clarke saunders | acoustics
specialist consultants

REPORT AS8175.180727.R2

UCLH PROTON BEAM THERAPY UNIT

CONDITION 25
INTERNAL NOISE BREAKOUT

Prepared: 03 August 2018

Bouygues UK
Elizabeth House
39 York Road
London SE1 7NQ

Head Office -
Westgate House
39 - 41 Romsey Road
Winchester
SO22 5BE
mail@clarkesaunders.com

London Office -
103 Gaunt Street
London
SE1 6DP
london@clarkesaunders.com

Exeter Office -
Sowton Business Park
Capital Court
Bittern Road
Sowton, Exeter
EX2 7FW
exeter@clarkesaunders.com

Tel: +44 (0) 1962 872130
mail@clarkesaunders.com

www.clarkesaunders.com

CONTENTS

List of Attachments

1.0 INTRODUCTION

Planning approval has been granted by Camden Council for the Phase 4 Proton Beam Therapy Unit upon the Former Odeon site and Rosenheim Building site (application ref. 2013/8192/P). Condition 25 of the consent requires submission of details for a scheme of mitigation developed to safeguard the amenities of the adjoining premises and the area against noise generated from within the building.

Bouygues UK has instructed Clarke Saunders to advise on the requirements and specification of such a scheme.

This report describes the means by which noise transmission will be controlled to reasonable levels within adjoining and nearby buildings.

2.0 CAMDEN REQUIREMENTS

Condition 25 of the consent reads as follows:

> *Prior to the laying of the first slab below ground level, a scheme for noise mitigation for the external façade shall be submitted to and approved by the local planning authority in writing and the buildings shall not be occupied until completed fully in accordance with such scheme as will have been approved.*

The condition has been set in observance of the requirements of policies CS5 and CS7 of the London Borough of Camden Local Development Framework Core Strategy and policy DP26 of the London Borough of Camden Local Development Framework.

None of the policies CS5, CS7 or DP26 provide guidance of acceptable levels of noise breakout from buildings. It is noted, however, that Table E of section 28.4 of Camden's Local Development Framework sets upper limits for noise emissions from plant and machinery, when assessed at 1 metre from a sensitive façade. These are summarised below.

<table>
<tr><th>Noise description and location of measurement</th><th>Time</th><th>Noise Level</th></tr>
<tr><td>Noise at 1 metre external to a sensitive façade</td><td rowspan="3">00:00h – 24:00h</td><td>5dB $< L_{A90}$</td></tr>
<tr><td>Noise that has a distinguishable discrete continuous note (whine, hiss, screech, hum) at 1 metre external to a sensitive façade</td><td>10dB $< L_{A90}$</td></tr>
<tr><td>Noise that has distinct impulses (bangs, clicks, clatters, thumps) at 1 metre external to a sensitive façade.</td><td>10dB $< L_{A90}$</td></tr>
</table>

Table 2.1 Summary of Camden LDF Acceptance Limits (from Table E of section 28.4)

3.0 SENSITIVE RECEPTORS

The development site is bounded to the west and south by Paramount Court, with the Jeremy Bentham public house at the southern end of the Huntley Street wing. Both have dwellings on their upper levels and share party walls with the Beam Therapy building.

Maple House lies to the north of the site, on the north side of Grafton Way and also has dwellings on its upper floors.

4.0 INTERNAL NOISE SOURCES

Parts of the Proton Beam Therapy building in which elevated levels of noise are expected, such as plantrooms, beam unit, etc., are located below ground and, as such would not produce significant levels of noise externally.

Internal areas located against the facades are generally occupied, i.e. wards and offices, and so will not generate exceptional levels of noise.

An MRI scanner room is located at ground level on the south side of the courtyard building, facing the rear windows of Paramount Court, as indicated in figure AS8175/SP25.1. Scanner operation can produce internal noise levels of up to around L_{eq} 80dB(A) over some 'flights', with characteristic 'ringing', 'chattering' and 'impulse' sounds.

It is presumed that the scanner could be in use at any time during daytime periods.

5.0 EXTERNAL BACKGROUND NOISE

Details and findings of pre-commencement environmental noise surveys have been provided previously[1].

Lowest background noise levels ($L_{A90,5min}$) at the survey position representative of conditions at the rear of Paramount Court during the period 07:00h to 23:00h were recorded as 50dB.

6.0 ASSESSMENT OF NOISE BREAKOUT

The acoustic performance specification of the building façades has been determined on the basis of external noise intrusion. The courtyard building facades, being exposed low levels of ambient noise, have a relatively low performance requirement of R_W 31dB as a minimum.

[1] Clarke Saunders Associates report ref. AS7143.131106.R4, December 2013

Calculations show that, on the basis of a typical façade system achieving sound reduction of R_w 31dB, noise levels at the nearest affected windows of the Paramount Court apartments due to MRI operation will be less than 30dB(A) $L_{eq,T}$.

This is around 20dB lower than the background noise level, and so would be in accordance with the requirements set out in Table 2.1. Based on this assessment, it is considered unlikely that scanner noise will be audible from Paramount Court.

7.0 CONCLUSION

Specifications of façade sound reduction have been set for all building façades of the Phase 4 Proton Beam Therapy Unit development at the site of the former Odeon cinema and Rosenheim Building.

The specifications have been developed to control the high levels external noise intruding within the building. As such, the external envelope is expected to provide ample control of internal noise breakout from the room types located on the façades, predominantly being wards, offices and waiting areas.

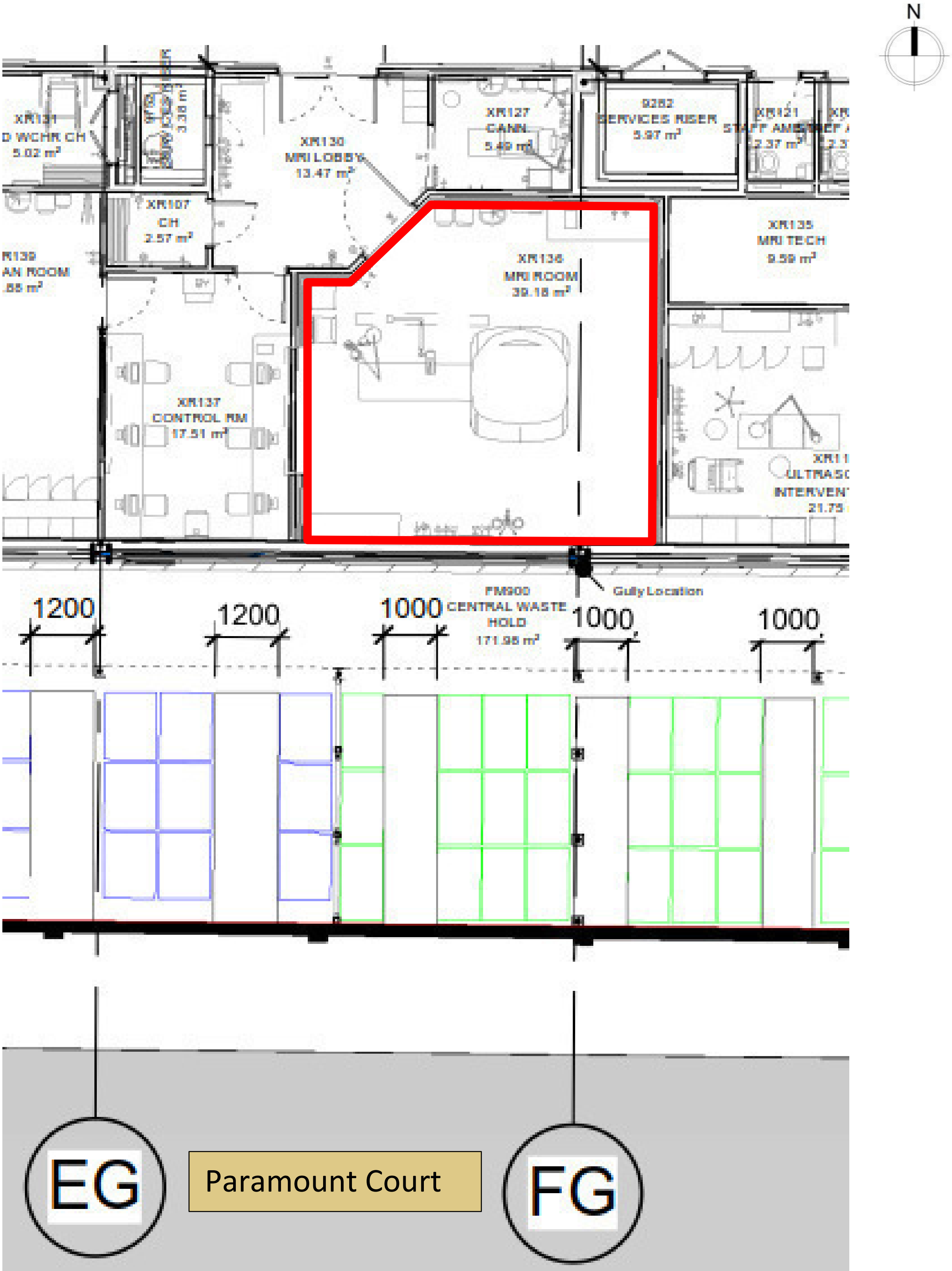
The case of an MRI scanner room located against an area of façade having relatively low sound reduction requirement has been identified. Calculations based upon measurements of scanner noise have been undertaken, which show that breakout noise levels around 20dB below background levels can be expected at 1m from the nearest sensitive façade.

It is, therefore, expected that the requirements of Camden's Condition 25 will be satisfied by the building envelope design.

Matt Sugden

Matt Sugden MIOA

CLARKE SAUNDERS ASSOCIATES


N
XR131
D WCHR CH
5.02 m²
XR130
MRI LOBBY
13.47 m²
XR127
CANN
5.49 m²
9282
SERVICES RISER
5.97 m²
XR121
STAFF AMENITIES
2.37 m²
XR107
CH
2.57 m²
XR135
MRI TECH
9.59 m²
XR136
MRI ROOM
39.18 m²
XR137
CONTROL RM
17.51 m²
Gully Location
FM900
CENTRAL WASTE
HOLD
171.96 m²
1200
1200
1000
1000
1000
EG
Paramount Court
FG

APPENDIX A

ACOUSTIC TERMINOLOGY & HUMAN RESPONSE TO BROADBAND SOUND

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.
R	*Sound Reduction Index.* Effectively the *Level Difference* of a building element when measured in an accredited laboratory test suite in accordance with the procedures laid down in BS EN ISO 10140-2:2010 and corrected for its size and the reverberant characteristics of the receive room.
R_w D_w $D_{nT,w}$ $D_{n,e,w}$ $D_{n,f,w}$	Value of parameter, determined as above, but weighted in accordance with the procedures laid down in BS EN ISO 717-1 to provide a single-figure value.

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

APPENDIX A

ACOUSTIC TERMINOLOGY & HUMAN RESPONSE TO BROADBAND SOUND

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

APPENDIX B
AS8175 UCLH Proton Beam Therapy Unit
MRI Scanner Room Noise Breakout Assessment

To Rear of Paramount Court

			63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	dB(A)
MRI room Lp, dB			75	70	73	75	79	73	68	59	**81**
R of façade (R_w 31dB)			27	22	23	27	28	39	42	40	
Reverberant/direct field correction, dB			-6	-6	-6	-6	-6	-6	-6	-6	
Façade W, m	6 m										
Façade H, m	3 m										
Distance to receptor	9 m										
Plane source distance loss, dB											
		Effective line source region	-3	-3	-3	-3	-3	-3	-3	-3	
		Effective point source region	-13	-13	-13	-13	-13	-13	-13	-13	
Noise Level at Receiver		$L_{eq,T}$	**25**	**26**	**28**	**25**	**28**	**11**	**3**	**-4**	**30**