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Planning Statement
KOKO - Rooftop
Overheating Analysis

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Overheating Analysis
KOKO - Rooftop
Introduction

Introduction

Eight Associates has been appointed to undertake an overheating analysis of the rooftop of KOKO in order to provide design stage guidance and maximise occupant comfort levels. The rooftop comprises the existing Cupola and a roof conservatory. Thermal modelling has been undertaken to demonstrate compliance with CIBSE TM52 requirements. The current proposal is to minimise overheating risk by following the Cooling Hierarchy.

Building Summary

The scheme is located in the London Borough of Camden. The project comprises the demolition of 65 Bayham Place, 1 Bayham Street and new build development of a 32-bedroom hotel extension to the rear with additional basement areas. The proposed scope of works includes the refurbishment of the cupola and the extension of the roof to create a roof conservatory.

Planning Context

The Camden Local Plan does not set out any specific requirement for avoiding overheating. This report is aligned with national standards and regulations. 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).

Methodology

The methodology used within this report has been to establish the thermal comfort levels in the occupied spaces through the use of 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.

Criteria for defining overheating

According to the CIBSE TM 52 – The limits of thermal comfort: avoiding overheating in European buildings (2013) and CIBSE Guide A – Environmental Design (2015), to reduce the risk of overheating the space has to comply with at least two of the following three criteria:

a) The first criterion sets a limit for the number of hours that the operative temperature can exceed the threshold comfort temperature (upper limit of the range of comfort temperature) by 1 K or more during the occupied hours of a typical non-heating season (1 May to 30 September).
b) The second criterion deals with the severity of overheating within any one day, which can be as important as its frequency, the level of which is a function of both temperature rise and its duration. This criterion sets a daily limit for acceptability.
c) The third criterion sets an absolute maximum daily temperature for a room, beyond which the level of overheating is unacceptable.

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Overheating Analysis
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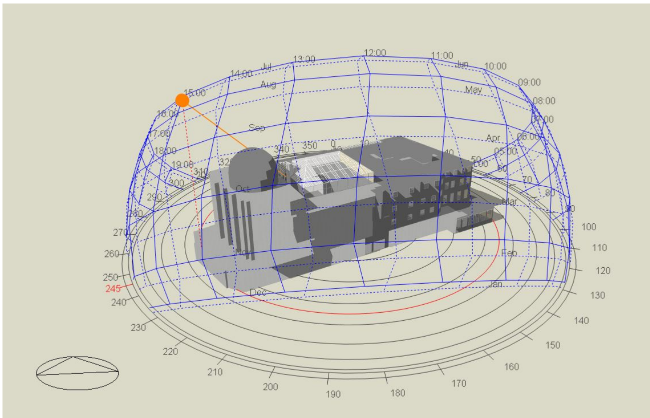
Model Inputs

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 (DSY) Current Series, London Heathrow, has been used for the purposes of this report.

Building Fabric U-Values

Element	Proposed U-value (W/m^{2}K)
External walls – Dome	3.40
External walls – Conservatory	0.17
Roof – Dome	3.80
Roof – Conservatory	0.12
Openings	1.70

Internal Gains

Typical hours based on the relative activity for class use, on weekdays and weekends throughout the year have been specified for lighting, equipment and occupancy.

Space	Occupancy people/m^2	Lighting W/m^2 per 100 lux	Small power W/m^2
Dome and conservatory	0.105	2.5	4.72
WC	0.118	2.5	-
Circulation areas	0.115	2.5	-
Storage	0.110	2.5	-

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Overheating Analysis
KOKO - Rooftop
Results – Initial Case

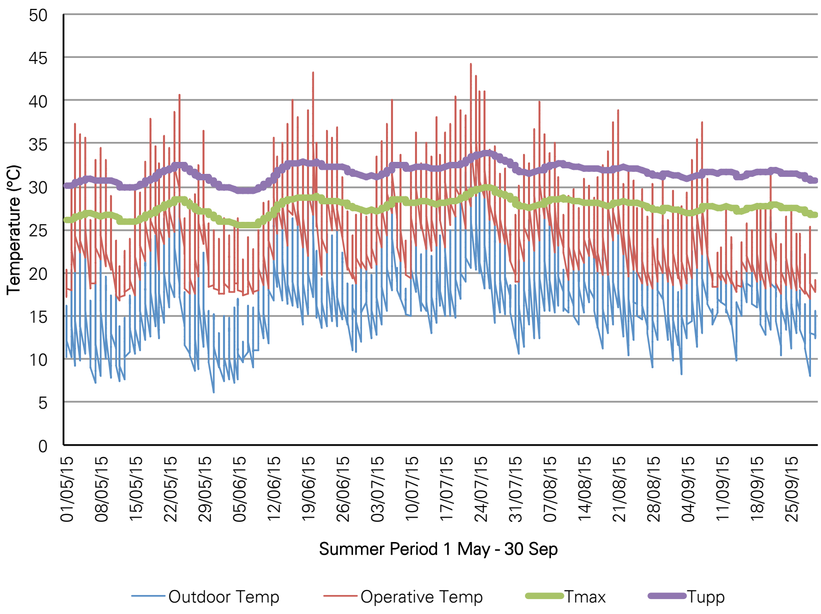
Overview of Results

The graphs below show the outdoor and indoor temperature of the cupola-dome and the roof conservatory. The graphs also show the T_{max}, which is the upper range of thermal comfort, and T_{upp}, which is the absolute upper limit of thermal comfort.

In order to comply with the overheating criteria the building must comply with two of the following three criteria.

- Criterion 1 - The percentage of hours with temperature more than the T_{max} should be less than 3%.
- Criterion 2 - The weighted exceedance shall be less than or equal to 6 in any one day
- Criterion 3 - No occupied hour of the building shall exceed the absolute upper limit temperature. ($T_{upp} = T_{max} + 4K$)

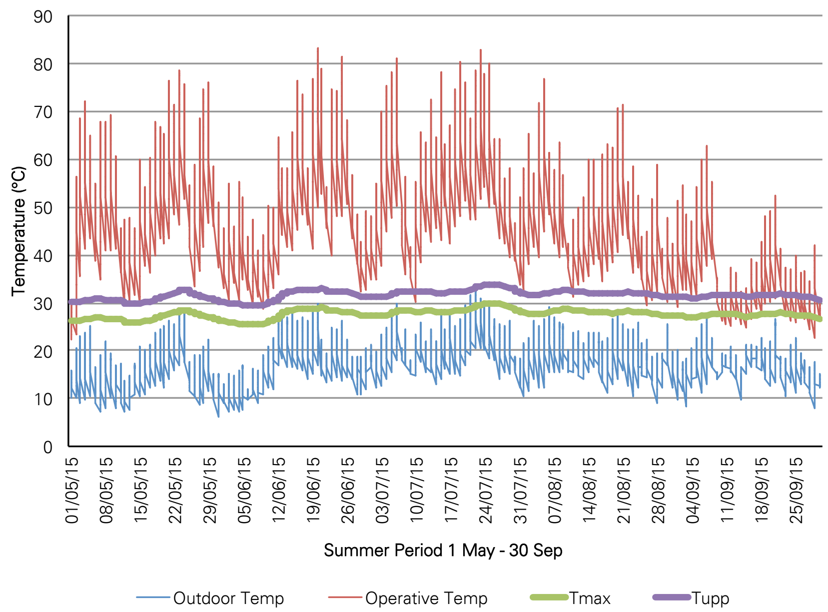
Cupola-Dome Initial Case



Room	Criterion 1	Criterion 2	Criterion 3	Compliance
Cupola-Dome	41.9%	164.21	548	FAIL

Overheating Analysis
KOKO - Rooftop
Results – Initial Case

Roof Conservatory
Initial Case



Room	Criterion 1	Criterion 2	Criterion 3	Compliance
Roof Conservatory	98.7%	730.90	2444	FAIL

Summary – Initial Case

As it is shown above, the cupola-dome and the roof conservatory cannot meet the TM 52 requirements. Therefore a numerous passive design measures will be implemented as described ion the following pages, in order to reduce the cooling demand.

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Overheating Analysis
KOKO - Rooftop
Passive Design Measures

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, and consequently cooling demand, windows with a solar factor of 0.28 have been modelled for every glazed area.
Shading	Internal shading roll or blinds with high reflective slats have been modelled to reduce solar gains. The shading device should have a reflectance of 0.5 and a solar transmittance of 0.05. This system will operate using inside air temperature controls, shading will be activated when the inside temperature exceeds the threshold temperature of 22°C.
Thermal Mass	The development consists of a lightweight metal structure; therefore, there will be no exposed concrete to provide thermal mass.
Mechanical Ventilation Rates	Mechanical ventilation has been specified. The system has to provide an air change rate of 3 AC/H throughout the occupied spaces.
Natural Ventilation Rates	Natural ventilation through openable windows has been adopted for this scheme. The ventilation rate has been calculated by the software according to the openable windows and skylights (4 façade glass doors and 8 roof lights), the percentage of opening of each window and the varying environmental conditions throughout the year. This percentage has been estimated as follows: • Façade: 100% • Roof lights: 30% Moreover, the scheme has been modelled with a discharge coefficient rate of 0.65 and a wind factor of 1. The windows were open when the internal temperature went above 22°C and when the rooms were occupied.

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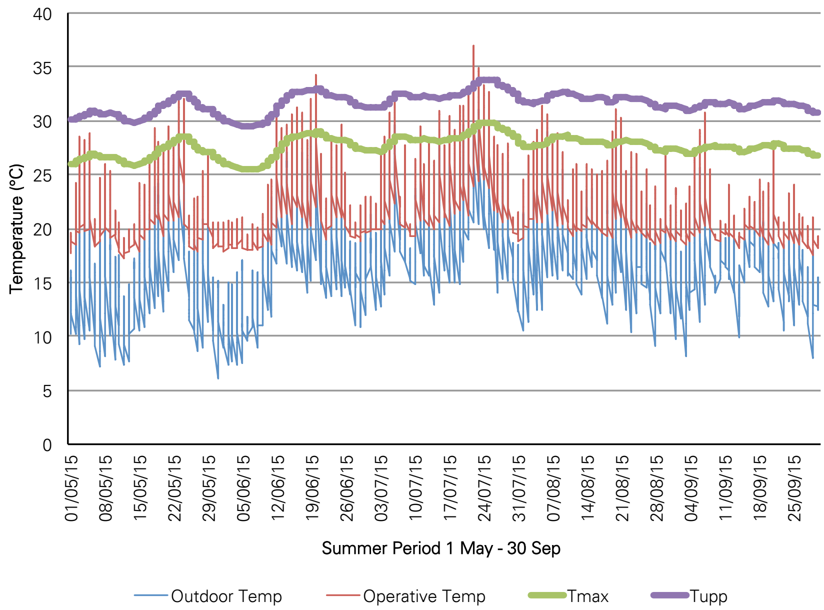
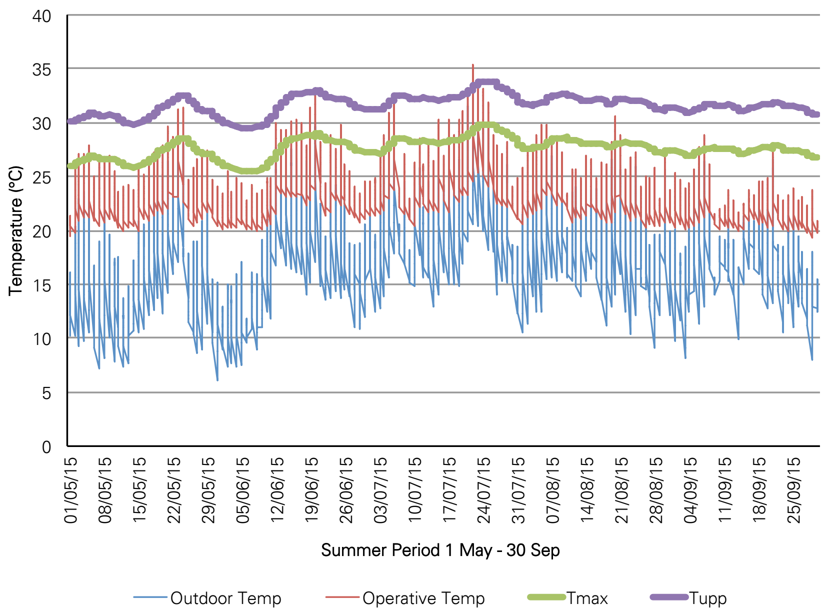
Overheating Analysis
KOKO - Rooftop
Results – Passive Design Measures

Cupola-Dome Passive Design Measures



Room	Criterion 1	Criterion 2	Criterion 3	Compliance
Cupola-Dome	12.0%	69.01	25	FAIL

Roof Conservatory Passive Design Measures



Room	Criterion 1	Criterion 2	Criterion 3	Compliance
Roof Conservatory	11.1%	53.18	15	FAIL

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Overheating Analysis
KOKO - Rooftop
Results – Passive Design Measures

Explanation of Results

The development, in the absence of active cooling, cannot meet the overheating requirements in the Cupola-Dome and Roof Conservatory. This is mainly because of the excessive solar heat gains.

Criterion 1 shows that cupola-dome and roof conservatory will experience temperatures above the thermal comfort T_{max} for more than 3% of the total summer occupied hours. This value is outside of the acceptable range.

Criterion 2 shows that the maximum weighted exceedance is up to 69.01 within one day (this value is a function of temperature rise and its duration). According to CIBSE Guide A and TM 52, no one day should have a weighted exceedance more than 6.

Criterion 3 shows than there are up to 25 hours above the absolute maximum daily temperature.

Please note that according to CIBSE TM52, the space has to comply with at least two of the three criteria.

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Overheating Analysis
KOKO - Rooftop
Active Cooling System

Active Cooling System

The results above confirm that the passive design measures are not adequate to provide the required thermal comfort range in all the habitable rooms. Therefore, an active cooling system is crucial in order to retain the thermal comfort in the occupied spaces.

The proposed development has been simulated with an active cooling system with an Energy Efficiency Ration (EER) of 3.5.

A mixed mode strategy has been implemented. The development has been modelled with natural ventilation and an active cooling system. The windows were open when the internal temperature was higher than 22 °C and the cooling system was activated when the internal temperature was higher than 22 °C.

The following cooling capacities have been simulated:

- Cupola-Dome – 5kW
- Roof conservatory – 20kW

These capacities are indicative and must be subject to a detailed analysis by the building services engineer/installer. The heating and cooling capacities for each unit have been modelled as indicated above.

Please note than in order to prevent high temperatures early in the morning, a pre-cooling strategy should be implemented. Therefore, the cooling will be activated from 05:00 to 24:00.

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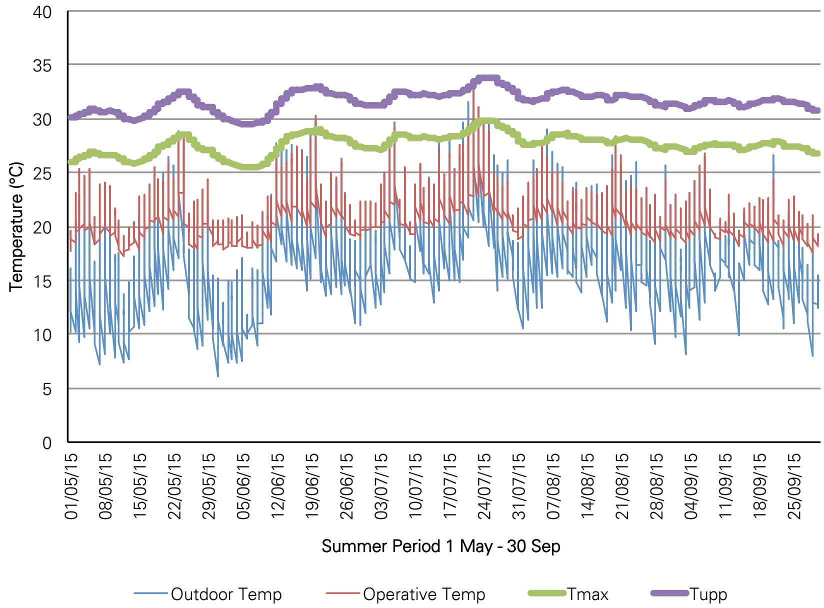
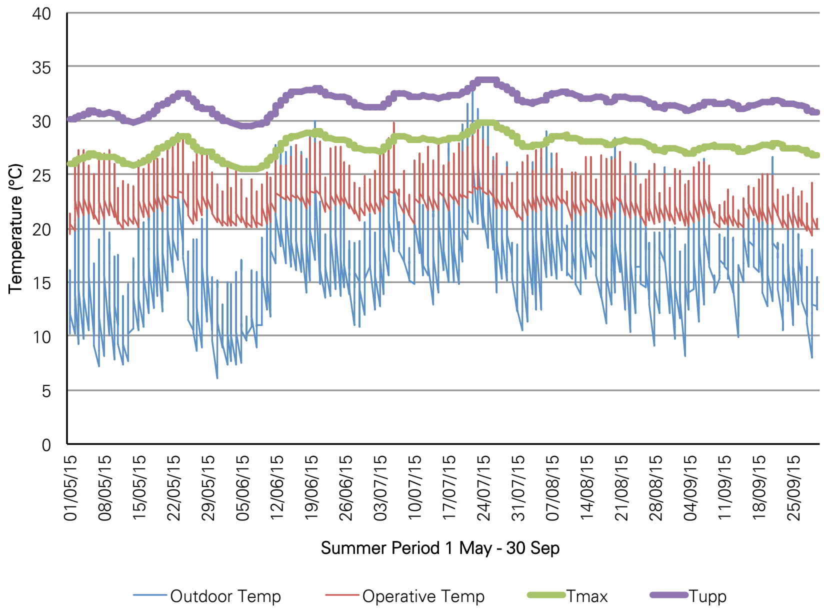
Overheating Analysis
KOKO - Rooftop
Results – Active Cooling System

Cupola-Dome
Mixed mode



Room	Criterion 1	Criterion 2	Criterion 3	Compliance
Cupola-Dome	1.3%	24.61	0	PASS

Roof Conservatory
Active Cooling System Only



Room	Criterion 1	Criterion 2	Criterion 3	Compliance
Roof Conservatory	1.8%	5.55	0	PASS

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Overheating Analysis KOKO - Rooftop Results – Active Cooling System

Explanation of Results Active Cooling System

The development meets the overheating requirements in cupola-dome and roof conservatory with a mixed mode strategy.

Criterion 1 shows that all spaces will not experience temperatures above the thermal comfort T_{max}. According to CIBSE TM 52, no space should experience temperatures above the thermal comfort T_{max} for more than 3% of the total summer occupied hours.

Criterion 2 shows that the maximum weighted exceedance is up to 24.61 within one day (this value is a function of temperature rise and its duration). According to CIBSE Guide A and TM 52, no one day should have a weighted exceedance more than 6.

Criterion 3 shows than there are no hours above the absolute maximum daily temperature.

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Overheating Analysis
KOKO - Rooftop
Conclusions

Conclusions

The analysis has responded to CIBSE TM52 requirements relating to overheating. The report has set out how the cupola-dome and roof conservatory perform against strict thermal comfort standards for overheating. The scheme has implemented passive design measures and the modelling results indicate that the two analysed spaces are compliant with the overheating requirements only when active cooling supplements natural ventilation.

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

- Energy efficiency lighting and appliances have been recommended to reduce internal heat gains;
- The roof conservatory building fabric elements will be well insulated over the standards set out by Building Regulations;
- Reduced solar gains with a solar factor of 0.28 for the windows will help to keep the heat out of the building;
- Internal shading device for the façade and roof lights will help to minimise the heat that is penetrating the building;
- Mechanical ventilation to provide fresh air and purge the heat out;
- Natural ventilation supplies fresh air to the building through openable windows (as per ventilation rates section on Page 5 within this report) to reduce the need for air conditioning.

Note that the analysis was performed assuming that opening windows and shading devices 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.

It is also necessary to note that external temperatures are likely to increase because of climate change. The consequences of increased summer peak temperatures would be non-compliance with the thermal comfort recommendations unless active cooling measures are implemented.