BURO HAPPOLD

# Design Note

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| Project | UCL Shop, London |
| Subject | Condenser replacement noise assessment |
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## 1 Introduction

The proposal is to replace two condensing units with a new condensing unit at an outdoor mechanical plant area (lightwell) located adjacent to the vacant University College London (UCL) Shop, London.

This Design Note aims to demonstrate that the new condensing unit does not materially contribute to the existing sound level generated in the outdoor plant area. The following figures show the extent of equipment existing condensers in the plant area in question. The condensers coloured red are proposed to be replaced by a new condensing unit.

**Figure 1—1 External plant area (view 1)**

**Figure 1—2 External plant area (view 2)**

# 2 Acoustic Survey

## 2.1 Existing Sound Levels

A noise survey was carried out to assess the existing sound level generated in the plant room, and at the nearest affected window. It should be noted that not all condensing units were operating at the time of the survey. The operational condensers are shaded in green below.

**Figure 2—1 Operating condensers (view 1)**

**Figure 2—2 Operating condensers (view 2)**

As shown in the figures above, only 4 of 15 condensers were operating during the survey. It should be noted that the condensers being replaced were not operating at the time of the survey.

The measurement was undertaken at the nearest window, which belongs to UCL (South Wing), approximately 2.5 metres from most condensers. The sound level measured is summarised in the following table.

**Table 2—1 Measured sound pressure levels**

| Location | Ambient $L_{Aeq,T}$ sound level - dB | Background $L_{A90,T}$ sound level - dB |
|---|---|---|
| Outside the nearest affected window, approximately 2.5 metres from most condensers | 55 dB | 54 dB |

It can be seen from the table above that the equivalent $L_{Aeq,T}$[1] sound pressure level is within 1 dB of the background $L_{A90,T}$[2] sound pressure level. This indicates that the dominant sound source at the measurement location is the condensers highlighted in green.

Furthermore, if 13 condensers (excluding the two that will be replaced) were operating at the same time, the sound level within the plant area would be around $L_{Aeq,T}$ 60 dB. This is on the basis that all of the condensers have similar sound output, which is highly likely given the size of the units.

[1] $L_{Aeq,T}$ – the average A-weighted sound pressure level within a measurement period. Typically thought of as the average ambient noise level at a particular time and likely to be due to a combination of various noise sources, near and far

[2] $L_{A90,T}$ – the A-weighted sound pressure level exceeded 90% of the measurement period, i.e. a level which would be perceived as a constant, background noise level. Typically, largely unaffected by local traffic pass-bys or by transient events. More usually attributable to constantly-running building services plant or distant road traffic. What you would hear when there is no local traffic present (or other readily identifiable noise sources)

### 2.2 Proposed Condensing Unit vs Existing Sound Levels

The proposed unit is a Daikin RXYSQ-TY1 with a manufacturer quoted sound pressure level of $L_{eq,T}$ 55 dBA at 1 metre from the unit. The sound level at 2.5 metres from the unit at the nearest window is calculated as $L_{eq,T}$ 47 dBA in free field conditions. Given that the condensers are in a semi-reverberant environment (lightwell), the contribution from the condensing unit is circa $L_{eq,T}$ 52 dBA (+5 dB for the reverberant field).

Therefore, the cumulative sound pressure level in the plant area (with all condensers operating) would increase by up to 1 dB (60 dBA + 52 dBA = 61 dBA), which is imperceptible by most people.

# 3 Noise Impact on Noise Sensitive Receptors

The nearest identified noise-sensitive receptors (NSRs) are located approximately 80 metres from the UCL Shop plant area. Furthermore, high-rise buildings are located between the plant area and NSRs, providing acoustic shielding. The following figure shows the distance between the plant area and the nearest identified NSR.

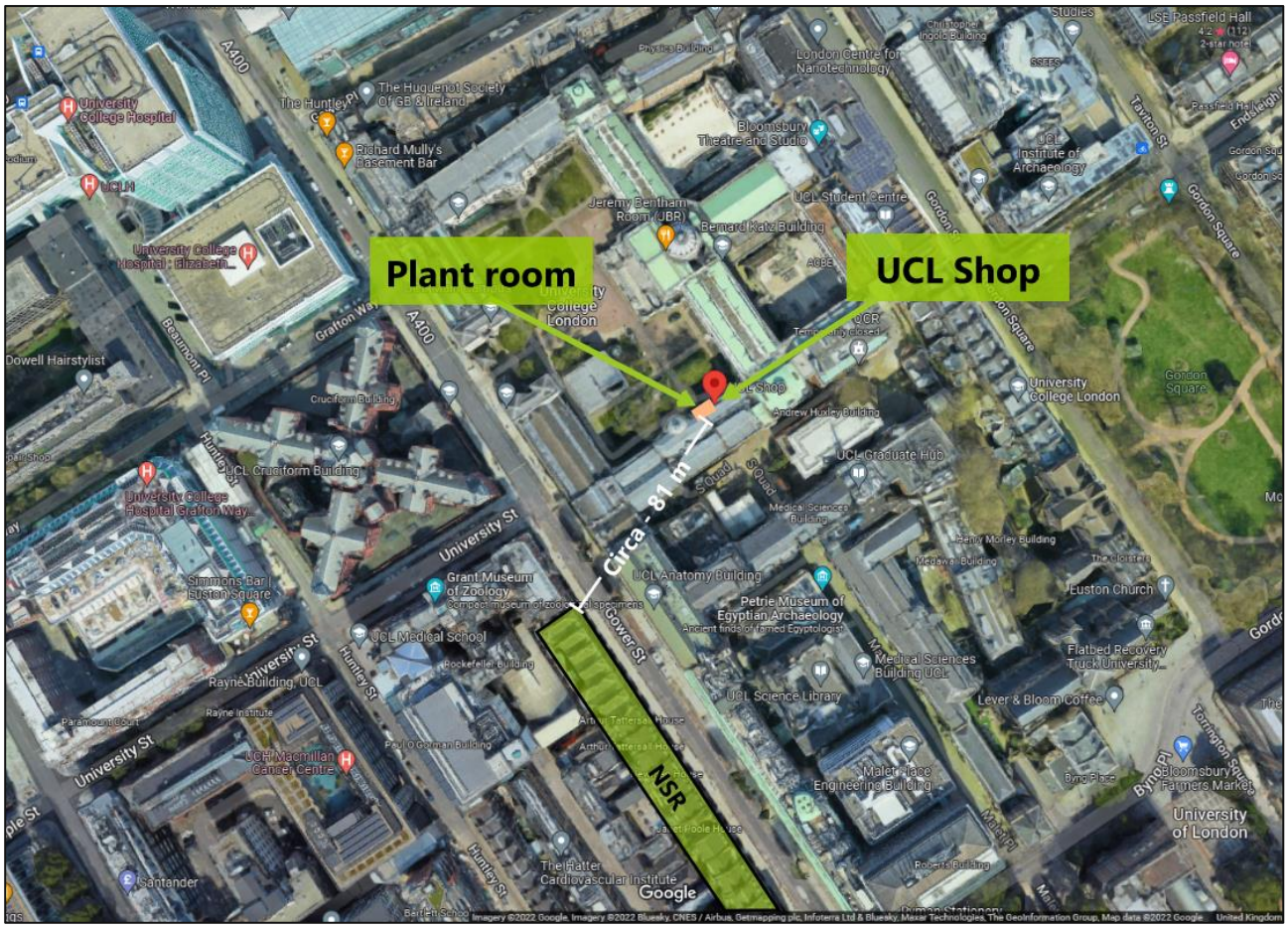


**Figure 3—1 Sitemap**

The calculated sound pressure level at the NSR can be calculated by taking into account the following parameters:

- distance correction (log ratio)
- attenuation due to shielding from the surrounding buildings

The formula for the distance correction is:

$$L_{p2} = L_{p1} - 20log\frac{r_2}{r_1}$$

where:

$r_1$ = distance from the reference sound source
$r_2$ = new distance from the reference sound source
$L_{p1}$ = source sound pressure level at distance $r_1$
$L_{p2}$ = source sound pressure level at distance $r_2$

Attenuation due to acoustic shielding primarily depends on the following:

- height of the barrier (or buildings)
- distance between sound source and receiver (NSR)
- height of the source and receiver (NSR)

Higher attenuation (limited to 24 dB) is achieved with a taller 'effective barrier height'. In this context, the buildings between the plant area and NSR are significantly taller than the height of the plant area and NSR. Therefore, the attenuation from the buildings is anticipated to be up to 20 dB, if not greater.

The sound pressure level at the NSR can be calculated by subtracting the distance and shielding attenuation from the sound pressure level of the condensing unit.

As described above, the proposed unit is a Daikin RXYSQ-TY1 with a manufacturer quoted sound pressure level of $L_{eq,T}$ 55 dBA at 1 metre. Therefore, the sound pressure level of the condensing unit at the NSR is:

**Table 3—1 Calculated sound pressure at NSR**

| Condenser sound pressure level | Distance correction to NSR | Attenuation due to acoustic shielding | Sound pressure level at NSR | Comment |
|---|---|---|---|---|
| $L_{eq,T}$ 55 dBA @ 1 metre | - 38 dB | - 20 dB | $L_{eq,T}$ < 10 dBA | Inaudible at NSR |

It can be seen from the table above that the sound pressure level from the proposed condensing unit is $L_{eq,T}$ < 10 dBA at the nearest NSR. Therefore, the condenser will be inaudible at the NSR.

Assuming all 15 condensers were operating at $L_{eq,T}$ 55 dBA @ 1 metre, the sound pressure level at the NSR is calculated to be:

**Table 3—2 Calculated sound pressure at NSR with all condensers operating**

| 15 x condensers operating at $L_{eq,T}$ 55 dBA @ 1 metre | Distance correction to NSR | Attenuation due to acoustic shielding | Sound pressure level at NSR | Comment |
|---|---|---|---|---|
| $L_{eq,T}$ 67 dBA @ 1 metre | - 38 dB | - 20 dB | $L_{eq,T}$ < 10 dBA | Inaudible at NSR |

It can be seen from the table above that the sound pressure level from the proposed condensing unit is $L_{eq,T}$ < 10 dBA at the nearest NSR. Therefore, the condenser will be inaudible at the NSR if all condensers operate simultaneously.

# 4 Conclusion

Measurements and calculations show that the proposed condensing unit can increase the cumulative sound level of the plant area by up to 1 dB. A 1 dB increase is imperceptible by most people. Therefore, it would not have any significant negative impact on the nearest affected window, nor will it significantly impact the acoustic amenity around UCL.

Furthermore, the nearest noise-sensitive residential receptor is located approximately 80 metres from the plant area and shielded by the lightwell and surrounding UCL buildings. Calculations show that the proposed condensing unit will be inaudible at the nearest identified NSR. Furthermore, the plant area (assuming all condensing units are operating) will be inaudible at the nearest identified NSR.

Based on the above, noise is not considered a barrier to development.