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REF: AS8175.190618.L3.1

20 June 2019

Mr P Segal
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Dear Paul

AS8175 UCLH PROTON BEAM THERAPY UNIT

Condition 21 Kitchen Extract Fan Sound Attenuation

Noise emissions from the proposed extract fan serving the Level 5 kitchen on the UCLH Proton Beam Therapy unit are subject to the following Condition 21:

Prior to the installation of any kitchen extract system, details of how the system will be sound attenuated and isolated from the structure shall be submitted to and approved by the Council such that the use can be carried out without detriment to the amenity of adjoining or surrounding premises and in accordance with the noise criteria outlined in condition number 24. Prior to occupation, the approved measures shall be installed and remain in place for the lifetime of the development.

The referenced Condition 24 states;

Noise levels at a point 1 metre external to sensitive facades shall be at least 5dB(A) less than the existing background measurement (LA90), expressed in dB(A) when all plant/equipment (or any part of it) is in operation unless the plant/equipment hereby permitted will have a noise that has a distinguishable, discrete continuous note (whine, hiss, screech, hum) and/or if there are distinct impulses (bangs, clicks, clatters, thumps), then the noise levels from that piece of plant/equipment at any sensitive façade shall be at least 10dB(A) below the LA90, expressed in dB(A).

Clarke Saunders Associates has undertaken a desktop assessment of noise emissions from the proposed kitchen extract fan, as required, prior to its installation.

The fan (item ref. EF-6 18) is to be located on the Level 6 roof close to Core 1 at the western end of the Grafton Way building, as shown in the attached figure AS8175/SP21.1. Duct-mounted attenuators are to be provided on the fan intake and discharge sides. The discharge duct will be orientated with its axis vertical, with an air velocity at termination of 15m/s.

The roof around Core 1 plant will be fitted with acoustic louvres which, in conjunction with rooftop plantroom structures, will form an open-top enclosure around the plant.

The nearest sensitive facade has been identified at the top floor apartment at the northern end of Paramount Court. Please refer to figure AS8175/SP21.1. This window is approximately one storey below the Level 6 roof.

Noise emissions have been confirmed by the fan supplier as follows.

Frequency (Hz)	63	125	250	500	1k	2k	4k	8k	dB(A)
L_{WA} in-duct discharge, dB	48	66	70	72	71	68	63	56	77
L_{WA} casing, dB	31	49	53	55	54	51	46	39	60

Fan Sound Power Levels dB re. 1 pW

The fan discharge attenuator has been specified with the following performance in terms of insertion loss:

Frequency (Hz)	63	125	250	500	1k	2k	4k	8k	dB(A)
Attenuator insertion loss, dB	3	6	7	7	9	7	6	7	-

Discharge attenuator insertion loss (minimum values) dB re. 20μPa

Background noise levels surveyed on the Grafton Way boundary of the vacant development site did not fall below 52dB $L_{A90,15min}$ in any surveyed 24-hour period. It is expected that, with its view of Tottenham Court Road, background noise levels at the receptor window were no lower and, in all probability, slightly higher than the measured levels.

In order for the cumulative noise level from all plant affecting the ambient noise at the receptor not to exceed the conditioned 47dB L_{Aeq}, an individual noise emission limit of 27dB L_{Aeq} has been adopted for fan design purposes.

Fan noise levels have been calculated to whole number precision at the windows of the nearest affected receptor. Please refer to Appendix B. These show that kitchen extract noise is not expected to exceed 27dB L_{Aeq} at the upper floors of Paramount Court. Noise is not expected to contain discrete tonal characteristics or be impulsive in nature.

The fan will be mounted upon the roof by means of vibration isolators incorporating steel springs, thereby controlling structure-borne noise transfer within the patient bedrooms below.

This assessment shows that fan noise at the most affected receptors is expected to be at least 25dB below the background noise level and, when considered cumulatively with other plant, is unlikely to result in overall noise emissions exceeding the requirements of Condition 24. Subsequently, Condition 21 is expected to be satisfied.

Yours sincerely
for CLARKE SAUNDERS ASSOCIATES
[redacted]

Matt Sugden
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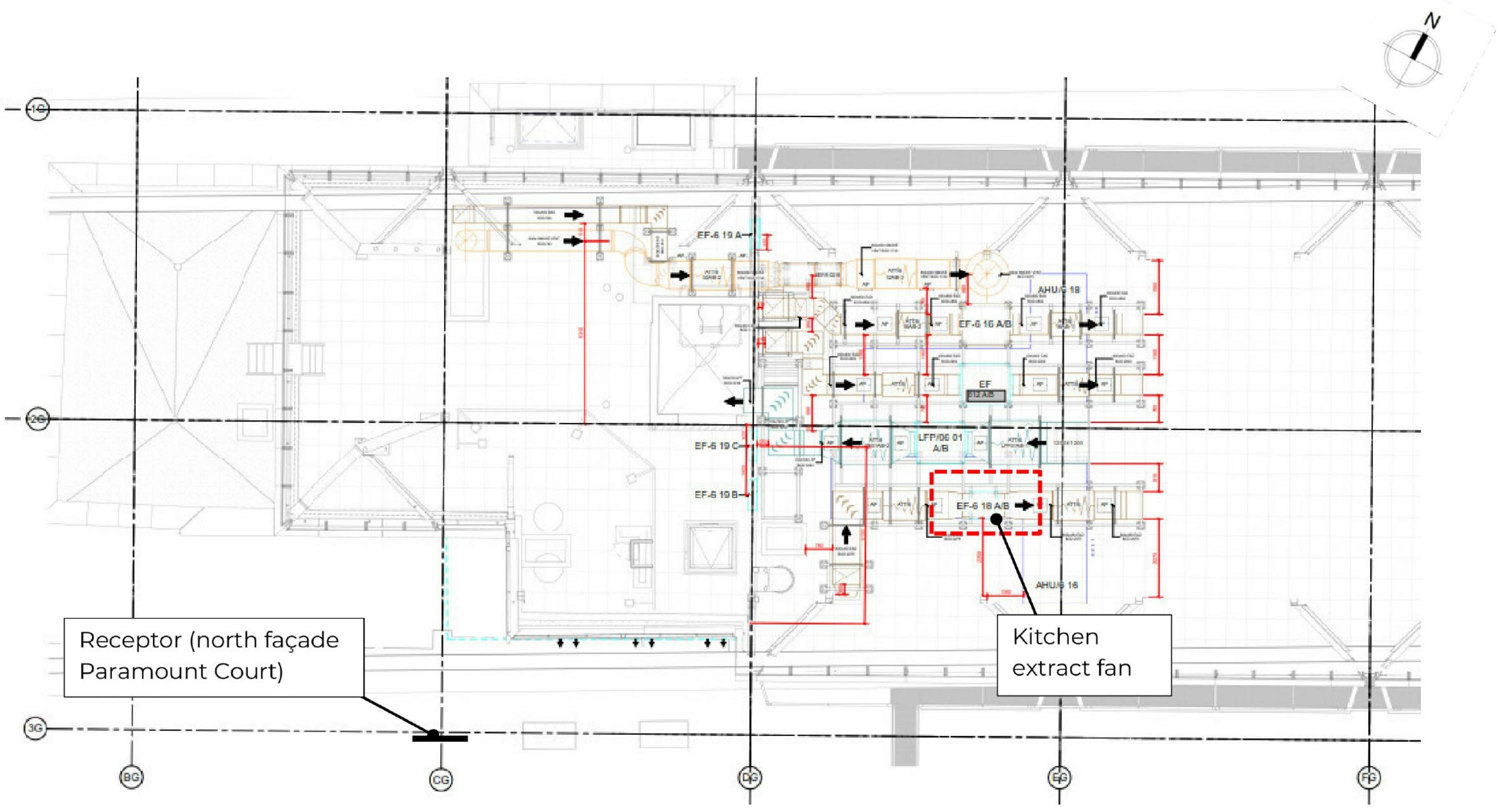
Encl.


N
1G
2G
3G
BG
CG
DG
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EF-6 19 A
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EF-6 19 B
AHU/6 18
EF-6 16 A/B
EF
LFP/06 01
A/B
EF-6 18 A/B
AHU/6 16
Receptor (north façade
Paramount Court)
Kitchen
extract fan

AS8175 UCLH PROTON BEAM THERAPY UNIT

APPENDIX B

CONDITION 21 – KITCHEN EXTRACT FAN NOISE ASSESSMENT

Kitchen extract fan		**63Hz**	**125Hz**	**250Hz**	**500Hz**	**1kHz**	**2kHz**	**4kHz**	**8kHz**	**dB(A)**
Fan discharge	L_{wA}	48	66	70	72	71	68	63	56	77
Attenuator		-3	-6	-7	-7	-9	-7	-6	-7	
Directivity (120^0)		0	0	0	-2	-2	-4	-4	-4	
Spherical propagation effect		-11	-11	-11	-11	-11	-11	-11	-11	
Distance loss (20m)		-26	-26	-26	-26	-26	-26	-26	-26	
Screening/louvre		-5	-5	-5	-5	-5	-5	-5	-5	
Contribution at receptor	L_{Aeq}	*3*	*18*	*21*	*21*	*18*	*15*	*11*	*3*	*26*
Fan casing	L_{wA}	31	49	53	55	54	51	46	39	60
Hemispherical propagation effect		-8	-8	-8	-8	-8	-8	-8	-8	
Distance loss (20m)		-26	-26	-26	-26	-26	-26	-26	-26	
Screening/louvre		-5	-5	-5	-5	-5	-5	-5	-5	
Contribution at receptor	L_{Aeq}	*-8*	*10*	*14*	*16*	*15*	*12*	*7*	*0*	*21*
Total fan noise level at receiver	L_{Aeq}	3	19	22	22	20	17	12	5	27

Discharge velocity noise		**63Hz**	**125Hz**	**250Hz**	**500Hz**	**1kHz**	**2kHz**	**4kHz**	**8kHz**	**dB(A)**
20m/s discharge (ref. VDI 2081)	L_{wA}	31	41	46	49	48	44	39	31	54
Directivity (120^0)		-11	-11	-11	-11	-11	-11	-11	-11	
Spherical propagation effect		-11	-11	-11	-11	-11	-11	-11	-11	
Distance loss (20m)		-26	-26	-26	-26	-26	-26	-26	-26	
Screening/louvre		-5	-5	-5	-5	-5	-5	-5	-5	
Contribution at receptor	L_{Aeq}	-22	-12	-7	-4	-5	-9	-14	-22	1

Compound noise level	L_{Aeq}	3	19	22	22	20	17	12	5	27

Night-time target 27dB(A)

1.1 Acoustic Terminology

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

Sound Vibrations propagating through a medium (air, water, etc.) that are detectable by the auditory system.

Noise Sound that is unwanted by or disturbing to the perceiver.

Frequency The rate per second of vibration constituting a wave, measured in Hertz (Hz), where 1Hz = 1 vibration cycle per second. The human hearing can generally detect sound having frequencies in the range 20Hz to 20kHz. Frequency corresponds to the perception of 'pitch', with low frequencies producing low 'notes' and higher frequencies producing high 'notes'.

dB(A): Human hearing is more susceptible to mid-frequency sounds than those at high and low frequencies. To take account of this in measurements and predictions, the 'A' weighting scale is used so that the level of sound corresponds roughly to the level as it is typically discerned by humans. The measured or calculated 'A' weighted sound level is designated as dB(A) or L_A.

L_{eq} : 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 concept of L_{eq} (equivalent continuous sound level) has primarily been used in assessing noise from industry, although its use is becoming more widespread in defining many other types of sounds, such as from amplified music and environmental sources such as aircraft and construction.

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

L_{10} & L_{90} : Statistical L_n indices are used to describe the level and the degree of fluctuation of non-steady sound. 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 a typical maximum level. Similarly, L_{90} is the typical minimum level and is often used to describe background noise.

It is common practice to use the L_{10} index to describe noise from traffic as, being a high average, it takes into account the increased annoyance that results from the non-steady nature of traffic flow.

1.2 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 has 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, e.g. 250 Hz octave band extends from 176 Hz to 353 Hz. The most commonly used octave bands are:

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

1.3 Human Perception of Broadband Noise

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

INTERPRETATION

Change in Sound Level dB	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

1.4 Earth Bunds and Barriers - Effective Screen Height

When considering the reduction in sound level of a source provided by a barrier, it is necessary to establish the "effective screen height". For example if a tall barrier exists between a sound source and a listener, with the barrier close to the listener, the listener will perceive the sound as being 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 sound would seem quieter than if he were standing. This is explained by the fact that the "effective screen height" is changing with the three cases above. In general, the greater the effective screen height, the greater the perceived reduction in sound level.

Similarly, the attenuation provided by a barrier will be greater where it is aligned close to either the source or the listener than where the barrier is midway between the two.