Appendix 9.4 Overheating and Noise Assessment

17 November 2022

Introduction

1.1. This Appendix has been created by WSP and is primarily focused on the potential risk to occupants from noise break-in during overheating periods. During these periods, a reliance on open windows (or large vents) to provide relief from overheating could lead to higher noise levels than usual in dwellings, which has the potential to adversely impact residents.

1.2. The noise survey results suggest that noise levels at the site are in the medium to high risk categories according to the methodology in the Acoustics Ventilation and Overheating Residential Design Guide produced by the Institute of Acoustics and the Association of Noise Consultants (AVO Guide) [Ref. 18]. Therefore, there is a high risk of adverse effects due to noise, should open windows or vents be relied upon to provide relief from overheating.

1.3. The overheating and noise assessment is an iterative process and relies on several inputs including:

- the noise levels at the site;
- the design of the buildings (e.g. size of window / vent openings / rooms etc.); and
- the frequency of overheating events that require windows or vents to be opened.

1.4. For the purpose of this assessment, it is important to differentiate between the different ventilation types, as they are subject to different criteria:

- Whole building ventilation is intended to be continuous to remove moisture and pollutants from the building, in buildings with mechanical ventilation systems the windows can typically be assumed to be closed for the purposes of assessing noise.
- Purge ventilation is manually controlled ventilation of spaces at a relatively high rate to rapidly dilute pollutants and / or moisture – as this is an occasional and temporary event it is usually assumed that internal noise levels can be higher than usual and no criteria are applied.
- Ventilation provision to control overheating has a specific set of noise criteria which are applied, set out in the AVO Guide [Ref. 18] and discussed in this Appendix.

Noise Model

1.5. A 3D noise model of the Proposed Development and surrounding area has been built using the CadnaA software package, based on the latest architectural plans from SimpsonHaugh. The results of the noise surveys have been used to calibrate the road noise sources in the model.

1.6. The noise model calculates future noise levels at the façades of the Proposed Development, in order to inform the specification of façade and ventilation systems to provide acceptable internal noise levels for residents.

Acoustics Ventilation and Overheating Guide

1.7. The technical guidance within the AVO Guide has been used to inform the initial overheating assessment in this Appendix.

1.8. The AVO Guide [Ref. 18] proposes that, providing overheating only occurs part of the time, occupants may accept a trade-off between acoustic and thermal conditions if they have some control over their environment and own level of comfort; i.e. they may be more willing to accept a short-term increase in noise levels in order to achieve better thermal comfort.

1.9. In the case of the overheating condition, the effect of increased internal ambient noise from external noise sources will depend both on the absolute noise level and the amount of time for which the overheating condition occurs.

1.10. The AVO Guide [Ref. 18] recommends that priority is given to minimising heat gains via the building design, in order to reduce the amount and duration of ventilation required to control overheating and the consequential effect from increased ingress of noise.

Provisions for Meeting Overheating Criteria

1.11. A large openable 'rapid purge vent' will be provided in each room, to provide relief from overheating by natural means.

1.12. The vent comprises a "*4mm thick perforated metal overpanel, with a blanked window/door opening component behind*".

1.13. The overheating assessment has demonstrated that it will not be necessary for the purge vent to be open during the night time (23:00-07:00hrs).

Potential sound reduction of vent

1.14. It is currently understood that the vent has a free area circa. 50%, does not contain any specific acoustic materials and does not provide a specific level of sound attenuation. It has therefore been considered as an open area in the façade with dimensions of 0.63m x 2.08m.

1.15. The noise level difference (from outside to inside) of the vent has been estimated as the element normalised level difference ($D_{n,e}$) of the opening, calculated using the methodology in Annex D of BS 12354-3:2015. Based on a vent size of 1.3m^2, the opening in the façade would provide a $D_{n,e}$ of 9 dB.

1.16. Considering the volume and sound absorption in typical rooms, the outside-to-inside level difference is calculated to be approximately as follows in two 'typical' rooms:

Table 1 - AVO Guide Assessment Assumptions

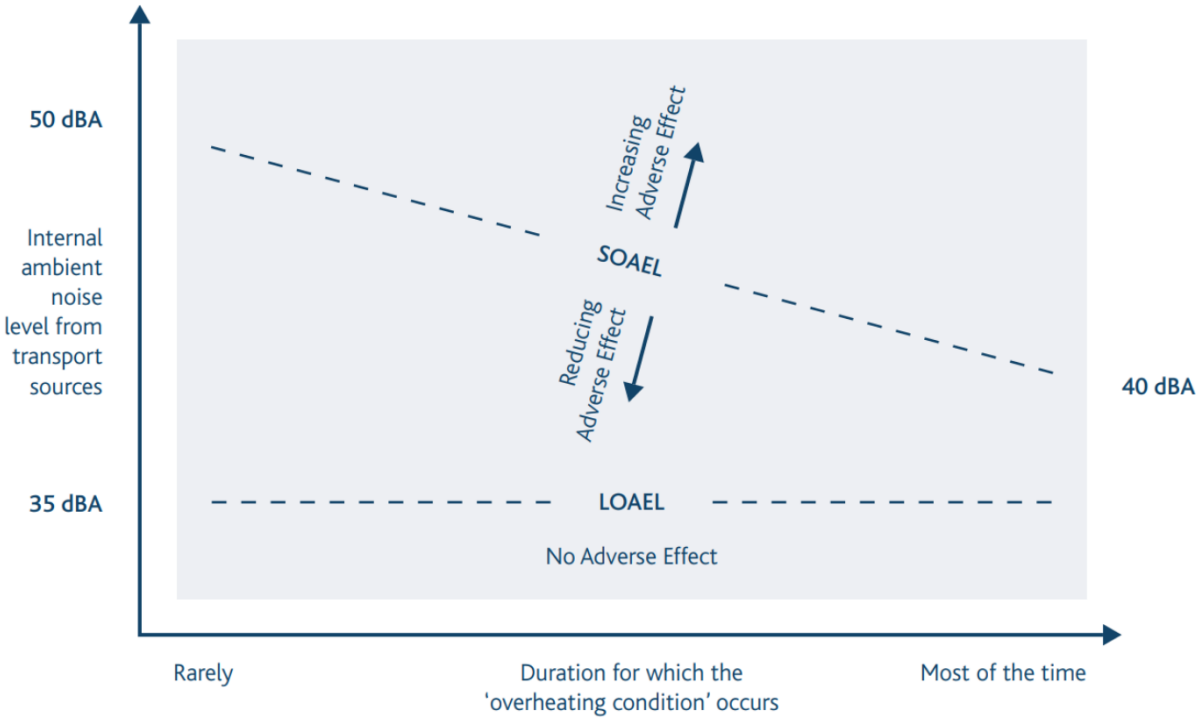
Room	Room volume	Reverberation time	Vent open area	Vent sound reduction $D_{n,e}$	Outside-inside sound reduction with vent open
Bedroom	30 m^3	0.5 secs	1.3 m^2	9 dB	6 dB
Living room	81 m^3	0.5 secs	1.3 m^2	9 dB	10 dB

1.17. Considering the low level of sound attenuation provided by the vent, noise breaking in through other elements of the façade would not contribute significantly to the internal noise level when the vent is open.

Assessment of Impact

1.18. The methodology described in the AVO Guide aims to weigh the internal noise level with vents open, against the duration that the vents are expected to be open. The method provides the graphs shown below, which are used to estimate the significance of the noise impact.

Figure 1 - AVO Guide Assessment of Adverse Impact - Daytime



1.19. Only daytime impacts are considered as the overheating assessment has demonstrated that it will not be necessary for the vent to be open between 23:00hrs and 07:00hrs.

1.20. The durations that open vents will be required to mitigate overheating are taken from WSP's Overheating Assessment [Ref. 22]. The values have been used to determine general worst case % total opening hours for the overheating period (May to September) for typical rooms as follows:

- Bedroom - vent open for 64% of overheating period
- Living room - vent open for 70% of overheating period

1.21. Assuming the calculated sound reductions provided when the vent is open, and the opening durations above, the suitability of the proposed vent has been determined for different ranges of external noise levels as follows (using the SOAEL graph in Figure 1 above):

Table 2 – Suitability of Proposed Purge Vent

Suitability of proposed vent for providing relief from overheating	Predicted external noise level	
	Bedroom, dB $L_{Aeq,16hr}$	Living Room, dB $L_{Aeq,16hr}$
Purge vent suitable (internal levels < SOAEL)	≤ 50	≤ 53
Purge vent unsuitable based on current opening duration	52-56	56-60
Purge vent unsuitable regardless of opening duration	> 56	> 60

1.22. The categories in the table above can be interpreted as follows:

- Green - The purge vent is deemed suitable at these external noise levels, because internal noise levels would be below the SOAEL (i.e. they would be Not Significant) which would indicate a Negligible to Minor Adverse effect at worst.
- Red – Based on the current purge vent opening durations, the vent is not suitable in this range of external noise levels because internal noise levels would be above the SOAEL, indicating Moderate or Major Adverse effect . However, if the opening duration could be reduced, the vent may be suitable.
- Purple - The vent is not suitable at these external noise levels because internal noise levels would be above the SOAEL regardless of the opening durations. Even if only used 'rarely', the effect would be Moderate or Major Adverse.

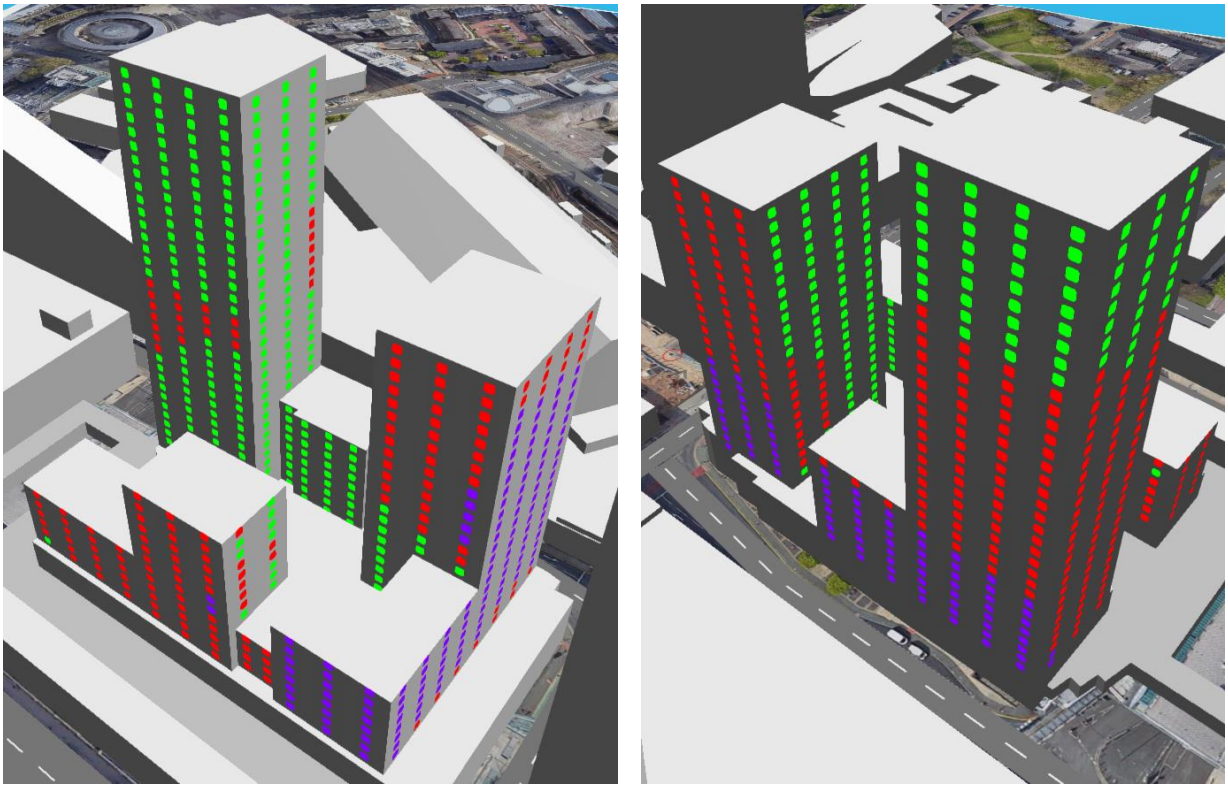
1.23. The above noise level ranges above have been mapped onto the various façades of the proposed residential buildings, as shown in the figures below, to indicate the potential suitability of the proposed ventilation design for providing relief from overheating in the flats for different parts of the façades.

Suitability of purge vent – typical bedroom

Table 3 – Suitability of Proposed Purge Vent – Typical Bedroom

Suitability of proposed vent for providing relief from overheating	Predicted external noise level, dB $L_{Aeq,16hr}$
Purge vent suitable (internal levels < SOAEL)	≤ 50
Purge vent unsuitable based on current opening duration	50-56
Purge vent unsuitable regardless of opening duration	> 56

Figure 2 - Suitability of Purge Vent – Typical Bedroom – View from SW / NW

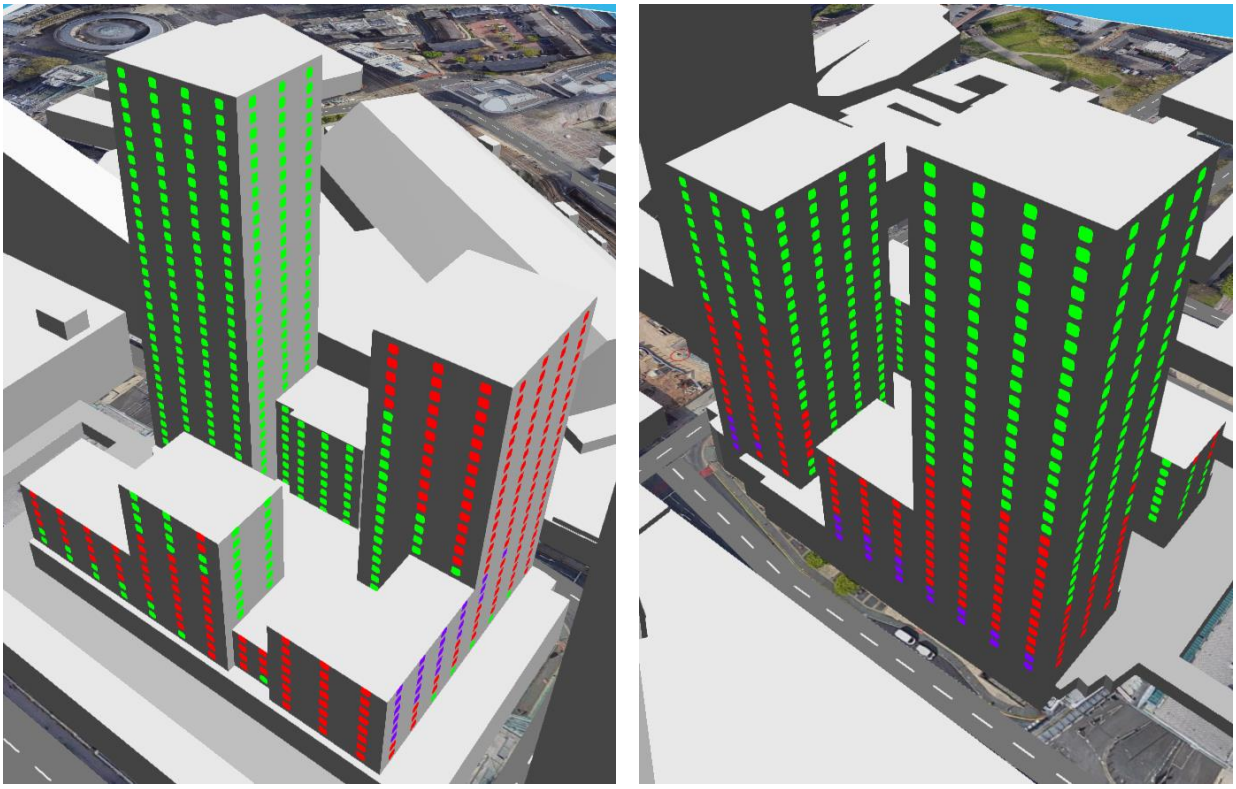


Suitability of purge vent – typical living room

Table 4 – Suitability of Proposed Purge Vent – Typical Living Room

Suitability of proposed vent for providing relief from overheating	Predicted external noise level, dB $L_{Aeq,16hr}$
Purge vent suitable (internal levels < SOAEL)	≤ 53
Purge vent unsuitable based on current opening duration	53-60
Purge vent unsuitable regardless of opening duration	> 60

Figure 3 - Suitability of Purge Vent – Typical Living Room – View from SW / NW



Conclusion

1.24. The building design assumes that the purge vent will remain closed at night whilst providing acceptable thermal conditions internally, evidenced through thermal modelling. Therefore, any adverse impacts due to noise ingress during overheating conditions will be limited to the daytime. This is in line with the planning requirements of MCC (assuming the façade with closed windows provides sufficient level of sound insulation).

1.25. For substantial proportions of the façades of the Proposed Development (shown in green above) the purge vent is deemed suitable based on the predicted daytime external noise levels, because internal noise levels would be below the SOAEL (i.e. they would be Not Significant) which would indicate a Negligible to Minor Adverse effects at worst during the day.

1.26. There are portions of the residential façades (shown above in red) where, based on the results of the overheating modelling, the rapid purge vents are not suitable for providing relief from overheating according to the AVO Guide [Ref. 18]. When the vents are used for the required opening durations to mitigate overheating they could generate Moderate to Major effects for future occupants during the day. These effects would be Significant in ES terms.

1.27. In these areas enhanced mechanical ventilation rates (over standard whole-dwelling rates) are to be provided by an additional mechanical fan so that the required purge vent opening times are reduced.

1.28. Indicative thermal modelling has suggested that increasing ventilation rates could reduce required vent opening durations substantially- reducing the applicable SOAEL. This would mean that the purge vent is suitable in a greater number of locations because it does not need to be opened as often to provide acceptable thermal conditions internally.

1.29. There are some portions of the façades (shown above in purple) where, regardless of the duration of openings, the purge vents will not be suitable according to the AVO guide [Ref. 18]. When the vents are used for the required opening durations to mitigate overheating they could generate Moderate to Major effects for future occupants during the daytime. These impacts would be Significant in ES terms. Other methods of providing relief from overheating in these locations should be investigated.

1.30. In the most affected areas other methods of providing relief from overheating, such as 'trim cooling' or comfort cooling will be utilised. The intention is to enable acceptable thermal conditions to be provided through the year without opening purge vents, maintaining acceptable internal noise levels (below the SOAEL) for occupants. The details of this strategy will be developed during the detailed design stages.

1.31. Through the adoption of the mitigation methods above, internal noise levels will be below the SOAEL in the AVO Guide [Ref. 18], meaning that effects will range from Negligible to Minor Adverse. These effects will be permanent but only occur occasionally during the overheating period. This effect is not significant in ES terms.