**Acoustics, Ventilation and Overheating Residential Design Guide**

The Acoustics Ventilation and Overheating – Residential Design Guide was published by the Association of Noise Consultants (ANC) in January 2020. This followed the publishing of the Draft for Consultation published in March 2018.

The Guide promotes an approach to environmental noise assessments for new residential developments that takes account of the interdependence of any acoustic measures that may be required, the ventilation provision and the need to avoid overheating, demonstrating how the competing aspects of thermal and acoustic comfort can be managed.

Specific recommendations made by the document are concerned with transportation noise only, and does not consider noise arising from industrial, commercial or entertainment noise sources. However, it does consider the noise that may arise from any mechanical ventilation systems that may be required.

The aims of the Guide are set out in paragraph 1.14, which states:

“1.14 The AVO Guide seeks to:

* encourage an assessment of noise that recognises the interdependence between the acoustics, ventilation and overheating designs;
* provide a means of assessment to satisfy the need to consider acoustics, ventilation and overheating at the planning stage;
* assist in educating clients, environmental health/planning officers and other stakeholders of the interdependence of design for acoustics, ventilation and overheating.”

In respect of the concept of Good Acoustic Design as promoted by the ProPG, paragraph 1.19 of the AVO Guide states:

“1.19 The ProPG emphasises the importance and principles of good acoustic design; the AVO Guide is intended to contribute to the practice of good acoustic design. It is noted that the over-arching aspiration of good acoustic design is that residents may open windows without any adverse acoustic impact (ProPG para. 2.33); where a site layout achieves these conditions, the portion of the AVO Guide relating to environmental noise is not applicable.”

The Guide then goes on to state:

“1.20 In particular, the paragraphs 2.34 – 2.36 of the ProPG indicate that an integrated design approach must be taken to acoustic, ventilation and thermal comfort conditions:

* Para 2.34: ‘design the accommodation so that it provides good standards of acoustics, ventilation and thermal comfort’
* Para 2.36: ‘[where a] scheme is reliant on open windows to mitigate overheating, it is also necessary to consider the potential noise impact during the overheating condition. In this case a more detailed assessment of the potential impact on occupants should be provided in the ADS’.”

and:

“1.20 In addition, Para 2.38 says: ‘Where mechanical services are used as part of the ventilation or thermal comfort strategy for the scheme, the impact of noise generated by these systems on occupants should also be assessed’.”

Chapter 2 of the Guide is concerned with relevant legislation and guidance relating to ventilation, overheating and acoustics. Paragraph 2.4 of this chapter acknowledges that Approved Document F of the Building Regulations (ADF) states that:

“Ventilation may also provide a means to control thermal comfort but this is not controlled under the Building Regulations”.

Paragraph 2.4 then goes on to state:

“However, it is important to differentiate between the need to provide ‘purge ventilation’ as required occasionally under ADF (ie to remove smoke from burnt food etc); against the need to provide ventilation for the ‘overheating condition’ which is not covered by the Building Regulations.”

The four template ventilation systems that comply with the ventilation requirements for new dwellings that are described in ADF are summarised in Table 2-2 of the AVO Guide.

Chapter 2 of the guide also states that overheating is taken to mean:

“the phenomenon of excessive or prolonged high temperatures in homes, resulting from internal or external heat gains, which may have adverse effects on the comfort, health or productivity of the occupants.”

Paragraph 2.15 makes reference to the Overheating Risk – Early Stage Tool included in the document ‘Overheating in New Homes’ published by the Good Homes Alliance (GHA), confirming that this may be used to evaluate overheating risk at the stage that the acoustic assessment is carried out.

In considering cooling strategies that may be applied to dwelling Chapter 2 of the Guide states:

“2.19 In accordance with sustainable design and construction principles, development proposals should, amongst other things, maximise opportunities to orientate buildings and streets to minimise summer and maximise winter solar gains; use trees and other shading; increase green areas in the envelope of a building, including its roof and environs; and maximise natural ventilation. These sustainable design principles mirror good acoustic design as described in the ProPG. More information is available in paragraph A.19.

“2.20 To minimise the risk of overheating in most residential buildings it is normally necessary to use some form of cooling system. The three main methods of providing additional cooling are:

* Passive ventilative cooling – Introducing external air to a space to provide a cooling effect without the use of fans. The most common method is to use open windows but other façade openings can also be used.
Note that trickle vents do not enable sufficient airflow to have a significant cooling effect.
* Mechanical ventilative cooling – Using fans to introduce external air to a space to provide a cooling effect. Due to the airflow required, this type of system often involves significant plant and duct size requirements.
* Comfort cooling – Using a mechanical system to cool the air within a space to achieve a user-defined setpoint. This type of system will require some form of mechanical device to cool the air, such as a fan coil unit (FCU).

“2.21 A more recently developed alternative to the systems above is a tempered fresh air system. These systems add a small amount of cooling to the whole dwelling ventilation supply system (e.g. to the MVHR). This provides a reduced temperature fresh air supply which can provide some cooling to a space. Unlike comfort cooling, these systems are not designed to achieve a specific temperature in a space.”

The final part of Chapter 2 discusses current planning policy, regulations and guidance documents relating to acoustics, including the NPSE, BS8233 and the Pro PG referred to above.

Chapter 3 of the Guide is concerned with Internal Ambient Noise Level Guidelines, pointing out that the contribution from transportation noise sources should be considered separately from and independently of the contribution from ventilation noise.

In this context the Guide states:

“3.4 For both sources of noise, the guidance makes a clear distinction between provisions for fresh air to achieve whole dwelling ventilation rates (‘ADF ventilation condition’), and provisions for ventilative cooling to mitigate overheating (‘overheating condition’)

“3.4 In terms of noise effect, the important distinction between these two situations is that the ADF ventilation condition applies for the entire time whereas the overheating condition applies only for part of the time.“

In considering appropriate internal ambient noise levels due to transportation noise the Guide states:

“3.9 It is suggested here that the desirable internal noise standards within Table 4 of BS 8233:2014 should be achieved when providing adequate ventilation as defined by ADF whole dwelling ventilation. However, it is considered reasonable to allow higher levels of internal ambient noise from transport sources when higher rates of ventilation are required in relation to the overheating condition.

“3.10 The basis for this is that the overheating condition occurs for only part of the time. During this period, occupants may accept a trade-off between acoustic and thermal conditions, given that they have some control over their environment. In other words, occupants may, at their own discretion, be more willing to accept higher short-term noise levels in order to achieve better thermal comfort. The importance of control is relevant to daytime exposure, but not to night time exposure where the consideration is sleep disturbance.”

“3.13 The values in Table 3-2 are based on the assumption of a 13 dB difference between external free-field noise levels and internal ambient noise levels. Refer to paragraph 3.24 for further discussion.

“3.14 Table 3-2 suggests that a Level 2 assessment is not required in situations where it is expected that reasonable internal conditions, described in ProPG as BS 8233 levels relaxed by up to 5 dB, will be achieved.”

“3.18 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. A good design process should therefore, as a priority, seek to minimise heat gains thereby reducing the amount and duration of ventilation required to control overheating and the consequential effect from increased ingress of noise.

“3.19 No quantitative guidance regarding the combined effect of level and duration for the overheating condition is included in the current version of this document. However, the situation is summarised qualitatively in Figure 3-2 and also addressed in the worked examples included in Appendix B.”

Table 3-1 of the Guide confirms that for the ventilation conditions set out in Approved Document F of the Building Regulations (the ADF ventilation condition) the internal noise standards set out on BS8233: 2014 are appropriate, noting that no specific acoustic criteria need to be met under purge ventilation conditions.

Figure 3-1 of the Guide sets out in a flow chart the proposed two-level noise assessment procedure that is to apply to transportation noise in the potential overheating condition. In turn this assessment procedure makes reference to:

* a Level 1 assessment where the risk of an adverse effect is assessed in accordance with the guidance provided in Table 3-2; and
* a Level 2 assessment where the risk of an adverse effect is assessed in accordance with the guidance provided in Table 3-3 and Figure 3.2.

The Guide provides guidance on appropriate internal ambient noise levels due to mechanical ventilation systems in:

* Table 3-4, which sets out the indoor ambient noise levels from mechanical services that are likely to be acceptable for the ADF ventilation condition; and
* Table 3-5, which sets out the indoor ambient noise levels from mechanical services that are likely to be acceptable for ventilation condition required to avoid overheating.

Appendix A of the guide provides additional information, including more detailed guidance on ventilation and overheating criteria and the achievement of satisfactory levels of thermal comfort.

In respect of overheating criteria and guidance reference is made to CIBSE Technical Memorandum 59 ‘Design methodology for the assessment of overheating risk in homes’. This document sets out sets out a standardised methodology for predicting temperatures inside dwellings (including care homes and student accommodation) and also provides overheating ‘compliance criteria’.

Paragraph A.22 of the AVO Guide states:

“A.22 CIBSE TM59 notes that:

This methodology is proposed for all residences and should especially be considered for:
— large developments
— developments in urban areas, particularly in southern England
— blocks of flats
— dwellings with high levels of insulation and air-tightness
— single aspect flats.

Individual houses and developments with a low risk of overheating may not require the use of dynamic thermal modelling…”

The Guide then goes on to discuss the compliance criteria specified in CIBSE TM59 for homes that are predominantly naturally ventilated and for homes that are predominantly mechanically ventilated.

Reference is also made to:

* the Standard Assessment Procedure for Energy Rating of Dwellings’ (SAP), 2012; and
* the Housing Health and Safety Rating System; and
* the IEA Energy in Buildings and Communities Programme – Annex 62 – Ventilative Cooling.

Dynamic thermal modelling is also discussed as is the early stage overheating assessment tool contained in the document ‘Overheating in New Homes’ published by the Good Homes Alliance.

The latter includes the consideration of situations where noise levels may be a reason for occupants preferring to keep windows closed for all or part of the day or night- time periods. It is suggested that this assessment tool may be of assistance in enabling non-specialists to obtain a quantitative estimate of the potential overheating risk for proposed developments.

Appendix B is concerned with the practical application of the Guide, with Table B-1 identifying three steps to link the noise assessment to the ventilation and overheating strategies. Figure B-1 shows the typical activity of the acoustic designer in developing the design.

In considering the acoustics effects of the ventilation strategy guideline external noise constraints are proposed for ADF ventilation Systems 1 & 2, System 3 and System 4. A summary of potential level differences associated with the different ventilation Systems from ADF is provided in Table B-2, the level differences equating to the external free-field noise level and the internal reverberant level.

The need to assess individual noise events (in contrast to average noise levels expressed in terms of dB LAeq) is also discussed.

Table B-3 provides a summary of the potential noise issues associated with ventilation strategies described in ADF.

Table B-4 provides a summary of the potential noise issues associated with various cooling strategy that may be required in order to control overheating.

Table B-5 includes a number of examples of passive ventilation solutions that can provide enhanced levels of sound insulation.

The Guide than goes on to recommend:

* the items of information that may be considered appropriate for submission to local planning authorities in connection with planning applications; and
* a schedule of acoustic performance requirements that may be appropriate to include in any testing schedule that may be required.

The final section of Appendix B consists of a worked example.

Appendix C of the Guide is concerned with the sound insulation provided by partially open windows, and discusses:

* the results of a field study covering 102 dwellings in Switzerland that were affected by road traffic noise; and
* laboratory measurements made in the UK for 14 window types and arrangements with various degrees of opening.