

First Street South Block C, Manchester

Part O Overheating Report



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Abacus Consult Limited

First Street South Block C, Part O Overheating Report

Project: First Street South Block C

Subject: Part O Overheating Report

Prepared for: Downing Living Manchester South Ltd Partnership Incorporated

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1.0 Introduction

Abacus Consult Ltd have been commissioned to test the overheating risk of the proposed First Street South Block C student accommodation in Manchester against the requirements of Approved Document O. A CIBSE TM59 dynamic thermal simulation has been undertaken to predict the summertime temperatures for the bedrooms and living kitchen spaces. The TM59 criteria provides a basis for assessing the risk of perceived overheating. The results contained within this report are estimates of the temperatures that may be experienced in a typical year based on the CIBSE DSY weather files. Actual occupancies, internal gains and external weather conditions can vary from the predicted scenario, and therefore the actual internal room condition can be different as a result. This document in no way attempts to assess the scheme for compliance with the purge ventilation requirements of Approved Document F. This assessment aims to identify whether the proposals meet the requirements of Approved Document O using the CIBSE TM59 methodology.

1.01 Approved Document O

Approved Document Part O of the Building Regulations aims to reduce the risk of overheating in new residential buildings by setting limits on solar gains and requiring adequate means of removing excess heat. It provides guidance on both simplified and dynamic thermal modelling approaches to demonstrate compliance. The regulation ensures that dwellings are designed to maintain comfortable internal conditions during summer months without excessive reliance on active cooling systems, promoting occupant health and energy efficiency.

1.02 Building information

Building C is on the First Street South campus, bound by Hulme Street to the north and Medlock Street to the west. It is a 28 storey building with plant, switch rooms, main entrance and management suite on level 00, amenity areas on levels 00 and 01 and student accommodation areas on levels 1 to 27. The proposals will deliver a residential building comprising 555 bed spaces.



Figure 1 – Indicative site map from Google Maps

1.03 Air Quality Considerations

The RPS Air Quality Report (AQR) has been considered when producing this report and the following has been extracted:

The results of modelling indicate that the annual-mean limit value for NO₂ will be exceeded at:

- LEVEL 01 - All residential units (2 studios, 7 cluster bedrooms, 2 cluster kitchens).
- LEVEL 02 - 2 cluster kitchens, all cluster bedrooms and the studio closest to the cluster bedrooms on the west side.
- LEVEL 03 - 2 cluster kitchens and the two cluster bedrooms closest to the cluster kitchen on the west side.

The areas listed above feature a sealed façade and therefore cannot utilise rapid ventilation panels which resulted in a failure on the initial TM59. Air conditioning to these spaces has been included to mitigate overheating as passive solutions could not be achieved.

2.0 TM59 Assessment Methodology

The TM59 methodology is a standardised approach to predicting overheating risk for residential building designs using dynamic thermal analysis. The testing of the methodology has focused on flats as they tend to represent a higher overheating risk than houses. The aim is to produce a test that encourages good design that is comfortable within sensible limits, without being so stringent that it over promotes the use of mechanical cooling. CIBSE TM59 also sets out profiles that represent reasonable usage patterns for a home suitable for evaluating overheating risk. The profiles are developed to test a design and do not cover all usage modes. The Methodology is intended for use by designers to influence building design for the better. It can be used at planning stage to assess risk, as well as at later design stages.

The TM59 methodology will:

- Allow different designs to be compared based on reasonable assumptions
- Support design decisions that improve comfort without cooling
- Provide consistency across the industry for overheating risk prediction

The TM59 methodology will not:

- Guarantee that people will always be comfortable in compliant spaces, however they act
- Take into account unusual use

The basis of the design comfort criteria for CIBSE TM59 is:

- CIBSE TM52: Limits of thermal comfort: avoiding overheating (2013) – Provides the principles of thermal comfort
- CIBSE Guide A: Environmental design (2015) – Includes advice regarding sleep quality

The methodology is prescriptive so as to be consistently applied. It uses thermal modelling tools, defined internal gains profiles and specific weather files with a clearly defined thresholds to provide a clear pass/fail result.

CIBSE TM59 sets out two different overheating criteria for different design strategies. The two strategies are:

- Buildings that are predominantly naturally ventilated
- Buildings that are predominantly mechanically ventilated

For homes that are predominantly naturally ventilated, two criteria apply. These are:

1. Living Rooms, Kitchens and Bedrooms – Hours of exceedance

The number of hours during which ΔT is greater than or equal to one degree ($^{\circ}\text{K}$) during the period May to September inclusive shall not be more than 3% of occupied hours. ΔT is defined as operative temperature less the maximum acceptable temperature. ΔT is rounded to the nearest whole degree

2. Bedrooms Only – Sleeping Conditions

During the sleeping hours the operative temperature in the bedroom from 10pm to 7am shall not exceed 26°C for more than 1% of annual hours. This has been determined as being 32 hours a year.

TM59 compliance criteria for predominantly naturally ventilated buildings		
	Criterion 1 $\Delta T \geq 1\text{K}$ (Max 3%)	Criterion 2 Average hours above 26°C (Max 1%)
Bedrooms	≤ 110 (3% occupied hours)	≤ 32 (1% occupied hours)
Kitchen/living	≤ 68 (3% occupied hours)	n/a

Table 1 – TM59 compliance criteria

The TM59 criteria set out above provides a basis for assessing the risk of perceived overheating. The criteria above and results contained within this report are estimates of the temperatures that may be experienced in a typical year based on the CIBSE weather files. Actual occupancies, internal gains and external weather conditions will vary, and internal room condition may be different as a result.

2.01 Heat gains

For the purposes of the assessment, lighting energy is assumed to be proportional to floor area, and lighting loads are measured in W/m^2 . From 6 pm to 11 pm, $2 \text{ W}/\text{m}^2$ should be assumed as the default for efficient new buildings. This assumes that good daylight levels are available (also noting that only May to September is assessed within CIBSE TM52). For existing buildings, or specialist lighting designs, a calculated higher value should be used. For communal corridors, use $2 \text{ W}/\text{m}^2$; this may be assumed as zero if passive infrared (PIR) sensors are present.

2.02 Communal Corridors

Extract from TM59: 2017 Section 3.9

'Communal corridor heat gains should be modelled based on calculated losses from pipework.'

Extract from TM59: 2017 Section 5.2

'For communal corridors, use $2 \text{ W}/\text{m}^2$; this may be assumed as zero if passive infrared (PIR) sensors are present.'

3.0 Thermal model input criteria

3.01 Software

The CIBSE TM59 calculations have been carried out using IESVE. IESVE is a dynamic simulation software that is fully compliant with CIBSE AM11. IESVE uses the 'SunCast' solar shading module to model the sun path and solar shading effect for the proposed building. The 'MacroFlo' module has been used to simulate the natural ventilation openings using a selection of appropriate control profiles.

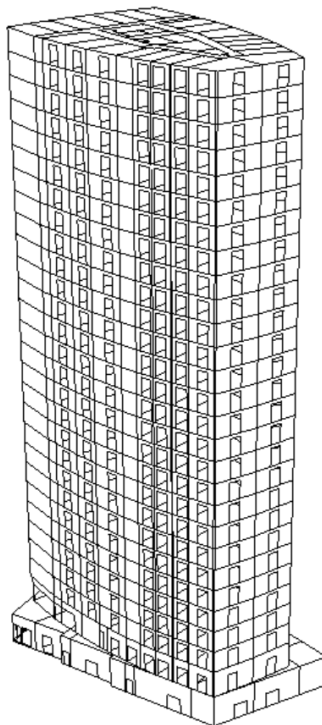


Figure 2 – Dynamic thermal model of the First Street South Block C building.

3.02 Architectural layouts

The SHP drawings that have been used to create the model are as follows:

- 63088-SHA-ZZ-00-D-A-200101_General Arrangement Plan Level 00_P01_S4
- 63088-SHA-ZZ-01-D-A-200101_General Arrangement Plan Level 01_P01_S4
- 63088-SHA-ZZ-ZZ-D-A-200101_General Arrangement Plan Type 01 (Levels 02,08,14)_P02_S3

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- 63088-SHA-ZZ-ZZ-D-A-200102_General Arrangement Plan Type 02 (Levels 03,05,07,_P01_S4
- 63088-SHA-ZZ-ZZ-D-A-200103_General Arrangement Plan Type 03 (Levels 04,06,10,_P01_S4
- 63088-SHA-ZZ-ZZ-D-A-200104_General Arrangement Plan Type 04 (Levels 16,18,20,_P01_S4
- 63088-SHA-ZZ-ZZ-D-A-200105_General Arrangement Plan Type 05 (Levels 17,19,21,_P01_S4
- 63088-SHA-ZZ-28-D-A-200101_General Arrangement Plan Level 28 - Roof Plant_P01_S4
- 63088-SHA-ZZ-RF-D-A-200101_General Arrangement Plan Roof Level_P01_S4

3.04 Rapid ventilation panels

Denoted on the plans as being an inward openable door, able to open to 90° with a minimum free area of 0.6m². Each studio, cluster bedroom and cluster kitchen has been assigned at least one rapid ventilation panel as indicated on the SHP architectural layouts. The TM59 assessment will consider the building as being predominantly naturally ventilated due to the inclusion of rapid ventilation panels on levels 05-23. The background ventilation of these rooms is via MVHR systems.

3.05 Fabric specification

The fabric specification is set out in Table 2 below. The specification is the same as that set out in the proposed BRUKL report.

Elements	U Value	Notes
External walls	0.73 w/m ² /K	
Exposed floors	0.18 w/m ² /K	
Flat roofs	0.18 w/m ² /K	
Windows	0.73 w/m ² /K	
Personnel doors	1.6 w/m ² /K	
Air permeability – 3 m ³ / (h.m ²) at 50Pa		

Table 2 – Proposed fabric specification

3.06 Mechanical ventilation

Mechanical ventilation with heat recovery is included in the analysis based on the results of the Part L modelling. Ventilation extract rates have been set up in the model in accordance with the flow rates listed below. Ventilation flow rates for the kitchen/living spaces have been increased to 30l/s from the minimum Part F boost rate of 13l/s to mitigate overheating. For the avoidance of doubt, Part F purge vent is not assessed in this thermal comfort analysis. Part F purge vent and any requirement for additional mechanical ventilation to meet Part F purge vent is assessed separately.

	Flow rate
Cluster bathroom	8 l/s
Kitchen/living (not air conditioned)	30 l/s
Kitchen/living (air conditioned)	13l/s
Studio	21 l/s

Table 3 – MVHR flow rates included in the TM59 model

3.07 Weather files

The Manchester DSY1 2020 High 50 weather files has been used as directed by the TM59 methodology, as it is the closest DSY weather file to the site.

3.08 Internal Gains

The internal gains and profiles that have been used for the internal temperature analysis model have been taken from CIBSE TM59 and the full tables for reference can be found in Appendix A. Single occupancy has been assigned to all the bedrooms because they are single occupancy rooms, let on a single occupancy basis.

3.09 Acoustic restrictions

For acoustic break in reasons, the opening hours of the rapid vents limited for the purposes of this analysis. Vents should remain closed overnight between the hours of 23:00 and 07:00.

4.0 Results and Conclusions

4.01 TM59 overheating assessment results

It can be seen from the results table Appendix B that the proposals as described in this document, fully comply with the requirements of CIBSE TM59. All rooms passed initial simulation under the Manchester DSY1 weather file. The TM59 analysis does not include the use of blinds in line with Part O. The analysis as described in this report therefore complies with CIBSE TM59 when mechanical extract ventilation rates are set to the requirements stated in section 3.06. The full results from the simulation can be found in Appendix B.

4.02 Results for PMV and PPD

Thermal modelling has also been undertaken to establish the predicted mean vote (PMV) and the Predicted Percentage of Dissatisfied (PPD) indices for each air conditioned space. This demonstrates compliance with BREEAM Hea04 criteria as the number of hours outside of the recommended range is under 3% of the total occupied hours and therefore meet CIBSE Guide A standards. Results showing the PMV/PPD indices for the occupied spaces within the proposed First Street Block C using the Manchester DSY 1 2020's high emissions 50th percentile range weather file can be found below.

4.03 Design for a projected climate change environment

For the purposes of BREEAM Hea04 the proposed building has also been simulated against the Manchester DSY2 2050s high emissions 50th percentile and DSY3 2050s high emissions 50th percentile weather files to simulate future climate conditions and assess the adaptability for climate change. The future weather file simulations proved the following:

- Thermal modelling demonstrates compliance with CIBSE AM11 Building Energy and Environmental Modelling criteria.
- The TM59 calculation still achieves a pass through the use of opening the rapid vent panels to overcome overheating issues.
- Modelling of the air conditioned/mechanically ventilated building spaces demonstrates that during occupied hours the temperature range meets CIBSE Guide A Environmental Design criteria.

4.04 Limitations of the TM59 assessment criteria

The TM59 criteria provides a basis for assessing the risk of perceived overheating. The results contained within this report are estimates of the temperatures that may be experienced in a typical year based on the CIBSE DSY weather files. Actual occupancies, internal gains and external weather conditions can vary from the predicted scenario, and therefore the actual internal room condition can be different as a result. This document in no way attempts to assess the scheme for compliance with the purge ventilation requirements of Approved Document F.

Appendix A – TM59 gains and occupancy profiles

Unit/ room type	Occupancy	Equipment load
Studio	2 people at 70% gains from 11 pm to 8 am 2 people at 100% gains from 8 am to 11 pm	Peak load of 450 W from 6 pm to 8 pm*. 200 W from 8 pm to 10 pm 110 W from 9 am to 6 pm and 10 pm to 12 pm Base load of 85 W for the rest of the day
1-bedroom apartment: living room/kitchen	1 person from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 450 W from 6 pm to 8 pm 200 W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day
1-bedroom apartment: living room	1 person at 75% gains from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 150 W from 6 pm to 10 pm 60 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 35 W for the rest of the day
1-bedroom apartment: kitchen	1 person at 25% gains from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 300 W from 6 pm to 8 pm Base load of 50 W for the rest of the day
2-bedroom apartment: living room/kitchen	2 people from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 450 W from 6 pm to 8 pm 200 W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day
2-bedroom apartment: living room	2 people at 75% gains from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 150 W from 6 pm to 10 pm 60 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 35 W for the rest of the day
2-bedroom apartment: kitchen	2 people at 25% gains from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 300 W from 6 pm to 8 pm Base load of 50 W for the rest of the day
3-bedroom apartment: living room/kitchen	3 people from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 450 W from 6 pm to 8 pm 200W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day
3-bedroom apartment: living room	3 people at 75% gains from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 150 W from 6 pm to 10 pm 60 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 35 W for the rest of the day
3-bedroom apartment: kitchen	3 people at 25% gains from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 300 W from 6 pm to 8 pm base load of 50 W for the rest of the day
Double bedroom	2 people at 70% gains from 11 pm to 8 am 2 people at full gains from 8 am to 9 am and from 10 pm to 11 pm 1 person at full gains in the bedroom from 9 am to 10 pm	Peak load of 80 W from 8 am to 11 pm Base load of 10 W during the sleeping hours
Single bedroom (too small to accommodate double bed)	1 person at 70% gains from 11 pm to 8 am 1 person at full gains from 8 am to 11 pm	Peak load of 80 W from 8 am to 11 pm Base load of 10 W during sleeping hours
Communal corridors	Assumed to be zero	Pipework heat loss only; see section 3.1 above

* All times in GMT

Extract from TM59: 2017 Section 6

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Number of people	Description	Peak load (W)		Period																							
		Sensible	Latent	00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
				Hour-Ending																							
				1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	24.00
1	Single bedroom occupancy	75	55	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.7
2	Double bedroom occupancy	150	110	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	0.7
2	Studio occupancy	150	110	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1-bed: living/kitchen occupancy	75	55	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
1	1-bed: living occupancy	75	55	0	0	0	0	0	0	0	0	0	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0
1	1-bed: kitchen occupancy	75	55	0	0	0	0	0	0	0	0	0	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0
2	2-bed: living/kitchen occupancy	150	110	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
2	2-bed: living occupancy	150	110	0	0	0	0	0	0	0	0	0	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0
2	2-bed: kitchen occupancy	150	110	0	0	0	0	0	0	0	0	0	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0
3	3-bed: living/kitchen occupancy	225	165	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
3	3-bed: living occupancy	225	165	0	0	0	0	0	0	0	0	0	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0
3	3-bed: kitchen occupancy	225	165	0	0	0	0	0	0	0	0	0	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0
	Single bedroom equipment	80		0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.13
	Double bedroom equipment	80		0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.13
	Studio equipment	450		0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
	Living/kitchen equipment	450		0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
	Living equipment	150		0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
	Kitchen equipment	300		0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
	Lighting profile	2 (W/m2)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0

Extract from TM59: 2017 Section 6

Appendix B – Manchester DSY1 TM59 results for a typical floor

Room Name	Room ID	Criterion 1 $\Delta T \geq 1K$ (Max 3%)	Criterion 2 Average hours above 26°C (Max 32)	Complies with TM59?
5BED CLUSTER BEDROOM 1	LV00000B	0.3	11	✓
STUDIO 1	ST000000	0	1	✓
STUDIO 2	ST000006	0.1	2	✓
STUDIO 3	ST000005	0.1	3	✓
STUDIO 4	ST000004	0.1	3	✓
STUDIO 5	ST000003	0.2	3	✓
STUDIO 6	ST000002	0.2	3	✓
STUDIO 7	ST000001	0.2	3	✓
STUDIO 8	LV000010	1.1	12	✓
STUDIO 9	LV00000F	2.6	20	✓
STUDIO 11	LV000006	0	0	✓
STUDIO 12	LV00000C	0.1	4	✓
4BED CLUSTER BEDROOM 1	LV00000D	0.2	4	✓
4BED CLUSTER BEDROOM 2	LV000011	0.1	1	✓
4BED CLUSTER BEDROOM 3	LV000012	0.1	1	✓
4BED CLUSTER BEDROOM 4	LV000013	0.3	5	✓
4BED CLUSTER KLD	LV000004	0.1	1	✓
5BED CLUSTER BEDROOM 2	LV000007	0.1	2	✓
5BED CLUSTER BEDROOM 3	LV000008	0	0	✓
5BED CLUSTER BEDROOM 4	LV000001	0	0	✓
5BED CLUSTER BEDROOM 5	LV00000A	0	0	✓
5BED CLUSTER KLD	LV000009	0	1	✓
STUDIO 10	LV00000E	0.2	3	✓
4BED CLUSTER BEDROOM 1	LV00000D	0.2	3	✓