

Design Note

Project Manchester Life Development Company 3, Poland Street Zone – Phoenix Ironworks
Subject Stage 3 Overheating Analysis
Project no 0052279
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P00	Issued for information	LJ/JW	23/09/22	MR
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1 Executive Summary

An overheating analysis has been carried out using IES Virtual Environments (VE) for the residential spaces at Phoenix Ironworks, in accordance with methodology defined in Approved Document O. The overheating assessment was carried out for the following scenario:

- Scenario 1 - Natural ventilation provided via openable windows and standard mechanical ventilation (MVHR) provided for background ventilation throughout a day.

The results for this scenario are included within section 5 of this report, identifying that this scenario can meet the Approved Document O criteria and therefore overheating risk is at a minimum. The following is a summary of the design measures that help mitigate the overheating risks:

- Window openings, designed to meet Part F purge ventilation. Attention has been made to ensure effective opening areas to be achieved
- Mechanical ventilation based on MVHR to provide background ventilation;
- Window /glazing size has been discussed extensively during the design stage, driven by minimising heat loss to meet and exceed Manchester City Council's Core Strategy Policy EN6, i.e. a 15% improvement over Part L 2010 building regulations standard.
- Solar gain reduction by using windows with low g value, whilst still maintaining light transmittance of no less than 60% and allowing homes to benefit from the winter solar gains to reduce energy cost.

A further two scenarios were tested in the event that the windows are not able to be opened due to high external ambient noise levels. These additional scenarios are as follows:

- Scenario 2** - Windows closed, with MVHR units providing ventilation to meet Building Regulations Part F background requirements throughout a day. No mechanical cooling provided.
- Scenario 3** - No openable windows and enhanced MVHR designed to provide ventilation at a rate of 4 air changes per hour (ACH) in all occupied rooms. No mechanical cooling provided.

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Scenario 2 (windows closed) results in a large quantity of the rooms failing the TM59 criteria 2 due to a large number of hours exceeding 26°C from 10pm-7am. The TM59 assessment requires a maximum of 32hrs where the temperature exceeds 26°C, however in this scenario multiple rooms exceed 26°C for over 100hrs.

Scenario 3 (enhanced mechanical ventilation) identifies that all space analysed are compliant with both criteria 1 and 2 of the CIBSE TM59 methodology and therefore there is no risk of overheating occurring.

2 Introduction

Thermal comfort assessments have been undertaken for the residential spaces of the Phoenix Ironworks development. This is necessary to evaluate the comfort level in the habitable rooms, and to future-proof the development against the risks of increased temperatures due to climate change.

Thermal comfort has been assessed in accordance with the new Approved Document O. The document is the government's first formal consideration of overheating within buildings and aims to mitigate overheating risk in new residential buildings only. The document calls for compliance with requirement O1 (overheating mitigation), which states reasonable provision must be made to encourage the design/construction of buildings which:

1. Limit unwanted solar gains in summer
2. Provide an adequate means to remove heat from the indoor environment.

The analysis was done on a sample basis, by selecting apartments with the highest risk of overheating and at the same time including as many apartments typologies as possible. The habitable spaces (i.e. living/kitchen areas and bedrooms) of each apartment are analysed within the overheating calculations.

The residential spaces do not have mechanical cooling proposed and so were assessed against the CIBSE TM59 adaptive thermal comfort criteria, which allows for tolerance of occupants in naturally ventilated environments.

3 Methodology

Compliance with requirement O1 was achieved by following the design methodology for the assessment of overheating risk in homes within CIBSE's Technical Memorandum (TM59) document. TM59 provides separate compliance criteria for dwellings, while it also refers to TM52 for adaptive thermal comfort. TM59 differs to TM52 in that only 2 criteria are assessed, however both must be adhered to. Additionally, the criterion set out in TM59 are specific to residential areas. TM52 and TM59 share the same first criterion. The second TM59 criterion varies depending on whether the home is predominantly naturally or mechanically ventilated.

TM59 Criteria:

- 1 For living rooms, kitchens and bedrooms: the number of hours during which ΔT is greater than or equal to 1°C during the period May to September inclusive shall not be more than 3 per cent of occupied hours.

Appendix A $\Delta T = T_{op} - T_{max}$, where:

T_{op} – actual operative room temperature

T_{max} – the limiting maximum acceptable temperature (func. of outdoor temp)

- 2 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 (>32 hours per year).

Dynamic thermal simulation has been carried out and results shown in the following sections are reported against TM59 criteria.

4 Modelling Inputs & Assumptions

4.1 Building geometry and fabric

Building heights and internal layouts were taken from the latest architectural information from CRTKL Architects, received on 24/02/23. A selection of apartments at highest risk of overheating due to their orientation and geometry were modelled; these include apartments on higher floors, with large areas of south-facing glazing, and inline apartments with only one external wall. In addition, the worst-case ground-floor apartments were modelled. Approved Document O stipulates that ground-floor windows will be closed at all times, unless securely openable via lockable louvred shutters or grilles/railings. Since this level of design is yet to be finalised, a worst-case situation has been modelled.

Table 4-1 highlights the fabric assumptions for the site.

Table 4.1 – Building fabric assumptions

Element	Parameter	Value
External wall	U value	0.14 W/m ² K
Roof	U value	0.1 W/m ² K
External glazing	U value	1.3 W/m ² K
	g value	0.53

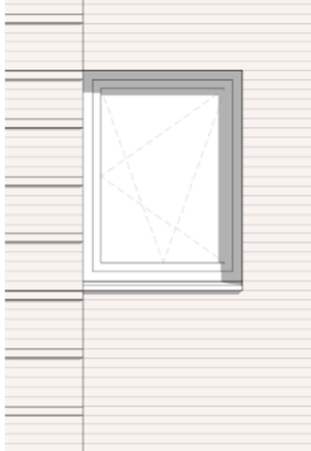
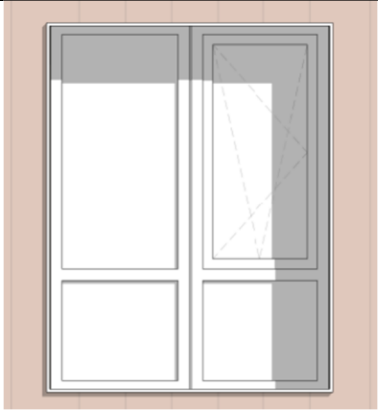
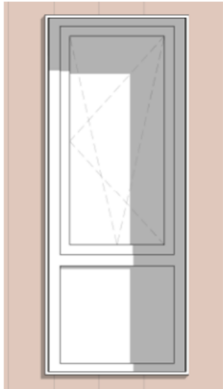
4.2 Internal Gains

The internal gain levels and profiles were taken directly from the IES VE TM59 Template and can be found in Appendix 1.

4.3 Window Openings

The following configurations of windows have been modelled; their parameters are shown in table 4.2 below. When using windows as a means of natural ventilation to mitigate overheating, compliance with Building Regulations Part F1 (Means of Ventilation) was ensured, such that any hinged or pivot window that opened between 15 and 30 degrees has an opening area at least 1/10th of the total room floor area.

Table 4.2 – modelled window details

Window Name	Example of window type	Hanging Type	Openable Area	Max angle open	Equivalent orifice area
Window 1		Side hung	90.0%	90°	94.3% of gross
Window 2		Side Hung	90%	90°	94.3% of gross
Window 3		Side Hung	90.0%	90°	94.3% of gross
Window 4		Side Hung	90.0%	90°	94.3% of gross

Approved Document O has provided clarity over TM59 on window opening modulating profiles. The profiles used are taken from the document, and are as follows:

- a) When a room is occupied during daytime (8am-11pm), openings should be modelled to do all the following:
 - i. Start to open when the internal temperature exceeds 22°C.
 - ii. Be fully open when the internal temperature exceeds 26°C.
 - iii. Start to close when the internal temperature falls below 26°C.
 - iv. Be fully closed when the internal temperature falls below 22°C.
- b) At night (11pm to 8am), openings should be modelled as fully open if both of the following apply.
 - i. The opening is on the first floor or above and not easily accessible.
 - ii. The internal temperature exceeds 23°C at 11pm.

For ground-floor rooms, windows are to be modelled as openable only if they are made secure by use of either fixed or lockable louvred shutters, or fixed or lockable window grilles or railings. Since this level of design is yet to be finalised, a worst-case situation of always closed has been modelled.

4.4 Mechanical ventilation

For ground-floor spaces without openable windows, the amount of enhanced MVHR was incrementally increased until a peak rate was found which could mitigate the worst-case overheating scenario.

4.5 Shading

Shading from surrounding buildings has been modelled. Window recesses shown in the latest architectural layouts have also been modelled, providing further shading.

4.6 Weather

In accordance with CIBSE TM59, the DSY1 weather file for Manchester location was used, specific to the 2020s with high emissions (50th percentile scenario). For context, TM49 demonstrates the probability of a summer being as warm as or warmer than DSY1 is 1 in 9, for DSY2 this decreases to 1 in 19 and 1 in 27 for DSY 2 and 3 respectively (based on weighted cooling degree hours metric). Passing DSY1 for the 2020s, high emissions, 50% percentile scenario is mandatory for TM59 compliance and for this reason is the only weather file that has been modelled.

4.7 Cooling

No cooling system has been proposed for the residential spaces.

5 Results

The below table summarises the results of the overheating assessment for the case of openable windows (as per section 4.3) and background mechanical ventilation to Part F regulations.

Table 5.1 TM59 Criteria 1 and 2 results for all habitable rooms

Room ID	TM59 Criteria 1 (living areas and bedrooms)		TM59 Criteria 2 (bedrooms only)	
	% Hours $T_{op}-T_{max} > 1^{\circ}\text{C}$	Pass? (<3%hrs)	Hours between 10pm-7am $> 26^{\circ}\text{C}$	Pass? (<32hrs)
Bedroom 1GF 1B2P B	0.3	PASS	26	PASS
Bedroom 1GF 1B2P A	0.3	PASS	24	PASS
Bedroom 1GF 2B4P A	0.2	PASS	26	PASS
Bedroom 2GF 2B4P A	0.2	PASS	28	PASS
Kitchen Living GF 1B2P B	0.2	PASS	8	N/A
Kitchen Living GF 1B2P A	0.3	PASS	9	N/A
Kitchen Living GF 2B4P A	0.4	PASS	9	N/A
Kitchen Living TH A	0.2	PASS	0	N/A
Bedroom 1TH A	0	PASS	19	PASS
Bedroom 2TH A	0	PASS	21	PASS
Kitchen Living TH B	0.4	PASS	0	N/A
Bedroom 1TH B	0	PASS	8	PASS
Bedroom 1GF 1B2P E	0.3	PASS	20	PASS
Kitchen Living GF 1B2P E	0.8	PASS	7	N/A
Bedroom 1GF 1B2P D	0	PASS	19	PASS
Kitchen Living GF 1B2P D	0.1	PASS	8	N/A
Bedroom 1GF 1B2B G	0	PASS	17	PASS
Bedroom 1GF 1B2P F	0	PASS	20	PASS
Kitchen Living GF 1B2B G	0	PASS	4	N/A
Kitchen Living GF 1B2P F	0	PASS	1	N/A
Bedroom 1 1F 1B2P C	0.5	PASS	4	PASS
Kitchen Living 1F 1B2P C	1.6	PASS	4	PASS
Bedroom 1 1F 1B2P B	0.2	PASS	3	PASS
Kitchen Living 1F 1B2P B	0.6	PASS	2	N/A
Bedroom 1 1F 1B2P E	0.1	PASS	5	PASS
Bedroom 1 1F 1B2P D	0.3	PASS	5	PASS
Kitchen Living 1F 1B2P E	0.6	PASS	6	N/A
Kitchen Living 1F 1B2P D	0.3	PASS	5	N/A
Bedroom 3 TH A	0.1	PASS	3	PASS
Bedroom 2TH B	0.1	PASS	3	PASS
Bedroom 3 TH B	0.1	PASS	3	PASS
Bedroom 1 1F 2B4P B	0.4	PASS	5	PASS
Kitchen Living 1F 2B4P B	0.6	PASS	0	N/A
Bedroom 21F 2B4P B	0.3	PASS	5	PASS
Bedroom 1 1F 1B2P F	0.4	PASS	7	PASS
Kitchen Living 1F 1B2P F	0.9	PASS	9	N/A
Bedroom 21F 2B4P C	0.4	PASS	6	PASS
Kitchen Living 1F 2B4P C	1	PASS	11	N/A
Bedroom 1 1F 2B4P C	0.4	PASS	6	PASS
Bedroom 21F 2B4P E	0.4	PASS	8	PASS
Bedroom 21F 2B4P D	0.2	PASS	6	PASS
Kitchen Living 1F 2B4P E	1.1	PASS	11	N/A

Kitchen Living 1F 2B4P D	0.7	PASS	10	N/A
Bedroom 1 1F 2B4P E	0.2	PASS	7	PASS
Bedroom 1 1F 2B4P D	0.1	PASS	6	PASS
Bedroom 3 1F 3B6P B	0.3	PASS	5	PASS
Kitchen Living 1F 3B6P B	0.7	PASS	1	N/A
Bedroom 21F 3B6P B	0.4	PASS	4	PASS
Bedroom 1 1F 3B6P B	0.2	PASS	6	PASS
Bedroom 3 1F 3B6P A	0.4	PASS	5	PASS
Bedroom 1 1F 3B6P A	0.6	PASS	8	PASS
Kitchen Living 1F 3B6P A	1.4	PASS	1	N/A
Bedroom 21F 3B6P A	0.9	PASS	7	PASS
Bedroom 1 1F 2B4P G	0.4	PASS	3	PASS
Kitchen Living 1F 2B4P G	0.8	PASS	3	N/A
Bedroom 21F 2B4P G	0.5	PASS	3	PASS
Kitchen Living 1F 1B2P A	0.6	PASS	3	N/A
Bedroom 1 1F 1B2P A	0.4	PASS	3	PASS
Bedroom 1 1F 2B4P A	0.5	PASS	4	PASS
Kitchen Living 1F 2B4P A	1.2	PASS	3	N/A
Bedroom 21F 2B4P A	0.6	PASS	4	PASS
Bedroom 1 2F 1B2P C	0.5	PASS	4	PASS
Kitchen Living 2F 1B2P C	1.6	PASS	3	N/A
Bedroom 1 2F 1B2P B	0.2	PASS	3	PASS
Kitchen Living 2F 1B2P B	0.6	PASS	2	N/A
Bedroom 1 2F 1B2P E	0.2	PASS	5	PASS
Bedroom 1 2F 1B2P D	0.3	PASS	5	PASS
Kitchen Living 2F 1B2P E	0.5	PASS	6	N/A
Kitchen Living 2F 1B2P D	0.2	PASS	5	N/A
Bedroom 1 2F 2B4P B	0.4	PASS	5	PASS
Kitchen Living 2F 2B4P B	0.6	PASS	0	N/A
Bedroom 2 2F 2B4P B	0.3	PASS	4	PASS
Bedroom 1 2F 1B2P F	0.4	PASS	5	PASS
Kitchen Living 2F 1B2P F	0.9	PASS	9	N/A
Bedroom 2 2F 2B4P C	0.4	PASS	6	PASS
Kitchen Living 2F 2B4P C	1	PASS	10	N/A
Bedroom 1 2F 2B4P C	0.4	PASS	6	PASS
Bedroom 2 2F 2B4P E	0.4	PASS	8	PASS
Bedroom 2 2F 2B4P D	0.2	PASS	6	PASS
Kitchen Living 2F 2B4P E	1	PASS	11	N/A
Kitchen Living 2F 2B4P D	0.7	PASS	10	N/A
Bedroom 1 2F 2B4P E	0.2	PASS	7	PASS
Bedroom 1 2F 2B4P D	0	PASS	5	PASS
Bedroom 3 2F 3B6P B	0.3	PASS	5	PASS
Kitchen Living 2F 3B6P B	0.7	PASS	1	N/A
Bedroom 2 2F 3B6P B	0.4	PASS	4	PASS
Bedroom 1 2F 3B6P B	0.2	PASS	5	PASS
Bedroom 3 2F 3B6P A	0.4	PASS	5	PASS
Bedroom 1 2F 3B6P A	0.6	PASS	8	PASS
Kitchen Living 2F 3B6P A	1.4	PASS	1	N/A
Bedroom 2 2F 3B6P A	0.8	PASS	7	PASS
Bedroom 1 2F 2B4P G	0.4	PASS	3	PASS
Kitchen Living 2F 2B4P G	0.9	PASS	3	N/A
Bedroom 2 2F 2B4P G	0.5	PASS	3	PASS
Kitchen Living 2F 1B2P A	0.7	PASS	2	N/A

Bedroom 1 2F 1B2P A	0.4	PASS	3	PASS
Bedroom 1 2F 2B4P A	0.5	PASS	4	PASS
Kitchen Living 2F 2B4P A	1.1	PASS	3	N/A
Bedroom 2 2F 2B4P A	0.5	PASS	4	PASS
Bedroom 1 3F 1B2P C	0.5	PASS	4	PASS
Bedroom 1 4F 1B2P C	0.5	PASS	4	PASS
Kitchen Living 3F 1B2P C	1.5	PASS	4	N/A
Kitchen Living 4F 1B2P C	1.8	PASS	4	N/A
Bedroom 1 3F 1B2P B	0.2	PASS	3	PASS
Bedroom 1 4F 1B2P B	0.2	PASS	3	PASS
Kitchen Living 3F 1B2P B	0.6	PASS	2	N/A
Kitchen Living 4F 1B2P B	0.6	PASS	2	N/A
Bedroom 1 3F 1B2P E	0.2	PASS	5	PASS
Bedroom 1 4F 1B2P E	0.2	PASS	5	PASS
Bedroom 1 3F 1B2P D	0.3	PASS	5	PASS
Bedroom 1 4F 1B2P D	0.2	PASS	5	PASS
Kitchen Living 3F 1B2P E	0.6	PASS	6	N/A
Kitchen Living 4F 1B2P E	0.4	PASS	6	N/A
Kitchen Living 3F 1B2P D	0.3	PASS	6	N/A
Kitchen Living 4F 1B2P D	0.2	PASS	5	N/A
Bedroom 1 3F 2B4P B	0.4	PASS	5	PASS
Bedroom 1 4F 2B4P B	0.3	PASS	5	PASS
Kitchen Living 3F 2B4P B	0.6	PASS	0	N/A
Kitchen Living 4F 2B4P B	0.4	PASS	0	N/A
Bedroom 2 3F 2B4P B	0.3	PASS	4	PASS
Bedroom 2 4F 2B4P B	0.1	PASS	5	PASS
Bedroom 1 3F 1B2P F	0.4	PASS	5	PASS
Bedroom 1 4F 1B2P F	0.4	PASS	5	PASS
Kitchen Living 3F 1B2P F	0.9	PASS	9	N/A
Kitchen Living 4F 1B2P F	0.9	PASS	9	N/A
Bedroom 2 3F 2B4P C	0.4	PASS	6	PASS
Bedroom 2 4F 2B4P C	0.4	PASS	5	PASS
Kitchen Living 3F 2B4P C	1	PASS	10	N/A
Kitchen Living 4F 2B4P C	0.9	PASS	10	N/A
Bedroom 1 3F 2B4P C	0.4	PASS	6	PASS
Bedroom 1 4F 2B4P C	0.4	PASS	6	PASS
Bedroom 2 3F 2B4P E	0.4	PASS	8	PASS
Bedroom 2 3F 2B4P D	0.2	PASS	6	PASS
Kitchen Living 3F 2B4P E	1	PASS	11	N/A
Kitchen Living 3F 2B4P D	0.7	PASS	10	N/A
Bedroom 1 3F 2B4P E	0.2	PASS	7	PASS
Bedroom 1 Duplex B L	0.2	PASS	5	PASS
Bedroom 1 3F 2B4P D	0	PASS	5	PASS
Bedroom 3 3F 3B6P B	0.3	PASS	5	PASS
Bedroom 3 4F 3B6P B	0.2	PASS	5	PASS
Kitchen Living 3F 3B6P B	0.7	PASS	1	N/A
Kitchen Living 4F 3B6P B	0.7	PASS	1	N/A
Bedroom 2 3F 3B6P B	0.4	PASS	4	PASS
Bedroom 2 4F 3B6P B	0.4	PASS	4	PASS
Bedroom 1 3F 3B6P B	0.2	PASS	5	PASS
Bedroom 1 4F 3B6P B	0.2	PASS	5	PASS
Bedroom 3 3F 3B6P A	0.4	PASS	5	PASS
Bedroom 3 4F 3B6P A	0.3	PASS	5	PASS

Bedroom 1 3F 3B6P A	0.6	PASS	8	PASS
Bedroom 1 4F 3B6P A	0.6	PASS	9	PASS
Kitchen Living 3F 3B6P A	1.4	PASS	1	N/A
Kitchen Living 4F 3B6P A	1.4	PASS	1	N/A
Bedroom 2 3F 3B6P A	0.8	PASS	7	PASS
Bedroom 2 4F 3B6P A	0.8	PASS	6	PASS
Bedroom 1 3F 2B4P F	0.4	PASS	3	PASS
Bedroom 1 4F 2B4P F	0.3	PASS	3	PASS
Kitchen Living 3F 2B4P F	0.7	PASS	3	N/A
Kitchen Living 4F 2B4P F	0.7	PASS	2	N/A
Bedroom 2 3F 2B4P F	0.4	PASS	3	PASS
Bedroom 2 4F 2B4P F	0.4	PASS	3	PASS
Kitchen Living 3F 1B2P A	0.7	PASS	2	N/A
Kitchen Living 4F 1B2P A	0.6	PASS	2	N/A
Bedroom 1 3F 1B2P A	0.4	PASS	3	PASS
Bedroom 1 4F 1B2P A	0.4	PASS	3	PASS
Bedroom 1 3F 2B4P A	0.3	PASS	4	PASS
Bedroom 1 4F 2B4P A	0.3	PASS	4	PASS
Kitchen Living 3F 2B4P A	0.8	PASS	2	N/A
Kitchen Living 4F 2B4P A	0.7	PASS	2	N/A
Bedroom 2 3F 2B4P A	0.2	PASS	3	PASS
Bedroom 2 4F 2B4P A	0.2	PASS	3	PASS
Bedroom Duplex A L	0	PASS	5	PASS
Kitchen Living Duplex A L	0.4	PASS	4	N/A
Kitchen Living Duplex B L	0.7	PASS	4	N/A
Bedroom 3 Duplex B U	0.1	PASS	5	PASS
Bedroom 3 Duplex A U	0	PASS	5	PASS
Bedroom 2 Duplex A U	0	PASS	2	PASS
Bedroom 1 5F 1B2P C	0.5	PASS	4	PASS
Kitchen Living 5F 1B2P C	1.8	PASS	4	N/A
Bedroom 1 5F 1B2P B	0.2	PASS	3	PASS
Kitchen Living 5F 1B2P B	0.6	PASS	2	N/A
Bedroom 3 5F 3B6P B	0.3	PASS	4	PASS
Kitchen Living 5F 3B6P B	0.7	PASS	1	N/A
Bedroom 2 5F 3B6P B	0.4	PASS	4	PASS
Bedroom 1 5F 3B6P B	0.2	PASS	5	PASS
Bedroom 3 5F 3B6P A	0.4	PASS	4	PASS
Bedroom 1 5F 3B6P A	0.6	PASS	7	PASS
Kitchen Living 5F 3B6P A	1.3	PASS	1	N/A
Bedroom 2 5F 3B6P A	0.8	PASS	6	PASS
Bedroom 1 5F 2B4P F	0.3	PASS	3	PASS
Kitchen Living 5F 2B4P F	0.6	PASS	2	N/A
Bedroom 2 5F 2B4P F	0.4	PASS	3	PASS
Kitchen Living 5F 1B2P A	0.6	PASS	2	N/A
Bedroom 1 5F 1B2P A	0.4	PASS	3	PASS
Bedroom 1 5F 2B4P A	0.2	PASS	3	PASS
Kitchen Living 5F 2B4P A	0.6	PASS	2	N/A
Bedroom 2 5F 2B4P A	0.2	PASS	3	PASS
Bedroom 2 Duplex A U	0	PASS	2	PASS
Bedroom 1 6F 1B2P C	0.6	PASS	4	PASS
Kitchen Living 6F 1B2P C	1.8	PASS	3	N/A
Bedroom 1 6F 1B2P B	0.2	PASS	3	PASS
Kitchen Living 6F 1B2P B	0.6	PASS	2	N/A

Bedroom 1 6F 2B4P F	0.3	PASS	3	PASS
Kitchen Living 6F 2B4P F	0.7	PASS	2	N/A
Bedroom 2 6F 2B4P F	0.4	PASS	3	PASS
Kitchen Living 6F 1B2P A	0.6	PASS	2	N/A
Bedroom 1 6F 1B2P A	0.4	PASS	3	PASS
Bedroom 1 6F 2B4P A	0.2	PASS	3	PASS
Kitchen Living 6F 2B4P A	0.6	PASS	2	N/A
Bedroom 2 6F 2B4P A	0.2	PASS	3	PASS
Bedroom 1 7F 2B4P C	0.7	PASS	4	PASS
Kitchen Living 7F 2B4P C	1.7	PASS	3	N/A
Bedroom 1 7F 1B2P B	0.2	PASS	3	PASS
Kitchen Living 7F 1B2P B	0.6	PASS	2	N/A
Bedroom 1 7F 2B4P A	0.3	PASS	3	PASS
Kitchen Living 7F 2B4P A	0.7	PASS	2	N/A
Bedroom 2 7F 2B4P A	0.4	PASS	3	PASS
Kitchen Living 7F 1B2P	0.6	PASS	2	N/A
Bedroom 1 7F 1B2P	0.3	PASS	3	PASS
Bedroom 1 7F 2B4P A	0.2	PASS	3	PASS
Kitchen Living 7F 2B4P A	0.6	PASS	2	N/A
Bedroom 2 7F 2B4P A	0.2	PASS	3	PASS
Bedroom 1 8F 2B4P A	0.3	PASS	3	PASS
Kitchen Living 8F 2B4P A	0.7	PASS	2	N/A
Bedroom 2 8F 2B4P A	0.4	PASS	3	PASS
Kitchen Living 8F 1B2P	0.6	PASS	2	N/A
Bedroom 1 8F 1B2P	0.3	PASS	3	PASS
Bedroom 3 8F 3B6P A	0.3	PASS	3	PASS
Bedroom 2 8F 3B6P A	0.2	PASS	3	PASS
Kitchen Living 8F 3B6P A	0.6	PASS	3	N/A
Bedroom 1 8F 3B6P A	0	PASS	2	PASS
Bedroom 3 8F 3B6P B	0.2	PASS	3	PASS
Kitchen Living 8F 3B6P B	0.6	PASS	3	N/A
Bedroom 2 8F 3B6P B	0.2	PASS	3	PASS
Bedroom 1 8F 3B6P B	0	PASS	2	PASS
Bedroom 1 9F 2B4P A	0.3	PASS	3	PASS
Kitchen Living 9F 2B4P A	0.8	PASS	3	N/A
Bedroom 2 9F 2B4P A	0.5	PASS	3	PASS
Bedroom 3 9F 3B6P A	0.4	PASS	3	PASS
Bedroom 2 9F 3B6P A	0.4	PASS	4	PASS
Kitchen Living 9F 3B6P A	0.8	PASS	4	N/A
Bedroom 1 9F 3B6P A	0.1	PASS	2	PASS
Bedroom 3 9F 3B6P B	0.2	PASS	3	PASS
Kitchen Living 9F 3B6P B	0.6	PASS	3	N/A
Bedroom 2 9F 3B6P B	0.2	PASS	3	PASS
Bedroom 1 9F 3B6P B	0	PASS	2	PASS

6 Conclusions of overheating assessment

The results show that, with the assumptions outlined in Section 4, overheating has been mitigated in all bedrooms and living rooms – fulfilling both TM59 criteria outlined in Section 3 through the use of natural ventilation via openable windows. The following is a summary of the design measures that help mitigate the overheating risks adopted by the proposed buildings:

- Window openings, designed to meet Part F purge ventilation. Attention has been made to ensure effective opening areas to be achieved;
- Mechanical ventilation based on MVHR to provide background ventilation;
- Window /glazing size has been discussed extensively during the design stage, driven by minimising heat loss to meet compliance with Part L 2022
- Solar gain reduction by using windows with low g value, whilst still maintaining light transmittance of no less than 60% and allowing homes to benefit from the winter solar gains to reduce energy cost.

7 Overheating Risk Assessment if Windows Cannot Be Open

7.1 Acoustics Ventilation and Overheating (AVO) Guidance & Part O

Two additional assessment scenarios have been carried to review the overheating risk should the windows not be able to be opened due to the external ambient noise levels, based on AVO guidance, Part O of the Building Regulations and the acoustician advice.

- **Scenario 2** - Windows closed, with MVHR units providing ventilation to meet Building Regulations Part F background requirements throughout a day. No mechanical cooling provided.
- **Scenario 3** - No openable windows and enhanced MVHR designed to provide ventilation at a rate of 4 air changes per hour (ACH) in all occupied rooms. No mechanical cooling provided.

7.2 Scenario 2: Overheating Risk Results Using 'Standard' MVHR With No Opening Windows

With scenario 1 being outlined in section 4, scenario 2 is the following:

- **Scenario 2** - Windows closed, with MVHR units providing ventilation to meet Building Regulations Part F background requirements throughout a day. No mechanical cooling provided.

The results indicate that when windows cannot be open (with MVHR providing background ventilation throughout the day), TM59 overheating criteria cannot be met and there is a major risk of overheating occurring in multiple spaces.

For scenario 2; opening windows, and a 'standard' MVHR providing background ventilation only, ALL rooms fail TM59

7.3 Scenario 3: Overheating Risk Results Using 'Enhanced' MVHR With No Opening Windows

A further assessment was carried out to review the overheating potential for the case of mechanically ventilated rooms (at 4ACH) and no openable windows. An iterative approach was taken to this assessment, with ACH rates slowly increased from 2ACH until all areas were passing the TM59 criteria at 4ACH.

For scenario 3; opening windows, and an 'enhanced' MVHR providing mechanical ventilation, ALL rooms pass TM59

7.4 Conclusion

Where windows cannot be opened due to the external ambient noise level exceeding the limits outlined within Part O of the Building Regulations and the AVO guidance an alternative means of mitigating any overheating risk is required. Test Scenario 2 shows that all rooms fail the TM59 overheating analysis when 'standard' MVHR units are used, however Scenario 3 confirms that they pass with 'Enhanced' MVHR units.

All rooms where the ambient noise level exceeds the limits of Part O and AVO guidance will be provided with enhanced MVHR units in order to meet the TM59 overheating criteria.

8 Appendices

8.1 Appendix 1: TM59 Internal Gains

Room type	Gain type	Peak value	Modulating profile
Double bedroom	People	2 people (75W sensible, 55W latent each)	08:00-09:00 fully occupied 09:00-22:00 50% occupied 22:00-23:00 fully occupied 23:00-08:00 70% of maximum (sleeping)
	Equipment	80W	09:00-23:00 maximum 23:00-09:00 13% of maximum
	Lighting	2W/m ²	18:00-23:00 on 23:00-18:00 off
Single bedroom	People	1 person (75W sensible, 55W latent)	08:00-23:00 occupied 23:00-08:00 70% of maximum (sleeping)
	Equipment	80W	09:00-23:00 maximum 23:00-09:00 13% of maximum
	Lighting	2W/m ²	18:00-23:00 on 23:00-18:00 off
Studio	People	2 people (75W sensible, 55W latent each)	00:00-24:00 fully occupied
	Equipment	450W	09:00-18:00 24% of maximum 18:00-20:00 maximum 20:00-22:00 44% of maximum 22:00-24:00 24% of maximum 24:00-00:00 19% of maximum
	Lighting	2W/m ²	18:00-23:00 on 23:00-18:00 off
1 Double bedroom kitchen/living	People	2 person (75W sensible, 55W latent)	09:00-22:00 fully occupied 22:00-09:00 unoccupied
	Cooking/equipment	450W	09:00-18:00 24% of maximum 18:00-20:00 maximum

			20:00-22:00 44% of maximum 22:00-24:00 24% of maximum 24:00-09:00 19% of maximum
	Lighting	2W/m ²	18:00-23:00 on 23:00-18:00 off
2 Double bedroom kitchen/living	People	4 person (75W sensible, 55W latent)	09:00-22:00 fully occupied 22:00-09:00 unoccupied
	Cooking/equipment	450W	09:00-18:00 24% of maximum 18:00-20:00 maximum 20:00-22:00 44% of maximum 22:00-24:00 24% of maximum 24:00-09:00 19% of maximum
	Lighting	2W/m ²	18:00-23:00 on 23:00-18:00 off
1 Double bedroom and 1 Single bedroom kitchen/living	People	3 person (75W sensible, 55W latent)	09:00-22:00 fully occupied 22:00-09:00 unoccupied
	Cooking/equipment	450W	09:00-18:00 24% of maximum 18:00-20:00 maximum 20:00-22:00 44% of maximum 22:00-24:00 24% of maximum 24:00-09:00 19% of maximum
	Lighting	2W/m ²	18:00-23:00 on 23:00-18:00 off
2 Double bedroom and 1 Single bedroom kitchen/living	People	5 person (75W sensible, 55W latent)	09:00-22:00 fully occupied 22:00-09:00 unoccupied
	Cooking/equipment	450W	09:00-18:00 24% of maximum 18:00-20:00 maximum 20:00-22:00 44% of maximum 22:00-24:00 24% of maximum 24:00-09:00 19% of maximum
	Lighting	2W/m ²	18:00-23:00 on 23:00-18:00 off

