The Pirate Club

Pirate Castle

Noise Survey and Recommendations for Noise Emission Limits

Report ref
AAc/114448/R02

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Noise Survey and Recommendations for Noise Emission Limits

February 2007

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It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party

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Executive Summary

As part of an extension to the existing Pirate Castle building, Arup Acoustics has been commissioned to carry out a background noise survey and to determine noise emission limits for services and operational noise breakout.

A noise survey in the vicinity of Pirate Castle has been performed, and noise emission limits determined. Based on the current plant selection, and assuming no tonality, the proposed roof-mounted mechanical services meet the conditions imposed by Camden Town Council.

Suitability of natural ventilation (ie open windows and doors in the main hall/annexe) has been assessed against mechanical ventilation. Mechanical ventilation should be used for all but the quietest of activities during the day and for all activities during the evening in order to limit noise break-out to local residential buildings.

Cladding of ducted connections should be provided unless there is no concern regarding noise emissions from the ducting.

In absence of a criterion for entertainment noise breakout to local residential buildings, a level of 10dB below background level was initially suggested in order to minimise local disturbance. The Camden Unitary Development Plan (UDP), revised in June 2006 was later used found to specify that noise from entertainment venues should not raise the lowest measured background level by more than 5dB(A). Levels have been assessed according to both criteria, recognising that while the UDP is the criterion for planning, further measures may be required due to the proximity of the new residential buildings at 35 Oval Road and the nature of the noise from Pirate Castle.

The proposed construction of the annexe meets the planning condition for break-out noise to local residential buildings according to the Camden Unitary Development Plan. Acoustic treatment to the ceiling of the main hall/annexe has been recommended to reduce the reverberant sound pressure level and for internal acoustic comfort. Further mitigation has been suggested for additional attenuation of noise.

1 Introduction

Arup Acoustics has been commissioned by The Pirate Club to:

- perform a survey of background noise levels in the vicinity of Pirate Castle and identify noise emission limits
- assess the suitability of natural ventilation (ie open windows and doors in the main building/annexe) with reference to meeting noise emission limits from internal activity
- assess roof-mounted plant for compliance with noise emission limits and propose mitigation as necessary
- advise on the transmission loss of the proposed structure with relation to occupational noise

2 Site Description

Pirate Castle is located on Oval Road, London NW1. To the north-west lies the Regents Canal, and a residential area (Gilbeys Yard). Oval Road passes the building on the east side. The site for a proposed Baratt development lies at 35, Oval Road, on the south side of the building.

A site map is shown in Figure 1.

3 Noise Survey

Noise monitoring was undertaken using an unmanned sound level meter located upon the roof of Pirate Castle from 13-18 October 2006. These data were supplemented by attended evening monitoring undertaken at ground level at locations representative of the nearby residential properties on 17 October 2006. Figure 1 shows the manned locations L1, L2 and L3, and the unmanned logging measurement location.

Location 1 was approximately 5m from the nearest residential façade in Gilbeys Yard, at the level of housing, facing Pirate Castle. This was the closest measurement location to the railway lines. Location 2 was similar, located closer to Oval Road.

Location 3 was approximately 2m in front of a 6-storey office façade. Measurements here were therefore subject to a façade effect (a 3dB increase) for sound incident on the façade.

Pirate Castle have agreed not to operate events or building services later than 2300. The relevant minimum noise levels were therefore derived from measurements before this time.

4 Noise Emission Criteria

4.1 Plant Noise

An email from Anona Arthur at the London Borough of Camden states that noise level output from plant should not increase existing background noise levels.

In order to meet this, the following are required by the London Borough of Camden:

- *Noise levels at a point 1 metre external to sensitive facades shall be at least 5dB(A) less than the existing background measurement (L_{A90})... when all plant/equipment are in operation.*
  When it is anticipated that any plant/equipment 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) special attention should be given to reducing the noise levels from that piece of plant/equipment at any sensitive façade to at least 10dB(A) below the L_{A90}.

- *For each of the octave band of centre frequencies 63Hz - 8kHz inclusive, noise levels from all plant/equipment (measured in L_{Aeq}) shall add not more than 1 decibel to the existing background noise level L_{A90}.*

It was agreed by the London Borough of Camden in a telephone conversation on 26 January 2007 that should the noise criterion of 5dB(A) below lowest background noise level be met, the octave band requirement does not apply.

4.2 Occupational Noise

A limiting level of 10dB below lowest measured background level was originally proposed as the criterion for occupational noise at a local façade. However, the Camden Unitary Development Plan (UDP) states that 'noise levels from places of entertainment on adjoining residential sites at which planning permission will not be granted' shall not increase $L_{Aeq, 1m}$ by more the 5dB as compared to the same measure, from the same position, and over a comparable period, with no entertainment taking place'. This limitation applies from 0700 – 2300. Thus the UDP allows a relaxation of 15dB from the criterion of 10dB below lowest measured background level.

It is the opinion of Arup Acoustics that in this case, should the UDP criterion be met, noise complaints could still result due to the nature of the noise and the proximity of the Pirate Castle building to the proposed adjacent residential development. The UDP and the -10dB criterion are therefore presented side-by-side, and predicted levels/attenuation required are compared to both.

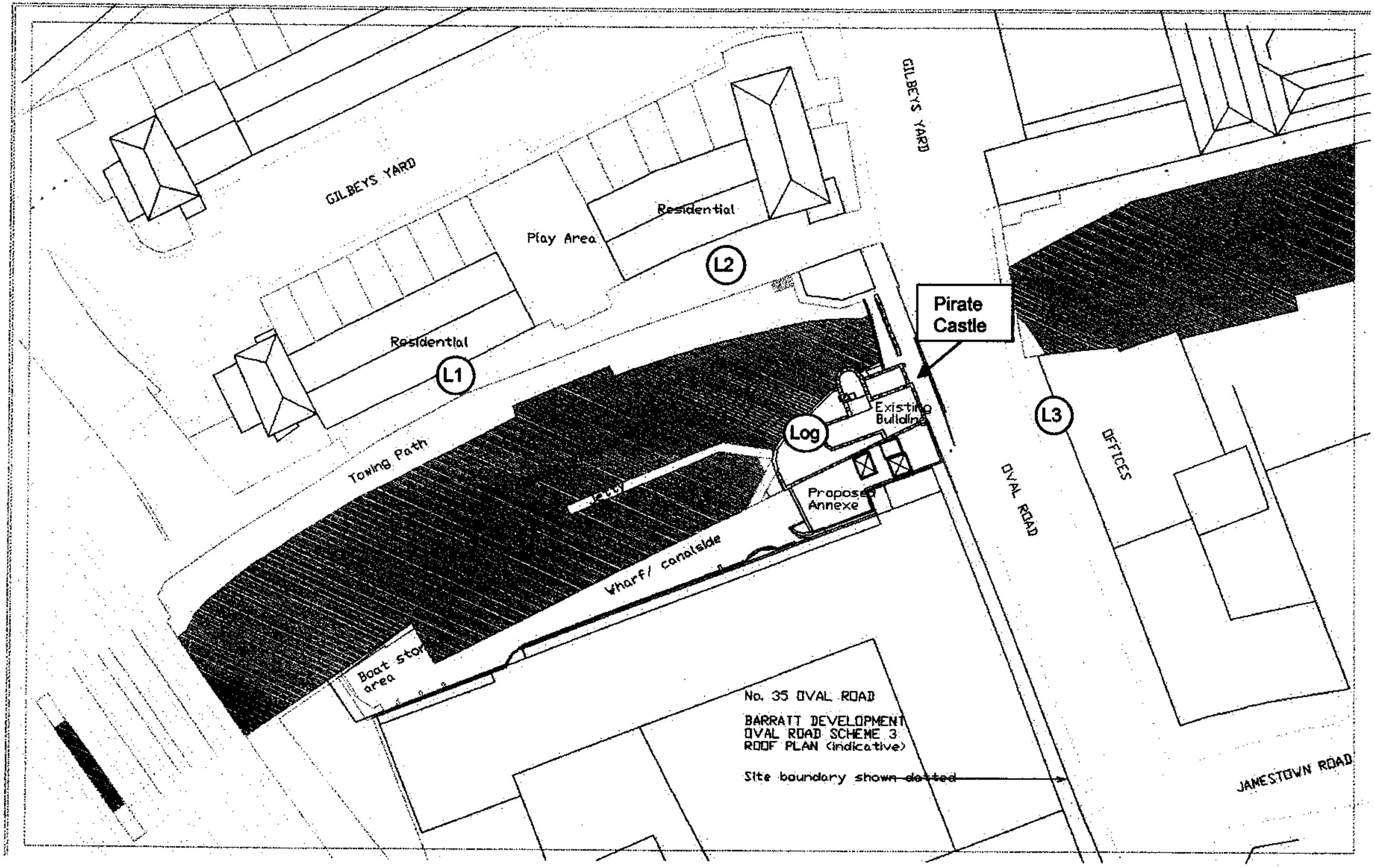

Figure 1: Site map showing measurement locations

5 Results

Table 1 shows the lowest background noise levels measured in the vicinity of Pirate Castle. Since location L3 was 2m from a façade, it has been corrected accordingly. The manned measurements show levels compatible with those measured by the unmanned logger at roof level, giving confidence that the ground level results were representative. Table 2 shows the limitations of plant noise in the three measurement locations.

Location	Lowest Measured Background (dBL_{A90}) Level
L1. Residential, Gilbeys Yard, near railway	46
L2. Residential, Gilbeys Yard, near Oval Road	46
L3. Offices opposite Pirate Castle	42
Unmanned logging measurement location	43

Table 1: Lowest measured background levels dBL_{A90} in the vicinity of Pirate Castle 0700 - 2300

Location	Limiting Noise Level dB(A)
L1. Residential, Gilbeys Yard, near railway	41
L2. Residential, Gilbeys Yard, near Oval Road	41
L3. Offices opposite Pirate Castle	37

Table 2: Noise emission limits expressed as spectral levels in octave bands and as a single figure dBL_{A90}

Should mechanical services noise be tonal or impulsive, the limiting levels shown in Table 3 would need to be reduced by 5dB.

6 Limiting Plant Noise Levels

A single Air Handling Unit (AHU) has been proposed as part of the extension of The Pirate Castle. This is to be located on the roof of the Annexe, as part of the new building. Figure 2 shows the proposed location.

A new Barratt residential development at 35 Oval Road adjacent to The Pirate Castle could result in a residential façade about 2m away from the proposed AHU.

Typical noise levels for an AHU, based on the plant selection made by Arup Building Group 4 are shown in Table 3.

Sound Power Levels	Octave Band Centre Frequency, Hz								dB(A)
	63	125	250	500	1k	2k	4k	8k	
AHU breakout	69	72	65	62	55	53	44	33	64
Fresh air intake	63	61	54	56	46	45	38	30	59
Exhaust air outlet	79	71	49	44	35	51	51	48	60

Table 3: AHU sound power levels, dB re 10^{-12}W

Table 4 shows the amount by which the proposed AHU exceeds the noise limitations imposed by Camden Council at the façade of 35 Oval Road, assuming that the units do not show tonality. Should units showing tonality be used, the limiting levels would be reduced by a further 5dB.

	Octave Band Centre Frequency, Hz								dB(A)
	63	125	250	500	1k	2k	4k	8k	
Excess of limit, dB	6	9	3	6	0	6	4	0	4

Table 4: Limiting AHU sound power levels, dB re 10^{-12} W

Encasing the AHU using a lightweight double-skinned modular panel system, in addition to adding extra attenuation to the air intake and discharge would reduce the noise levels to meet the criterion imposed by the London Borough of Camden. A construction of 16-gauge outer, 50mm airgap with insulation, 20-gauge perforated inner for the enclosure has been assumed.

The transmission loss for the recommended enclosure and the attenuation required on the exhaust air outlet are shown in Table 5. These summarise the minimum attenuation required to meet the imposed noise limit at the nearest residential façade (ie the Baratt residential development). The AHU air intake and outlet levels are free-field levels.

Attenuation required, dB	Octave Band Centre Frequency, Hz							
	63	125	250	500	1k	2k	4k	8k
AHU casing radiated	4	11	5	8	2	7	3	0
Exhaust air intake	0	0	0	2	0	10	0	0
Exhaust air outlet	14	10	0	0	0	5	10	0

Table 5: Attenuation required to meet Camden Council noise limits at nearest residential facade

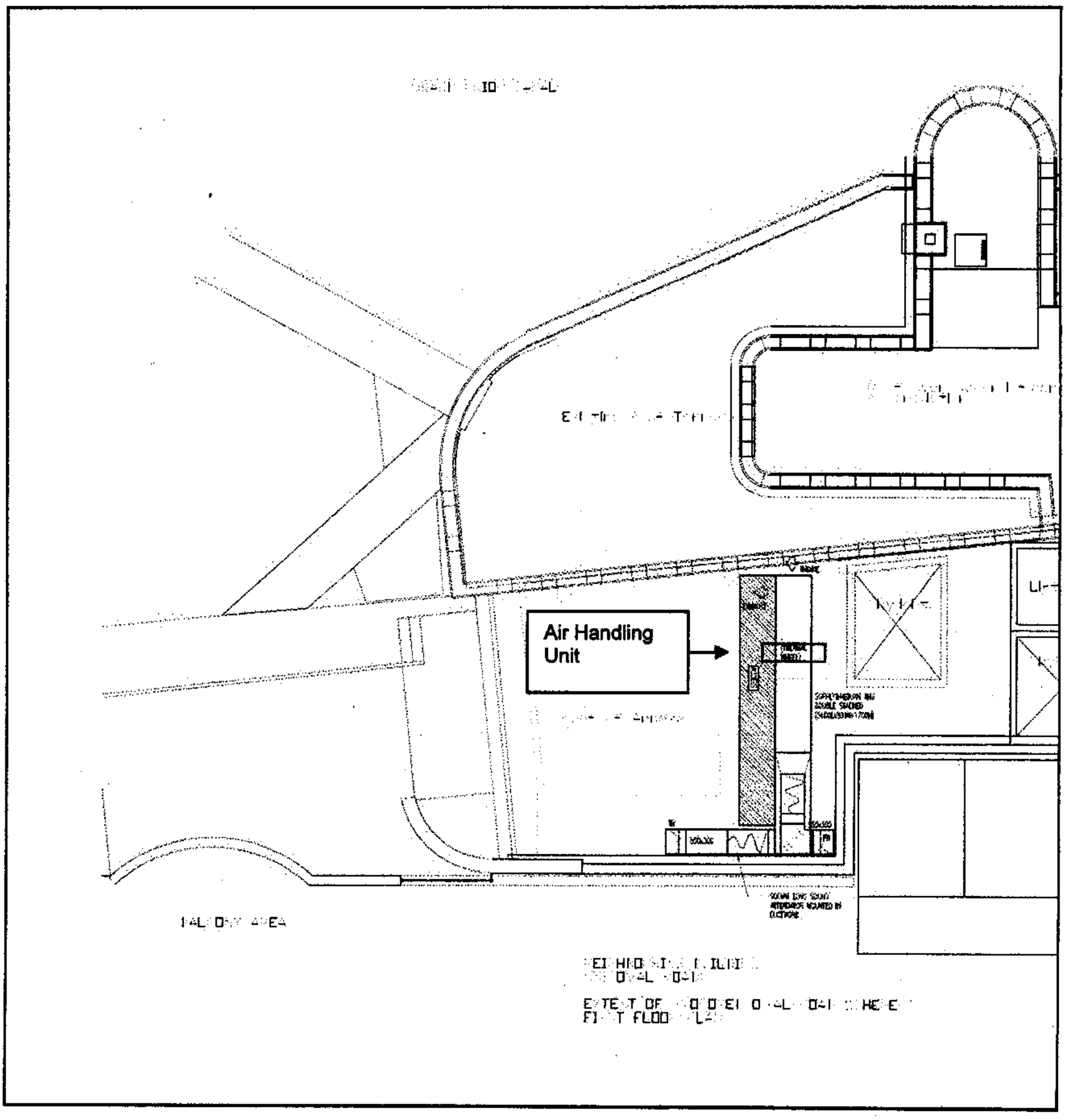

Figure 2: Pirate Castle roof showing location of proposed plant

7 Recommendations For Mitigation Of Noise Breakout

7.1 Mechanical Ventilation Recommendations

Arup Acoustics was asked to consider three possible scenarios for usage of Pirate Castle and comment on whether natural ventilation would be possible without causing disturbance to local residents.

The three situations, chosen as representative by the users of activities that will take place in the main hall/annexe of the Pirate Castle, are:

- quiet activity, eg children watching a video
- approximately 30 children playing
- amplified music, eg a disco.

Calculations assume natural ventilation, ie that the door and windows of The Pirate Club are open. Source levels are shown in Table 6. Calculated levels at the nearest proposed residential façade, assuming that are shown in Table 7. Table 8 shows predicted excesses of activities over limiting levels with natural ventilation.

Activity	Octave Band Centre Frequency, Hz								dB L_{Aeq}
	63	125	250	500	1k	2k	4k	8k	
Quiet activity	43	45	53	59	60	57	49	37	63
30 children playing	58	60	68	74	75	72	64	52	78
Amplified music	93	93	90	91	95	89	86	86	97

Table 6: Source levels for various activities in Pirate Castle

Activity	Doors and Windows Open, dBL_{Aeq}	Doors and Windows Closed, dBL_{Aeq}
Quiet activity	40	2
30 children playing	55	17
Amplified music	74	37

Table 7: Calculated levels generated by three different activity types in Pirate Castle at 1m from nearest proposed residential façade

Time	Activity	Excess over UDP Limiting Level, dB(A)	Excess Over - 10dB Limiting Level
Day	Quiet activity	-20	-5
Evening	Quiet activity	-8	7
Day	30 children playing	-5	10
Evening	30 children playing	7	22
Day	Amplified music	14	29
Evening	Amplified music	26	41

Table 8: Excesses over limiting levels caused by various activities, with windows and doors open

Lowest measured daytime background levels were around 12dB higher than those measured in the evening. The results therefore show that all activity other than the quietest events should use mechanical ventilation rather than natural ventilation in order to enable windows and doors to be shut and therefore minimise noise breakout to the new residential development, even during the day. In the evening, mechanical ventilation should be used for ventilation regardless of the activity.

Table 9 shows excesses over limiting levels with windows and doors closed.

Time	Activity	Excess over UDP Limiting Level, dB(A)	Excess over - 10dB Limiting Level
Day	Quiet activity	-37	-22
Evening	Quiet activity	-25	-10
Day	30 children playing	-21	-6
Evening	30 children playing	-9	6
Day	Amplified music	-8	7
Evening	Amplified music	4	19

Table 9: Excesses over limiting levels caused by various activities, with windows and doors closed

It has been assumed that no acoustic treatment has been added to the interior of the main hall and annexe of Pirate Castle. Table 10 shows the reduction in reverberant sound pressure level resulting from treating various percentage areas of the ceiling with a highly absorbent material.

Treatment Area as a Percentage Area of Total Ceiling	Reduction in Reverberant Sound Pressure Level, dB
25%	4
50%	6
100%	8.5

Table 10: Reduction provided by treatment of percentage areas of ceiling in Main Hall/Annexe

While it can be seen that acoustic treatment of the ceiling will result in a significant reduction in sound pressure levels, treating the entire ceiling will not be sufficient to alter the need for a closed façade on the south side for the noisiest activities during the evening. However, it is recommended that some acoustic treatment is added to the main hall and/or annexe to create a more pleasant internal acoustic environment.

Noise breaking out through existing windows of Pirate Castle (overlooking the canal) is not anticipated to be a problem. Noise levels at the nearest residential façade across the river were calculated for levels typical of a disco, and were not found to exceed the -10dB limit.

7.2 Transmission Loss Recommendations

At the nearby residential façade of 35 Oval Road position with the highest exposure to noise, with the activity causing the highest level of noise (amplified music eg a disco), the L_{Aeq} at the nearest residential façade would increase by 5dB(A) (assuming windows and doors are shut). Assuming 6/12/6 double glazing is used for the windows and doors of the annexe, this would be adequate for the planning condition imposed by the Camden UDP. However, it is suggested that noise at this level may still cause disturbance to residents in the new development at 35 Oval Road. Further mitigation is therefore recommended. This could take the form of one or more of the following:

- limiting levels in the Pirate Castle venue using an audio limiter
- install a moving partition over the windows and door of the annexe.

To reduce breakout from the skylight in particular, one or more of the following are suggested:

- moving the skylight so that it is lobbied from the main entertainment venue or
- using a glazing with an increased transmission loss for the skyligh

A1 Acoustic Terminology

Decibel (dB)

The ratio of sound pressures which we can hear is a ratio of 10^6 (one million:one). For convenience, therefore, a logarithmic measurement scale is used. The resulting parameter is called the 'sound pressure level' (L_p) and the associated measurement unit is the decibel (dB). As the decibel is a logarithmic ratio, the laws of logarithmic addition and subtraction apply.

A-Weighting

The A-weighted sound level, expressed as "dB(A)", allows for the frequency-dependent characteristics of hearing. Corrections are applied for each octave band, and the resultant values summed, to obtain a single overall level.

Frequency

Frequency is the rate of repetition of a sound wave. The subjective equivalent in music is pitch. The unit of frequency is the hertz (Hz), which is identical to cycles per second. A 1000Hz is often denoted as 1kHz, eg 2kHz = 2000Hz. Human hearing ranges approximately from 20Hz to 20kHz. For design purposes the octave bands between 63Hz to 8kHz are generally used. The most commonly used frequency bands are octave bands, in which the mid frequency of each band is twice that of the band below it. For more detailed analysis, each octave band may be split into three one-third octave bands or in some cases, narrow frequency bands.

Equivalent Continuous Sound Level

An index for assessment for overall noise exposure is the equivalent continuous sound level, L_{eq}. This is a notional steady level which would, over a given period of time, deliver the same sound energy as the actual time-varying sound over the same period. Hence fluctuating levels can be described in terms of a single figure level.

Statistical Noise Levels

For levels of noise that vary widely with time, for example road traffic noise, it is necessary to employ an index which allows for this variation. The L_{10}, the level exceeded for 10% of the time period under consideration, and can be used for the assessment of road traffic noise (note that L_{Aeq} is used in BS 8233 for assessing traffic noise). The L_{90}, the level exceeded for 90% of the time, has been adopted to represent the background noise level. The L_1, the level exceeded for 1% of the time, is representative of the maximum levels recorded during the sample period. A weighted statistical noise levels are denoted L_{A10}, dBL_{A90} etc. The reference time period (T) is normally included, eg $dBL_{A10,\ 5min}$ or $dBL_{A90,\ 8hr}$.

B1 Noise Survey Details

B1.1 Manned Noise Survey

Date/time:	Wednesday 17 October 2006 between 1650 and 2315.
Sample duration:	1 x 10 minute measurement at each location 1650 to 2050 1 x 5 minute measurements at each location 2100 to 2315
Measurement locations:	Locations L1, L2 and L3 (as shown in Figure 1). All measurements were carried out at a height of approximately 1.2m above local ground.
Personnel:	Jonathan Osborne and Luca Dellatorre (Arup Acoustics)
Equipment:	1 x Bruel & Kjaer 2260 modular real time analyser; Calibration was checked by means of suitable calibrator before and after use. A drift of less than 0.5 dB was observed.

B1.2 Unmanned Noise Survey

Start date/time:	Friday 13 October 2006 at approx 1555.
End date / time:	Wednesday 18 October 2006 at approx 1455.
Sample duration:	Continuous 10 minute measurements.
Measurement locations:	On the roof of Pirate Castle at a height of 1.2m above the roof level (as shown on Figure 1).
Equipment:	1 x Rion NR32 sound level meter 1 x Outdoor Microphone kit Calibration was checked by means of suitable calibrator before and after use. A drift of less than 0.5dB was observed.