Technical Assessment

Site Address:	Manchester Royal Infirmary, Oxford Road, Manchester, M13 9WL
Project Reference No:	NP-009515-3
Subject:	Assessment of Acoustic Louvre Performance
Client:	CM Oxendale Ltd.
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Introduction

NOVA Acoustics has been commissioned to carry out validation testing of louvred barriers installed around the perimeter of a rooftop plant enclosure at Manchester Royal Infirmary.

A preliminary acoustic assessment for the development was carried out in June 2023 (NOVA report ref. NP-009515). The aim of the assessment was to predict the effects of replacing existing aluminium barriers with new acoustic louvre panelling. It has now been requested that measurements are taken in order to confirm the initial predictions.

In the original report, it was noted that 5no. of the existing chiller units would be replaced with newer models, and 4no. new impulse fans would be installed in future phases of the development. As the purpose of the assessment was to predict the performance of the louvre panelling exclusively, the replacement of the units was outside of the scope of the report. As such, this is also outside of the scope of the validation testing.

Methodology

NOVA Acoustics has been informed that the chiller units operate based entirely on demand, and it is not possible to ‘force’ the units to operate. As such, it is likely that they will not be operational at maximum capacity until summer 2025 when the outdoor ambient temperature rises. Given this, testing has instead been carried out with a simulated scenario.

To replicate the noise emissions from a single chiller unit, a dodecahedral speaker was positioned at a height of approximately 2m (chiller fan height). The speaker was set to play broadband pink noise at a level of approximately 105 dBA at 1m. This noise level was selected in order to be loud enough so that the measurements would be relatively unaffected by the residual noise climate.

Measurements were taken at varying distances from the speaker, and then adjacent to the external face of the louvre panelling. Pictures of the testing scenario can be seen overleaf.

Figure 1 – Pictures of Onsite Testing Arrangement (Images Shown are Positions at 1m)

It should be noted that in order to accurately validate the results of the original assessment, all testing would need to be carried out with the chiller units operational. As such, the results in this report are largely indicative, and further testing may be required when the units are fully operational.

Results

The measurements taken at 2m from the speaker are compared with the measurements taken 2m from the outside face of the louvre panelling in the table below. In all cases, the residual noise level has been logarithmically subtracted from the ambient noise level to give a specific measurement.

Description	1/1 Octave Frequency Band (Hz, dB)							Overall (dB)
	63	125	250	500	1k	2k	4k	
L_{eq} at 2m from Speaker	73	87	96	93	90	88	87	101 (A)
L_{eq} at 2m from External Louvre Face	59	68	73	68	60	55	57	73 (A)
Calculated Reduction	14	18	23	26	30	32	30	28

Table 1 – Calculated Difference Level – On-site Measurements

Analysis

The results are analysed using the following methodologies:

- The measured noise levels are compared with predictions derived from hand calculations. This is calculated considering the sound reduction data provided by the manufacturer of the louvre, and the contribution of noise flanking over the top of the panelling.
- The measured noise levels are compared with the results of software noise modelling.
- Both methods use formulas taken from ISO 9613-2.

Hand Calculations

The results for the hand calculations are shown in the table below.

Description	1/1 Octave Frequency Band (Hz, dB)							Overall (dB)
	63	125	250	500	1k	2k	4k	
Calculated Sound Power Level of Speaker (L_W)	84	98	107	104	101	99	98	107
Propagation Loss to Measurement Position (6m, Q4)				-21				--
Louvre Attenuation (SRI)	*-8*	*-10*	*-12*	*-15*	*-18*	*-20*	*-20*	--
Barrier Attenuation (SRI)	*-7*	*-9*	*-12*	*-23*	*-33*	*-41*	*-32*	--
Noise Contribution Over Louvre (L_{eq})	60	72	79	74	67	63	63	75 (A)
Noise Contribution Through Louvre (L_{eq})	61	73	79	66	52	42	51	71 (A)
Predicted Noise Level at 2m from Louvre Face (L_{eq})	64	75	82	74	67	63	63	77 (A)
Measured Noise Level at 2m from Louvre Face (L_{eq})	64	73	77	72	65	60	62	73 (A)
Difference between Prediction and Measurement (L_{eq})	0	-2	-5	-2	-3	-3	-1	-4

Table 2 – Calculated Difference Level – Hand Calculations

As can be seen, the difference between the predicted noise levels and the measured noise levels is generally between 0 dB and 3 dB. As the testing results are lower than the prediction in all octave frequency bands, this suggests that the louvre panelling is performing effectively.

Software Noise Modelling

The measurement results are compared with the results obtained using the SoundPlan 9.0 software model used in the original assessment in the following table. The graphic representation of the model can be seen below.

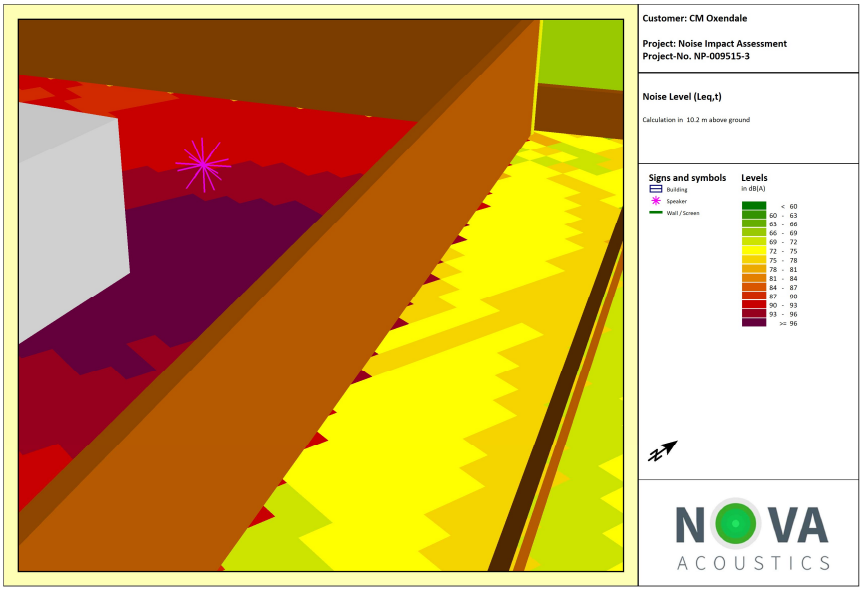

Figure 2 – SoundPlan Noise Model (Grid Height of 10m)

Description	1/1 Octave Frequency Band (Hz, dB)							Overall (dB)
	63	125	250	500	1k	2k	4k	
Predicted Noise Level at 2m from Louvre Face (L_{eq})	63	74	80	76	71	65	64	77 (A)
Measured Noise Level at 2m from Louvre Face (L_{eq})	64	73	77	72	65	60	62	73 (A)
Difference between Prediction and Measurement (L_{eq})	+1	-1	-3	-4	-6	-5	-2	-4

Table 3 – Calculated Difference Level – SoundPlan Software

With the exception of a negligible increase in the 63 Hz octave band, the noise levels measured on site are again lower than the predicted levels.

Conclusion

The measured noise levels are below the predictions obtained using hand calculations and software noise modelling. Given this, providing the panelling has been installed in the locations specified in the original assessment, it is thought that the predicted results are likely to be an overestimate, and that the louvre panelling is performing effectively.

Appendix A – Acoustic Terminology

A-weighted sound pressure level, L_{pA}	Quantity of A-weighted sound pressure given by the following formula in decibels (dBA). $L_{pA} = 10 \log_{10} (pA/p_0)^2$. Where: pA is the A-weighted sound pressure in pascals (Pa) and $p0$ is the reference sound pressure (20 µPa)
Equivalent continuous A-weighted sound pressure level, $L_{Aeq,T}$	Value of the A-weighted sound pressure level in decibels (dB) of a continuous, steady sound that, within a specified time interval, T, has the same mean-squared sound pressure as the sound under consideration that varies with time
Facade level	Sound pressure level 1 m in front of the facade
Free-field level	Sound pressure level away from reflecting surfaces
Octave Band	Band of frequencies in which the upper limit of the band is twice the frequency of the lower limit
Sound Pressure, p	root-mean-square value of the variation in air pressure, measured in pascals (Pa) above and below atmospheric pressure, caused by the sound
Sound Pressure Level, L_p	Quantity of sound pressure, in decibels (dB), given by the formula: $L_p = 10\log_{10}(p/p_0)^{2.}$ Where: p is the root-mean-square sound pressure in pascals (Pa) and $p0$ is the reference sound pressure (20 µPa)

Appendix B – Surveying Equipment

Piece of Equipment	Serial No.
Svantek 971A Class 1 Sound Level Meter	143583
Cesva CB006 Class 1 Calibrator	901927

Table 4 – Surveying Equipment

All sound level meters are calibrated every 24 months, and all calibrators are calibrated every 12 months, by a third-party calibration laboratory. All microphones were fitted with a protective windshield for the entire measurements period. Calibration certificates can be provided upon request.

Meteorological Conditions

All weather conditions were suitable for measurement in accordance with BS7445. Wind speeds were consistently less than 5 m/s and there was no precipitation.

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