

# SANDY BROWN

*Consultants in Acoustics, Noise & Vibration*

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## **Land to the west of Rodney Street, Manchester**

### *3D modelling & level 2 AVO assessment*

#### **Introduction and summary**

A level 2 assessment in line with the *Acoustics, Ventilation and Overheating, Residential Design Guide* (AVO) has been undertaken for Block A to the north of the site. This building fell into a 'Medium' AVO risk category following the level 1 assessment hence further assessment was deemed necessary.

Block B and the Townhouses fell into 'Low' and 'Negligible' AVO risk categories following a level 1 assessment and as such, use of partially opening windows to control overheating for the dwellings in these buildings is considered to be acceptable without further assessment.

3D modelling has been carried out to assess the noise levels outside the apartments, based on the proposed site and building geometry and environmental noise survey results. Assessment of noise ingress via partially open windows to apartments in Block A has also been carried out.

The results indicate that the AVO SOAEL thresholds are expected to be met during the night-time with use of partially open windows for the selected apartments, even if windows are open 'most of the time'. There are however bedrooms and living rooms in Block A where the SOAEL thresholds of AVO may be exceeded during the daytime if windows need to be opened to control overheating. To mitigate this, a mechanical ventilation strategy has been developed by Method to avoid use of opening windows to control overheating to these apartments during the daytime.

Approved Document O provides guidance on maximum noise ingress to dwellings during the night-time, though this document is not expected to be applicable for the scheme. Manchester City Council have suggested that these criteria should however ideally be met. The assessment indicates that noise ingress to apartments during the night-time with partially open windows to control overheating would be in line with the Approved Document O criteria.

## Basis

The assessment is based on the following:

- 22013-R01-B Acoustic planning report
- Site plan and elevation GAs available May 2022
- Window schedules and locations available 9 June 2022
- Apartments selected for overheating assessment in Block A from Method Consulting.
- Acoustic Ventilation Overheating: Residential Design Guide (AVO)
- Approved Document O: Requirement O1: Overheating mitigation (Regulation 40B), The Building Regulations 2010

## 3D modelling

A computer model of the site and its surroundings has been built using CadnaA software by Datakustik, with the purposes of calculating the external noise levels at the different facades of the proposed development based on the results of the environmental noise surveys.

The software carries out calculations using a ray tracing technique. This takes into account the effects of topography, reflections, screening and distance attenuation on noise sources to predict noise levels in three dimensions. Calculations are carried out in accordance with ISO 9613 *Attenuation of sound during propagation outdoors*.

The model includes ground absorption for green landscaping areas as identified on site. If this changes to hard ground surfaces then this has the potential to increase the facade noise levels and so may need to be updated as the design progresses.

An image of the computer model is provided in Figure 1.

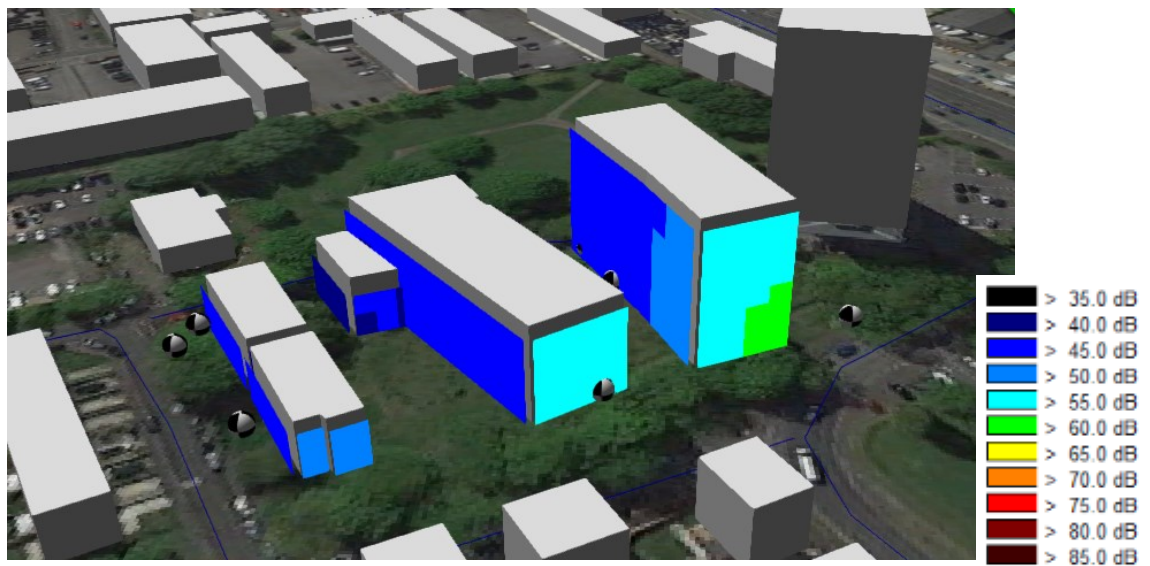


Figure 1 Screenshot of 3D environmental noise model (daytime)

## Apartments selected for overheating assessment

The apartments in Block A that have been selected for the overheating assessment by Method are shown in Figure 2.

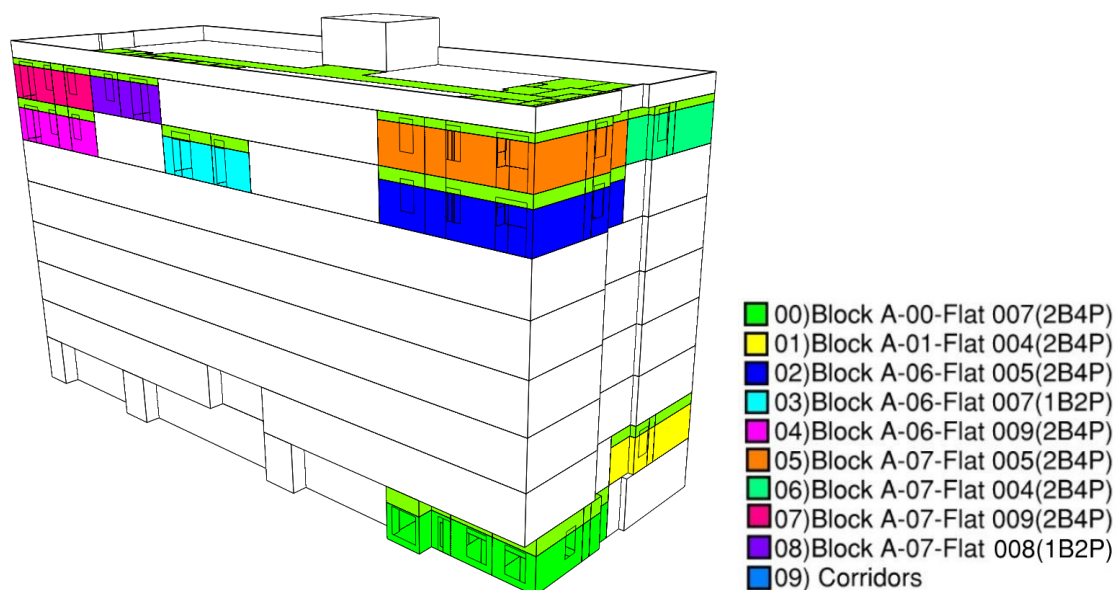


Figure 2 Block A apartments selected for overheating assessment

Our level 2 AVO assessment is focused on these apartments. The apartments selected for the other blocks are within 'low' and 'negligible' AVO risk categories following the level 1 assessment, and therefore no further AVO assessment is needed.

## Level 2 AVO assessment

### Predicted external noise levels

The predicted worst-case external free-field noise levels at the selected apartments in Block A are detailed in Table 1.

Table 1 Predicted external free-field levels from 3D model

| Location                   | $L_{Aeq,16hrs}$ (dB) day<br>(0700-2300) | $L_{Aeq,8hrs}$ (dB) night-<br>time (2300-0700) | Not normally<br>exceeded $L_{AFmax}$<br>(dB) |
|----------------------------|-----------------------------------------|------------------------------------------------|----------------------------------------------|
| Block A-00-Flat 007(2B4P)  | 58                                      | 51                                             | 65                                           |
| Block A-01-Flat 004(2B4P)  | 58                                      | 50                                             | 71                                           |
| Block A-06-Flat 005 (2B4P) | 51                                      | 50                                             | 63                                           |

| Location                   | $L_{Aeq,16hrs}$ (dB) day<br>(0700-2300) | $L_{Aeq,8hrs}$ (dB) night-<br>time (2300-0700) | Not normally<br>exceeded $L_{AFmax}$<br>(dB) |
|----------------------------|-----------------------------------------|------------------------------------------------|----------------------------------------------|
| Block A-06-Flat 007 (1B2P) | 46                                      | 44                                             | 55                                           |
| Block A-06-Flat 009 (2B4P) | 45                                      | 44                                             | 63                                           |
| Block A-07-Flat 005 (2B4P) | 50                                      | 49                                             | 63                                           |
| Block A-07-Flat 004 (2B4P) | 56                                      | 50                                             | 70                                           |
| Block A-07-Flat 009 (2B4P) | 46                                      | 44                                             | 63                                           |
| Block A-07-Flat 008 (1B2P) | 46                                      | 44                                             | 55                                           |

## Noise ingress via partially open windows during overheating

The current design includes partially opening windows to control overheating in the apartments. The noise attenuation provided by a partially open window depends on the degree of opening.

Appendix C of the AVO guide provides the following information based on a field study in Switzerland:

*They measured (free-field) outside-to-inside level differences of  $10.0 \pm 2.9\text{dB}$  for open windows and  $15.8 \text{ Open} \pm 2.7\text{dB}$  for tilted windows. A value of 13dB is consistent with a situation between 'open' and 'tilted'.*

The calculated internal noise levels set out below are based on the following which are understood to be in line with the current design:

- Ground floor: Side hung windows to bedrooms and living rooms to the north and south elevations bedrooms achieving an outside to inside level difference of 13 dB.
- A bottom hung tilted partially open inwards window to all bedrooms achieving an outside to inside level difference of 16 dB
- A bottom hung tilted partially open inwards window to living rooms on the east and west facades achieving an outside to inside level difference of 16 dB
- A Juliette style partially open window to living rooms on north and south facades achieving an outside to inside level difference of 13 dB
- For living rooms with more than one window, Method Consulting confirmed that only the Juliette style window is proposed to be open for overheating control.

A potential variation of  $\pm 3$  dB should be considered to allow for adjustment of window openings.

Table 2 Predicted internal levels based on partially open window

| Location                          | $L_{Aeq,16hrs}$ (dB) day<br>(0700-2300) | $L_{Aeq,8hrs}$ (dB) night-time<br>(2300-0700) | Not normally exceeded<br>$L_{AFmax}$ (dB) |
|-----------------------------------|-----------------------------------------|-----------------------------------------------|-------------------------------------------|
| <i>Block A-00-Flat 007(2B4P)</i>  |                                         |                                               |                                           |
| Bedroom                           | 43                                      | 37                                            | 52                                        |
| Living room                       | 38                                      | 33                                            |                                           |
| <i>Block A-01-Flat 004(2B4P)</i>  |                                         |                                               |                                           |
| Bedroom                           | 42                                      | 34                                            | 55                                        |
| Living room                       | 47                                      | 39                                            |                                           |
| <i>Block A-06-Flat 005 (2B4P)</i> |                                         |                                               |                                           |
| Bedroom                           | 35                                      | 34                                            | 47                                        |
| Living room                       | 39                                      | 36                                            |                                           |
| <i>Block A-06-Flat 007 (1B2P)</i> |                                         |                                               |                                           |
| Bedroom                           | 30                                      | 28                                            | 39                                        |
| Living room                       | 33                                      | 31                                            |                                           |
| <i>Block A-06-Flat 009 (2B4P)</i> |                                         |                                               |                                           |
| Bedroom                           | 29                                      | 28                                            | 47                                        |
| Living room                       | 39                                      | 36                                            |                                           |
| <i>Block A-07-Flat 005 (2B4P)</i> |                                         |                                               |                                           |
| Bedroom                           | 34                                      | 33                                            | 47                                        |
| Living room                       | 39                                      | 35                                            |                                           |
| <i>Block A-07-Flat 004 (2B4P)</i> |                                         |                                               |                                           |
| Bedroom                           | 40                                      | 34                                            | 54                                        |
| Living room                       | 45                                      | 38                                            |                                           |
| <i>Block A-07-Flat 009 (2B4P)</i> |                                         |                                               |                                           |
| Bedroom                           | 30                                      | 28                                            | 47                                        |
| Living room                       | 39                                      | 36                                            |                                           |

| Location                          | $L_{Aeq,16hrs}$ (dB) day<br>(0700-2300) | $L_{Aeq,8hrs}$ (dB) night-time<br>(2300-0700) | Not normally exceeded<br>$L_{AFmax}$ (dB) |
|-----------------------------------|-----------------------------------------|-----------------------------------------------|-------------------------------------------|
| <i>Block A-07-Flat 008 (1B2P)</i> |                                         |                                               |                                           |
| Bedroom                           | 30                                      | 28                                            | 39                                        |
| Living room                       | 33                                      | 31                                            |                                           |

The chart formats below are from the AVO guide. Whether the Significant Observed Adverse Effect Level (SOAEL) threshold is exceeded depends on the duration that partially open windows are needed to control overheating.

For each assessment, the position of the dot along the X-axis would be hours where windows would need to be opened to control overheating which will be determined as part of the overheating assessment provided by Method. The position of the dot on the Y-axis would be the predicted noise ingress levels presented in Table 2.

The assessment is to be considered from the beginning of May to the end of September, which is 153 days.

- The daytime X-axis would then extend to a maximum of  $153 \times 16hrs = 2448$  hrs
- The night-time X-axis would extend to a maximum of  $153 \times 8$  hrs = 1224 hrs.

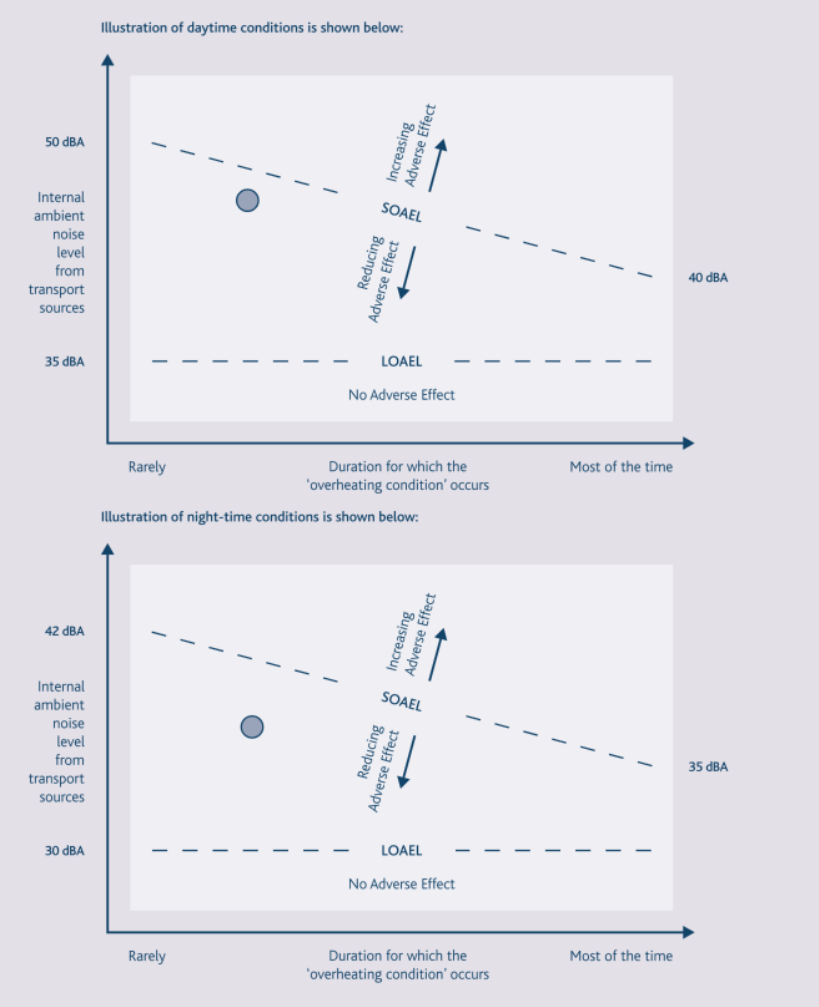


Figure 3 Example AVO assessment charts

Table 3-3 of the AVO guide provides examples of outcomes for internal ambient noise levels. This is shown below.

**Table 3-3** Guidance for Level 2 assessment of noise from transport noise sources<sup>[Note 1]</sup> relating to overheating condition

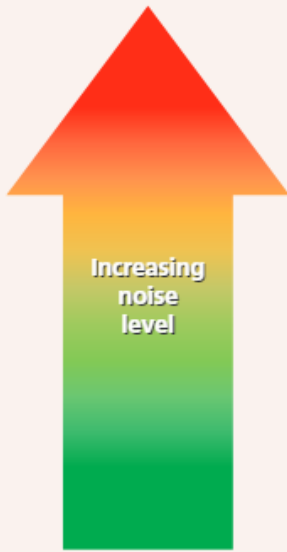
| Internal ambient noise level <sup>[Note 2]</sup>                                                                         |                                       |                                                                                    | Examples of Outcomes <sup>[Note 5]</sup>                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|--------------------------------------------------------------------------------------------------------------------------|---------------------------------------|------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $L_{Aeq,T}$ <sup>[Note 3]</sup><br>during<br>07:00 – 23:00<br><sup>[Note 6]</sup>                                        | $L_{Aeq,16h}$ during<br>23:00 – 07:00 | Individual noise<br>events during<br>23:00 – 07:00<br><sup>[Note 4]</sup>          |                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| > 50 dB                                                                                                                  | > 42 dB                               | Normally<br>exceeds 65 dB<br>$L_{A1max}$                                           | Noise causes<br>a material<br>change in<br>behaviour<br>e.g. having to<br>keep windows<br>closed most<br>of the time                  | Avoiding certain activities during<br>periods of intrusion. Having to keep<br>windows closed most of the time<br>because of the noise. Potential<br>for sleep disturbance resulting<br>in difficulty in getting to sleep,<br>premature awakening and difficulty<br>in getting back to sleep. Quality<br>of life diminished due to change<br>in acoustic character of the area.                                                                                                                                                                                                                                                                                                                                                                                                                             |
|  <p>Increasing<br/>noise<br/>level</p> |                                       |                                                                                    | Increasing<br>likelihood of<br>impact on<br>reliable speech<br>communication<br>during the<br>day or sleep<br>disturbance<br>at night | <p>At higher noise levels, more<br/>significant behavioural change<br/>is expected and may only be<br/>considered suitable if occurring<br/>for limited periods.</p> <p>As noise levels increase, small<br/>behaviour changes are expected<br/>e.g. turning up the volume on the<br/>television; speaking a little more<br/>loudly; having to close windows<br/>for certain activities, for example<br/>ones which require a high level of<br/>concentration. Potential for some<br/>reported sleep disturbance. Affects<br/>the acoustic environment inside<br/>the dwelling such that there is a<br/>perceived change in quality of life.</p> <p>At lower noise levels, limited<br/>behavioural change is expected<br/>unless conditions are prevalent<br/>for most of the time. <sup>[Note 8]</sup></p> |
| ≤ 35 dB                                                                                                                  | ≤ 30 dB                               | Do not<br>normally<br>exceed $L_{A1max}$<br>45 dB more<br>than 10 times<br>a night | Noise can<br>be heard, but<br>does not cause<br>any change in<br>behaviour                                                            | Noise can be heard, but does not<br>cause any change in behaviour,<br>attitude, or other physiological<br>response <sup>[Note 9]</sup> . Can slightly affect the<br>acoustic character of the area but<br>not such that there is a perceived<br>change in the quality of life.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

Figure 4 Excerpt of Table 3-3 of AVO guide

## Acoustic AVO assessment

The assessment indicates that there is a potential risk of the SOAEL threshold being exceeded during the daytime for the following apartments selected by Method for the overheating assessment:

- Block A-07-Flat 004 (2B4P): Living room
- Block A-01-Flat 004 (2B4P): Living room and Bedroom
- Block A-00-Flat 007 (2B4P): Bedroom.

There are other apartments which are predicted to be exposed to similar external noise levels which could lead to the SOAEL threshold being exceeded during the daytime with windows open these are summarised below:

- Block A-01-Flat 005(2B4P): Bedroom
- Block A-02-Flat 005(2B4P): Bedroom
- Block A-03-Flat 005(2B4P): Bedroom
- Block A -02-Flat 004(2B4P): Living room and Bedroom
- Block A -03-Flat 004(2B4P): Living room and Bedroom
- Block A -04-Flat 004(2B4P): Living room and Bedroom
- Block A -05-Flat 004(2B4P): Living room and Bedroom
- Block A-07-Flat 003(2B4P): Living room
- Block A-07-Flat 002(2B4P): Living room
- Block A-06-Flat 004(2B4P): Living room
- Block A-06-Flat 003(2B4P): Living room
- Block A-06-Flat 002(2B4P): Living room
- Block A-05-Flat 003(2B4P): Living room
- Block A-05-Flat 002(2B4P): Living room
- Block A-04-Flat 003(2B4P): Living room
- Block A-04-Flat 002(2B4P): Living room
- Block A-03-Flat 003(2B4P): Living room
- Block A-03-Flat 002(2B4P): Living room
- Block A-02-Flat 003(2B4P): Living room
- Block A-02-Flat 002(2B4P): Living room
- Block A-01-Flat 003(2B4P): Living room
- Block A-01-Flat 002(2B4P): Living room
- Block A-00-Flat 003(2B4P): Living room and Bedroom.

A mechanical ventilation has been developed by Method for the apartments listed above to allow windows to remain closed during the daytime, hence mitigating the potential AVO noise issue.

In all of the other the instances assessed, the predicted levels are below the AVO SOAEL thresholds even if windows are open *'most of the time'* to control overheating.

All of the night-time noise ingress levels predicted are within the AVO SOAEL thresholds.

## Approved Document O

Approved Document O states the following in relation to noise ingress via opening windows in relation to overheating:

*'In locations where external noise may be an issue (for example, where the local planning authority considered external noise to be an issue at the planning stage), the overheating mitigation strategy should take account of the likelihood that windows will be closed during sleeping hours (23:00-07:00 hours).*

*Windows are likely to be closed during sleeping hours if noise within bedrooms exceeds the following limits.*

- a.  $L_{Aeq,T}$  40 dB average over 8 hours (between 23:00-07:00)
- b.  $L_{AFmax}$  55 dB more than 10 times a night (between 23:00-07:00).'

These values are predicted to be complied with based on the assessment carried out above.

It should be noted that Approved Document O is not expected to be applicable for the development due to the anticipated registration date with Building Control and the date that site works are anticipated to commence.