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17 Greville Place – Overheating Risk Assessment Report

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Executive Summary

A Dynamic Simulation Modelling (DSM) study has been carried out to assess the risk of overheating in the current design of the 17 Greville Place development. The analysis has been conducted in accordance with the Part O building regulations (2021) and using the CIBSE TM59 overheating methodology for primarily mechanically ventilated residences. This methodology specifies standard internal gain profiles and opening criteria.

The results of the assessment show that **4 bedrooms** fail the TM59 criteria with the naturally ventilated and with blinds design only outlined in this report for the following urban weather files:

- London_LHR_DSY1_2020High50.epw – Compliance weather file based on TM59 guidance
- London_LHR_DSY1_2050Medium50_.epw
- London_LHR _DSY2_2020High50_.epw

The pass of the TM59 criteria was achieved through the implementation of comfort cooling.

Please note that results and recommendations are based on the parameters described in this report. If any of the inputs change, results are likely to change. This means the recommendations may no longer be appropriate, or the building may not meet the necessary requirements.

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1. Introduction

17 Greville Place is in the Borough of Camden, London, just south of Greville Road and adjacent to the intersection with Mortimer Crescent. It is situated in a primarily residential area surrounded by greenery, including mature trees and landscaped spaces, and is part of a neighbourhood characterized by a mix of low-rise apartment buildings and individual homes.

Location of the development

The site comprises a three-storey semi-detached single-family dwelling set over four floors, built in the 1850s. The external elevations feature London stock brickwork with stucco dressings and a slate roof. The site also benefits from vehicular access and off-street parking, enhancing its practicality and appeal.

This study evaluates the current development for its ability to avoid overheating. Results were generated through Dynamic Thermal Simulation (DSM), using industry validated software IES Virtual Environment 2023. All bedrooms and living/kitchen areas have been assessed against CIBSE 'TM59: 2017 - Design methodology for the assessment of overheating risk in homes'.

1.1. TM59 assessment requirement

Thermal comfort is a complex phenomenon as people will have a perception of their thermal comfort based on a range of factors including clothing, activity, outdoor temperatures, and recent experience: for this reason, a single absolute temperature value cannot always define occupant comfort.

To address the dynamic nature of thermal comfort, CIBSE TM59 outlines two criteria to assess overheating for homes, which are predominantly naturally ventilated. The criteria are based on operative temperature, which can be considered as a simple representation of the temperature experienced by occupants; operative temperature considers the impact of dry bulb air temperature, mean radiant temperature, and air speed in the space.

For predominantly mechanically ventilated homes TM59 specifies the following criteria to pass the assessment:

For homes with restricted window openings, 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 hours.

1.2. Approved document Part O requirement

The aim of requirement O1 is to protect the health and welfare of occupants of the building by reducing the occurrence of high indoor temperatures. Requirement O1 is met be designing and constructing the building to achieve both of the following:

- Limiting unwanted solar gains in summer.
- Providing an adequate means of removing excess heat from the indoor environment.

In meeting the above obligations account must be taken for the safety of the occupant and their reasonable enjoyment of the residence. Mechanical cooling may only be used where insufficient heat is capable of being removed from the indoor environment without it. Compliance with O1 has been demonstrated by dynamic thermal modelling follows the limits set out in section 2.6 for the window opening profiles which are:

2.6 All of the following limits on CIBSE's TM59, section 3.3, apply.

a. When a room is occupied during the day (8am to 11pm), openings should be modelled to do all of 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.
c. When a ground floor or easily accessible room is unoccupied, both of the following apply.
   i. In the day, windows, patio doors and balcony doors should be modelled as open, if this can be done securely, following the guidance in paragraph 3.7 below.
   ii. At night, windows, patio doors and balcony doors should be modelled as closed.
d. An entrance door should be included, which should be shut all the time.

Table 1. Approved document Part O, Section 2.6

The dynamic thermal modelling has been carried out in accordance with sections 2.7 to 2.9 (of Approved Document O) ensuring that the acceptable strategies for reducing overheating risk such as the following.

- Fixed shading devices e.g. Shutters, external blinds, overhangs and awnings.
- Glazing design e.g. Size, orientation, g-value and depth of window reveal.
- Building design e.g. placement of balconies.
- Shading provided by adjacent permanent buildings.

The means of removal of excess heat from the residential building aligns with sections 2.10 and 2.11 (of Approved Document O) to by any of the following.

- Opening windows
- Ventilation louvres in external walls
- A mechanical ventilation system
- A mechanical cooling system

It should be noted that to meet the requirement of O1 mechanical cooling (air-conditioning) is expected to be used only where requirement O1 cannot be met using openings and passive measures.

2. Design parameters

2.1. Drawings

All bedrooms and kitchen/living/dining spaces have been assessed as following:

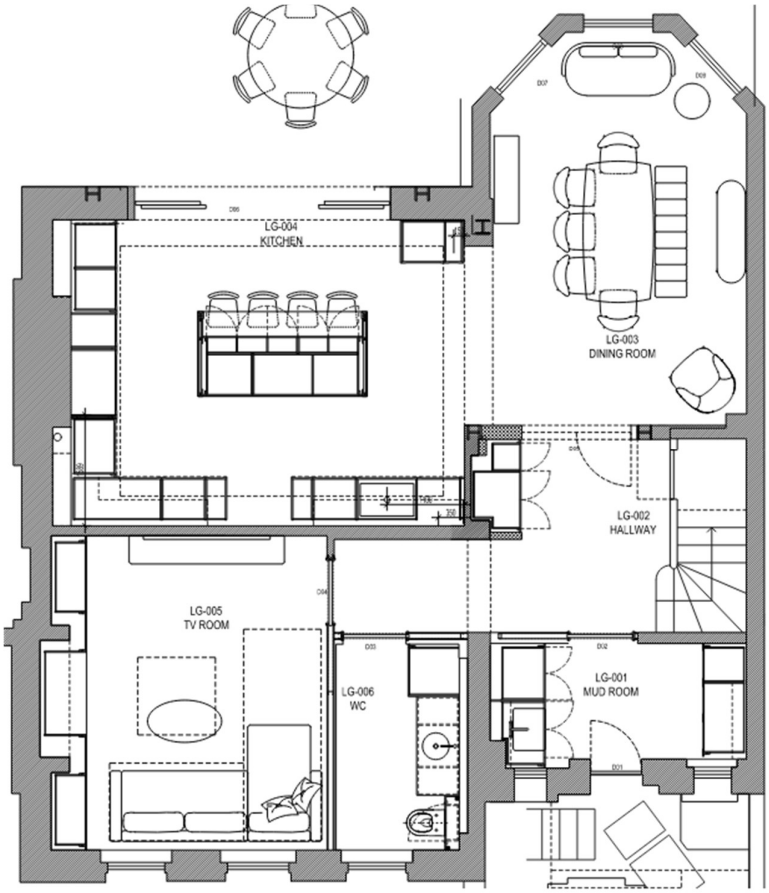


Figure 1. Lower Ground Floor Level

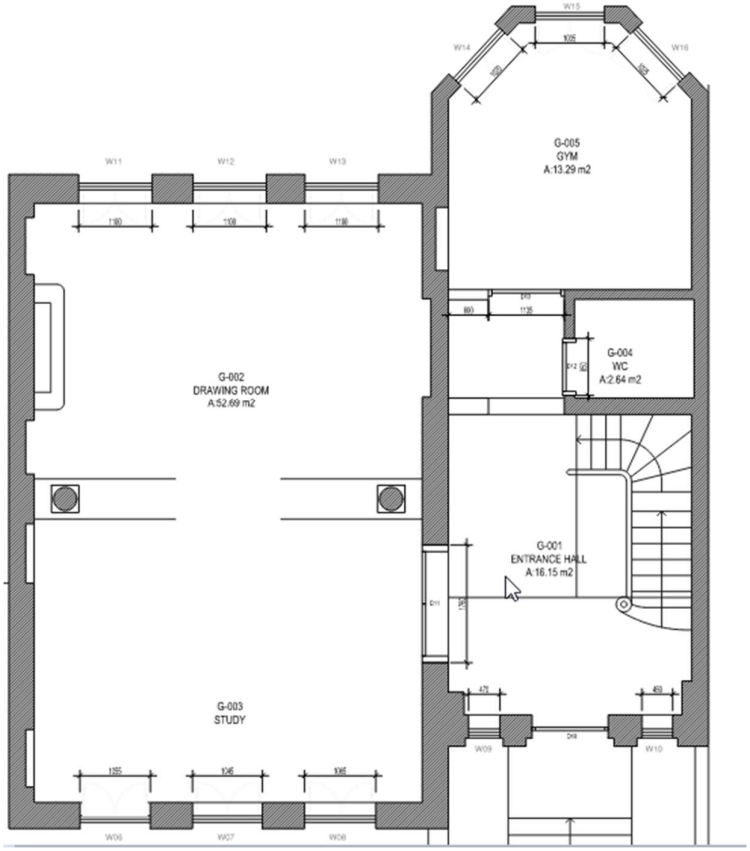


Figure 2. Ground Floor Level

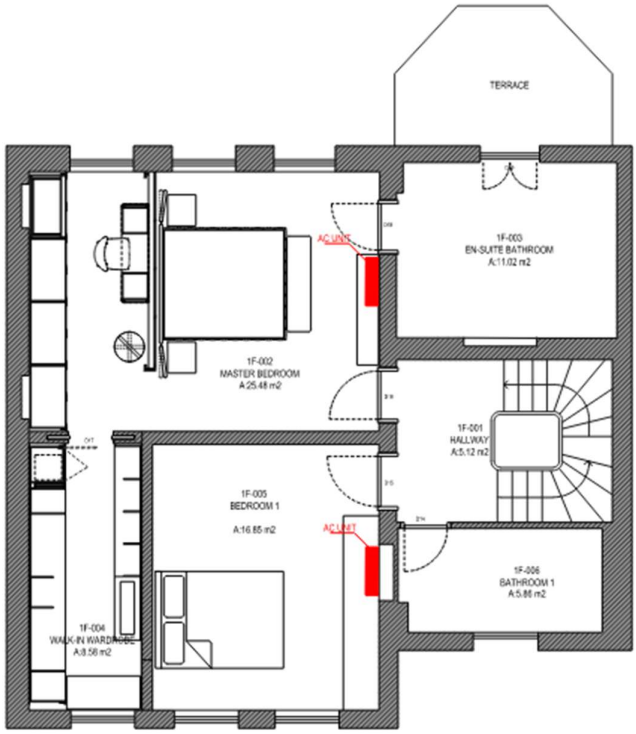


Figure 3. First Floor Level

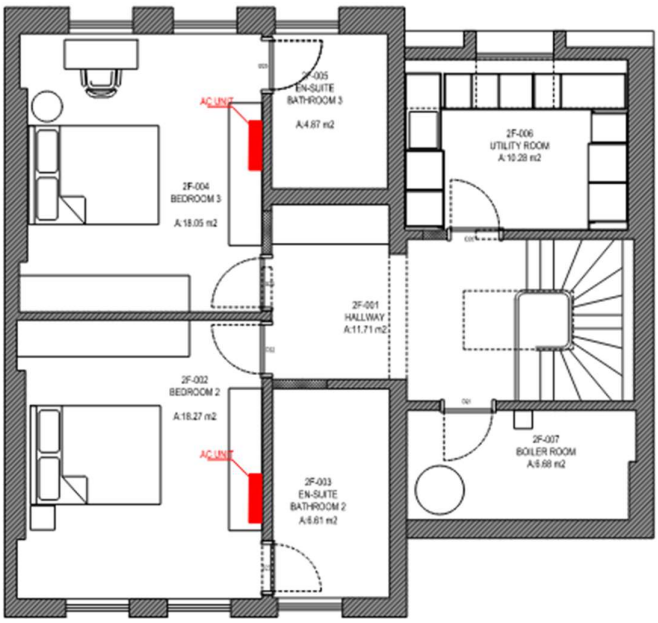
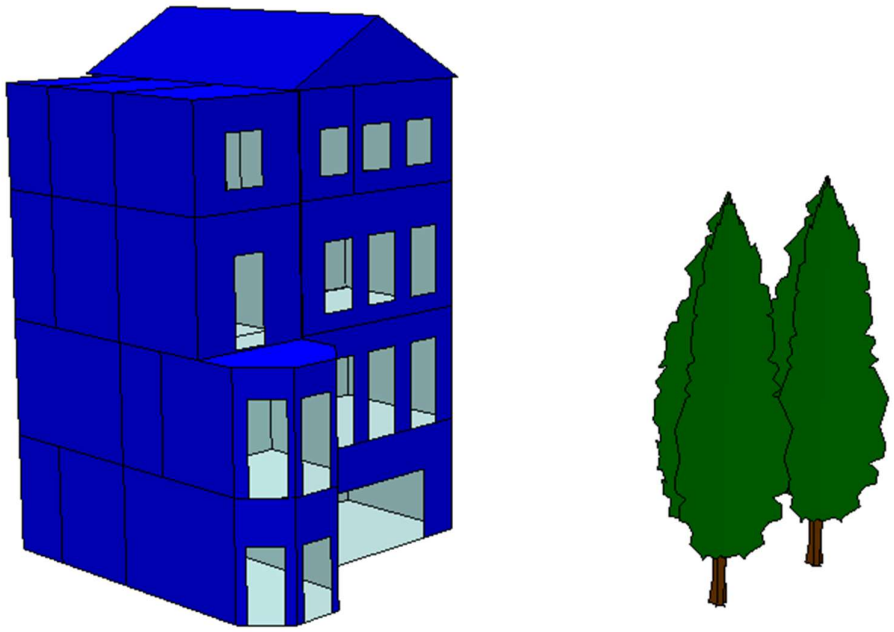


Figure 4. Second Floor Level

A 3D representation of the model as constructed in IES is shown in the next figure.



2.2. Fabric parameters

The fabric input values have been estimated based on the building's age. The assumed parameters are as follows:

- **External walls U-value**: 1.73 W/m²K
- **Roof U-value**: 0.40 W/m²K
- **Ground-exposed floor U-value**: 0.70 W/m²K
- **Windows U-value**: 4.80 W/m²K
- **Door U-value**: 3.00 W/m²K
- **Air permeability**: 7 m³/hr/m²

2.3. Solar Control

Due to the building's age, external shading solutions may not be feasible, as altering the building's appearance may be restricted.

While internal blinds do not formally contribute to compliance with Part O, they can still serve as a practical measure to reduce overheating when used in conjunction with other strategies, such as improved ventilation or glazing enhancements, to align with the regulation's intent.

Instead of traditional window shutters, blackout roller blinds have been installed as a modern alternative. These blinds offer a sleek and contemporary solution for blocking sunlight, providing better control over natural light, improving energy efficiency, and preserving the space's aesthetic integrity.

2.4. Window types

The existing window schedule, provided by the architect, offers detailed information on the dimensions, types, and degrees of opening for the windows and doors throughout the building. Organized by floor, the schedule lists each window with its dimensions (in mm), type (e.g., sash window, French door, casement window), and degree of opening, which ranges from 50% to 100%.

Floor	Window ID	Dimensions (WxH mm)	Window Type	Degree of Opening
Lower Ground Floor	W01	810 x 1530	Sash window	50%
	W02	810 x 1530	Sash window	50%
	W03	810 x 1530	Sash window	50%
	W04	460 x 830	Casement window	50%
	W05	530 x 830	Casement window	50%
Ground Floor	W06	1050 x 2575	French door	100%
	W07	1050 x 2575	French door	100%
	W08	1050 x 2575	French door	100%
	W09	460 x 760	Casement window	100%

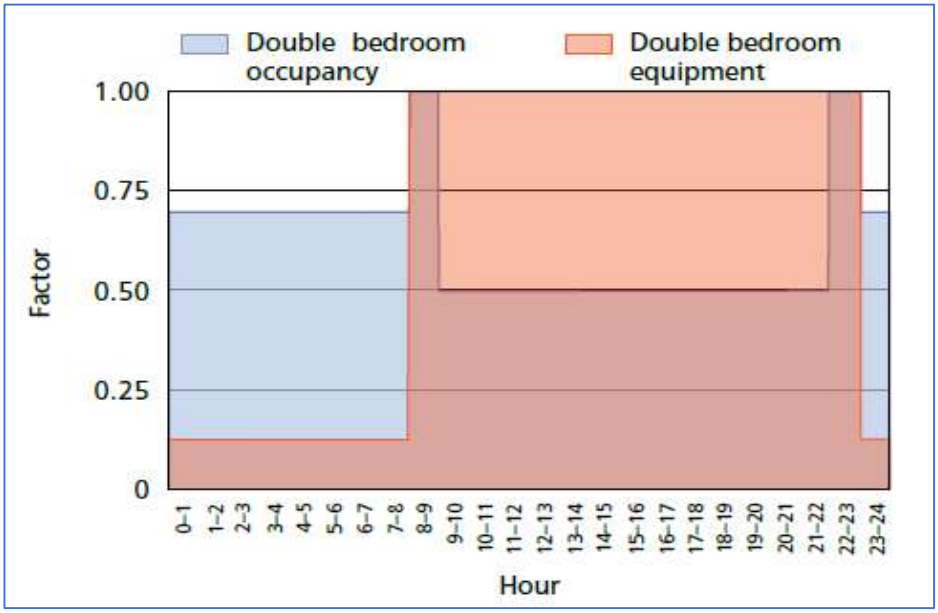
	W10	460 x 760	Casement window	100%
	W11	1050 x 2575	French door	100%
	W12	1050 x 2575	French door	100%
	W13	1050 x 2575	French door	100%
	W14	1020 x 2575	French door	100%
	W15	1020 x 2575	French door	100%
	W16	1020 x 2575	French door	100%
First Floor	W17	1070 x 2000	Sash window	50%
	W18	1070 x 2000	Sash window	50%
	W19	1070 x 2000	Sash window	50%
	W20	1090 x 1900	Sash window	50%
	W21	1060 x 2000	Sash window	50%
	W22	1060 x 2000	Sash window	50%
	W23	1060 x 2000	Sash window	50%
	W24	1000 x 2510	French door	100%
Second Floor	W25	1040 x 1560	Sash window	50%

	W26	1040 x 1560	Sash window	50%
	W27	1070 x 1560	Sash window	50%
	W28	1055 x 1300	Sash window	50%
	W29	1055 x 1300	Sash window	50%
	W30	1055 x 1300	Sash window	50%
	W31	1275 x 1480	Sash window	50%

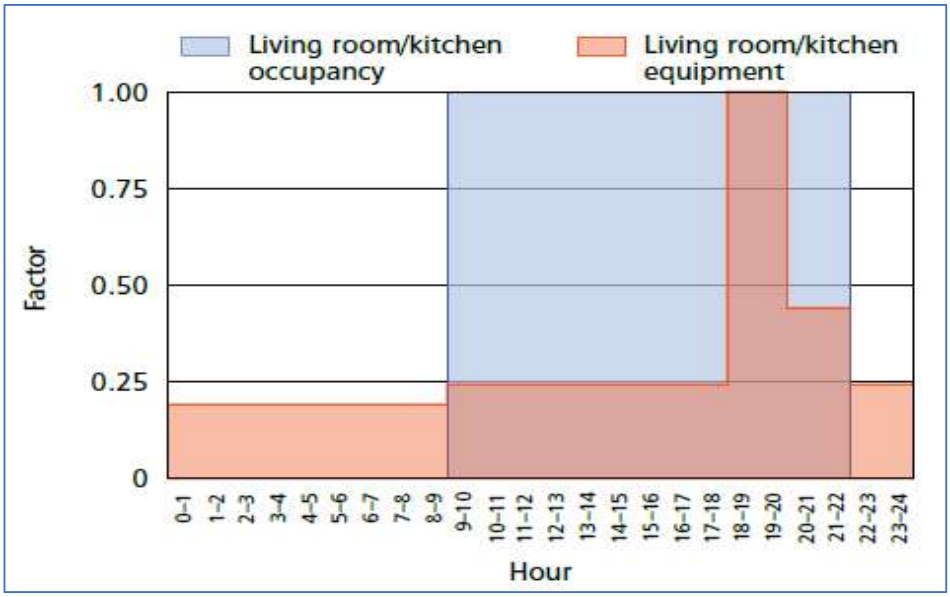
2.5. Gain Profiles

TM59 outlines standardized usage profiles for different dwellings sizes and types of spaces. The purpose of these profiles is to represent the typical to worst-case scenarios for occupancy, lighting, and equipment usage throughout the day. For all spaces, the lighting profiles are in effect from 18:00 to 23:00. The occupancy and equipment profiles that were utilized in the modelling process are provided below.

Heat gain profile: double bedroom:



Heat gain profile: combined living room / kitchen:



2.6. Internal Gains

The following table gives the internal gains and number of occupants modelled for each of the rooms analyzed, based on the CIBSE TM59 guidance.

Room Type	Lighting Gain (W/m^2)	Number of people	Sensible Gain (W/Person)	Latent Gain	Equipment (Peak -W)
Kitchen	2	2	150	110	300
Three bedroom - Kitchen/Dining /living	2	2	150	110	450
Bedrooms	2	2	150	110	80

2.7. Weather files

The CIBSE TM59 guidance requires that developments refer to the latest CIBSE Design Summer Year (DSY) weather files. Developments are required to pass the DSY1 file most appropriate for the site location for the 2020s, high emissions, 50th percentile scenario . The appropriate nearest available weather file location is the London Heathrow Weather Centre file.
The analysis has been carried out using the following weather files:

- London_LHR_DSY1_2020High50.epw – Compliance weather file based on TM59 guidance

- London_LHR_DSY1_2050Medium50_.epw
- London_LHR _DSY2_2020High50_.epw

2.8. Mechanical Ventilation Rates

Mechanical ventilation hasn't been considered as a solution for this development.

3. Cooling hierarchy

The Camden Planning Guidance aligns its cooling hierarchy with the guidance provided by the London Plan and broader sustainability frameworks. To minimize overheating and reduce cooling demand, the following key strategies were analysed prior to the consideration of comfort cooling:

1. **Minimise internal heat generation through energy-efficient design.**
   The building is an older edifice, and as such, modifications to the fabric, such as insulation or significant alterations to glazing systems, are not feasible. Consequently, passive design measures to reduce internal heat generation must focus on alternative strategies, such as utilizing internal shading solutions and optimizing natural ventilation, to limit heat gain while maintaining the building's integrity. Therefore the following have been included in the design:
   - *Roller blinds with a shading coefficient of 0.4 has been included in the design. Their effect on reducing overheating has been individually assessed and documented in the revised assessment.*
   - *Ceiling Fans: Ceiling fans have been modelled within the dynamic thermal model to evaluate their impact on cooling effectiveness. Results indicate that their contribution to overheating reduction is minimal compared to active cooling solutions.*

2. **Reduce the amount of heat entering a building in summer**
   Situated in a residential area with abundant greenery, including mature trees and landscaped spaces, the building benefits from natural shading that reduces solar heat gain, enhancing thermal comfort and energy efficiency without the need for additional shading devices or green infrastructure.

3. **Manage the heat within the building through exposed thermal mass and high ceilings**
   Due to the building's age, mechanical ventilation is not a viable option as there is insufficient ceiling space to accommodate the required systems.

4. **Passive Ventilation**
   Due to the building's age, this is not a viable option as there is insufficient ceiling space to accommodate the required systems.

Natural ventilation through openable windows has been prioritized.

5. **Mechanical Ventilation**
   Due to insufficient ceiling space, mechanical ventilation with heat recovery is not a viable solution for this building.

6. **Active Cooling Systems: Only consider active cooling (e.g., air conditioning) after all passive measures have been exhausted and ensure low-carbon options are implemented when required.**
   Active cooling has been implemented only after exhausting passive measures.
   The selected system ensures low-carbon solutions, aligning with environmental and regulatory compliance.

4. Results

The following tables show that the spaces are failing to comply with the TM59 criterion 1 (for London_LHR_DSY1_2020High50_.epw).
We have **tested with openable windows, roller blinds and ceiling fans.**

Openable windows only (without blinds)

	Criterion 1 -				Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Result

Location	Day % Hrs > 26°C
	Limit = **3%**
		Night # Hrs > 26°C
		Limit = 33 or max 1%
			Night # Hrs > 26°C
			Limit = 33 or max 1%
				*Night # Hrs > 26°C
				Limit = **33 hours or max 1%**			

		22 - 00	00-07	total			
1F-005 Bedroom 1	7.6	2.7	0.3	3.0	40	5	Fail
1F-002 Master Bedroom	6.7	2.6	0.2	2.8	36	5	Fail
2F-004 Bedroom 3	6.7	3.2	0.4	3.6	31	5	Fail
2F-002 Bedroom 2	7.4	2.9	0.3	3.2	36	5	Fail

Results for bedrooms only without blinds

**For bedrooms only: to guarantee comfort during thesleeping hours the operative temperature in the*

bedroom from 10 pm to 7 am shall not exceed 26 °Cfor more than 1% of annual hours. (Note: 1% of the annual hours between 22:00 and 07:00 for bedroomsis 32 hours, so 33 or more hours above 26 °C will be recorded as a fail).

Openable windows only (with blinds)

	Criterion 1 -				Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Result
Location	Day % Hrs > 26°C Limit = 3%	Night # Hrs > 26°C Limit = 33 or max 1%	Night # Hrs > 26°C Limit = 33 or max 1%	Night # Hrs > 26°C Limit = 33 or max 1%			
		22 - 00	00-07	total			
1F-005 Bedroom 1	6.7	1	0.2	1.2	30	4	**Fail**
1F-002 Master Bedroom	6.0	1.4	0.5	1.9	24	5	**Fail**
2F-004 Bedroom 3	6.0	2.0	0.1	2.1	29	4	**Fail**
2F-002 Bedroom 2	6.8	2.3	0	2.3	20	4	**Fail**

Results for bedrooms only with blinds

Openable windows only (with blinds + ceiling fans)

	Criterion 1 -				Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Result
Location	Day % Hrs > 26°C Limit = 3%	Night # Hrs > 26°C Limit = 33 or max 1%	Night # Hrs > 26°C Limit = 33 or max 1%	Night # Hrs > 26°C Limit = 33 or max 1%			
		22 - 00	00-07	total			
1F-005 Bedroom 1	6.7	0.9	0.2	1.1	25	4	**Fail**

1F-002 Master Bedroom	6.0	1.4	0.5	1.9	20	4	**Fail**
2F-004 Bedroom 3	6.0	1.9	0.1	2.0	19	4	**Fail**
2F-002 Bedroom 2	6.8	2.2	0	2.2	20	4	**Fail**

Results for bedrooms only with blinds and ceiling fans

Openable windows only

	Criterion 1 -	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Result
Location	Day % Hrs > 26°C Limit = 3%			
LG-004 Kitchen	2.2	24	4	**Pass**
LG-003 Dining Room	2.2	24	4	**Pass**
LG-005 TV Room	1.9	26	4	**Pass**
G-002 Drawing Room	2.5	24	4	**Pass**
G-003 Study	1.9	27	4	**Pass**
G-005 Gym	2.6	27	4	**Pass**

Results for the other occupied spaces

Openable windows and comfort cooling

	Criterion 1 -				Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Result
Location	Day % Hrs > 26°C	Night # Hrs > 26°C	Night # Hrs > 26°C	Night # Hrs > 26°C			

	Limit = 3%	Limit = 33 or max 1%	Limit = 33 or max 1%	Limit = 33 or max 1%			
		22 - 00	00-07	total			
1F-005 Bedroom 1	0.1	0	0	0	0	0	Pass
1F-002 Master Bedroom	0.7	0.3	0.3	0.6	1	1	Pass
2F-004 Bedroom 3	0	0	0	0	0	0	Pass
2F-002 Bedroom 2	0	0	0	0	0	0	Pass

Results for bedrooms only

Openable windows only

	Criterion 1 -	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Result
Location	Day % Hrs > 26°C			
	Limit = 3%			
LG-004 Kitchen	2.2	24	4	Pass
LG-003 Dining Room	2.2	24	4	Pass
LG-005 TV Room	1.9	26	4	Pass
G-002 Drawing Room	2.5	24	4	Pass
G-003 Study	1.9	27	4	Pass
G-005 Gym	2.6	27	4	Pass

Results for the other occupied spaces

With the implementation of comfort cooling, the bedrooms meet the TM59 criteria under current weather conditions. However, for future weather scenarios, it is recommended to

implement additional mitigation measures, such as increasing the cooling capacity, to ensure continued compliance.

Furthermore, other occupied spaces, including the kitchen, dining room, TV room, drawing room, study, and gym, would also require comfort cooling to maintain acceptable thermal conditions.

Detailed TM59 results for selected future weather scenarios are provided in Appendix A.

5. Conclusion

A Dynamic Simulation Modelling (DSM) study has been carried out to assess the risk of overheating in the current design of the 17 Greville development. The analysis has been conducted in accordance with the Part O building regulations (2021) and using the CIBSE TM59 overheating methodology for primarily mechanically ventilated residences. This methodology specifies standard internal gain profiles and opening criteria.

Built in 1850, the building's age imposes significant constraints on implementing passive measures. The analysis, aligned with the City of Westminster's cooling hierarchy and the London Plan, considered various measures to address overheating and cooling demand:

- **Passive Design**: Modifications to the building fabric, such as insulation or glazing upgrades, are unfeasible. Instead, internal shading (such as roller blinds – please refer to page 17) and openable windows were prioritized to minimize heat gain. Having solely roller blinds will not overcome the overheating effect which is mainly caused by poor fabric performance.
- **Shading and Green Infrastructure**: Existing mature trees and landscaped surroundings provide effective natural shading, reducing the need for additional interventions.
- **Ventilation and Thermal Mass**: The limited ceiling space and structural constraints render mechanical ventilation and additional thermal mass solutions impractical. Ceiling fans have been implemented but their introduction resulted in a marginal improvement as mentioned in "4. Results" section
- **Active Cooling Systems**: Comfort cooling has been integrated into the design to meet overheating criteria for bedrooms and maintain thermal comfort.

For the spaces to pass, the implementation of comfort cooling is required for remaining in line with the Part O acceptable strategies for mitigating heat risk.

The results of the assessment show that the bedrooms don't meet the TM59 criteria with only passive measures for the compliance weather file London_LHR _DSY1_2020High50_.epw.

With the addition of comfort cooling, the bedrooms now meet the TM59 overheating criteria under current weather conditions. However, additional occupied spaces—including the kitchen, dining room, gym, study, and drawing room—will also require cooling to maintain acceptable comfort levels. Additionally, the cooling system will be assessed for capacity

upgrades in a phased manner, aligning with future climate projections to maintain compliance.

It should be further noted that the results of the simulations undertaken within this report reflect the risk of overheating under the conditions and assumptions listed herewith, including, but not limited to:

- Fabric performance
- Occupancy
- Internal gains
- Weather data
- Ventilation rates
- Façade design
- Orientation and overshadowing

Changes to any of the listed assumptions will invalidate the results of the study and will require a new risk assessment against the TM59 overheating criteria.

APPENDIX A – Future weather files results

The following table shows that the spaces are failing to comply with the TM59 criterion 1 (as it is mandatory) for more extreme (DSY 2 and DSY3) as well as future files (2050's or 2080's)

- London_LHR _DSY1_2050Medium50_.epw

Openable windows only

	Criterion 1 -				Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Result
Location	Day % Hrs > 26°C Limit = 3%	Night # Hrs > 26°C Limit = 33 or max 1%	Night # Hrs > 26°C Limit = 33 or max 1%	Night # Hrs > 26°C Limit = 33 or max 1%			
		22 - 00	00-07	total			
1F-005 Bedroom 1	7.6	2.7	0.3	3.0	40	5	Fail
1F-002 Master Bedroom	7.0	2.6	0.2	2.8	38	5	Fail
2F-004 Bedroom 3	6.7	3.2	0.4	3.6	31	5	Fail
2F-002 Bedroom 2	7.4	2.9	0.3	3.2	36	5	Fail

Results for bedrooms only

Openable windows only

	Criterion 1 -	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Result
Location	Day % Hrs > 26°C Limit = 3%			
LG-004 Kitchen	4.2	33	5	**Fail**
LG-003 Dining Room	4.1	34	5	**Fail**
LG-005 TV Room	4.1	36	5	**Fail**
G-002 Drawing Room	4.5	34	5	**Fail**
G-003 Study	3.9	38	5	**Fail**
G-005 Gym	4.3	37	5	**Fail**

Results for the other occupied spaces

- London_LHR _DSY2_2020High50_.epw

Openable windows only

	Criterion 1 -				Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Result
Location	Day % Hrs > 26°C Limit = 3%	Night # Hrs > 26°C Limit = 33 or max 1%	Night # Hrs > 26°C Limit = 33 or max 1%	Night # Hrs > 26°C Limit = 33 or max 1%			
		22 - 00	00-07	total			
1F-005 Bedroom 1	7.6	2.7	0.3	3.0	40	5	Fail
1F-002 Master Bedroom	6.7	2.6	0.2	2.8	36	5	Fail

2F-004 Bedroom 3	6.9	3.4	0.4	3.8	35	5	Fail
2F-002 Bedroom 2	7.4	2.9	0.3	3.2	34	5	Fail

Results for bedrooms only

Openable windows only

	Criterion 1 -	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Result
Location	Day % Hrs > 26°C Limit = 3%			
LG-004 Kitchen	3.3	42	7	**Fail**
LG-003 Dining Room	3.5	43	7	**Fail**
LG-005 TV Room	3.9	46	7	**Fail**
G-002 Drawing Room	3.6	44	7	**Fail**
G-003 Study	3.6	46	7	**Fail**
G-005 Gym	3.7	45	7	**Fail**

Results for the other occupied spaces