TECHNICAL MEMO

Our Ref: 3177_003m_2-0_sz

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SUBJECT: CORNERSTONE BARRISTERS, HOLBORN

1 INTRODUCTION

In January 2017 Anderson Acoustics carried out a plant noise assessment at Cornerstone Barristers, 2-3 Grays Inn Square, Holborn. The assessment concerned a plant installation consisting of 1 no. external Mitsubishi PURY-P350YLM-A1 and 1 no. external Mitsubishi PURY-P400YLM-A1 heat recovery outdoor units at lower ground floor level inside a light-well. The units are each connected to a short duct extending up to ground floor level.

Acoustic surveys and associated report refs. 3177_001R_1-0_SZ and 3177_002M_3-0_SZ showed that there is a difference of up to +31 dB between the plant rating level (up to 75 dB $L_{Ar,Tr}$) and the typical background ('plant off') sound level (44 dB $L_{A90,T}$) at the nearest neighbouring residential window. The window is located at third floor level and opens out to the light-well. The plant rating level includes a +3 dB correction penalty for an intermittent 'rattling' characteristic applied in accordance with BS 4142 (the relevant British Standard for rating and assessing industrial and commercial sound).

A summary of the measured noise levels together with the predicted acoustic impact of a proposed ductwork extension is provided below.

2 SURVEYS

2.1 Methodology

Attended noise measurements were taken with the plant both on and off on two dates during January 2017. Noise levels were measured using a Rion NL-52 precision integrating sound level meter (s/n 00620960) with the microphone fitted with a windshield. One-minute $L_{Amax,F}$, L_{Aeq}, and L_{A90} including 1/3 octave band measurements were obtained using the 'F' time weighting.

The sound level meter was calibrated before and after each survey period using a Rion NC-74 sound calibrator (s/n 34625646) with no significant calibration drift observed.

2.2 Weather Conditions

On 10/01/2017 conditions were dry whilst on 31/01/2017 there was some light precipitation present. It is considered that these conditions did not have any significant impact on the measurements.

2.3 Survey Results

The ambient L_{Aeq}, and background L_{A90} values from each survey are summarised in Table 1 below.

Table 1: Survey results summary

Plant operation	Survey date	Value	$L_{Aeq,1min}$	$L_{A90,1min}$	Comment
Plant on	10/01/2017	Minimum	66	64	Approx. 2 m from third floor window. Data based on 5 consecutive 1 minute measurements
		Maximum	67	66	
		Modal	67	65	
	31/01/2017	Minimum	68	67	Approx. 2.5 m from third floor window. Data based on 60 consecutive 1 minute measurements
		Maximum	72	71	
		Modal	70	70	
Plant off	10/01/2017	Minimum	44	43	Data based on 5 consecutive 1 minute measurements
		Maximum	46	44	
		Modal	45; 46	44	
	31/01/2017	Minimum	44	43	Data based on 5 consecutive 1 minute measurements

2.4 Observations

The heat recovery outdoor units were noted to be the dominant sources of noise during the 'plant on' periods. Some variation in intensity was noted with some periods of rattling and whining; this is to be expected given that the outdoor units are providing heating / cooling to the building and thus vary their load depending on external conditions.

During the 'plant off' periods, the dominant sources of noise were noted to be plant serving neighbouring premises, distant road traffic and aircraft flyover.

Minimal differences between the measured ambient L_{Aeq} levels and the background L_{A90} levels indicated steady ambient levels during both 'plant on' and 'plant off' periods.

2.5 Summary of Plant Noise Rating Level

The plant noise rating level based on the 'worst case' measured 'plant on' level and calculated in accordance with BS 4142 is shown in Table 2 below.

Table 2: Plant noise rating level

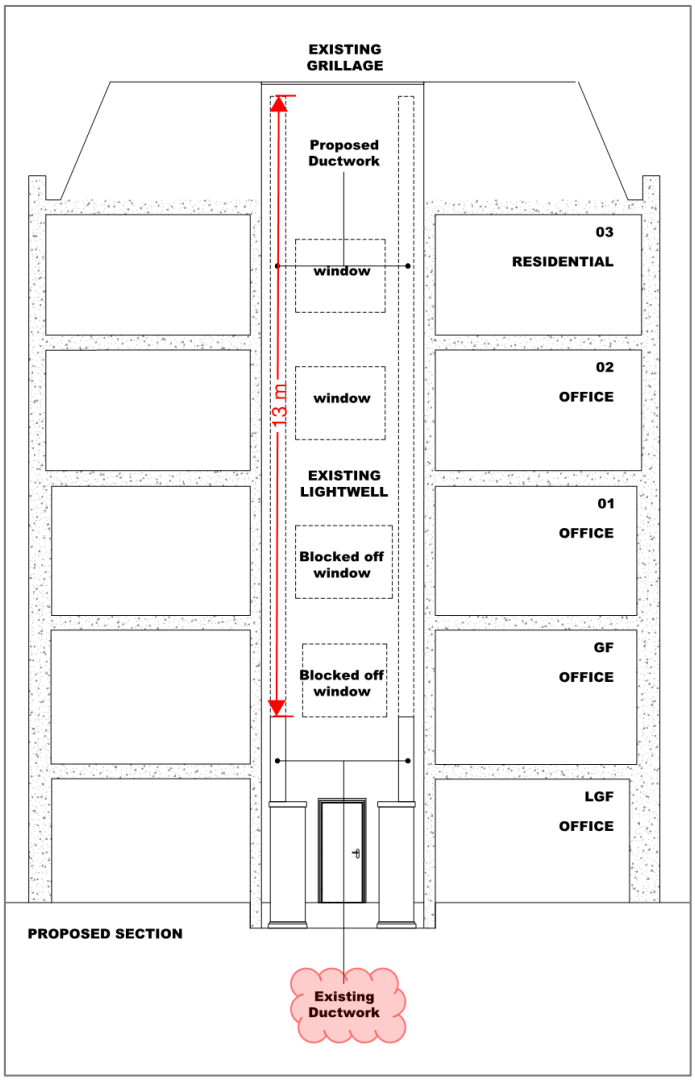
Description	dB
Measured ambient $L_{Aeq,T}$ with plant on	72
Correction penalty ('rattling' characteristic)	+3
Plant rating level $L_{Ar,Tr}$	75
Measured background $L_{A90,T}$ with plant off	44
Difference ~ rating level and background level	31

3 ASSESSMENT OF PROPOSED MITIGATION

3.1 Proposal

As detailed on the revision P01 drawing no. CRNST-CA-00-ZZ-DR-A-4001, it is proposed that the ductwork be extended by approximately 13 m up the sides of the light-well as shown in Figure 1.

Figure 1: Proposed ductwork extensions



It is understood that there are also plans to acoustically lag the ductwork in order to help control the 'rattling' characteristic.

3.2 Predicted Levels

Calculations have been carried out to predict the acoustic impact of the proposal. Our calculations are based on the following assumptions:

- Equal contribution to the measured noise level from each heat recovery outdoor unit;
- Equal contribution to the measured noise level from the air intake 'sides' of each unit and air discharge (ducted) 'tops' of each unit; and

- Ductwork cross-sectional dimensions approximately 1000 x 500 mm.

Note: the acoustic lagging is likely to reduce the 'rattling' characteristic, however the overall effect this will have on the overall $L_{Aeq,T}$ is difficult to quantity. This is because it is not clear how much of the 'rattle' is from ductwork resonance as opposed to resonance from the units themselves.

As detailed in Table 3, it is predicted that the ductwork extension will reduce plant noise emissions by 3 dB outside the third floor residential window, see Table 3:

Table 3: Predicted level after mitigation

Element	*Centre Frequency Hz*								
	63	125	250	500	1k	2k	4k	8k	dB(A)
Worst case measured LAeq,1min plant noise level 2.5 m from window	81	77	73	70	66	61	55	46	72
Assumed contribution from air intake 'sides' of units 2.5 m from window	78	74	70	67	63	58	52	43	69
Predicted contribution from 'sides' of units	78	74	70	67	63	58	52	43	69
Assumed contribution from air discharge 'top' of units 2.5 m from window	78	74	70	67	63	58	52	43	69
160 deg directivity correction	-3	-5	-8	-12	-15	-18	-18	-18	
Natural duct losses, 13 m long 1000 x 500 mm cross section	-19	-13	-6	-3	-3	-3	-3	-3	
Predicted contribution from 'top' of units	56	56	56	52	45	37	31	22	52
Total predicted LAeq,1min plant noise level 2.5 m from window	78	74	70	67	63	58	52	43	69
Total predicted reduction 2.5 m from window									-3

The predicted plant noise rating level with the mitigation in place is shown in Table 4 below.

Table 4: Plant noise rating level with mitigation

Description	dB
Predicted ambient $L_{Aeq,T}$ with plant on	69
Correction penalty ('rattling' characteristic)	0 - 3
Plant rating level $L_{Ar,Tr}$	69 - 72
Measured background $L_{A90,T}$ with plant off	44
Difference ~ rating level and background level	25 - 28
Improvement	3 - 6

3.3 Discussion

Whilst BS 4142 provides a method for assessing the plant noise level against the background noise level, an alternative is to undertake an assessment in terms of absolute levels. BS 8233 provides guidance for internal noise levels within a range of building types and spaces. The third floor residential window is understood to serve a bathroom, for which there is no specific guidance. However noise levels of 45 -55 dB $L_{Aeq,T}$ are suggested for non-critical spaces such as corridors and circulation spaces.

It is understood that the third floor residential window consists of a double-glazed unit. This is likely to be providing a sound insulation performance of ≥ R_w 30 dB when closed. Thus an internal noise level of ≤ 42 dB is likely to be achieved inside the window which is comfortably within BS 8233 guidelines for non-critical spaces.

3.4 Conclusion

Our calculations predict that the proposed ductwork extension will reduce the 'worst case' plant rating level $L_{Ar,Tr}$ by between 3 and 6 dB at the third floor residential window.