

Create It Studios

166 PLYMOUTH GROVE

TM59 Overheating Strategy



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Installed building fabric will need to satisfy the u-value and g-value requirements in this strategy. Window openings will need to satisfy the limitations in this report. Guarding rails will need to be procured and installed as per the specifications in this report. This strategy is only valid where the noise and air quality thresholds are not exceeded. Sizing and specifications of mechanical systems will need to be completed by a specialist to satisfy the air exchanges and cooling requirements to meet this strategy.

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1. INTRODUCTION

1.1. PURPOSE

UK Overheating has been appointed by Create It Studios to develop an overheating strategy for the First floor of 166 Plymouth Grove, to include 3 flats, at 166 Plymouth Grove, Manchester, M13 0AF to support the planning application.

Dynamic thermal modelling has been undertaken based on the proposed architectural and thermal design and the identified noise constraints.

This report is necessarily technical in nature. To assist the reader, a glossary of technical terms is provided in Appendix A.

1.2. BASIS OF ASSESSMENT

1.2.1. MANCHESTER CITY COUNCIL PLANNING& NOISE GUIDANCE

The guidance document 'Planning & Noise – Technical Guidance' (October 2022) states:

Overheating can be 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.

An entirely new Approved Document O was released in December 2021 covering overheating and comes into force on 15 June 2022. This Approved Document covers the overheating mitigation requirements of the building regulations as set out in Part O of Schedule 1 to the Building Regulations and in a number of specific building regulations. Technical guidance is contained in Approved Document O. Approved Document O applies to new residential buildings.

Many buildings require closed windows to provide good internal acoustic conditions whereas opening a window is the normal way to keep a building cool. These opposing requirements are becoming a major issue in the design of buildings, in particular for housing, especially if we are to avoid the widespread use of mechanical cooling to reduce a development's carbon footprint.

TM59 (CIBSE: Design methodology for the assessment of overheating risk in homes) sets out a methodology for predicting temperatures inside dwellings and provides overheating compliance criteria. It also provides a standardised approach to predicting overheating using dynamic thermal modelling. TM59 acknowledges that the methodology is necessarily prescriptive to enable it to be consistently applied. The design aim should be to avoid the need to open windows during sleeping hours.

An overheating assessment might not always be undertaken for a project and without this information it is difficult to identify noise impacts that may occur during the overheating condition. It is recommended that either where a condition has been imposed to control internal noise levels for residential development or where overheating may be an issue, the guidance provided in the [AVO Guide](#) is followed.

The AVO (Acoustics, Ventilation and Overheating) guide was published to address the competing aspects of thermal and acoustic comfort and how these can be managed. It seeks to help those involved in building design and/or the Planning process to understand the likely degree of noise disturbance when windows are opened. It recommends an approach to acoustic assessments for new residential development that take due regard of the interdependence of provisions for acoustics, ventilation, and overheating.

1.2.2. CIBSE TM59

CIBSE TM59 was published in April 2017 and provides a standardised assessment methodology to determine the risk of overheating in residential properties. It includes assumptions for internal heat gains and occupancy profiles and presents criteria which differ depending on whether the home is predominantly naturally ventilated, or it is predominantly mechanically ventilated.

For homes that are predominantly naturally ventilated, including homes that have mechanical ventilation with heat recovery [MVHR], with good opportunities for natural ventilation in the summer, compliance is based on passing *both* of the following two criteria:

Table 1: CIBSE TM59 Predominantly Naturally Ventilated Criteria

Criterion	Requirement
a)	<i>For living rooms, kitchens and bedrooms:</i> the number of hours during which ΔT is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3 per cent of occupied hours.
b)	For bedrooms only: to guarantee comfort during the sleeping hours the operative temperature in the bedroom from 10 pm to 7 am shall not exceed 26 °C for more than 1% of annual hours. (Note: 1% of the annual hours between 22:00 and 07:00 for bedrooms is 32 hours, so 33 or more hours above 26 °C will be recorded as a fail).

For homes predominantly mechanically ventilated, because they have either no opportunity or extremely limited opportunities for opening windows (e.g. due to noise levels or air quality), occupied rooms should not exceed an operative temperature of 26 °C for more than 3% of annual occupied hours.

Care homes and accommodation for vulnerable occupants, which are predominantly naturally ventilated, should use criteria (a) and (b), but should assume Type 1 occupancy, as defined in CIBSE TM52. This results in a reduction in the acceptable comfortable temperature range from $\pm 3K$ to $\pm 2K$ (and a reduction of predicted mean vote from ± 0.5 to ± 0.2), reflecting the higher sensitivity of vulnerable occupants to increases in internal temperature.

1.2.3. ACOUSTICS, VENTILATION & OVERHEATING GUIDE

The *Acoustics, Ventilation and Overheating: Residential Design Guide* (AVOG) by the Association of Noise Consultants (ANC) and Institute of Acoustics was released in January 2020. The guide outlines a methodology for the assessment of airborne sound (from transport related sources) during normal ventilation and during overheating conditions, emphasising the co-dependency of acoustics, ventilation and overheating design.

The process is split into two stages. Level 1 considers an initial risk assessment based on external noise levels and Level 2 is a more advanced stage where opening a window to mitigate overheating is not possible.

Figure 3-1 Two-level noise assessment procedure - overheating condition

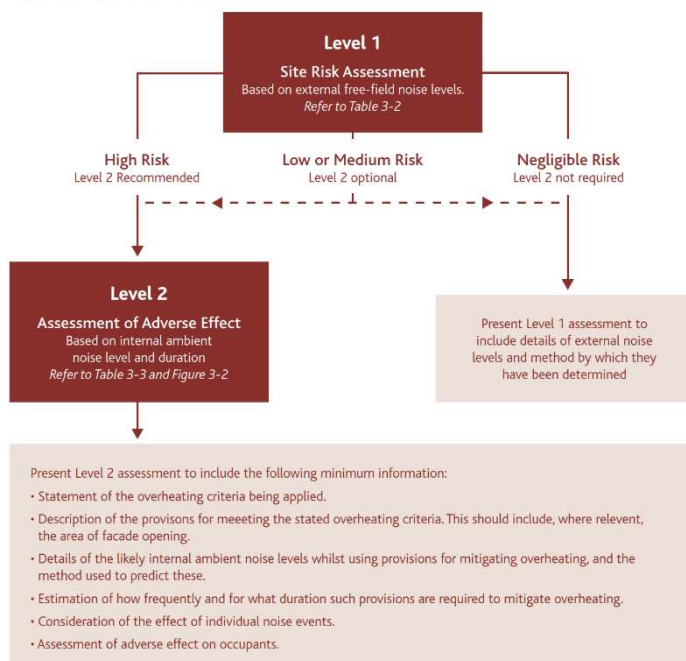
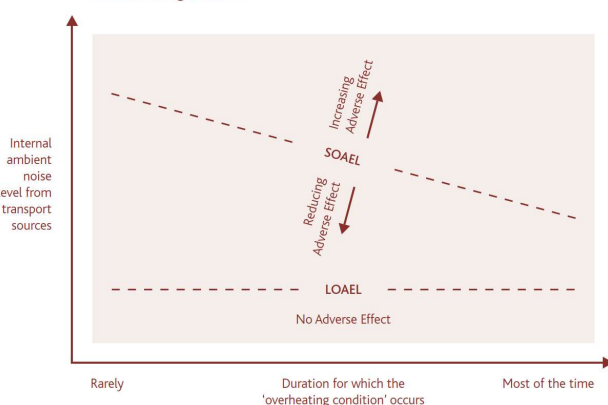


Figure 3-2 Qualitative guidance on combined effect of internal ambient noise level and duration of the overheating situation



The principle outlined in the guide is to base the internal noise target on how often any overheating mitigation is used.

Table 3-3 Guidance for Level 2 assessment of noise from transport noise sources¹ relating to overheating condition

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

Note 1 The noise levels suggested in tables 3-2 and 3-3 assume a steady road traffic noise source but may be adapted for other types of transport.

Note 2 The values presented in this table 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^{11,12,13}. With the exception of individual noise events, the references^{11,12,13} 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. Internal ambient noise levels would normally be considered for living rooms and bedrooms during the daytime. At night, the levels would normally only be applicable to bedrooms.

Note 3 A decision must be made regarding the appropriate averaging period to use. The averaging period should reflect the nature of the noise source, the occupancy profile and time at which overheating might be likely to occur. Further guidance can be found within the 2018 EMA Guidelines.

Note 4 Refer to references^{11,12,13,14,15} for further guidance regarding individual noise events. The $L_{Aeq,T}$ indicator associated with the upper category is intended for road traffic; it may be more appropriate to use the "one additional noise-induced awakening" method for noise from rail traffic or aircraft.

Note 5 The potential for adverse effect will also depend on how frequently and for what duration the overheating condition occurs. Refer to Figure 3-2.

Note 6 The daytime levels presented in this table may not be appropriate for residential care homes or other situations where conditions for daytime heating are known to be of particular importance.

Note 7 When evaluating the potential for adverse effect, all three aspects of noise exposure (i.e. daytime, night-time and individual noise events) should be evaluated.

Note 8 BS 6823 states that where development is considered necessary or desirable, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved.

Note 9 It is known that physiological responses do occur at lower levels of $L_{Aeq,T}$ than 45 dB.

However, this iterative process is not straight forward when applied in dynamic thermal modelling. Considered another way, the 'duration for which the overheating condition occurs' would be reduced where the design incorporates more measures to reduce heat gains.

For this project, a points system using the following considerations has been collated based on the design (total available points 10).

Benefit to Reducing Overheating	Measures	Points per Measure
Primary Measure	- Rooms > 45m³ - External shading - Centre-pane g-value ≤0.40 - Approx. glazing area as a proportion of floor area < 25 % - Building located in Northern England, Wales or Scotland - High exposed thermal mass - Dual aspect - Most glazed façade to North or East	1
Secondary Measure	- Ceiling heights > 2.4m - Bedrooms > 15m² - Open plan living/kitchen - Kitchen not on façade	0.5

From these factors, assigning a point for each that apply, the internal noise levels have been targeted based on the below scale.

Points	Daytime L _{Aeq,16h} in Rooms used During the Day
10	50 dB
7 to 9	47 dB
4 to 6	44 dB
1 to 3	42 dB
<1	40 dB

Table 1: Target Daytime Noise Levels for Overheating Assessment

During the night-time in bedrooms, the internal noise standards of Approved Document O apply.

1.2.4. PENINSULAR ACOUSTICS NOISE ASSESSMENT

An environmental noise assessment was undertaken for this assessment the purpose of satisfying condition 14a of planning application no. 137985/FO/2023 submitted to Manchester City Council. This information has been used to estimate the noise exposure at bedrooms.

The acoustic report by Peninsular Acoustics (ref. PA0982-R01-P02) confirms the following noise exposure.

Elevation	Daytime	Night-time Average	Night-time Maximum
Front	L _{Aeq,16h} 65 dB	L _{Aeq,8h} 59 dB	10 th highest L _{AFmax} 78 dB
Rear	L _{Ar,Tr} 69 dB	L _{Aeq,8h} 47 dB	10 th highest L _{AFmax} 72 dB

Table 2: Noise Exposure

The dwelling is proposed to have the following heat gain controlling measures:

Measure	Points
Rooms > 45m ³	1
Centre Pane G Value ≤ 0.4	1
Approx. glazing area as a proportion of floor area < 25%	1
High exposed thermal mass	1
Dual aspect	1
Ceiling heights > 2.4m	0.5
Open plan living/kitchen	0.5
Kitchen not on façade	0
Total	7

Table 3: Calculation of Daytime Internal Noise Limit

Based on this and the proposed dwelling details, daytime internal ambient noise levels are to be designed to not exceed 47 dB $L_{Aeq,16h}$ during summertime overheating, night-time window openings are to satisfy the standards of Part O, and the following outside to inside level difference is required by the window openings.

Elevation	Minimum Outside to Inside Level Difference from Window Openings	
	<i>Living Rooms/Kitchens/Studies</i>	<i>Bedrooms</i>
Front	18 dB	23 dB
Rear	22 dB	17 dB

Table 4: Window Opening Sound Insulation Provision

The following open window noise constraints apply:

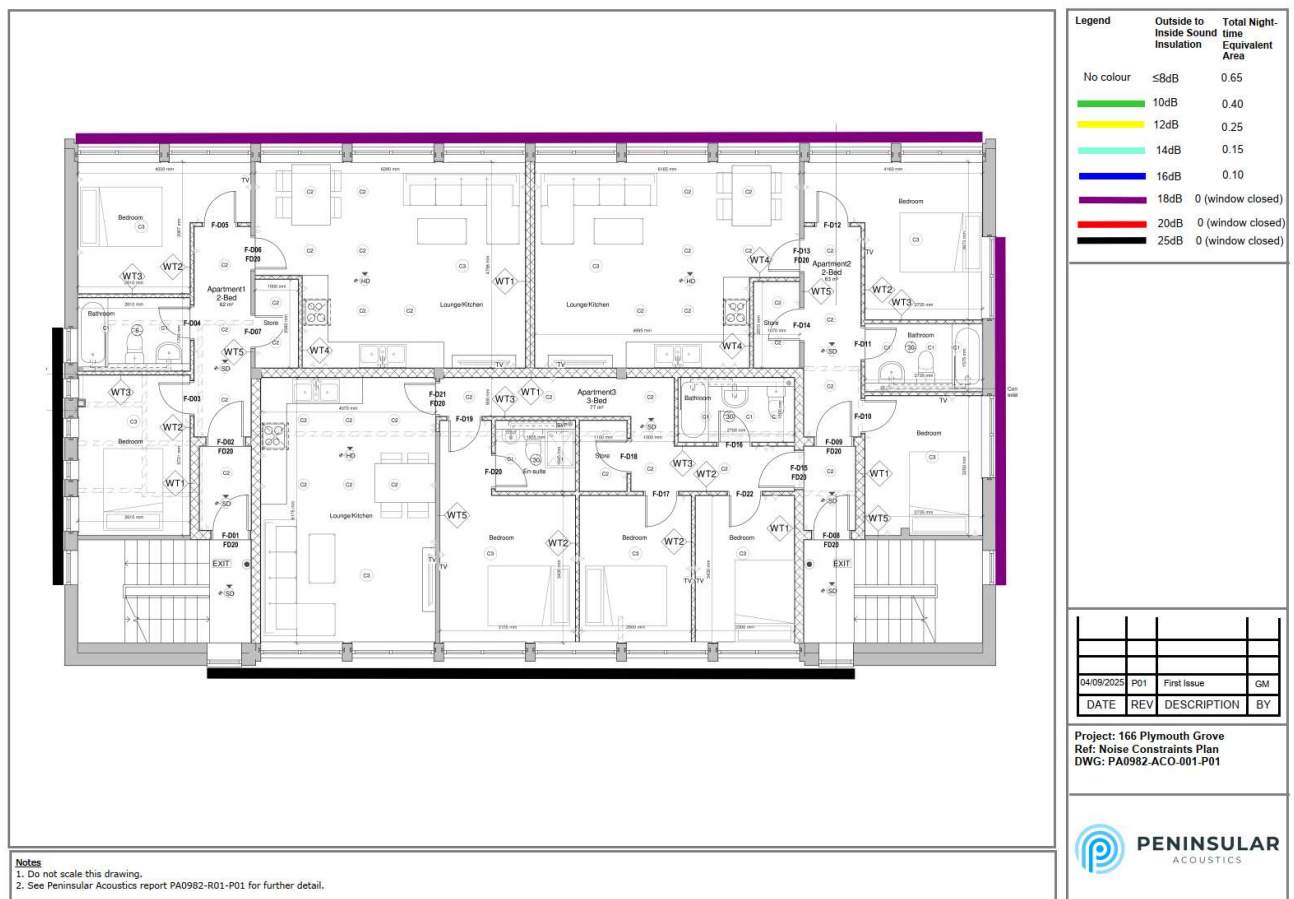


Figure 1: Daytime Noise Constraints

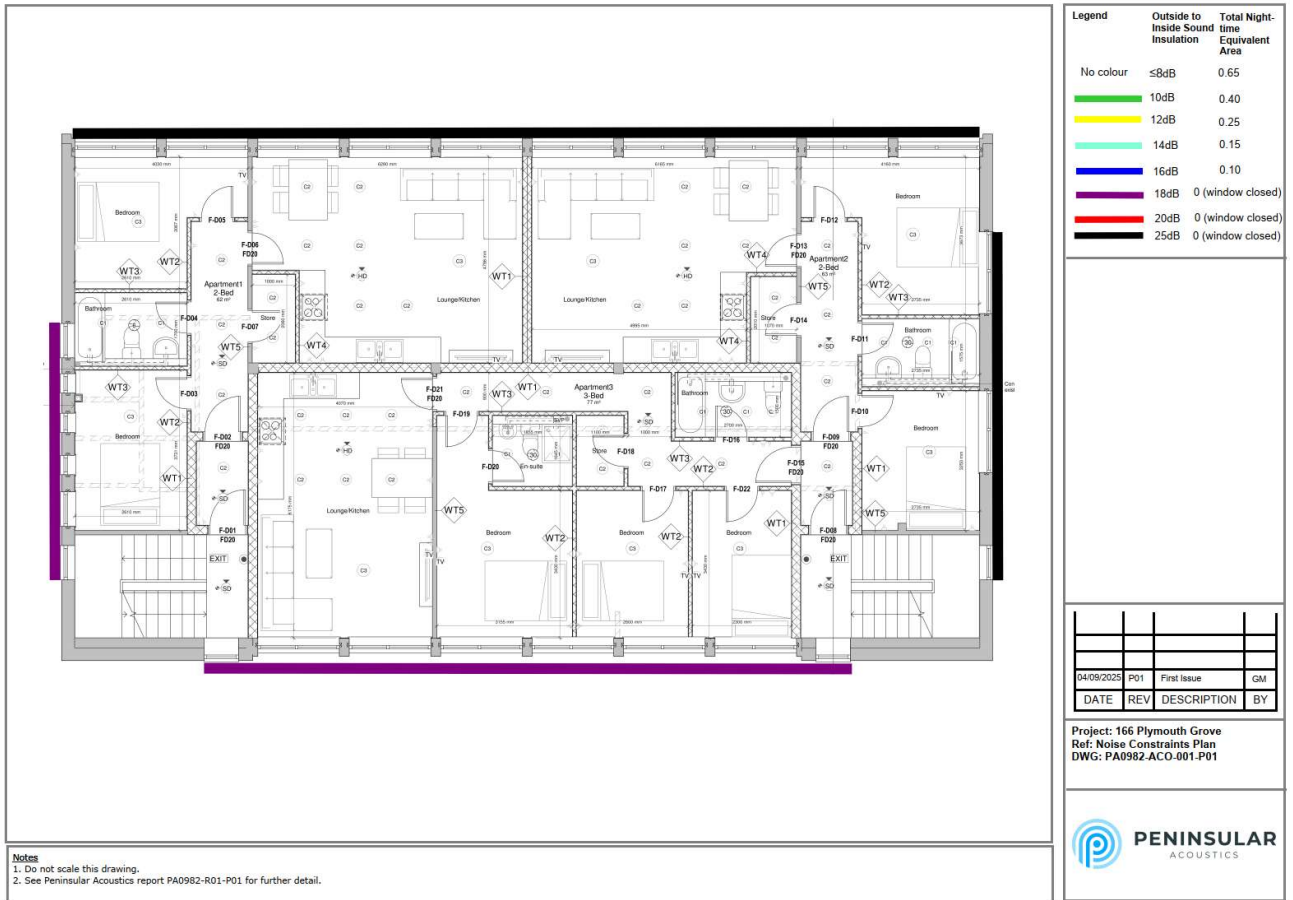


Figure 2: Nighttime Noise Constraints

2. SITE DETAILS

2.1. ORIENTATION

The building is located at 166 Plymouth Grove, Manchester, M13 0AF on site as per the below site plan.

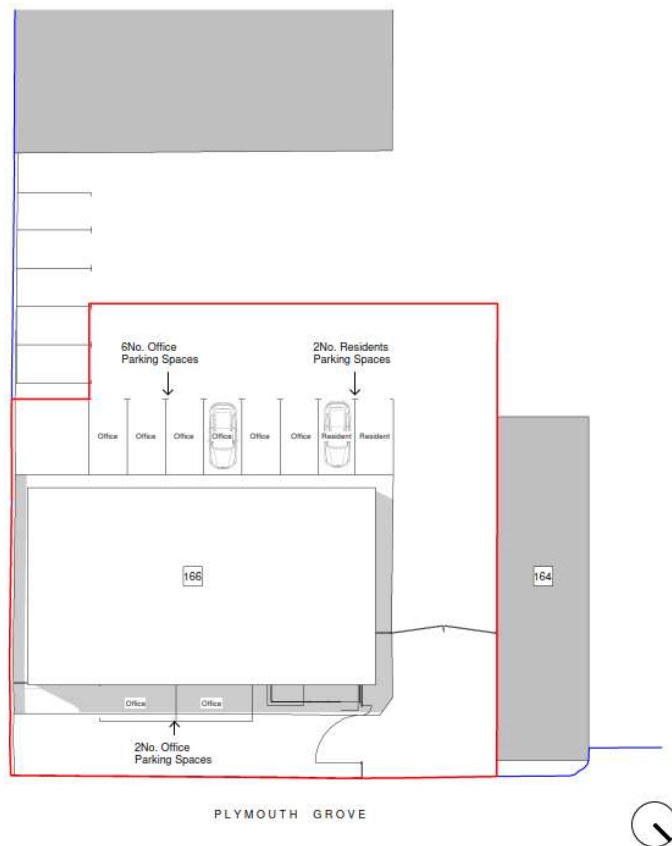


Figure 3: Site Plan

2.2. DESIGN

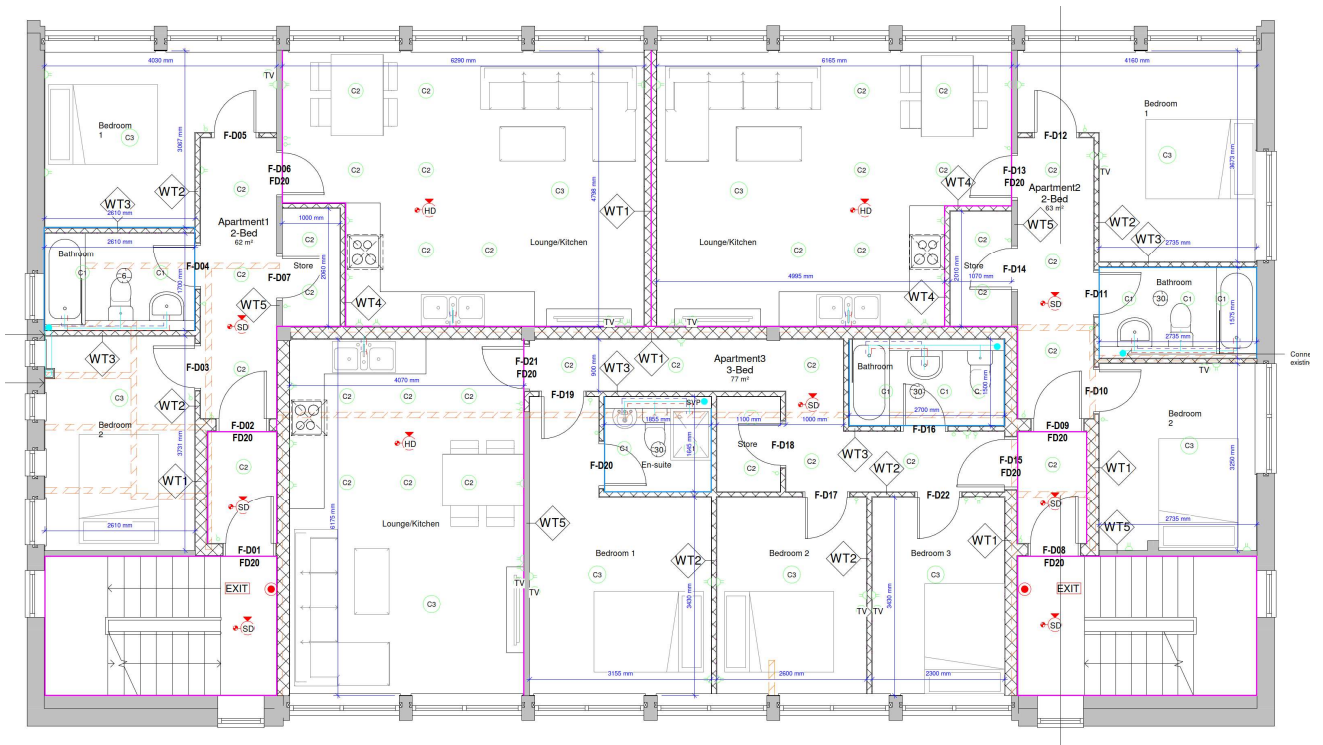


Figure 4: First Floor Layout



Figure 5: Elevations

3. ASSESSMENT METHODOLOGY

3.1. MODELLING ASSUMPTIONS

3.1.1. DYNAMIC THERMAL MODELLING SOFTWARE

Dynamic thermal modelling has been undertaken in full compliance with Approved Document O 2021 utilising 10-minute sample periods using IES Virtual Environment (version 2025.0.0.0).

3.1.2. BUILDING FABRIC

Building Fabric	Construction	U-value (W/m ² K)	Centre-pane G-value	Thermal Mass (kJ/m ² K)
External wall	Cavity Wall	0.30	n/a	83
Party Wall	12.5mm Plasterboard to either side of 200mm Blockwork	1.24	n/a	132
Internal Partition	Plasterboard on timber frame	1.68	n/a	9
First Floor	Timber frame floor (50mm service void, 100mm Mineral Wool insulation, 16mm acoustic hangers, 2x 15mm fire line plasterboard ceiling)	0.28	n/a	19
Second Floor	Timber frame floor (100mm Mineral Wool insulation, 16mm acoustic hangers, 2x 15mm fire line plasterboard ceiling)	0.30	n/a	19
Flat Entrance Door	Solid Door	1.20	n/a	53
Glazing Windows	Double Glazed	1.20	0.40	0

These constructions have been based on assumptions, however the G Glazing forms part of the strategy.

3.1.3. INTERNAL GAINS

3.1.3.1. Solar Gain

Solar gains are calculated automatically by the modelling software based on the orientation of the development, the transmission coefficients of the glazing and the solar angles. The Manchester 2020 DSY1 50th percentile high emissions weather file has been used.

3.1.3.2. Occupancy, Equipment and Lighting Gains

Occupancy, equipment lighting gains for the residential spaces are based on the guidance in CIBSE TM59 Design methodology for the assessment of overheating risk in homes. The following table lists rooms and the associated TM59 profiles.

Room	TM59 Type
Bedrooms	Double Bedroom
Living/Kitchen rooms	2 Bed Living/Kitchen

Penthouse Living/Kitchen	3 Bed Living/Kitchen
Bathrooms & En-suite	Bathroom

Table 2: Room TM59 Assignment

3.1.4. VENTILATION

3.1.4.1. Infiltration & Background Ventilation (Approved Document F)

A maximum air permeability of 5.0 m³/hr/m² @ 50 Pa has been assumed. This has been taken to correspond to an average infiltration rate of 0.25 ach.

Year-round background ventilation of 0.40 l/(s*m²) for Apartments 1 and 2 and 0.41 l/(s*m²) for Apartment 3 has been assumed as per Approved Document F.

3.1.4.2. Natural Ventilation

Window Ref.	No. Panes Openable	Opening Angle per Pane (degrees)		Total Equivalent Area (m ²)		Total Outside to Inside Sound Level Difference (dB)
		Day	Night	Day	Night	
AP1_W01_Side_North_Upper	1	27	27	0.83	0.83	n/a
AP1_W02_Side_North_Upper	1	27	27	0.83	0.83	n/a
AP1_W03_Side_North_Upper	1	27	27	0.83	0.83	n/a
AP1_W04_Side_North_Upper (N)	1	0	0	0	0	> 20
AP1_W05_Side_North_Upper (N)	1	0	0	0	0	> 20
AP1_W06_Top_West_Upper	1	90	90	0.29	0.29	n/a
AP1_W07_Top_West_Upper (N)	1	7	0	0.04	0	> 20
AP1_W08_Top_West_Upper (N)	1	0	0	0	0	> 20
AP1_W09_Top_West_Upper (N)	1	0	0	0	0	> 20
AP1_W10_Top_West_Upper (N)	1	0	0	0	0	> 20
AP2_W01_Side_East_Upper (N)	1	27	0	0.83	0	> 20
AP2_W02_Side_East_Upper (N)	1	27	0	0.83	0	> 20
AP2_W03_Side_North_Upper (N)	1	27	0	0.83	0	> 20
AP2_W04_Side_North_Upper (N)	1	27	0	0.83	0	> 20
AP2_W05_Side_North_Upper	1	27	27	0.83	0.83	n/a
AP2_W06_Side_North_Upper	1	27	27	0.83	0.83	n/a

Window Ref.	No. Panes Openable	Opening Angle per Pane (degrees)		Total Equivalent Area (m ²)		Total Outside to Inside Sound Level Difference (dB)
		Day	Night	Day	Night	
AP2_W07_Side_North_Upper	1	27	27	0.83	0.83	n/a
AP3_W01_Side_South_Upper	1	27	27	0.83	0.83	n/a
AP3_W02_Side_South_Upper	1	27	27	0.83	0.83	n/a
AP3_W03_Side_South_Upper (N)	1	27	0	0.83	0	> 20
AP3_W04_Side_South_Upper (N)	1	27	0	0.83	0	> 20
AP3_W05_Side_South_Upper (N)	1	27	0	0.83	0	> 20
AP3_W06_Side_South_Upper (N)	1	27	0	0.83	0	> 20
EA-Easily Accessible, N-Noise Constraints, P-Pollution Constraints, S- Shading						

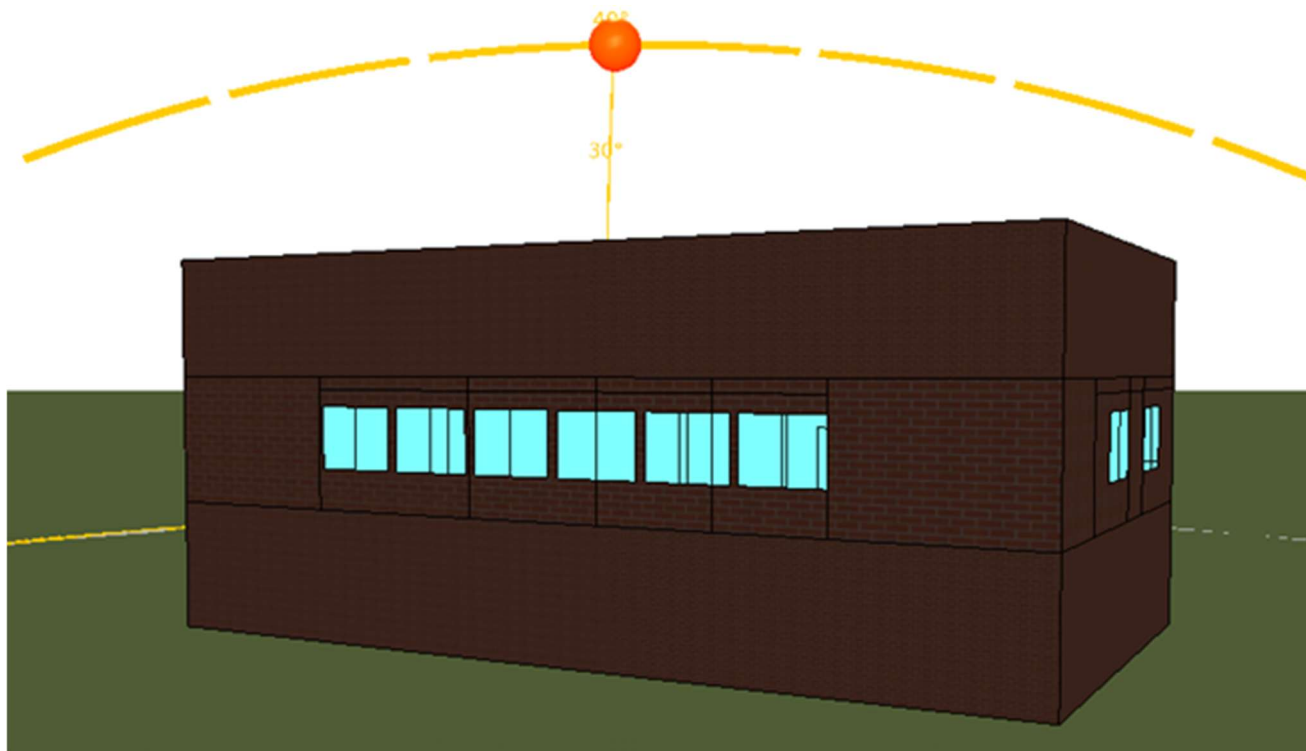
All internal doors are assumed to be open during the day to allow cross ventilation between rooms and closed at night when people are sleeping.

3.2. MODELLING APPROACH

The modelling has taken the following approach:

- Receive the floor plans and elevations
- Develop a geometric model of the house
- Apply the TM59 gain profiles to the rooms
- Apply the Approved Document F ventilation rate and the assumed air permeability
- Apply the assumed thermal performance to the building elements and standard solar performance of the glass
- For any rooms that do not pass the TM59 criteria, adopt the cooling hierarchy approach depicted in the London Plan (2021):
 - Minimise internal heat generation through energy efficient design;
 - Reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls;
 - Manage the heat within the building through exposed internal thermal mass and high ceilings;
 - Passive ventilation;
 - Mechanical ventilation; and if these don't work
 - Active cooling.

3.3. MODEL IMAGES



4. OVERHEATING STRATEGY

4.1. MITIGATION

Modelling has been based on TM59 and the Acoustics, Ventilation & Overheating: Residential Design Guide assuming the following provisions:

- Windows to provide 0.40 centre-pane g-value.
- Using an open window where noise is not a constraint

When accounting for noise constraints (see Section Peninsular Acoustics Noise Assessment), the simulations have resulted in the need for the below mitigation.

Apartment	Room Name	Mitigation		Requirement
1	Bedroom 1		Additional mechanical ventilation	40l/s air exchange, ventilator equivalent area @ 16,000mm ²
	Bedroom 2		Additional mechanical ventilation	30l/s air exchange, ventilator equivalent area @ 12,000mm ²
	Lounge/Kitchen		Additional mechanical ventilation	50l/s air exchange, ventilator equivalent area @ 20,000mm ²
2	Bedroom 1		Mechanical cooling	20l/s at 0.5kW cooling capacity, set point 22 degrees
	Bedroom 2		Additional mechanical ventilation	30l/s air exchange, ventilator equivalent area @ 12,000mm ²
	Lounge/Kitchen		Additional mechanical ventilation	20l/s air exchange, ventilator equivalent area @ 8,000mm ²
3	Bedroom 1		Additional mechanical ventilation	30l/s air exchange, ventilator equivalent area @ 12,000mm ²
	Bedroom 2		Additional mechanical ventilation	30l/s air exchange, ventilator equivalent area @ 12,000mm ²
	Bedroom 3		Additional mechanical ventilation	30l/s air exchange, ventilator equivalent area @ 12,000mm ²
	Lounge/Kitchen	None		

Where windowsill heights are below 1000mm, a guard rail is to be fitted.

The following windows must have guard rails (see Infiltration & Background Ventilation (Approved Document F) for references):

All windows to the First Floor apart from those on the West Elevation

Section 3.9 of Approved Document O advises that guarding should not allow children to easily climb it. Therefore, horizontal bars should generally be avoided.

Any Juliet Balconies must have an opening profile of at least 70% free area.

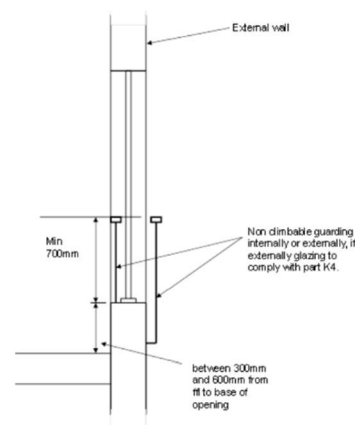


Diagram 3 – Indicates acceptable guarding arrangements where cill heights are between 600mm and 800mm above finished floor level. In this case the cill is not considered to be readily climbable by children, so compliance can be achieved by providing barrier rails to maintain an overall guard height of 800mm above floor level.

4.2. RESULTS

Full results of the dynamic thermal modelling are set out below, evaluated for TM52 occupant category Type 2, predominantly mechanically ventilated.

Room	Room Type	Occupied Hours	Max. Hours	Results
03 Lounge/Kitchen	Living/Kitchen	4745	142	105
01 Lounge/Kitchen	Living/Kitchen	4745	142	141
02 Lounge/Kitchen	Living/Kitchen	4745	142	142
03 Bedroom 1	Bedroom	8760	262	146
02 Bedroom 1	Bedroom	8760	262	140
03 Bedroom 2	Bedroom	8760	262	161
03 Bedroom 3	Bedroom	8760	262	142
01 Bedroom 2	Bedroom	8760	262	160
02 Bedroom 2	Bedroom	8760	262	168
01 Bedroom 1	Bedroom	8760	262	241

Appendix A

TECHNICAL TERMINOLOGY

Overheating Strategy Overheating Condition	The situation where measures are in place to mitigate overheating to meet agreed compliance criteria.
Dynamic thermal modelling	A technique that can be used to simulate internal temperatures in dwellings before they are built
Ventilative cooling	Cooling by means of introducing external ambient temperature air at a high ventilation rate. Can be either passive (no fans) or mechanical (with fans).
Purge ventilation	Ventilation to aid removal of high concentrations of pollutants and water vapour released from occasional activities such as painting and decorating or accidental releases such as smoke from burnt food or spillage of water.
Mechanical cooling	Cooling by means of a refrigerant cycle. This would include 'air conditioning' systems and the use of fan coil units (FCUs).
Equivalent area, A_{eq} a.k.a. EA	The area of a sharp-edged, circular orifice that gives the same flow rate as the actual opening at a given pressure-difference. In other words, the free-area of a notional circular hole made in an infinitely thin, infinite extent baffle that gives the same air-flow performance as the real opening. Used to describe the area of trickle vents in Approved Document F. Not to be confused with Effective area.
Equivalent continuous sound pressure level ($L_{eq,T}$)	The average of the total sound energy over a specified time period (T). L_{eq} represents the equivalent sound level that a fluctuating source would have compared to a steady source with the same total sound energy over a specific time period. Commonly used as a descriptor of human perception of sound over time.
Internal Ambient Noise Level (IANL)	The noise level within a room or enclosed space. Usually determined as an equivalent continuous sound pressure level over a specific time period ($L_{Aeq,T}$, dB)
"Free area" as used in AD-O	Approved Document O uses the term "Minimum free area" that is required to be achieved by the Equivalent area of the window openings. AD-O provides the accepted definition of Equivalent area for the description of "free area". The term "free area" is therefore avoided in this document to avoid further confusion.



Appendix B

AIR QUALITY LIMITS

Paragraph 3.5 of Approved Document O 2021 (England) states:

Buildings located near to significant local pollution sources should be designed to minimise the intake of external air pollutants. Guidance is given in Section 2 of Approved Document F, Volume 1: Dwellings.

Section 2 of Approved Document F, Volume 1: Dwellings is titled 'Minimising the ingress of external pollutants. Paragraph 2.1 and Table 2.1 are repeated below.

- 2.1** Ventilation systems should be designed to minimise the intake of external air pollutants following paragraphs 2.2 to 2.9 if either of the following applies.
- The pollutant values in the location of the dwelling exceed any of the limits in Table 2.1. This may have been determined through an air quality assessment. Where modelling or monitoring data is required, expert advice should be sought.
 - The dwelling is located near to any of the following sources of significant local pollution.
 - Road traffic, including traffic junctions and underground car parks.
 - Combustion plant (such as heating appliances) running on conventional fuels, most commonly natural gas.
 - Other combustion processes (for example, waste incineration, thermal oxidation abatement systems).
 - Discharges from industrial processes.
 - Fugitive (i.e. not effectively controlled) discharges from industrial processes and other sources.
 - Exhaust discharges from building ventilation systems.
 - Construction and demolition sites, which are a source of particles and vaporous discharges.
 - Other significant sources of local air pollution which may be detrimental to health.

Table 2.1 Limit values from Schedule 2 to the Air Quality Standards Regulations 2010

Pollutant	Exposure limit	Exposure time
Carbon monoxide	10mg/m ³	8-hour average
Sulphur dioxide	350µg/m ³	1-hour average
	125µg/m ³	1-day average
Nitrogen dioxide	200µg/m ³	1-hour average
	40µg/m ³	1-year average
Benzene	5µg/m ³	1-year average
Lead	0.5µg/m ³	1-year average
PM _{2.5}	25µg/m ³	1-year average
PM ₁₀	50µg/m ³	1-day average
	40µg/m ³	1-year average

NOTE: This section only gives guidance for typical situations. Expert advice may also be able to provide additional guidance on the suitability of other technologies to minimise the intake of external air pollutants, including filtration.

Where these limit values are exceeded outside an opening used to remove excess heat, an alternative means of removing excess heat should be used.



Appendix C

EXAMPLE MITIGATION

MECHANICAL VENTILATION SYSTEMS

Bedrooms

Vent Axia Coolbox

NBR CoolBox 50

150mmØ Insulated Flexible Duct (Max 3m)

150mmØ Insulated Flexible duct

Y Piece (150→125/125mm)

2 No. 125mmØ Acoustic Flexible ducts - Equally Spaced, Same Length (Max 1.5m)

2 No. RV125mmØ Adjustable Valves & RVK Collars

Acoustic Mat

Backdraught Shutter (Insulated)

150mmØ Tile Vent / Roof Terminal (by other)
Min. free area 15,535mm²

NBR Coolbox Inline Fan (Select Fan Speed Low)

All ducting to be secured by worm drive clips provided

Nuaire MEV-ECO with a Nuaire PVCSIL-1000 silencer

OCTAVE BAND INSERTION LOSS

	125	250	500	1000	2000	4000	8000
PVCSIL-500	0.2	4.2	7.4	19.0	19.3	21.6	22.2
PVCSIL-1000	0.4	9.6	15.0	35.4	36.5	40.7	41.7
PVCSIL-1500	0.9	13.4	21.4	50.5	51.6	55.0	45.1

Hz

Other Rooms

Vent Axia NBR Cool Unitary Fan

MECHANICAL COOLING DEVICES

Up to 3.6kW & 100 l/s – Any Room	Up to 6.1 kW & 262 l/s – Rooms other than Bedrooms
Powrmatic Vision  	Mitsubishi MSZ-LN   

SHADING DEVICES

See: [Enviroblinds](#)



External Shading Samples

GUARD RAILS



Guard Rail examples



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