CIBSE TM59 2017 Dynamic Thermal Model Report

(England Approved Document O (2021 edition) Building Regulations)

Site Address	404 Wilbraham Road, Manchester, M21 0UF
Reference	ET117274
Assessment Date	24/09/2026
Version	v1.0
Assessor	Iain Howarth

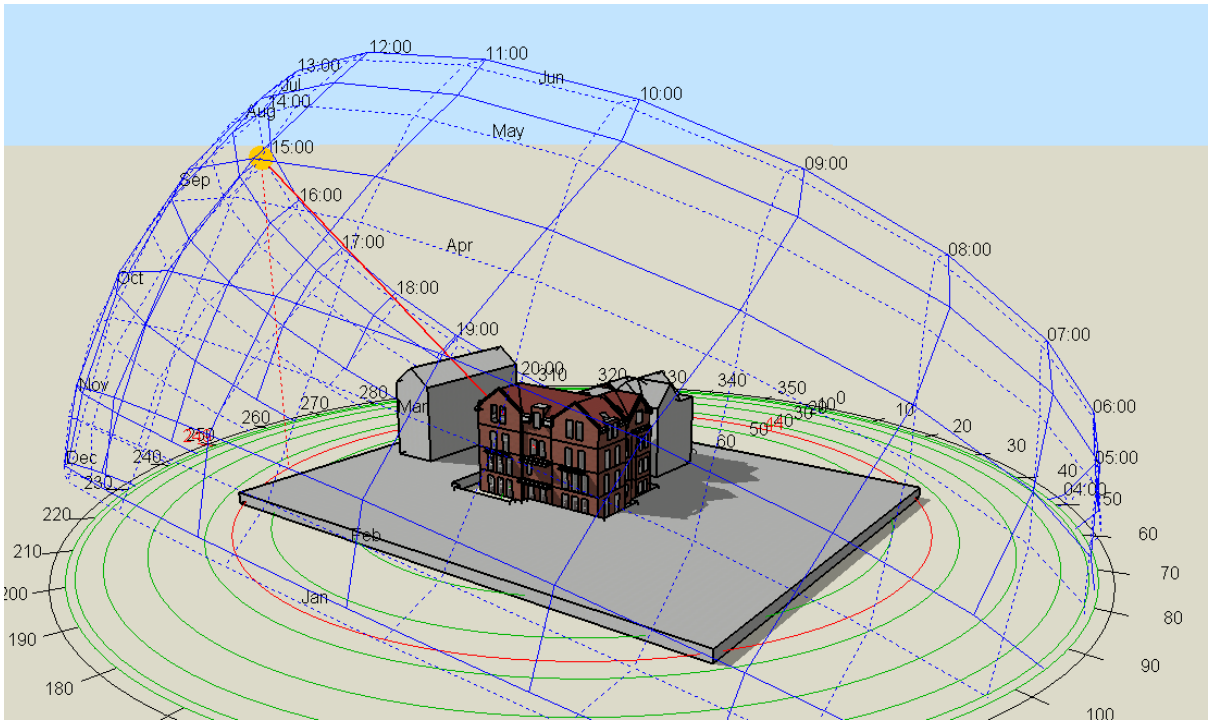


Figure 1. The building has been modelled using DesignBuilder Dynamic Simulation Modelling Software, using the EnergyPlus Simulation Engine.

Version History

Version	Release Date	Summary	Status
v1.0	24/09/2026	Initial results	Compliant

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1 Executive summary

This report details the methodology and findings of a study into the overheating risk for the proposed development at 404 Wilbraham Road, using dynamic simulation modelling.

Key design elements:

Shading	As seen on proposed elevations
Glazing design	G-values 0.50 & 0.55
Opening area	Predominately naturally ventilated
Ventilation	Continuous Mechanical Ventilation with Heat Recovery (MVHR)
Mechanical cooling	Not required

Compliance with CIBSE TM59 and Approved Document Part O is achieved through passive design measures alone, see Section 7 for a room by room breakdown.

2 Introduction

The purpose of this assessment is to investigate the potential risk of overheating within the proposed dwellings and to assess compliance with Approved Document Part O (ADO). Where necessary, potential mitigation strategies have been considered in line with the guidance.

Overheating is a growing concern in residential buildings and can significantly impact occupant health and wellbeing. While perceptions of thermal comfort are subjective and influenced by both human and environmental factors, the consequences of sustained high indoor temperatures can be severe. For instance, temperatures above 35°C can cause stress, anxiety, and even premature death in vulnerable occupants, while prolonged bedroom temperatures exceeding 26°C can contribute to sleep deprivation.

To evaluate overheating risk, the dwellings have been assessed using the CIBSE TM59 methodology, which provides a consistent and standardised framework with defined pass/fail criteria. While compliance with CIBSE TM59 does not guarantee comfort under all conditions or user behaviours, the approach enables:

- Consistent comparison across design options
- Informed decision-making for passive design strategies
- Industry-wide consistency in assessing overheating risk in homes

It is important to note that CIBSE TM59 does not account for unusual occupancy patterns or behaviours, and compliant designs may not ensure comfort in all cases.

Thermal analysis was carried out using DesignBuilder software, which is fully accredited and compliant with the CIBSE AM11 methodology.

In accordance with ADO requirements, simulations have been performed without the benefit of internal blinds, curtains, or shading from vegetation.

3 CIBSE TM59 "Design methodology for the assessment of overheating risk in homes"

3.1 Criteria for homes predominantly naturally ventilated

Based on the principals of CIBSE TM52, CIBSE TM59 sets two simplified criteria for compliance:

A. For living rooms, kitchens and bedrooms: 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. (CIBSE TM52 Criterion 1: Hours of exceedance).

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).

3.2 Criteria for homes predominantly mechanically ventilated

CIBSE TM59 states that the "predominantly mechanically ventilated" criteria should be applied to homes that are 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). CIBSE TM59 recommends the minimum opening area for natural ventilation should be at least 1/20th of the room floor area.

For homes falling within the "predominantly mechanically ventilated" definition, the CIBSE fixed temperature test must be followed, i.e. all occupied rooms should not exceed an operative temperature of 26˚C for more than 3% of the annual occupied annual hours (CIBSE Guide A (2015a)).

3.3 Adjustments for homes with vulnerable occupants

Care homes and accommodation for vulnerable occupants, which are predominantly naturally ventilated, should use criteria (a) and (b) from predominantly naturally ventilated homes above, with Type I occupancy.

If they are predominantly mechanically ventilated, the fixed temperature method should be used.

Where there is particular concern of high risk of overheating in accommodation for vulnerable occupants, a heatwave strategy should also be developed using additional weather files to explore performance and for demonstrating mitigation options under extreme events (e.g. heatwaves).

4 The Model

4.1 Considerations

The following factors are considered in the calculation of predicted indoor temperature by dynamic simulation model:

i. Mean outdoor temperatures.
ii. Infiltration.
iii. Geometry.
iv. Internal gains.
v. External shading.
vi. Natural ventilation.
vii. Internal shading.
viii. Mechanical ventilation.
ix. Fabric.
x. Active cooling.
xi. Glazing.
xii. Heat losses from pipework and heat interface units (HIUs)

4.2 Limitations

The majority of sites have limitations impacting design choices made during the design process. These limitations can have a significant impact on a development's overheating risk and as such must be considered when carrying out an overheating assessment.

Where information is not readily available, the following assumptions are followed during the CIBSE TM59 assessment.

- **Noise:** Noise levels are understood to exceed:

  a. 40dB LAeq,T, averaged over 8 hours (between 11pm and 7am).
  b. 55dB LAFmax, more than 10 times a night (between 11pm and 7am).
  Therefore windows are required to be restricted during sleeping hours (11pm to 7am) to the following equivalent areas:
  East and South: 0.01 m²
  West and North: 0.10 m²

- **Pollution:** The building(s) are not located near to significant local pollution sources.
- **Security:** Ground floor bedrooms or bedrooms adjacent to 3.2m high accessible ledges are assumed to be a security risk, however due to restricted windows for acoustic concerns, it is understood bedrooms are also secure.
- **Risk of falling:** Windows with a sill height below 1100 mm from internal FFL (finished floor level) and an internal FFL to external height change greater than 600mm have been modelled with openings unrestricted, appropriate guarding to be installed where necessary.
- **Protection from entrapment:** Louvred shutters, window railings and ventilation grilles should not allow body parts to become trapped. This is achieved with the following measures:
  - Not allow the passage of a 100mm diameter sphere.
  - Any hole which allows the passage of an 8mm diameter rod should also allow the passage of a 25mm diameter rod. Such holes should not taper in a way that allows finger entrapment.
  - Any looped cords must be fitted with child safety devices.

4.3 Sample size

CIBSE TM59 sets guidance on the sample size necessary when carrying out an overheating risk assessment. This guidance identifies dwellings with the following to be at the greatest risk of overheating:

a. with large glazing areas,

b. on the topmost floor,

c. having less shading,

d. having large, sun-facing windows,

e. having a single aspect, or

f. having limited opening windows

After reviewing design documentation and discussions with stakeholders a sample size of 2 has been decided upon, based on the following factors:

1. the scale of the development,
2. geographical location,
3. results of the modelling as they emerged, and
4. a low risk dwelling to illustrate the performance of the design

The specific units chosen are:

- Unit(s): 1, 2, 3 & 7

While it cannot be guaranteed that untested plots/units will not have a risk of overheating, the above sample has been used as a representative view of the development in accordance with TM59 guidance.

4.4 Weather file

In accordance with the guidance and recommendations of CIBSE TM59, representative dwellings have been modelled against the DSY1 weather file most appropriate to the site location (in this case the Manchester weather file location), for the 2020s, high emissions, 50% percentile scenario.

4.5 Geometry

A 3-D model of the dwelling has been created based on information contained within the set of architect drawings provided.

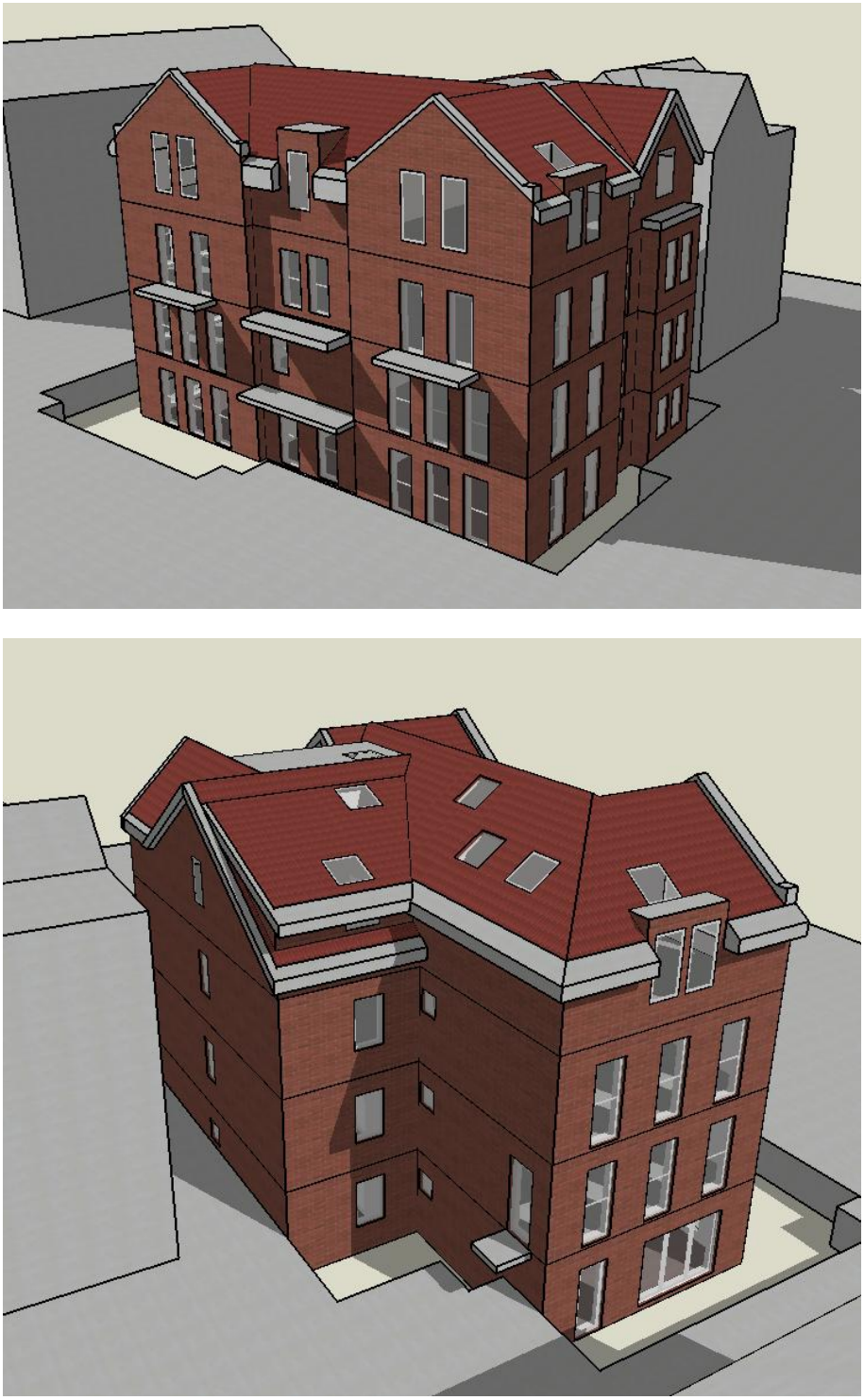


Figure 2. External renders

4.6 Zoning

TM59 performance criteria only applies to rooms falling within the following classifications: living area, kitchen area, circulation areas, bedrooms.

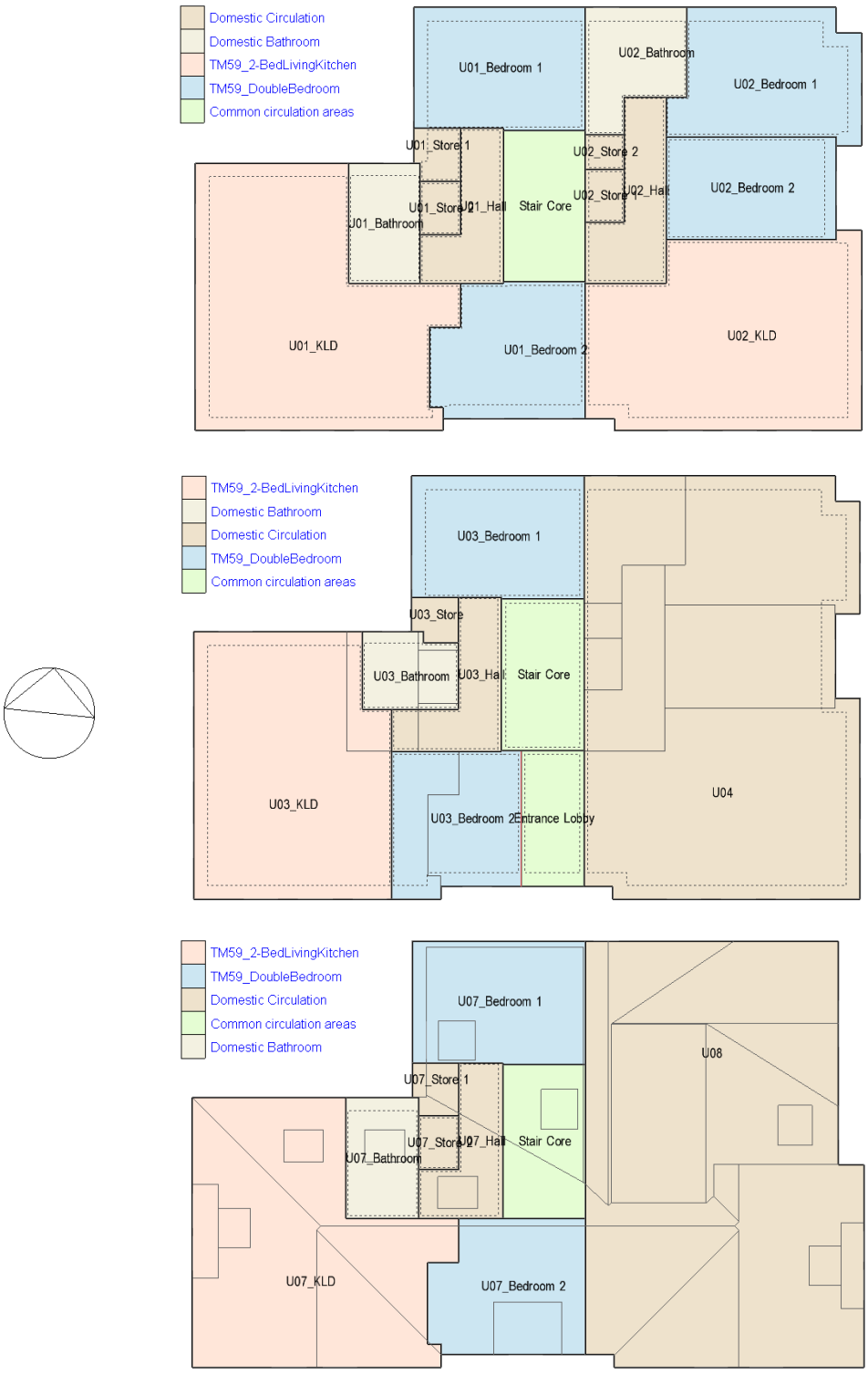


Figure 3. Internal zone layouts

5 Proposed Design

The following information has been used to produce the dwelling model:

5.1 Building Services

Element	Specification
HVAC	As per SAP calculations
Lighting	TM59 Template

5.2 Building Fabric

Element	Description	U-value	Thermal Mass
External Walls	Lightweight aggregate block cavity wall	0.13	Medium
Internal Walls	Timber stud & Light/mid aggregate blockwork	-	Low / Medium
Rafter Roof	Insulation between and below timber rafters	0.13	Low
Flat Roof	Insulation above timber joists (warm roof)	0.13	Low
Ground Floor	Insulated floor, screed finish	0.13	Medium
Internal Floor	Timber floors, chipboard	-	Low

5.3 Glazing Characteristics

Element	U-Value (W/m²K)	G-value[1]
Windows	1.40	0.50
Roof Windows	1.40	0.55

[1]*Maximum allowable g-value to assist with limiting the risk of overheating*

5.4 Ventilation & Infiltration

Element	Specification
Ventilation Strategy	Predominantly naturally ventilated via opening windows and internal acoustic transfer grilles to bedrooms and bathrooms
Mechanical Supply / Extract[1]	Whole house mechanical ventilation with heat recovery (MVHR)
DX-assisted Cooling	None Specified
Infiltration Rate	As per SAP calculations

[1] *Continuous mechanical ventilation is calculated using **85 l/s** whole dwelling ventilation rates.*

6 Window Layout



Figure 4. Proposed elevations

7 Results

7.1 Predominantly Naturally Ventilated

The table(s) below detail the TM59 results identifying which criteria show an acceptable overheating risk for predominantly naturally ventilated dwellings using passive measures alone.

Block	Zone	Criterion A (%)	Criterion B (hr)	Pass/Fail
00XLOWERGROUNDFLOOR	U01XBEDROOM1	0.00	11.83	Pass
00XLOWERGROUNDFLOOR	U01XBEDROOM2	0.02	24.50	Pass
00XLOWERGROUNDFLOOR	U01XKLD	0.53	N/A	Pass
00XLOWERGROUNDFLOOR	U02XBEDROOM1	0.00	19.83	Pass
00XLOWERGROUNDFLOOR	U02XBEDROOM2	0.00	28.83	Pass
00XLOWERGROUNDFLOOR	U02XKLD	0.09	N/A	Pass
01XUPPERGROUNDFLOOR	U03XBEDROOM1	0.00	15.33	Pass
01XUPPERGROUNDFLOOR	U03XBEDROOM2	0.04	31.67	Pass
01XUPPERGROUNDFLOOR	U03XKLD	1.39	N/A	Pass
03XSECONDFLOOR	U07XBEDROOM1	0.21	8.83	Pass
03XSECONDFLOOR	U07XBEDROOM2	0.13	19.17	Pass
03XSECONDFLOOR	U07XKLD	1.33	N/A	Pass

7.2 Predominantly Mechanically Ventilated

There are no predominantly mechanically ventilated dwellings within the scope of this assessment.

8 Overheating Mitigation Measures

Where dwellings are shown to have a risk of overheating, Approved Document O provides guidance on acceptable strategies for reducing the risk of overheating, see below.

8.1 Limiting solar gains

1. Fixed shading devices, comprising of the following:
    - Shutters
    - External blinds (internal blinds and curtains cannot be taken into account)
    - Overhangs
    - Awning
2. Glazing design, involving any of the following solutions:
    - Size
    - Orientation
    - G-value
    - Depth of the window reveal
3. Building design - e.g. the placement of balconies.
4. Shading provided by adjacent permanent buildings, structures or landscape.

Although internal blind / curtains and foliage, such as tree cover, can provide some reduction in solar gains, they should not be taken into account when considering whether requirement O1 has been met.

8.2 Removing excess heat

1. Opening windows (improved by cross-ventilation if applicable)
2. Ventilation louvres in external walls
3. A mechanical ventilation system (e.g. MVHR with summer bypass)
4. A mechanical cooling system

9 Mechanical Cooling

Based on the results of the dynamic thermal modelling, the dwelling does not require fixed mechanical cooling to meet the thermal comfort criteria. The predicted internal temperatures remain within acceptable limits under the design summer year (DSY) weather data, and the dwelling demonstrates compliance with the TM59 overheating criteria through passive means alone.

10 Conclusion

It should be demonstrated to the building control body that all practicable passive means of limiting unwanted solar gains and removing excess heat have been used first before adopting mechanical cooling to comply with Part O of the Building Regulations and with CIBSE TM59 Standards.

Following the proposed design specification, it can be seen that the proposed design satisfies both Criteria A and B, therefore demonstrating compliance with Part O of the Building Regulations. This is achieved through a number of design features including but not limited to; windows having a low g-value, unrestricted day time opening for increased purge ventilation and including mechanical ventilation with heat recovery (MVHR) for continuous background ventilation.

Appendix A – Compliance Checklist

Part 2b – Dynamic thermal modelling method

2b.1 Modelling details		
Dynamic software name and version	DesignBuilder 2025.1.1	
Weather file location used, including any additional, more extreme weather files	Manchester_DSY1_2020High50	
Number of sample units modelled, including an explanation of why the size/selection has been chosen	Section 4.3	
2b.2 Modelled occupancy		
Has the project passed the assessment described in CIBSE's TM59, taking into account the limits detailed in paragraphs 2.5 and 2.6?(1)	Yes	No
Details of the occupancy profiles used	Appendix B	
Details of the equipment profiles used	Appendix B	
Details of the opening profiles used	In accordance with ADO Section 2.6	
2b.3 Modelled overheating mitigation strategy		
Free areas	Section 6.0	
Infiltration and mechanical flow rates	Section 5.4	
Window g-value	Section 5.3	
Shading strategy	Section 6.0	
Mechanical cooling	Section 9.0	
2b.4 Modelling results		
Has the project passed the assessment described in CIBSE's TM59, taking into account the limits detailed in paragraphs 2.5 and 2.6?	Yes	No
What is the overall overheating strategy (i.e. what design features are key to the project passing)?	Section 10.0	
2b.5 Designer's declaration		
Has the building construction proposal been modelled accurately?	Yes	No
Designer's name		
Designer's organisation		
Designer's signature		
Registration number (if applicable)		
Date of design		

NOTE: 1. All references to paragraphs are to Approved Document O.

Appendix B – Table 2 Occupancy and equipment gain descriptions

Unit/ room type	*Occupancy*	*Equipment load*
Studio	*2 people at all times*	*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 5% 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 gain 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