RIBA Stage 2
Overheating Analysis
Chalcot House

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Contents:

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Overview

This report has assessed the proposed scheme in accordance with CIBSE Guide A and CIBSE TM59 requirements relating to overheating. Results are provided which show how the occupied spaces perform against the thermal comfort standards for overheating

The scheme has implemented passive design measures and the modelling results indicate that the scheme is compliant with the overheating requirements.

The proposal maximises passive design measures by responding to the local context in the following ways:

- Energy efficient lighting and appliances have been recommended to reduce internal heat gains;
- The building fabric will be insulated over and above the standards set out by Building Regulations and reduced solar gains from a glazing solar factor of 0.5 will help to keep heat out of the building;
- Internal shading devices to further limit solar gains;
- Mechanical ventilation with heat recovery and summer bypass to provide fresh air and purging of heat;
- Natural ventilation to supply fresh air to the building through openable windows

Note that the analysis was performed assuming that opening windows were controlled based on the level of occupancy and the operative indoor temperature of the space. To achieve the thermal comfort levels shown in this report the level of occupant control for the opening windows would need to be optimum i.e. fully responsive to indoor temperature.

Introduction
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Introduction

Eight Associates has been appointed in order to undertake an overheating analysis of Chalcot House to provide design stage guidance and maximise occupant comfort levels. Consequently, thermal modelling has been undertaken to demonstrate compliance with CIBSE TM59 requirements. The current proposal is to minimise overheating risk by following the Cooling Hierarchy.

Building Summary

The project consists of the development of a 2-storey building in London. The scheme is located in the London Borough of Camden and has a total gross internal area of approximately 535 m^2.

Planning Context

Camden Local Plan requires all new developments to complete dynamic thermal modelling to demonstrate that any risk of overheating has been mitigated by following the cooling hierarchy. This report is also aligned with national standards and regulations.

Methodology

The methodology used within this report has been to establish the thermal comfort levels in the occupied spaces through using dynamic simulation modelling and respond with suitable passive design measures to mitigate solar gains, provide adequate ventilation and increase thermal mass. National regulations have set high standards and numerous iterations have been undertaken to determine suitable fabric improvements. All assumptions in the modelling are provided in the model inputs section of this report.

Please note that the climate change scenario has been excluded from this report. External temperatures are likely to increase because of climate change. The consequences of increased summer peak temperatures could be non-compliance with the thermal comfort recommendations unless further measures were implemented.

Criteria for defining overheating

According to the CIBSE TM59: 2017 – Design methodology for the assessment of overheating risk in homes, to reduce the risk of overheating the space has to comply with the following criteria:

1. For living rooms, kitchen 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 (Same as Criterion 1 of TM52).
2. 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 the annual hours (1% of the annual hours between 22:00 and 07:00, equivalent to 32 hours).

Modelling Inputs
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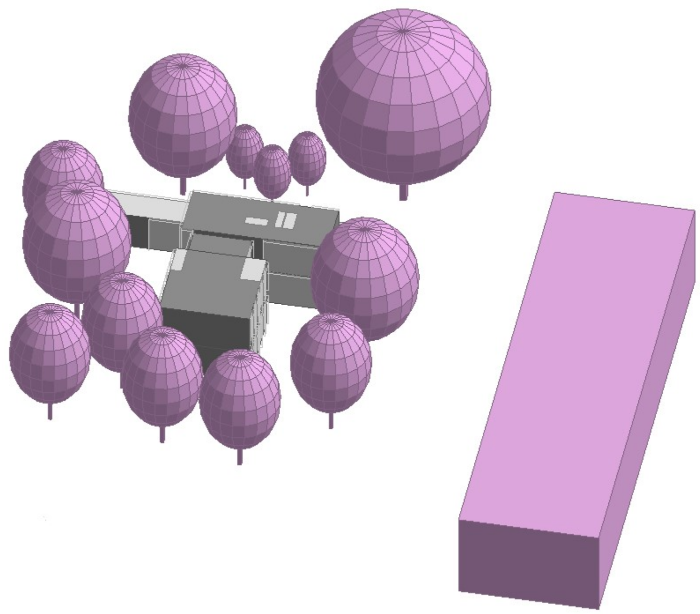
Simulation Software

An overheating analysis has been undertaken using Dynamic Simulation Modelling, Design Builder has been employed for this. Design Builder is a DCLG approved simulation environment that complies with the requirements of CIBSE Guide A. A screenshot of the model is shown below.



Weather File

The CIBSE Design Summer Year (DSY1), London Heathrow, for the 2020s, high emissions, 50% percentile scenario, has been used for the purposes of this report. DSY2 and DSY3 have also been investigated.

The three DSYs represent summers with different types of hot events.

- DSY1 – Moderately warm summer
- DSY2 – Short intense warm spell
- DSY3 – Long, less intense warm spell

Building Fabric U-Values

Element	Proposed U-value W/m^{2}K
Flat roof	0.10
Pitched roof	0.10
Wall	0.12
Ground floor	0.10
Swimming pool basin	0.10
Windows	0.90 (g-value 0.50)
Rooflights	1.00 (g-value 0.55)
Doors	1.20

Internal Gains

Standard profiles for occupancy, equipment and lighting were adopted as suggested by TM59 and can be found in Appendix B.

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Cooling Hierarchy

Major development proposals should reduce potential overheating and reliance on air conditioning systems and demonstrate this in accordance with the following cooling hierarchy:

1. Minimise internal heat generation through energy efficient design;
2. Reduce the amount of heat entering a building in summer through shading, albedo, fenestration, insulation and green roofs and walls;
3. Manage the heat within the building through exposed internal thermal mass and high ceilings;
4. Passive ventilation;
5. Mechanical ventilation;
6. Active cooling systems (ensuring they are the lowest carbon options).

Cooling Strategy

The cooling strategy is to implement energy efficient lighting and appliances to reduce internal heat gains; create a super-insulated fabric with shading devices and solar control glazing to keep the heat out.

Windows

Glazing will be a crucial aspect to ensure thermal comfort of the occupied spaces. In order to minimise solar gains, a solar factor of 0.5 has been used in the model for windows and 0.55 for rooflights.

Shading

Internal blinds with medium reflective slats have been modelled to reduce solar gains and it has been assumed they do not interfere with the opening of windows. Blinds will operate with inside air temperature controls, and they will be activated when the inside temperature exceeds the threshold temperature of 18°C.

Thermal Mass

The development consists of concrete slabs and steel frame walls. The concrete slab will provide a medium thermal mass. Thermal mass will absorb heat energy during the day and release it at night, keeping spaces at a steadier temperature.

Mechanical Ventilation Rates

Mechanical ventilation with heat recovery has been specified. The system has to provide at least an air flow of 10l/s/person and 0.3 l/s/m^2 as per Part F.

Natural Ventilation Rates

Maximising the openable area of windows is a key feature when reducing overheating risk, permitting occupant to ventilate their homes during periods of high temperature. Natural ventilation through openable windows has been adopted for this scheme. The openable area of windows and patio doors were taken from elevation drawings. More in general, the following has been integrated into the model:

- Full height doors to main house (front ground & front & rear 1st floor) to be single pivot door opening inwards.
- All other glazing areas to be sliding panels with 50% opening.

In accordance with TM59 all windows are assumed to be fully opened when all the following conditions are satisfied:

1. Internal temperatures exceed 22 °C;
2. During occupied periods

The ventilation rate has been calculated by the software according to the percentage of openable windows for each space and the varying environmental conditions throughout the year. Moreover, the scheme has been modelled with a discharge coefficient rate of 0.65 and a wind factor of 1. Air infiltration through cracks in the building structure was simulated and included in the natural ventilation rate.

Summary of Results

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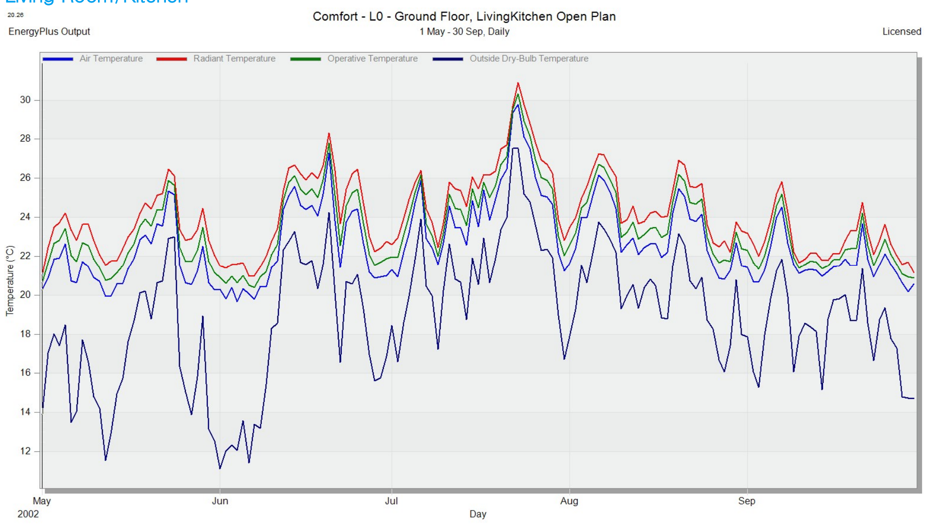
Results

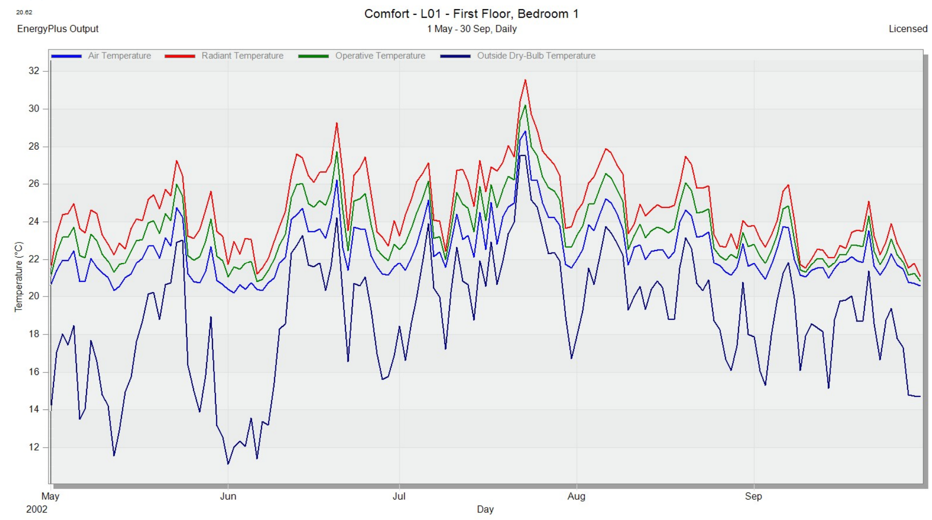
The graphs below present the outdoor, indoor mean air, indoor mean radiant and operative temperature for a sample of the worst performing rooms. A table confirming the results for all rooms is shown in Appendix A.

In summary, all rooms meet TM59 requirements.

Living Room/Kitchen



Bedroom 1



Conclusions
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Conclusions

The proposal has responded to CIBSE TM59 requirements relating to overheating. The report has set out how the occupied spaces perform against strict thermal comfort standards for overheating. The scheme has implemented passive design measures and the modelling results indicate that the scheme is compliant with the overheating requirements as set out in CIBSE TM59.

The proposal maximises passive design measures by responding to the local context in the following ways:

- Energy efficient lighting and appliances have been recommended to reduce internal heat gains;
- The building fabric will be insulated over and above the standards set out by Building Regulations and reduced solar gains from a glazing solar factor of 0.45 will help to keep heat out of the building;
- Internal shading devices to limit solar gains;
- Mechanical ventilation with heat recovery and summer bypass to provide fresh air and purging of heat;
- Natural ventilation to supply fresh air to the building through openable windows.

The overheating risk has also been investigated for DSY2 and DSY3. DSY2 includes a short and intense warm spell. DSY3 includes a long and less intense warm spell.

All rooms fail the TM59 requirements because of the intensity of the DSY2 and DSY3 weather file. It must be considered that it is very difficult to be able to address these variables in the future without substantially changing the design or retrofitting active cooling which is not considered viable.

Occupants would need to activate internal shading devices and open windows at a lower temperature set point than assumed for this study. Moreover, night ventilation for living rooms/kitchen could improve the overheating results. Plug-in fans could be used as an additional measure during heatwaves.

Note that the analysis was performed assuming that opening windows were controlled based on the level of occupancy and the operative indoor temperature of the space. To achieve the thermal comfort levels shown in this report the level of occupant control for the opening windows would need to be optimum i.e. fully responsive to indoor temperature.

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Appendix A

Appendix A – Result table

Block / Floor / Room / Unit	DSY1			DSY2			DSY3		
	Criterion 1 (%)	Criterion 2 (K.hr)	Compliance	Criterion 1 (%)	Criterion 2 (K.hr)	Compliance	Criterion 1 (%)	Criterion 2 (K.hr)	Compliance
L0 Ground Floor LivingKitchen	1.7	N/A	Pass	3.6	N/A	Fail	6.2	N/A	Fail
Bedroom 1	3.0	30	Pass	3.8	58	Fail	5.2	67	Fail
Bedroom 2	0.8	24	Pass	1.7	50	Fail	2.8	59	Fail
Bedroom 3	0.8	26	Pass	1.8	48	Fail	2.7	59	Fail
Bedroom 4	2.7	17	Pass	3.8	41	Fail	4.7	47	Fail
Total Rooms	5			5			5		
Pass	5			0			0		
Fail	0			5			5		

Appendix B
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Appendix B

Appendix B – Heat gain profile

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	0	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	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	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	0	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	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	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	0	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	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	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	1	1	0.44	0.44	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	1	1	0.44	0.44	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	1	1	1	1	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	1	1	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