directly north and south façades	45 dB R_w	6mm glass / 12mm gap / 16.8mm laminated glass
All other façades	38 dB R_w	6mm glass / 12mm gap / 10mm glass

4.7 The figure below presents a mark-up of the window sound insulation requirements according to each façade.

Figure 1: Window Sound Insulation Requirement Mark-up



4.8 It should be noted that the sound insulation performance requirements for windows should be achieved for the system as a whole, i.e. including all fixed glazed elements, openable sections, related framework, mullions and transoms, and infill cladding panels. A window specification is presented in Appendix C.

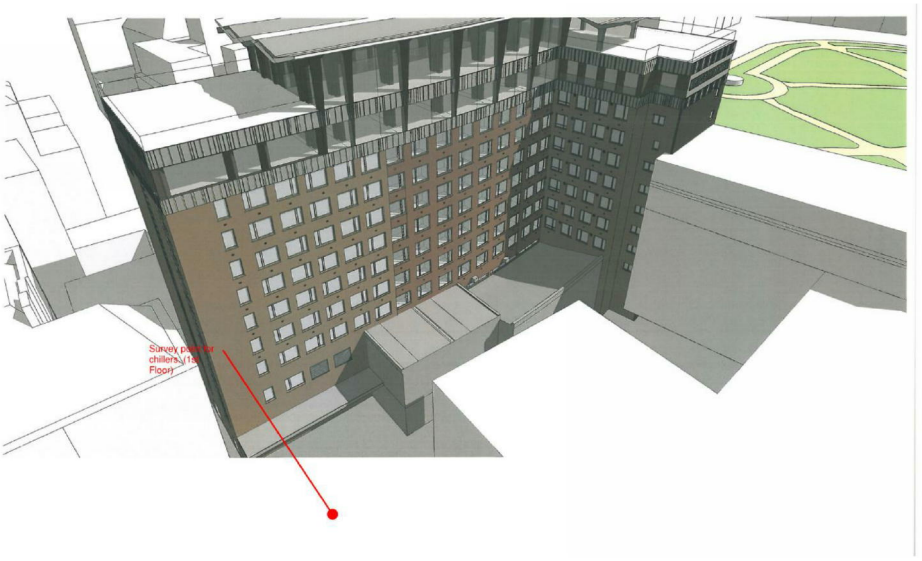
5.0 Conclusions

5.1 An ambient noise survey has been conducted for the proposed refurbishment of the Imperial Hotel façades.

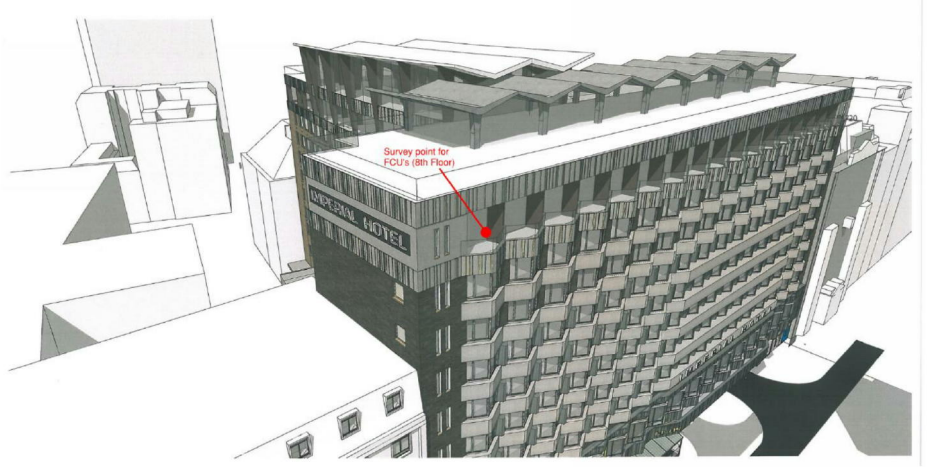
5.2 Measured ambient noise level data have been used to guide the development of the external building fabric with respect to BS8233 requirements for bedrooms.

5.3 Sound insulation performance requirements of the façades and doors should provide the minimum sound insulation performances set out in this report to ensure the internal noise level requirements are met.

Appendix A Site Location and Measurement Locations

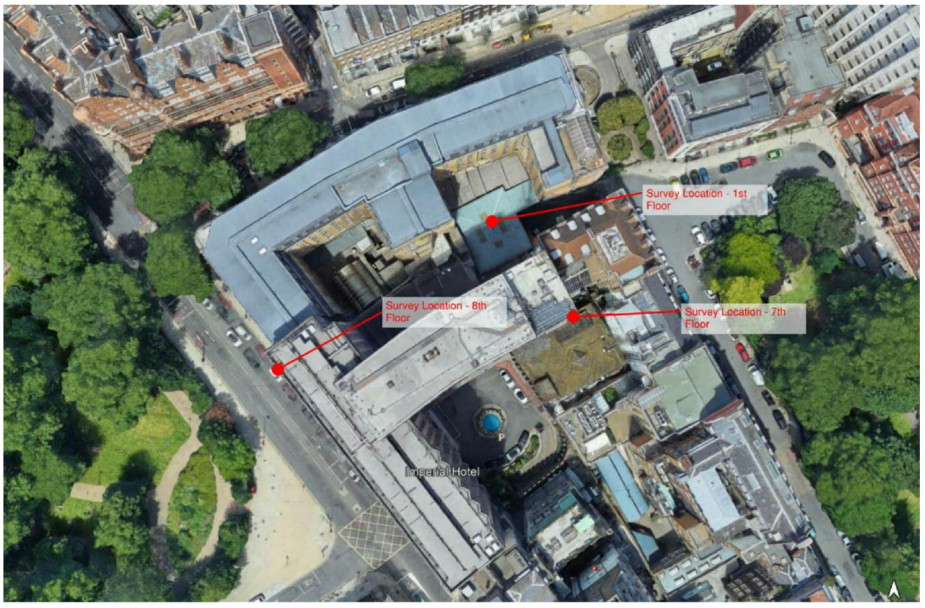


Isometric View – 1st Floor Noise Survey Location



Isometric View 7th Floor Noise Survey Location

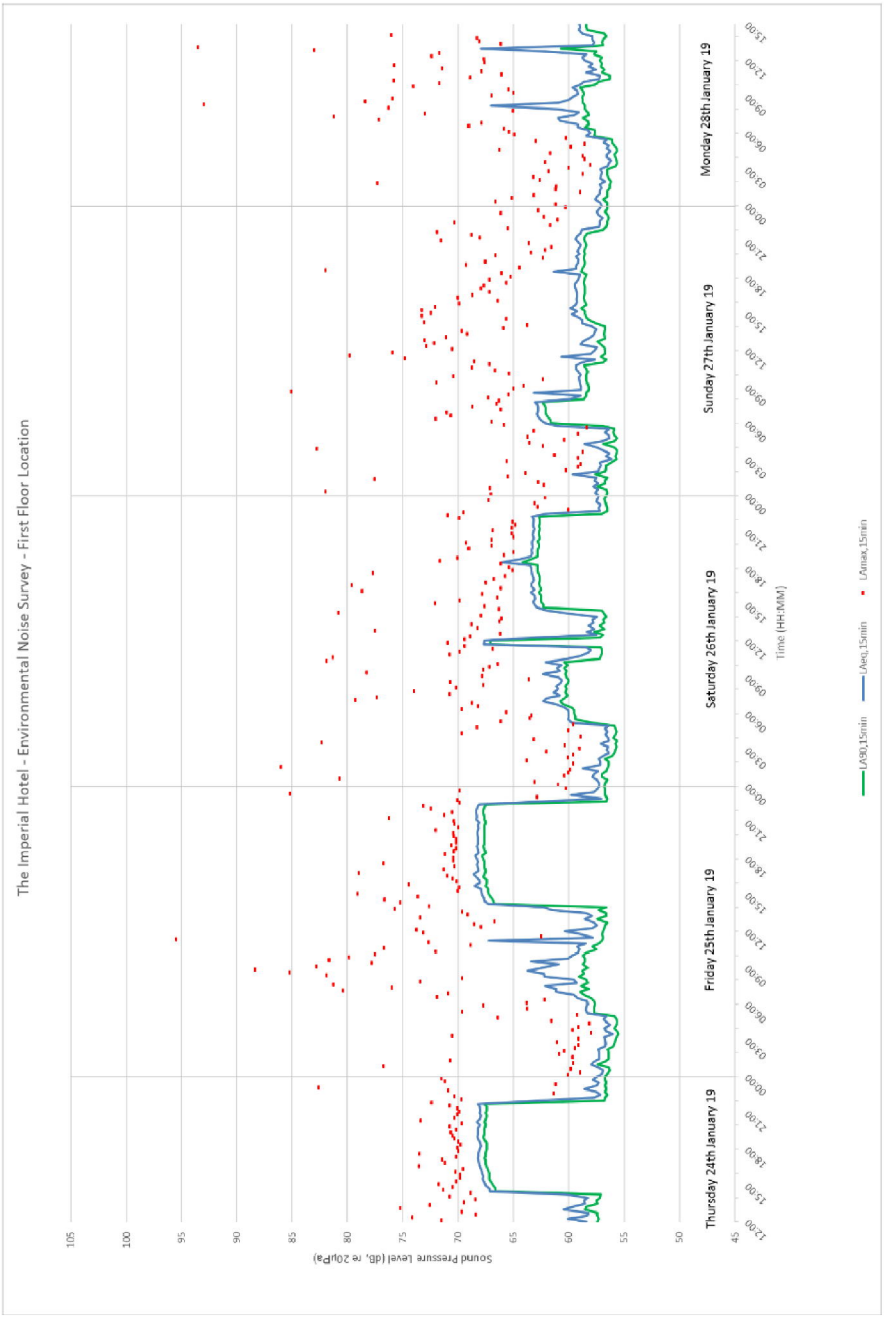
Isometric View – 8th Floor Noise Survey Location



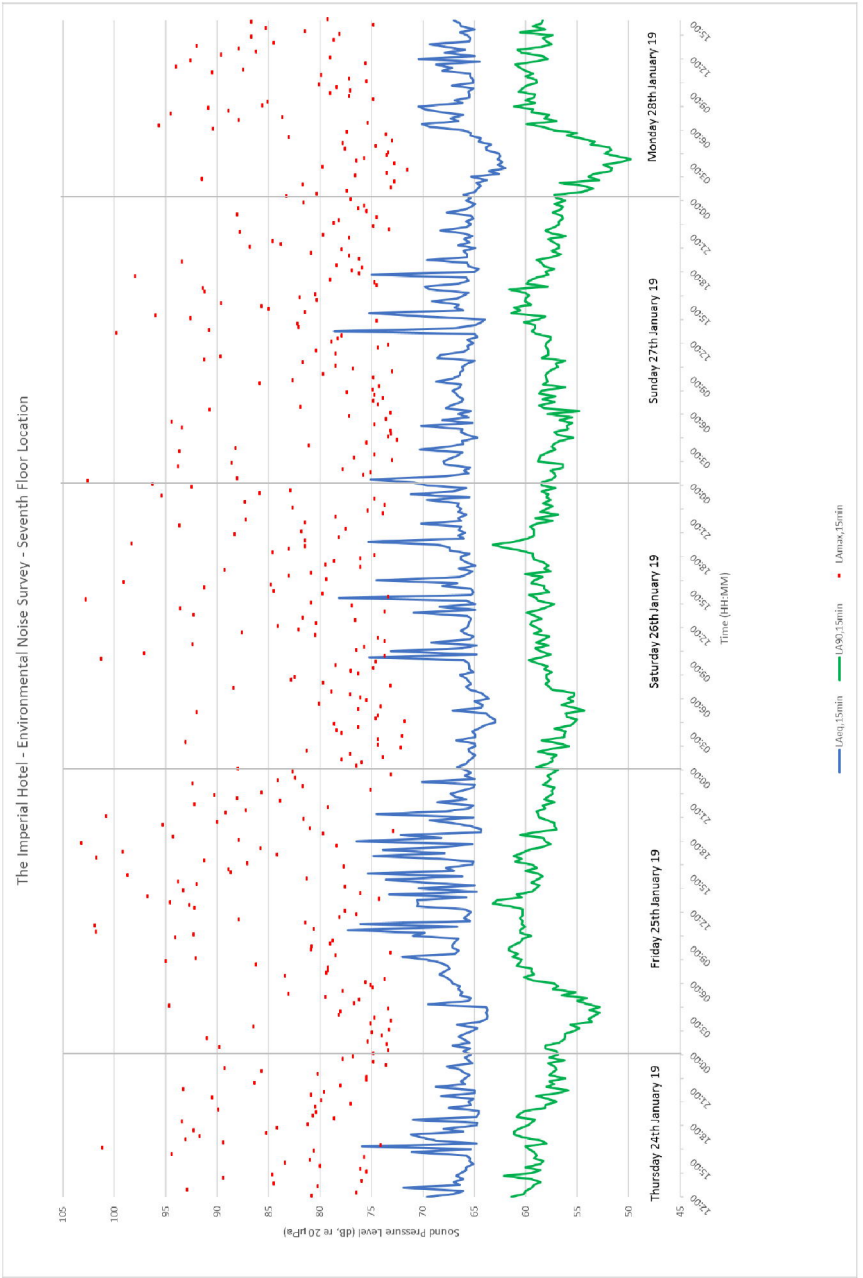
Top View – All Survey Locations

Appendix B Automated Noise Survey Results

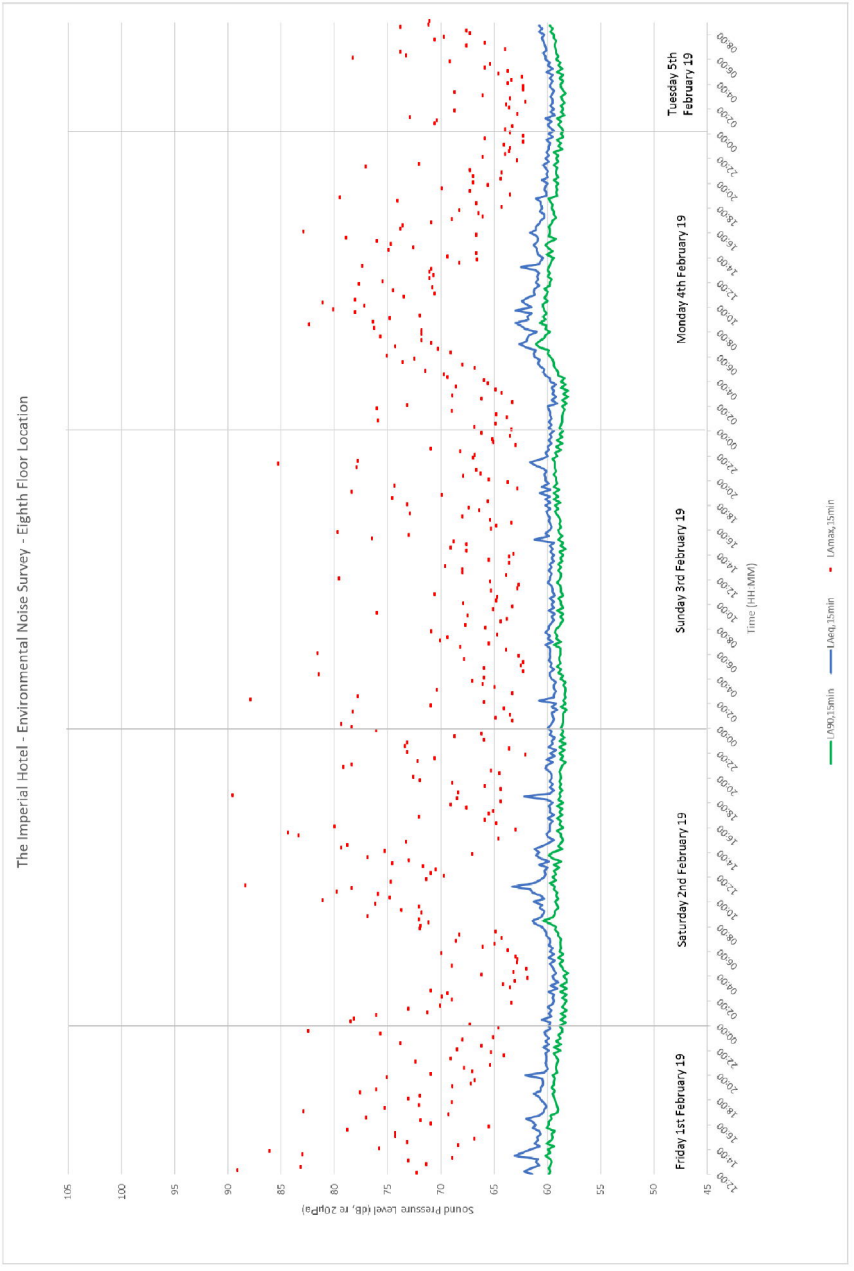
B.1 First Floor Location



B.2 7th Floor Location (Overlooking Russell Square)



B.3 8th Floor Location (Overlooking Courtyard)



Appendix C Window Acoustic Specifications

C.1 Window Acoustic Specifications

C.1.1 Windows, including all glazed elements, fixed and openable sections, related framework, mullions, transoms and, where applicable, furniture, all as are intended to be included within any part of the building façade, shall provide an airborne sound reduction performance of not less than the following;

Table C.1.1 : Window Acoustic Specifications

Façade	octave band centre frequency (Hz)							R_w, dB
	63	125	250	500	1k	2k	4k	
	sound reduction index, R, dB							
Overlooking Russell Square and directly north and south façades	24	28	32	43	46	48	55	45
All other façades	22	26	27	34	40	38	46	38

C.1.2 Performance shall be as measured in accordance with BS EN ISO 10140-2:2010 and rated in accordance with BS EN ISO 717-1:1997, and evidence to this effect shall be published as part of the tender response.

Appendix D Glossary of Terms

Decibel, dB	A unit of level derived from the logarithm of the ratio between the value of a quantity and a reference value. For sound pressure level (Lp) the reference quantity is 2x10-5 N/m2. The sound pressure level existing when microphone measured pressure is 2x10-5 N/m2 is 0 dB, the threshold of hearing.
L	Instantaneous value of Sound Pressure Level (Lp).
Frequency	Is related to sound pitch; frequency equals the ratio between velocity of sound and wavelength.
A weighting	Arithmetic corrections applied to values of Lp according to frequency. When logarithmically summed for all frequencies, the resulting single "A weighted value" becomes comparable with other such values from which a comparative loudness judgement can be made, then, without knowledge of frequency content of the source.
$L_{eq,T}$	Equivalent continuous level of sound pressure which, if it actually existed for the integration time period T of the measurement, would possess the same energy as the constantly varying values of Lp actually measured.
$L_{Aeq,T}$	Equivalent continuous level of A weighted sound pressure which, if it actually existed for the integration time period, T, of the measurement would possess the same energy as the constantly varying values of Lp actually measured.
$L_{n,T}$	Lp which was exceeded for n% of time, T.
$L_{An,T}$	Level in dBA which was exceeded for n% of time, T.
$L_{min,T}$	The instantaneous minimum sound pressure level, which occurred during time, T.
$L_{Amin,T}$	The instantaneous minimum A weighted sound pressure level which occurred during time, T.
$L_{max,T}$	The instantaneous maximum sound pressure level, which occurred during time, T.
$L_{Amax,T}$	The instantaneous maximum A weighted sound pressure level which occurred during time, T.
Background Noise Level	The value of $L_{A90,T}$, ref. BS 4142 : 2014.
Specific Noise Level	The value of $L_{Aeq,T}$ at the assessment position produced by the specific noise source, ref. BS 4142 : 2014.
Rating Level	The specific noise level, corrected to account for any characteristic features of the noise, by adding a 5 dB penalty for any tonal, impulsive or irregular qualities, ref. BS 4142 : 2014.
Specific Noise Source	The noise source under consideration when assessing the likelihood of complaint.
Assessment Position	Unless otherwise noted, is a point at 1 m from the façade of the nearest affected sensitive property.