

Technical Note

Project:	Plot F, Great Jackson Street, Manchester
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INTRODUCTION

Manchester City Council has advised that planning applications for residential applications must include an assessment in line with 'Acoustics, Ventilation and Overheating, Residential Design Guide', (AVO) published by the Association of Noise Consultants and the Institute of Acoustics in January 2020.

The apartments within the proposed development at Plot F, Great Jackson Street are to be ventilated using continuous mechanical supply and extract with heat recovery (MVHR) units in order to comply with the 'whole dwelling' ventilation requirements of Approved Document F of the Building Regulations (ADF). Purge ventilation is required under ADF to rapidly dilute pollutants (eg paint fumes) and/or water vapour to maintain indoor air quality. Purge ventilation of the apartments is to be provided by opening windows (purge panels) within the curtain wall.

The provisions for purge ventilation (eg openable purge panels) can also be used to improve thermal comfort, although this is not currently controlled under the Building Regulations. The AVO recommends that when using provisions for purge ventilation such as opening windows, an assessment is carried out of the potential effect of the subsequent internal noise levels within apartment rooms.

This Technical Note discusses the potential effect of the control of overheating on the internal noise levels within the proposed apartments of Plot F, Great Jackson Street, Manchester.

ACOUSTICS, VENTILATION AND OVERHEATING, RESIDENTIAL DESIGN GUIDE (AVO)

As stated in the Foreword of the document, the AVO

- 'provides an approach as to how the competing aspects of thermal and acoustic comfort can be managed'.

In the current absence of mandatory requirements under the Building Regulations in relation to the overheating of dwellings, the AVO is

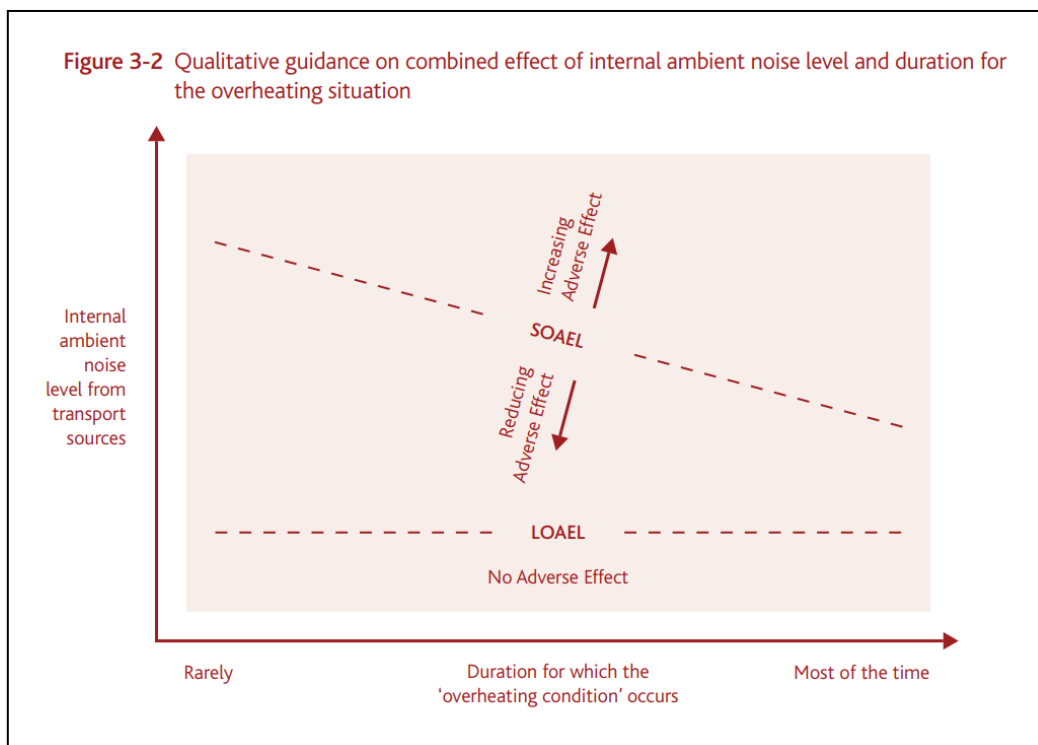
- 'intended to be used by acoustics practitioners as well as all those involved in the planning, development, design and commissioning of new dwellings. It recommends an approach to acoustic assessments for new residential development that takes due regard of the interdependence of provisions for acoustics, ventilation, and overheating'.

The AVO presents a method for assessing the risk of an adverse effect on occupants depending on 1) the potential internal noise level within apartments with windows open and 2) the duration of window opening.

With regard to the duration of window opening required to mitigate overheating, the AVO states:

- 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.

Figure 3-2 from the AVO is reproduced below.



It will be noted that no absolute noise levels are indicated on the y-axis and no specific durations are identified on the x-axis of Figure 3.2.

With regard to the duration of the overheating condition (i.e. the time that windows or purge panels may be open), 'rarely' and 'most of the time', as referenced in Figure 3-2 of the AVO are not defined, although reference is made to 'Overheating in New Homes', published by the Good Homes Alliance in July 2019, which provides an early design stage tool in order to identify key factors contributing to overheating risk, and possible mitigation measures.

The tool 'is not meant to provide a detailed assessment, but instead to sit between existing high level guidance...and detailed calculation and modelling tools...'.

The AVO recognises that further development work is required to better understand how long people will tolerate higher noise levels in their homes in order to stay cool, with the ultimate aim of creating 'cost effective and sustainable buildings'.

Furthermore, the AVO advises that:

- 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.

Importantly, the AVO acknowledges that

- Appropriate research work is urgently needed to better inform the guidance for the overheating condition.

and

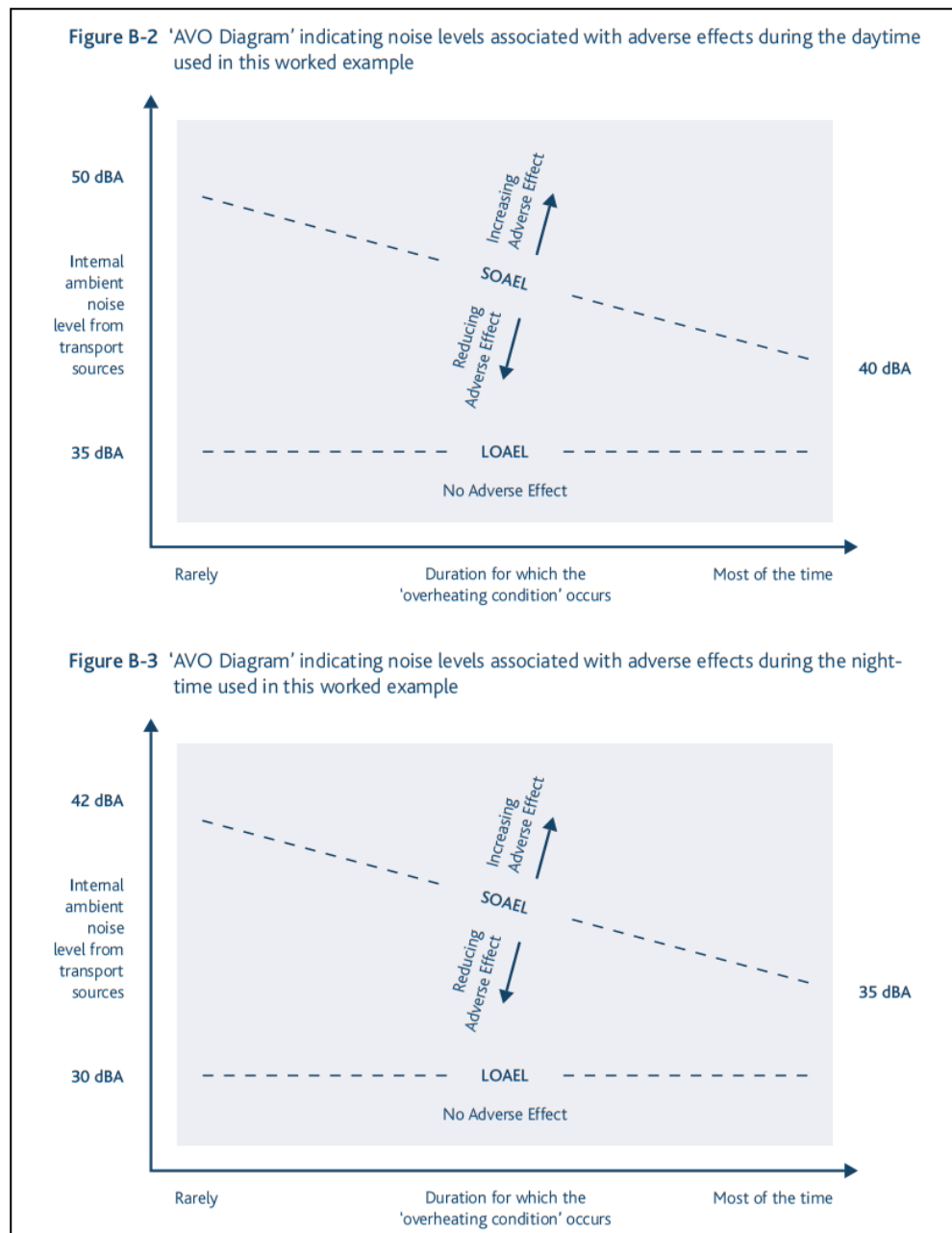
- There are other benefits for occupants from opening windows, such as the connection with the outside, sense of fresh air, experience of draughts when overheating, and sense of control over one's environment' and states that 'consideration of these factors is also beyond the scope of the AVO Guide.

Worked examples are provided in Appendix B of the AVO. These examples give suggested absolute dB levels for the SOAEL (Significant Observed Adverse Effect Level) and LOAEL (Lowest Observed Adverse Effect Level) curves in Figure 3-2. The LOAEL is defined as the level above which adverse effects on health and quality of life can be detected. The SOAEL is defined as the level above which significant adverse effects on health and quality of life occur.

The AVO advises that

- 'although for both LOAEL and SOAEL, the word 'level' is used, this does not mean that the impact can only be described as an individual noise level or exposure. It could also include factors such as the number of times the noise impact occurs, the duration of the impact, and the time of day the impact occurs. Thus, depending on the circumstance, the noise impact could be managed by reducing how often it occurs rather than just reducing the level of impact when it does occur.

Figures B-2 and B-3 from the AVO worked examples are reproduced below.



The AVO advises that the NPSE (Noise Policy Statement for England) states it is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times.

The AVO states that the suggested upper daytime noise limit of 50 dB LAeq,T is defined on the basis that it represents the upper end of the range for reliable speech communication. The upper night time noise limit of 42 dB LAeq,T is defined in the AVO with reference to the WHO Night Noise guidelines, which state that for external levels above 55dB LAeq,T, 'adverse health effects occur frequently and a sizeable proportion of the population is highly annoyed and sleep-disturbed'.

A noise level of 50dB LAeq,T is also the upper limit for indoor long-term ambient noise within open plan offices recommended in BS8233: 2014 'Guidance on sound insulation and noise reduction for buildings'.

The value of 'T', the averaging period used to determine the 'average' noise level 'LAeq,T', is not defined in the AVO. However, when discussing the further work required to better understand the issue of noise disturbance when windows are opened to control overheating, AVO states that further information is required, including

- how long will people tolerate higher noise levels in order to stay cool? One suggestion is to consider the overall average day (16h) and night (8h) time average noise levels. There is some logic to this as we all know that we can tolerate high noise levels for a short duration and moderately high levels for a little longer.

With regard to the absolute dB noise levels representing the LOAEL and the SOAEL in Figures B-2 and B-3, AVO states:

- The values presented....should not be regarded as fixed thresholds and reference can also be made to relevant dose-response relationships such as those described in a DEFRA 2014 study. the references are based on evidence drawn from *external* noise levels. There is currently very little robust evidence linking *internal* averaged noise levels with health outcomes and occupant behaviour.

Therefore, the noise levels identified in Figures B-2 and B-3 must be viewed with caution.

BUILDING REGULATIONS APPROVED DOCUMENT [X] – CONSULTATION VERSION (JAN 2021)

The consultation version of Building Regulations Approved Document [X] – ‘Overheating’ accompanies the January 2021 consultation on the Future Buildings Standard: Consultation on changes to Part L (conservation of fuel and power) and Part F (ventilation) of the Building Regulations for non-domestic buildings and dwellings; and overheating in new residential buildings. The Government is currently seeking views on the standards for work to residential buildings and the structure of the draft guidance.

The draft guidance states that

In the Secretary of State's view, the requirement for overheating is met if the building's overheating strategy is usable by occupants by taking account of the following.

- a. Noise at night – paragraphs 3.1 - 3.4.
- b. Pollution – paragraphs 3.5
- c. Security – paragraphs 3.6 - 3.8.
- d. Protection from falling – paragraphs 3.9 - 3.11.
- e. Protection from entrapment – paragraph 3.12

Section 3: Ensuring the overheating strategy is usable**Noise**

- 3.1. When the removing excess heat part of the overheating strategy is in use, noise levels in bedrooms should be kept to a minimum during the sleeping hours of 23.00 – 07.00. Noise within bedrooms should not normally exceed the following limits.
 - a. When openings are used
 - i. 40 dB LAeq, T, averaged over 8 hours.
 - ii. 55 dB LAFmax, maximum no more than 10 times a night.
 - b. When a mechanical system is used
 - i. 30 dB LAeq, T, averaged over 8 hours.
- 3.2 Building control bodies may accept as evidence that this requirement is satisfied, any of the following.
 - a. Documentation to demonstrate that the local planning authority did not consider external noise to be an issue at the site at the planning stage.
 - b. Noise measurements of the indoor environment once the building is completed. Measurements should be taken in accordance with the Association of Noise Consultants' Measurement of Sound Levels in Buildings with the overheating mitigation strategy in use.
 - c. Modelling of the noise of the indoor environment, using appropriate external noise measurements, with the overheating mitigation strategy in use.
- 3.3 Where noise measurements are used, sample testing on a development is appropriate. The sample should include one of each dwelling design, facing each orientation. The dwellings to be sample tested should be selected by the building control body in consultation with the person carrying out the measurement.

- 3.4 Where external noise is identified as an issue at the planning stage either of the following measures could be followed.
- a. Assess external noise and reduce the building's exposure.
 - b. Design the building to reduce the passage of noise from the external to the internal environment.

Guidance can be found in the Association of Noise Consultants' Acoustics, ventilation and overheating residential design guide.

Therefore, the draft version of Approved Document [X], whilst referring to the AVO, only requires that internal noise levels within bedrooms at night achieve certain criteria. No requirement for the achievement of daytime internal noise levels within dwellings in the overheating condition is presented in the draft version of Approved Document.

CIBSE TECHNICAL MEMORANDUM 59 'DESIGN METHODOLOGY FOR THE ASSESSMENT OF OVERHEATING RISK IN HOMES (TM59)'

CIBSE TM59 provides guidance on the assessment of overheating in dwellings. The document sets out a standardised methodology for predicting temperatures inside dwellings using dynamic thermal modelling and also provides overheating compliance criteria.

Dynamic thermal modelling has been carried out by Futureserv for a number of representative apartments within the proposed development at Plot F, Great Jackson Street. The detailed output from the modelling studies are provided under separate cover.

The initial input parameters for the TM59 model for Plot F, Great Jackson Street are identified in Table 1.

Assumptions	Target performance
Curtain Walling (W/m ² . K) (including frame and thermal bridging)	0.9
Glazing G-value (all glazing areas excluding purge vents)	0.4
Façade layout	As per floor plan
Weather data	Manchester_DSY1_2020High50.epw
MVHR flow rates – 1 bed	29 l/s
MVHR flow rates – 2 & 3 beds	37 l/s
Glazed Vent panel design	Glazed vent panels. G value of 0.22.
Vent panel conditions	54% openable area with 0.81m ² free area
Bedroom ventilation opening hours profile	Open 7am-11pm <u>and</u> when the temperature exceeds 22°C
Living room ventilation opening profile	Open 7am-7pm <u>and</u> when the temperature exceeds 22°C
Blind shading coefficient	0.28
Blind operational profile	When incident solar irradiance exceeds 300W/m ²

Table 1: CIBSE TM59 model assumptions

The 'DSY1' weather data used in the model is the 30 year average of weather years from 2009 to 2039.

It will be noted that in the TM59 model, the purge panels to bedrooms are prevented from opening between 11pm and 7am. Thus if compliance with the bedroom criterion of TM59 is achieved, then the bedroom purge vents can remain closed all night and the internal night time noise criteria of Manchester City Council can be achieved.

It should be noted that the opening hours of the purge vent are based on the vent opening at an internal temperature of 22 deg C. It could be considered that the TM59 model represents a worst case in terms of opening hours, as not all occupants may feel the need to open a purge vent at this temperature.

Furthermore, the TM59 modelling results identify the opening hours of the vent on the basis of the vent only closing when the internal temperature has dropped to 22 Deg C.

If the occupant of an apartment chose to close their vent before the internal temperature dropped back to 22 Deg C, it could quite often be the case that the internal temperature would not then rise above the 'fail' temperature criterion of TM59.

Therefore the opening hours of the purge vents identified by the TM59 model are not necessarily the opening hours required to maintain thermal comfort for the occupants. It would be quite possible to achieve thermal comfort with shorter opening hours than those stipulated by the TM59 modelling results.

The building design initially incorporated the following measures to mitigate overheating:

- 1) Low G value (0.4) of vision glazing to curtain wall to minimize solar heat gain to apartments
- 2) Low G value (0.22) of glazed vent panels to minimize solar heat gain to apartments
- 3) Blind shading coefficient of 0.28 to minimize solar heat gain to apartments
- 4) Continuously-running whole-house ventilation (MVHR) units with Summer Bypass within each apartment
- 5) Passive ventilative cooling via opening purge vents

PLOT F, GREAT JACKSON STREET DEVELOPMENT SITE

The proposed development comprises two residential towers F1 and F2 located on a site immediately to the north of Great Jackson Street.

EXTERNAL NOISE LEVELS

The prevailing noise levels at the development site have been determined by Fisher Acoustics by reference to noise surveys carried out around the site by Fisher Acoustics.

Figure 1 shows the calculated external daytime average (LAeq) noise levels expected to be incident upon the lower level façades of the proposed buildings. The incident noise levels assume that the development sites to the south of Plot F have not been built out. The noise levels presented are therefore a worst case, as these proposed large-scale buildings, including the planning-approved development at Plot G Great Jackson Street, will provide a degree of acoustic screening from road traffic on Mancunian Way, this being the principal noise source at and around the site.



Figure 1: Summary external daytime noise levels incident on each façade (dB LAeq)

RESULTS OF TM59 DYNAMIC THERMAL MODELLING

Night time

The dynamic thermal modelling carried out by Futureserv has confirmed that the night time criterion of TM59 is achieved without the need to open purge vents to the bedrooms and living rooms of all apartments within the proposed development between 11pm and 7am. Therefore, full compliance with the internal noise criteria of Manchester City Council for bedrooms at night time can be achieved.

Daytime

As identified in Table 1 above, the TM59 model assumes that the purge vents to bedrooms can be opened as required between 7am and 11pm.

In addition, the TM59 model assumes that the purge vents to living rooms can be opened as required between 7am and 7pm.

This restriction of purge vent opening times in living rooms is on the assumption that under normal circumstances, the impact of internal noise would be less significant during a normal working day than in the evening.

This follows from the acknowledgement in the AVO that the SOAEL is likely to be different at different times of the day.

On this point, the 'Guidelines for Environmental Noise Impact Assessment' published by the Institute of Environmental Management & Assessment (IEMA) in 2014 states

- Time-of-day sensitivity is related to the activity being undertaken by the individual affected by the noise.

It also can be argued that within the 16-hour period, the evening period (19:00–23:00 hours) is relatively more sensitive than the remaining 12-hour period [07:00 – 19:00 hours]. This is also activity-related, since during the evening people are generally at home relaxing, and children will be going to bed during this time.

With reference to the above, it is suggested that the varying sensitivities to noise over the course of the day could be described as follows:

- Daytime noise levels (7am – 7pm): Low sensitivity for both living rooms and bedrooms, due to residents either being out of the home, or generally being more active around the home.
- Evening noise levels (7pm – 11pm): High sensitivity in living rooms, due to the majority of people using this space for relaxation / leisure time. Medium to low sensitivity in bedrooms, as the majority of people will not be asleep during this period.
- Night-time noise levels (11pm – 7am): High sensitivity in bedrooms and low sensitivity in living rooms, due to the majority of residents being asleep during these hours.

To comply with the daytime criterion of TM59, the modelling has determined that the purge vents to the majority of living rooms must be opened for a certain length of time between 7am and 7pm.

However, as discussed above, the opening hours of the purge vents identified by the TM59 model are not necessarily the opening hours required to maintain thermal comfort for the occupants. It would be quite possible to achieve thermal comfort with shorter opening hours.

Purge ventilation opening hours

All living rooms in Towers F1 & F2 achieve the TM59 requirement given the restriction of purge vent opening times to 7pm.

Given the initial TM59 model input parameters detailed in Table 1, Table 2 identifies the number of hours per day that the purge vents would need to be opened within apartments.

North Apartment					
LKD			Bedrooms		
May	17:00 - 18:00	(1 hour)	May	17:00 - 18:00	(1 hour)
June	17:00 - 18:00	(1 hour)	June	17:00 - 18:00	(1 hour)
July	17:00 - 18:00	(1 hour)	July	17:00 - 18:00	(1 hour)
Aug	17:00 - 18:00	(1 hour)	Aug	13:00 - 18:00	(5 hour)
Sept	17:00 - 18:00	(1 hour)	Sept	17:00 - 18:00	(1 hour)
North East Apartment					
LKD			Bedrooms		
May	17:00 - 18:00	(1 hour)	May	17:00 - 18:00	(1 hour)
June	17:00 - 18:00	(1 hour)	June	17:00 - 18:00	(1 hour)
July	17:00 - 18:00	(1 hour)	July	17:00 - 21:00	(4 hour)
Aug	17:00 - 18:00	(1 hour)	Aug	07:00 - 22:00	(15 hours)
Sept	17:00 - 18:00	(1 hour)	Sept	17:00 - 18:00	(1 hour)
East Apartment					
LKD			Bedrooms		
May	17:00 - 18:00	(1 hour)	May	17:00 - 18:00	(1 hour)
June	17:00 - 18:00	(1 hour)	June	17:00 - 18:00	(1 hour)
July	17:00 - 18:00	(1 hour)	July	17:00 - 18:00	(1 hour)
Aug	17:00 - 18:00	(1 hour)	Aug	07:00 - 20:00	(13 hours)
Sept	17:00 - 18:00	(1 hour)	Sept	17:00 - 18:00	(1 hour)
South East Apartment					
LKD			Bedrooms		
May	17:00 - 18:00	(1 hour)	May	17:00 - 18:00	(1 hour)
June	17:00 - 18:00	(1 hour)	June	17:00 - 18:00	(1 hour)
July	17:00 - 18:00	(1 hour)	July	17:00 - 21:00	(4 hours)
Aug	17:00 - 18:00	(1 hour)	Aug	07:00 - 22:00	(15 hours)
Sept	17:00 - 18:00	(1 hour)	Sept	17:00 - 18:00	(1 hour)
South Apartment					
LKD			Bedrooms		
May	17:00 - 18:00	(1 hour)	May	17:00 - 18:00	(1 hour)
June	17:00 - 18:00	(1 hour)	June	17:00 - 18:00	(1 hour)
July	17:00 - 18:00	(1 hour)	July	17:00 - 19:00	(2 hours)
Aug	17:00 - 18:00	(1 hour)	Aug	07:00 - 19:00	(12 hours)
Sept	17:00 - 18:00	(1 hour)	Sept	17:00 - 18:00	(1 hour)
South West Apartment					
LKD			Bedrooms		
May	18:00 - 19:00	(1 hour)	May	22:00 - 23:00	(1 hour)
June	18:00 - 19:00	(1 hour)	June	22:00 - 23:00	(1 hour)
July	15:00 - 19:00	(4 hours)	July	22:00 - 23:00	(1 hour)
Aug	13:00 - 19:00	(6 hours)	Aug	13:00 - 23:00	(11 hours)
Sept	18:00 - 19:00	(1 hour)	Sept	22:00 - 23:00	(1 hour)
West Apartment					
LKD			Bedrooms		
May	17:00 - 18:00	(1 hour)	May	17:00 - 18:00	(1 hour)
June	17:00 - 18:00	(1 hour)	June	17:00 - 18:00	(1 hour)
July	17:00 - 18:00	(1 hour)	July	17:00 - 18:00	(1 hour)
Aug	17:00 - 18:00	(1 hour)	Aug	07:00 - 21:00	(14 hours)
Sept	17:00 - 18:00	(1 hour)	Sept	17:00 - 18:00	(1 hour)
North West Apartment					
LKD			Bedrooms		
May	17:00 - 18:00	(1 hour)	May	17:00 - 18:00	(1 hour)
June	17:00 - 18:00	(1 hour)	June	17:00 - 18:00	(1 hour)
July	17:00 - 18:00	(1 hour)	July	17:00 - 19:00	(2 hours)
Aug	17:00 - 18:00	(1 hour)	Aug	07:00 - 22:00	(15 hours)
Sept	17:00 - 18:00	(1 hour)	Sept	17:00 - 18:00	(1 hour)

Table 2: TM59 opening vent profiles, 11th floor apartments

It can be seen that for all but one apartment on each floor, the purge vents within living rooms would only need to be opened for only one hour each day in order to comply with the TM59 criterion.

Table 3 presents a further level of detail within the worst case performing apartment in each building. The table shows the number of hours that the purge vents are required to open throughout each month between May and September to comply with the TM59 criterion. It should be noted that the results are indicative and based on the dynamic simulation worst case scenario. The actual weather conditions and operational parameters will vary whilst the building is in use.

SW corner Apartment (F1_11F_3B_SW)	Open Plan Living Room/ Kitchen		Bedrooms	
	Hours of window opening to comply with TM59 / occurrence in the month	Occurrence in the month (days)	Hours of window opening to comply with TM59 / occurrence in the month	Occurrence in the month (days)
May (31)	0 – 3 hours	31	0 – 3 hours	31
	3 – 6 hours	0	3 – 6 hours	0
	6 – 9 hours	0	6 – 9 hours	0
	9 – 11 hours	0	9 – 12 hours	0
	11 – 13 hours	0	12 – 16 hours	0
June (30)	0 – 3 hours	30	0 – 3 hours	30
	3 – 6 hours	0	3 – 6 hours	0
	6 – 9 hours	0	6 – 9 hours	0
	9 – 11 hours	0	9 – 12 hours	0
	11 – 13 hours	0	12 – 16 hours	0
July (31)	0 – 3 hours	2	0 – 3 hours	31
	3 – 6 hours	29	3 – 6 hours	0
	6 – 9 hours	0	6 – 9 hours	0
	9 – 11 hours	0	9 – 12 hours	0
	11 – 13 hours	0	12 – 16 hours	0
Aug (31)	0 – 3 hours	0	3 – 6 hours	0
	3 – 6 hours	31	3 – 6 hours	0
	6 – 9 hours	0	6 – 9 hours	0
	9 – 11 hours	0	9 – 12 hours	31
	11 – 13 hours	0	12 – 16 hours	0
Sept (30)	0 – 3 hours	30	0 – 3 hours	30
	3 – 6 hours	0	3 – 6 hours	0
	6 – 9 hours	0	6 – 9 hours	0
	9 – 11 hours	0	9 – 12 hours	0
	11 – 13 hours	0	12 – 16 hours	0

Table 3: TM59 Vent opening hours, Southwest corner apartment, Plots F1 & F2, 11th floor

Potential average internal daytime noise levels in living rooms and bedrooms

Given the above opening hours of purge vents for the worst-case apartment, the internal daytime noise levels in living rooms and bedrooms have been determined.

The potential internal noise level within apartment rooms with the purge vents open can be initially estimated by assuming a partially open purge vent will provide an outside-to-inside level difference of 13 dB.

Tables 4 and 5 identify the expected daytime noise levels ($L_{Aeq,16}$ hours) in the south west corner apartments of Plots F1 and F2 respectively, these being the worst-case apartments with regard to the opening hours of purge vents to comply with the daytime requirement of TM59. The reported noise levels are expected to prevail up to approximately Level 18, above which a 1dB reduction in the noise levels is expected, relative to the lowest residential level of the buildings. As height up the buildings increases further, there will be a gradual decrease of external noise and hence internal noise levels will be lower.

In reality, as thermal comfort could be maintained with shorter opening hours than those identified by the TM59 model, the internal noise levels could be lower than stated in Tables 4 and 5.

SW corner Apartment (F1_11F_3B_SW)	Potential daytime internal noise level given compliance with TM59 / occurrence in the month		Potential daytime internal noise level given compliance with TM59 / occurrence in the month	
Month (days in month)	Open Plan Living Room/ Kitchen (dB $L_{Aeq,16hrs}$)	Occurrence in the month (days)	Bedrooms (dB $L_{Aeq,16hrs}$)	Occurrence in the month (days)
May (31)	47	31	47	31
June (30)	47	30	47	30
July (31)	47	0	47	31
	52	2	52	0
	53	29	53	0
Aug (31)	55	31	55	0
	57	0	57	31
Sept (30)	47	30	47	30

Table 4: Potential daytime internal noise level with open purge vents to comply with TM59, southwest corner apartments (up to level 18), Plot F1

SW corner Apartment (F2_11F_3B_SW)	Potential daytime internal noise level given compliance with TM59 / occurrence in the month		Potential daytime internal noise level given compliance with TM59 / occurrence in the month	
Month (days in month)	Open Plan Living Room/ Kitchen (dB LAeq,16hrs)	Occurrence in the month (days)	Bedrooms (dB LAeq,16hrs)	Occurrence in the month (days)
May (31)	46	31	46	31
June (30)	46	30	46	30
July (31)	46	0	46	31
	51	2	51	0
	52	29	52	0
Aug (31)	54	31	54	0
	56	0	56	31
Sept (30)	46	30	46	30

Table 5: Potential daytime internal noise level with open purge vents to comply with TM59, southwest corner apartments (up to level 18), Plot F2

It can be seen that the living rooms of the south west corner apartments on the lower levels of Plots F1 and F2 may experience daytime noise levels of between 51 dB LAeq,16hrs and 55 dB LAeq,16 hrs on up to 62 days of the year.

However, in the worst case these noise levels are a consequence of the vents being opened for only up to 6 hours on any one day, with no opening of any vent required beyond 7pm.

ASSESSMENT OF POTENTIAL FURTHER MITIGATION MEASURES

Given the potential internal noise levels in the south west corner apartments of Plots F1 & F2 during the month of August due to open purge vents, further mitigation has been assessed.

A passive mitigation measure could be the installation of acoustically attenuated purge vents, such as those manufactured by Tek Ltd.

The potential introduction of such purge vents has been assessed by Simpson Haugh architects (see separate design note). Unfortunately, it is not possible to incorporate louveres into the design due to the fact that they have not been tested at the heights required and associated warranties and insurance will not be possible to secure. Renaker is also unable to delay this element, in the hope a feasible louver solution may be found during the construction process, as they will shortly be procuring the façade at risk to avoid rapidly escalating construction materials costs. In the event Renaker were to be significantly delayed around procurement, it would pose a substantial risk of the delivery strategy being jeopardised. For the reasons set out within the enclosed design note, the inclusion of louveres has been discounted.

Alternatively, the MVHR unit in the affected apartments could be operated in 'summer boost' mode. This would reduce the number of hours that the purge vent would need to be opened to achieve TM59 compliance.

As a consequence however, the in-room noise level generated by the MVHR would increase. It is expected that even with high efficiency in-line attenuation, daytime noise levels within the apartment rooms could be 40dB LAeq to 48dB LAeq. Therefore the noise generated by the MVHR when running in 'summer boost' mode could be of the same order as the internal levels of noise experienced when the purge vents to apartments are opened.

The additional energy use of an MVHR running in 'summer boost' mode compared to the passive solution of an open purge vent should also be taken into consideration.

The benefit of individual purge ventilation fans serving the south west corner apartments of Plots F1 and F2 has been assessed. In particular, further TM59 modelling has been undertaken with a purge ventilation fan extracting air from the living room of these apartments at a rate of 41 l/s. The individual purge fan can be accommodated in the ceiling void of the living room and provided with in-line attenuation to achieve noise levels within the living room due to the operation of the fan of approximately 38 dB LAeq,16 hrs, such that the total noise level in the living room due to all sources is expected to be approximately 40 dB LAeq,16 hrs.

Whilst this noise level is 5dB greater than the daytime noise level of 35dB LAeq,16 hrs recommended in BS8233: 2014 (assuming opening purge vents are closed), the Standard states that 'the internal targets may be relaxed by up to 5dB and reasonable internal conditions still achieved'.

The TM59 has determined that the required opening hours of the purge vents to the southwest corner apartments would reduce to 1 hour given the operation of the purge fan between 7am to 11pm.

Given this reduction in purge vent opening hours, Tables 6 and 7 identify the expected daytime noise levels (LAeq,16 hours) in the south west corner apartments of Plots F1 and F2 respectively. The reported noise levels are expected to prevail up to approximately Level 18, above which a 1dB reduction in the noise levels is expected relative to the lowest residential level of the buildings. As height up the building increases further, there will be a gradual decrease of external noise and hence internal noise levels will be lower.

SW corner Apartment (F1_11F_3B_SW)	Potential daytime internal noise level given compliance with TM59 / occurrence in the month		Potential daytime internal noise level given compliance with TM59 / occurrence in the month	
Month (days in month)	Open Plan Living Room/ Kitchen (dB LAeq,16hrs)	Occurrence in the month (days)	Bedrooms (dB LAeq,16hrs)	Occurrence in the month (days)
May (31)	47	31	47	31
June (30)	47	30	47	30
July (31)	47	31	47	31
Aug (31)	47	31	47	0
	57	0	57	31
Sept (30)	47	31	47	30

Table 6: Potential daytime internal noise level with open purge vents to comply with TM59, southwest corner apartments (up to level 18), Plot F1

SW corner Apartment (F2_11F_3B_SW)	Potential daytime internal noise level given compliance with TM59 / occurrence in the month		Potential daytime internal noise level given compliance with TM59 / occurrence in the month	
Month (days in month)	Open Plan Living Room/ Kitchen (dB LAeq,16hrs)	Occurrence in the month (days)	Bedrooms (dB LAeq,16hrs)	Occurrence in the month (days)
May (31)	46	31	46	31
June (30)	46	30	46	30
July (31)	46	31	46	31
Aug (31)	46	31	46	0
	56	0	56	31
Sept (30)	46	31	46	30

Table 7: Potential daytime internal noise level with open purge vents to comply with TM59, southwest corner apartments (up to level 18), Plot F2

The purge ventilation fans would be required within the southwest corner apartments to all storeys of both blocks, as the external noise level is not predicted to reduce sufficiently with height to allow the purge vents of the these apartments to be opened for extended periods.

The power consumption of the proposed purge ventilation fans is only 20 Watts and as such, compliance with the requirements of Approved Document L (conservation of fuel and power) is still achieved.

Whilst 'whole-house' ventilation solutions are available that 'temper' the incoming warm air, the power consumption of these systems is typically 1000 Watts and as such are not compatible with low carbon aspirations or with the current design in relation to compliance with Approved Document L.

SUMMARY & CONCLUSION

The potential effect of the control of overheating on the internal noise levels within the proposed apartments of Plot F, Great Jackson Street, Manchester has been assessed in line with 'Acoustics, Ventilation and Overheating, Residential Design Guide', (AVO) published by the Association of Noise Consultants and the Institute of Acoustics.

Dynamic thermal modelling has been carried out to determine whether the buildings within the proposed development achieve the performance criteria of CIBSE Technical Memorandum 59 (TM59).

In particular, the TM59 modelling results identify the daily opening hours of the vents on the basis that the vents are opened when the internal temperature within a room reaches 22 Deg C and are closed when the internal temperature has dropped to 22 Deg C. The daily opening hours are identified between the months of May and September.

Following detailed assessments, the building design incorporates the following measures to mitigate overheating:

- 1) Low G value (0.4) of vision glazing to curtain wall to minimize solar heat gain to apartments
- 2) Low G value (0.22) of glazed vent panels to minimize solar heat gain to apartments
- 3) Blind shading coefficient of 0.28 to minimize solar heat gain to apartments
- 4) Continuously-running whole-house ventilation (MVHR) units with Summer Bypass within each apartment
- 5) Mechanical purge ventilation fan within living rooms on the southwest corner of each building
- 6) Passive ventilative cooling via opening purge vents

The modelling has confirmed that the night time criterion of TM59 is achieved without the need to open purge vents to the bedrooms and living rooms of all apartments within the proposed development between the hours of 11pm and 7am. Therefore, the internal noise criteria of Manchester City Council for bedrooms at night time can be achieved whilst avoiding overheating as defined by TM59.

It has also been determined that the opening purge vents within the building façade would need to be opened for a maximum of one hour a day in all apartments to achieve compliance with the TM59 criterion for living rooms. Opening purge vents to bedrooms would need to be opened for between one hour and four hours a day in May, June, July and September and up to fifteen hours a day in August.

In Building F1, the daytime noise level in living rooms requiring open purge vents for the identified hours is expected to be no greater than 47dB LAeq, 16 hrs.

In Building F2, the daytime noise level in living rooms requiring open purge vents for the identified hours is expected to be no greater than 46dB LAeq, 16 hrs.

The calculated noise levels are considered to be acceptable in the context of the control of overheating and with regard to the AVO Guide.

The assessment of the potential internal noise levels is based on the assumption that under normal circumstances, the impact of internal noise would be less significant during a normal working day than in the evening.

This follows from the acknowledgement in the AVO that the impact of internal noise is likely to be different at different times of the day.