Cooling Hierarchy for 73a Maygrove Road, Camden, London

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Contents

1.0	Executive Summary	2
2.0	Overheating Background	3
3.0	CIBSE Guidance	4
4.0	Overheating and Cooling Hierarchy	6
9.0	Conclusion	12

Appendices
Appendix 1: Criterion 3 of Part L1A of the Building Regulations
Appendix 2: Domestic Overheating Checklist
Appendix 3: Stage 1 results of the dynamic overheating modelling
Appendix 4: Stage 2 results of the dynamic overheating modelling
Appendix 5: Stage 3 results of the dynamic overheating modelling
Appendix 6: Stage 5 results of the dynamic overheating modelling
Appendix 7: Stage 6 results of the dynamic overheating modelling

1.0 EXECUTIVE SUMMARY

1.1 This report demonstrates that through the iterative design process that has been undertaken with the design team, the cooling hierarchy has been followed in line with London Plan Policy 5.9.

1.2 Although there are openable windows to allow for natural ventilation air change movements, without active cooling, the proposed development would fail the overheating criteria set out in *CIBSE TM59 Design methodology for the assessment of overheating risk in homes.*

1.3 Every measure has been undertaken to avoid active cooling, which included looking at the development to improve the energy efficiency of the dwellings, reduce the amount of solar gain penetration, explore the thermal mass of proposed construction, and introduce mechanical ventilation, before active cooling was included within the design.

1.4 All simulations have been carried out using software in accordance with CIBSE AM11: Building Energy and Environmental Modelling.

1.5 When following the Cooling Hierarchy, to avoid summer overheating within the proposed dwellings, an air source heat pump has been added to the design of the dwellings. When this is added, all internal temperatures are in line with CIBSE Guide A: Environmental Design and CIBSE TM52:2013 The Limits of Thermal Comfort: Avoiding Overheating in European Buildings

2.0 OVERHEATING BACKGROUND

2.1 The project team has considered overheating risk at an early stage to ensure that when the end users occupy the dwellings, thermal comfort levels are reduced to a minimum.

2.2 Thermal comfort is important within modern buildings. If temperature exceeds 28^{o}C, dissatisfaction can occur for occupants, resulting in poor productivity. For prolonged periods of time, high temperatures can also impact on occupant's health and wellbeing.

2.3 Traditional construction within the UK has predominately comprised of heavyweight materials, resulting in a 'high' thermal mass. The level of thermal mass will affect the internal temperature. If too high, elements will absorb heat more readily, and displace the heat within a room. If too low, then elements will not easily absorb heat, resulting in sustained temperatures in rooms.

2.4 Buildings also have overheating issues when large glazed façades are designed. South facing façades will receive the highest amount of direct sunlight, and adjoining rooms will therefore be subject to intense solar gains.

2.6 The project team has therefore incorporated specific glazing into the design of the building, such as low g-values, to restrict the amount of direct solar gain entering the adjoining rooms.

2.7 There are also other sources of 'internal gains' that can lead to overheating, and occupant dissatisfaction. Internal gains occur from lighting, people, computers and many other sources typically in the variable building fabric. Internal gains have been modelled with the dynamic simulation to account for heat gains.

3.0 CIBSE GUIDANCE

3.1 Overheating risk has been a growing concern amongst the domestic design, construction and provider community for at least a decade. Domestic overheating has not always been a problem in the UK but climate change, increased urbanisation, construction of highrise apartment blocks and winter energy efficiency measures have all contributed in the amplification of high internal temperatures. Homes that overheat cause significant discomfort and stress to the occupants and can ultimately lead to litigation and costly mitigation measures for the owners/developers.

3.2 The basis of design criteria is as follows; CIBSE TM52: Limits of thermal comfort: avoiding overheating in European buildings (2013) provides the principles of thermal comfort and should be the main reference for any additional detail; and, CIBSE Guide A: Environmental design (2015) includes advice regarding sleep quality (that may be compromised at temperatures above 24 °C), and recommends that peak bedroom temperatures should not exceed an absolute threshold of 26 °C.

3.3 CIBSE TM52:2013 sets out the following three criteria, which, taken together provide a robust yet balanced assessment of the risk of overheating of buildings in the UK and Europe:

- The first criterion sets a limit for the number of hours that the operative temperature exceeds the comfort temperature by 1°C or more during the occupied hours over the summer period (1st May to 30th September).
- The second criterion deals with the severity of the overheating within any one day. This sets a daily limit for acceptability.
- The third criterion sets an absolute maximum daily temperature for the room, beyond which the level of overheating is unacceptable.

3.4 The bedrooms within the building should be considered closely as no mechanical ventilation or cooling is present within the area.

3.5 The purpose of this report is to ascertain whether internal temperatures are likely to exceed the criterion recommended in CIBSE TM52:2013.

3.6 A room or building that fails any two of the three criteria above is potentially at risk of overheating. If a building fails CIBSE TM52:2013 limits, measures should be investigated to reduce internal temperatures and, therefore, reduce the likelihood of overheating.

3.7 Part L of the Building Regulations, 2013 (Criterion 3) – Limiting the effects of solar gains during the summer states that reasonable provision should be made to limit solar gains. This can be achieved by an appropriate combination of window size and orientation, solar protection through shading and other solar control measures, ventilation (day and night) and high thermal capacity. This assessment is carried out for regulatory compliance; however, this is a not a particularly sensitive analysis. Assessing the risk in accordance with CIBSE guidance provides a more in-depth analysis.

3.8 The bedrooms and living areas should be considered most closely as it is envisaged that these will be the rooms occupied for significant periods of time. Rooms such as WCs, circulations spaces and store rooms do not have overheating criteria or a suggested maximum temperature as it is envisaged that no one will occupy these rooms for a significant period.

3.9 Figure 1.0 below illustrates Table 1.8 of CIBSE Guide A: Environmental Design, and the benchmark summer peak temperatures and overheating criteria for different building types. The guidance indicates that the summer peak temperature for living areas is 28°C, and for bedrooms 26°C, with 1% annual occupied hours over 28°C and 26°C tolerance levels respectively:

Figure 1.0: Table 1.8 CIBSE Guide A: Environmental Design Page 1-12

Table 1.8 Benchmark summer peak temperatures and overheating criteria

Building	Benchmark summer peak temp. / °C	Overheating criterion
Offices	28	1% annual occupied hours over operative temp. of 28 °C
Schools	28	1% annual occupied hours over operative temp. of 28 °C
Dwellings:		
— living areas	28	1% annual occupied hours over operative temp. of 28 °C
— bedrooms	26	1% annual occupied hours over operative temp. of 26 °C

* DfES Building Bulletin BB87[30] recommends an allowable overheating criterion of 80 occupied hours in a year over an air temperature of 28 °C.

3.10 To ensure that the CIBSE standards are met, it is necessary to use appropriate simulation software in accordance with CIBSE AM11. Integrated Environmental Solutions, (IES), Virtual Environment, (VE), has been used to model the building.

4.0 OVERHEATING AND COOLING STRATEGY

4.1 Through the application of passive design and low energy measures the design team has worked to ensure that the risk of summer overheating and reliance on mechanical cooling is minimised in line with the 'cooling hierarchy' and London Plan Policy 5.9:

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
Active cooling

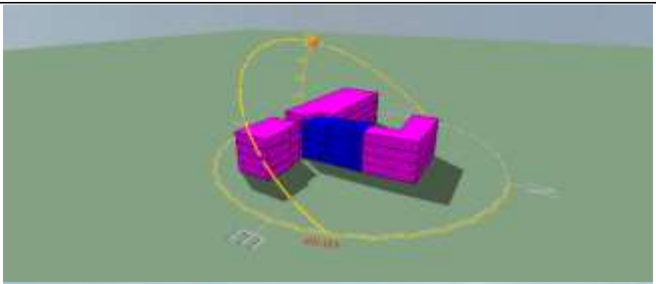
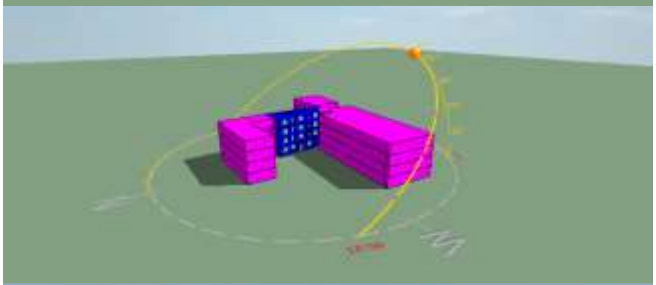
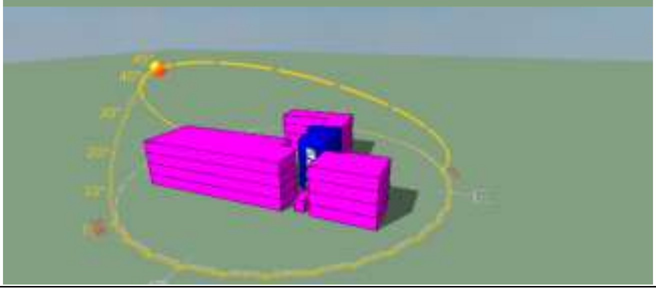
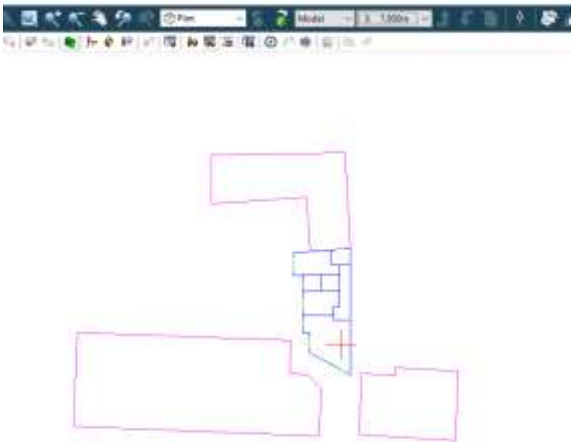
4.2 In line with Stage 1 of the 'cooling hierarchy', the results of Criterion 3 of Part L 1A of the Building Regulations can be seen in Appendix 1. The results indicate that current proposals excluding active cooling do not meet overheating requirements.

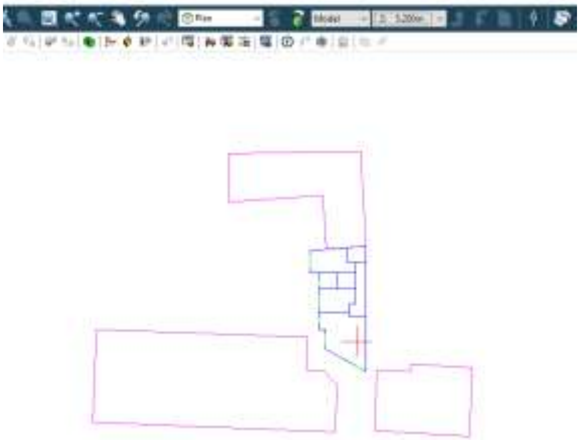
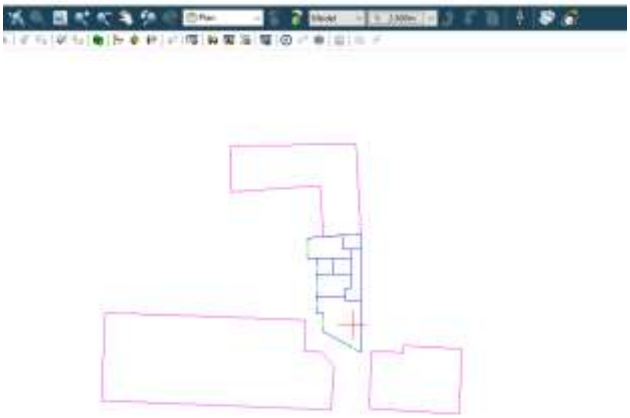
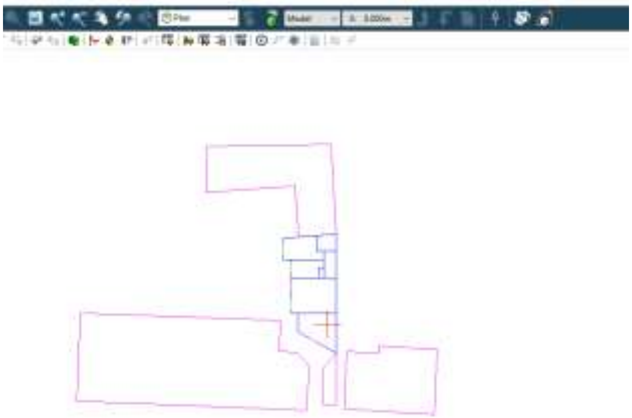
4.3 Section 1 and Section 2 of the "Domestic Overheating Checklist" can be seen in Appendix 2.

4.4 At this stage of the 'cooling hierarchy', there is limited ventilation for the proposed dwellings, therefore dynamic overheating modelling will be undertaken in line with *CIBSE TM59 Design methodology for the assessment of overheating risk in homes*. The following inputs have been incorporated into the modelling software at Stage 1 to demonstrate an energy efficient design. As a result, a 17% improvement over Building Regulations is achieved; the software used for the simulation is IES VE Version 2019.1.0.0, which is in line with CIBSE TM49:

Table 1.0: Cooling Hierarchy Stage 1 Dynamic Overheating Modelling Inputs

Site location	London
Site orientation	North
Weather file used	LondonDSY
Internal gains	Lighting – 12W/m2 People – Sensible Gain 70W/person; Latent Gain 45W/person Computers – 6W/m2
Occupancy profiles	System Occupied Hours – 8am – 6pm Modulation 1.0
Thermal elements performance (U-values and glazing g-values)	Ground Floor 0.16 Internal Floor / Ceiling 1.0 External Wall 0.27 External Door 1.40 Internal Partition 1.8 Glazing 1.30 / G-value 0.75 Roof 0.16
Shading features (i.e. blinds, overhangs etc.)	None
Thermal mass details, (CM)	Ground Floor 58

	Internal Floor / Ceiling 95 External Wall 95.70 External Door 14 Internal Partition 11 Roof 20
Ventilation strategy	Openable windows 2 ACH
Model images indicating the sample units modelled	  
Units' internal layout 03 02	

01	
00	
	

4.5 Appendix 3 illustrates the Stage 1 results of the dynamic overheating modelling. The results indicate that the dwellings do not comply with CIBSE TM59.

4.6 Following the 'cooling hierarchy', Stage 2 was then explored to determine if overheating criteria could be achieved. Within Stage 2 of the dynamic overheating modelling, window orientation was limited from South and East elevations to avoid summer overheating; the existing streetscape was explored to enhance local shading from existing buildings and the glazing g-values were reduced to 0.30. The results illustrate the overheating criteria is still not achieved and can be seen in Appendix 4.

4.7 Within Stage 3 of hierarchy, thermal mass was increased to regulate heat transfer between internal walls. A higher thermal mass will stop temperatures interacting with adjoining areas and reduce the overheating risk. The design team changed the proposed internal walls from timber stud to masonry. Furthermore, ceiling heights were increased by 200mm within the ceiling void to allow for greater ventilation and air flow movement. The below table illustrates Stage 3 dynamic overheating modelling inputs:

Table 2.0: Cooling Hierarchy Stage 3 Dynamic Overheating Modelling Inputs

Site location	London
Site orientation	North
Weather file used	LondonDSY
Internal gains	Lighting – 12W/m2 People – Sensible Gain 70W/person; Latent Gain 45W/person Computers – 6W/m2
Occupancy profiles	System Occupied Hours – 8am – 6pm Modulation 1.0
Thermal elements performance (U-values and glazing g-values)	Ground Floor 0.16 Internal Floor / Ceiling 1.0 External Wall 0.27 External Door 1.40 Internal Partition 1.8 Glazing 1.30 / G-value 0.30 Roof 0.16
Shading features (i.e. blinds, overhangs etc.)	None
Thermal mass details, (CM)	Ground Floor 58 Internal Floor / Ceiling 95 External Wall 95.70 External Door 14 *Internal Partition 120* Roof 20
Ventilation strategy	Openable Windows 2 ACH

4.8 With the increased thermal mass and greater ceiling heights, overheating criteria is still not achieved. The results can be seen in Appendix 5.

4.9 Due to restricted window openings not being able to open fully/continually because of expected noise pollution and security factors, significant passive ventilation is not a viable option at Stage 4 of the hierarchy, therefore no measures are proposed at this stage.

4.10 Working through the hierarchy, the design team explored the options within Stage 5, and mechanical ventilation was introduced. Proposed ventilation was modelled for all occupied rooms throughout the development. Apartment 1 on the lower ground floor currently has a proposed ventilation rate of 29 l/s, and all other upper floors have a proposed ventilation rate of 37 l/s. This is illustrated in Table 3.0 below:

Table 3.0: Cooling Hierarchy Stage 5 Dynamic Overheating Modelling Inputs

Site location	London
Site orientation	North
Weather file used	LondonDSY
Internal gains	Lighting – 12W/m2 People – Sensible Gain 70W/person; Latent Gain 45W/person Computers – 6W/m2
Occupancy profiles	System Occupied Hours – 8am – 6pm Modulation 1.0
Thermal elements performance (U-values and glazing g-values)	Ground Floor 0.16 Internal Floor / Ceiling 1.0 External Wall 0.27 External Door 1.40 Internal Partition 1.8 Glazing 1.30 / G-value 0.30 Roof 0.16
Shading features (i.e. blinds, overhangs etc.)	None
Thermal mass details, (CM)	Ground Floor 58 Internal Floor / Ceiling 95 External Wall 95.70 External Door 14 *Internal Partition 120* Roof 20
Ventilation strategy	Mechanical Ventilation Lower Ground Extract Fans 29 l/s Upper Floors Extract Fans 37 l/s

4.11 The results illustrated in Appendix 6 demonstrate that while working through the‘ cooling hierarchy’, internal temperatures have significantly reduced, however, are still not in line with CIBSE TM59.

4.12 Therefore, through an iterative design process, active cooling was introduced in Stage 6 of the hierarchy. Active cooling in the form of air source heat pumps was specified, which are located at ceiling height to minimise ground level ductwork

4.13 The results of Stage 6 of the ‘cooling hierarchy’ demonstrate that as a result of introducing active cooling into the design of the project, overheating criteria is now achieved in line with CIBSE TM59, and can be seen in Appendix 7.

5.0 CONCLUSION

5.1 In conclusion, by following the 'cooling hierarchy' as outlined in Table 11 of the GLA Overheating Requirements, and through detailed design guidance and consultation, overheating criteria as outlined within *CIBSE TM59 Design methodology for the assessment of overheating risk in homes* is achieved.

5.2 All aspects of the cooling hierarchy have been explored as demonstrated through this report. The only way to achieve overheating criteria is to propose active cooling in the form of air source heat pumps to the dwellings.

5.3 Further consultation with ALO and acoustician could be made to ascertain exact requirements for window openings which could allow for increased passive ventilation. However, when reviewing the results, due to the location and site constraints, it is unlikely that overheating criteria will solely be achieved without the use of active cooling.