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71B Flask Walk– Overheating Design Note

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Executive Summary

This document has been prepared to summarize the design parameters used the Thermal Modelling to assess overheating and considers only the residential living areas of 71B Flask Walk development and to justify the provision of a comfort cooling system.

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 compliance requirements.

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1. Introduction

This document has been prepared by Meca Engineering to summarise the design parameters used in the IES thermal modelling.

1.1 Description of the development

The development is located in London, in Hampstead and is a listed and recently refurbished residential building.

Heating is being produced by a new gas boiler which serves:
- underfloor heating at basement level, bathroom, dining room and kitchen
- radiators in all other rooms

The production of the domestic hot water is being made by a new hot water cylinder.

Intermittent extract fan for toilets.

Proposed Mechanical services are summarised in **Appendix A.**

2. Design parameters

- Design Drawings

The thermal model for the building was constructed according to the architect's drawings.

- Building Fabric Details

The façade contractor and / or Architect should confirm that the fabric parameters reported can be met (or improved upon), including:

- External walls U-values of 1.65 W/m^2K;
- Floor U-value of 1.1 W/m^2K;
- Roof U-value of 0.17 W/m^2K;
- Windows U-values of 4.30 W/m^2K;
- Air permeability of 10 $m^3/hr/m^2$.

The impact of thermal bridges (beyond those including in the curtain walling calculations) has been averaged.

3. Thermal Comfort

a. CIBSE TM59 Criteria

CIBSE TM59 provides two sets of criteria for the assessment of overheating in homes, which depends on whether occupants can use natural ventilation for the control of overheating. These are as follows:

For spaces for which natural ventilation is precluded - windows closed - scenario 1:

- Daytime: Operative temperatures in occupied spaces should not exceed 26°C for more than 3% of annual occupied hours.
- Night-time: As for naturally ventilated spaces.

For spaces which can be naturally ventilated – windows opened - scenario 2:

- Daytime: Operative temperatures in occupied spaces during the period May to September inclusive should not exceed Tmax (see TM59 for further information) for more than 3% of occupied hours.
- Night-time: Operative temperatures in bedrooms should not exceed 26°C for more than 1% of annual hours (translates to 33 hours total) between the hours of 10pm to 07am.

b. Climate

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 DSY1 2020s High 50 weather file, which is used in the baseline modelling.

c. Building Geometry

The building has been modelled based on architectural layouts received from 4orm on 04/07/2022.

d. 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
Dining/Study/Reception	2	3	150	110	150
Bedrooms	2	2	150	110	80

Notes:

- *Kitchen occupancy dependent on number of bedrooms. Applied at 25% max.*
- *Living occupancy dependent on number of bedrooms. Applied at 75% max.*
- *It has been assumed the corridors will include PIR lighting controls and therefore no associated lighting gains have been modelled, as per CIBSE TM59 guidance. No internal gains have been applied to corridors and these are outside the scope of the assessment.*

e. Ventilation

Mechanical Ventilation rates have been applied as follows:

WCs: 8 l/s

The size of opening in a façade is expressed in terms of its equivalent area. This is a standard definition used within the industry that considers the aerodynamic effects of a window. We are recommending providing a minimum equivalent opening area **greater than 5% of the room's floor area** to prevent excessive overheating.

Results

For the purpose of this analysis, two separate scenarios have been modelled as follows and shown in the table below:

- **Scenario 1**: Windows are assumed to remain closed, with ventilation provided only by the extract fan. Under this scenario, all spaces fail to comply with the criteria outlined in CIBSE TM59.

- **Scenario 2**: Windows were assumed to be openable approximately 100 mm. Under this scenario, all spaces have the results improved, however still fail to comply with the criteria outlined in CIBSE TM59. In this scenario, it has been assumed that when the space temperature reaches 23°C, the sliding sash of the window begins to open, provided the outside temperature is less than internal temperature, and is fully open at 25°C.

Scenario 1

Windows Closed						
	Criterion 1			Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Result
Location	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			
First Floor - Bedroom 1	38.6% *	12.3% *	50.9% *	65	6	Fail
First Floor - Bedroom 2	36.3% *	11.3% *	47.6% *	81	8	Fail

	Criterion 1	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Result
Ground Floor - Dining/Study	50.1% *	95	9	Fail
Ground Floor - Reception	16.8% *	51	6	Fail
Ground Floor - Kitchen	11.8% *	43	7	Fail

Scenario 2

Windows Open						
	Criterion 1			Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Result
Location	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			
First Floor - Bedroom 1	10.1% *	1.3% *	11.4% *	48	5	Fail
First Floor - Bedroom 2	5.6% *	0.5% *	6.1% *	42	5	Fail

	Criterion 1	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Result
Ground Floor - Dining/Study	8.5% *	51	6	Fail
Ground Floor - Reception	3.8% *	31	4	Fail
Ground Floor - Kitchen	3.6% *	31	5	Fail

[*]denotes the duration during which ΔT is greater than or equal to one degree during the period May to September inclusive.

f. Cooling hierarchy

The development is following the cooling hierarchy outlined below, to reduce the risk of overheating and subsequent reliance on active cooling:

1. Minimise internal heat generation through energy efficient design, considering the following:

- Layout and uses: locate any spaces that need to be kept cool or that generate heat on cooler sides of developments.

It is noted that the building is an existing, listed residential house.

- Reducing heat gains e.g. including low energy lighting.

Low energy lighting has been included in our simulation.

- Seal/ insulate heat generating processes.

The only 'heat generating' processes are the use of electronic devices and other domestic appliances which isn't significant.

- Reduce the distance heat needs to travel and insulate pipework.

All existing installed pipework is provided with thermal insulation.

- Design layouts to promote natural ventilation e.g. shallow floorplans and high floor to ceiling heights.

It is noted that the building is an existing, listed residential house, therefore the layout modifications cannot be achieved.

- Consider evaporation cooling which cools air through the evaporation of water.

It is noted that the building is an existing, listed residential house. Furthermore, evaporative cooling has limited temperature control.

- Consider 'free cooling' or 'night cooling', which uses the cooling capacity of ambient air to directly cool the space.

Night cooling was included in our simulation, however with no satisfactory results. Furthermore, in real life, the temperature during the daytime is considerably high which makes working from home extremely uncomfortable.

2. Reduce the amount of heat entering a building in summer:

- Consider the angle of the sun and optimum daylight and solar gain balance.

It is noted that the building is an existing, listed residential house, therefore there aren't any modifications in the window arrangement.

- Orientate and recess windows and openings to avoid excessive solar gain.

It is noted that the building is a listed edifice, therefore there aren't any modifications in the window arrangement.

- Consider low g-values and the proportion, size and location of windows.

It is noted that the building is an existing, listed residential house, therefore there aren't any modifications in the window arrangement.

- Make use of shadowing from other buildings.

This has been accounted for in the simulations carried out.

- Include adequate insulation.

It is noted that the building is an existing, listed residential house, therefore there can't be made any modifications to the fabric of the building.

- Design in shading: e.g. include internal courtyards, large shade-providing trees and vegetation, balconies, louvers, internal or external blinds, and shutters.

It is noted that the building is an existing, listed residential house, therefore no modifications have been considered to the external envelope for the simulation.

- Make use of the albedo effect (use light coloured or reflective materials to reflect the sun's rays).

It is noted that the building is an existing, listed residential house, no modifications have been considered to the external envelope for the simulation.

- Include green infrastructure e.g. green wall, green/blue roofs and landscaping, to regulate temperatures.

It is noted that the building is an existing, listed residential house, therefore there aren't any modifications in the external cladding of the building.

- Reduce the amount of heat entering a building in summer.

It is noted that the building is an existing, listed residential house.

3. Manage the heat within the building through exposed internal thermal mass and high ceilings, (see 'Thermal performance' Chapter 3 of this CPG).

It is noted that the building is an existing, listed residential house, therefore there can't be made any modifications to the structure of the building.

4. Passive ventilation:

- Natural ventilation, openable windows, the 'stack effect' system (see Chapter 3 of this guidance).

This has been taken into consideration when modelling Scenario 2.

- Design layouts to promote natural ventilation e.g. shallow floor plans and high floor to ceiling heights.

It is noted that the building is an existing, listed residential house, therefore no layout modifications can be made.

- Consider evaporation cooling which cools air through the evaporation of water.

As above, not applicable.

- Consider 'free cooling' or 'night cooling' which uses the cooling capacity of ambient air to directly cool the space

As above, night cooling has been considered.

5. Mechanical ventilation:
- Ensuring the most efficient system possible.
- Consider mechanical ventilation with heat recovery

It is noted that the building is an existing, listed residential house, with very limited ceiling voids. As such installing an heat recovery ventilation system isn't achievable.

6. Active cooling:
- Ensuring they are the lowest carbon options.
- Ground Source Heat Pumps and Air Source Heat Pumps can be used in reverse to provide cooling to buildings.
- Water based cooling systems also reduce the need for air conditioning by running cold water through pipes in the floor and/or ceiling to cool the air.

The building isn't equipped with any of the above, as such a new refrigerant based cooling system that uses inverter technology is proposed. The inverter technology reduces consumption by 30% by adjusting the motor speed to maintain a steady pace.

g. Recommendation

Due to the fact that the building is listed and limited, or no alterations can be done to the external façade or building fabric (such as shutters in front of windows or replacing existing windows with double glazed windows), the overheating measures are limited to the provision of a comfort cooling system.

The reliance on openable windows for the purposes of preventing overheating may not be desirable due to elevated noise levels present on the site. Whilst historically, acoustic considerations were not generally applied to opening windows for the purposes of overheating, more recent guidance from the ANC (Association of Noise Consultants) has sought to address this by stating that [where a] scheme is reliant on open windows to mitigate overheating, it is also necessary to consider the potential noise impact during the overheating condition. (Refer to ANC Residential Design Guide for further details).

In conclusion, we advise that to mitigate overheating a comfort cooling system should be installed.

Please consider that current analysis was made with existing information and assumptions.

APPENDIX A – Mechanical Services

Mechanical Services

Heating is being produced by a new gas boiler which serves:

- underfloor heating at basement level, bathroom, dining room and kitchen
- radiators in all other rooms

The production of the domestic hot water is being made by a new hot water cylinder.

Intermittent extract fan for toilets.

The proposed cooling equipment will be manufactured by Daikin and comprise of the following:

- Multi - split residential outdoor AC unit installed on external flat roof above stairs
- Outdoor unit c/w inverter technology that reduces the energy consumption by 30% compared to a traditional on / off system
- Outdoor unit has a 6.8 kW cooling capacity
- Indoor units to basement room, reception and offices space to provide cooling
- Indoor units cooling capacities as follows: 2.5 kW basement room; 5 kW reception

APPENDIX B – Building Geometry