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Planning Statement
Overheating Analysis
Norcutt Road

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Introduction
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Introduction

Eight Associates has been appointed in order to undertake an overheating analysis of the Norcutt Road scheme in order to provide design stage guidance and maximise occupant comfort level. Consequently, 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 comprises student accommodation of 50 bedrooms arranged in clusters. The building is 5 storeys high, and has a total Gross Internal Area of 1,330 m^2.

Planning Context

The scheme is located in Twickenham, part of the London Borough of Richmond upon Thames, which does not set out any specific requirement for avoiding overheating. This report is aligned with national standards and regulations such as CIBSE, British Standards and the GLA's London Plan.

Methodology

The methodology used within this report is 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.

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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Model Inputs
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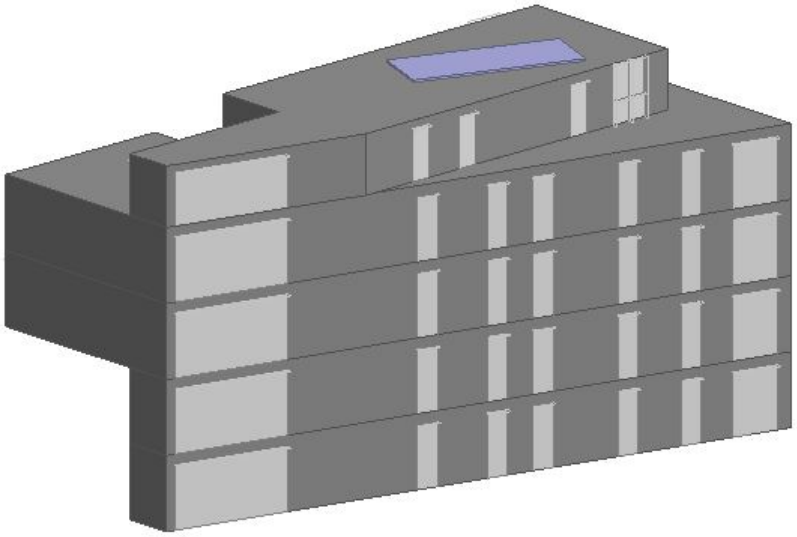
Simulation Software

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 (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	0.26
Ground floors	0.15
Exposed floors	0.15
Flat Roof	0.13
Openings	1.20

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	Small power W/m^2
Bedrooms	0.0963	6.0	4.32
Common Rooms	0.1142	6.0	5.27

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Passive Design Measures

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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, thus eliminating the need for cooling.

Windows

Glazing will be a crucial aspect in ensuring thermal comfort of the occupied spaces. In order to minimise solar gains, and consequently cooling demand, windows with a solar factor of 0.45 have been modelled for all glazed areas, with the exception of the student common rooms on the first to fourth floors, where a solar factor of 0.25 was necessary to limit solar gains in these spaces.

Shading

Internal blinds with high reflective slats have been modelled to reduce solar gains. This system will operate using inside air temperature controls, shading will be activated when the inside temperature exceeds the summer threshold temperature of 18°C.

Thermal Mass

The development consists primarily of a lightweight metal structure; therefore, there will be limited amounts of structural concrete to provide thermal mass. Consequently the building has been modelled as a 'lightweight' building.

The proposed internal wall build-ups are to be detailed at a later design stage, it is recommended that dense materials such as blockwork are considered as they will absorb heat energy during the day and release it at night, keeping spaces at a steadier temperature.

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Passive Design Measures
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Mechanical Ventilation Rates	Mechanical ventilation with heat recovery has been specified. The system has to provide an air change rate of 3 AC/H throughout the commonly occupied spaces. Student bedrooms will be provided with a supply air change rate of 1 AC/H.
Natural Ventilation Rates	Natural ventilation through openable windows has been adopted for this scheme. The ventilation rate has been calculated according to the percentage of openable windows for each space and the varying environmental conditions throughout the year. This percentage of openable windows has been modelled as per the façade and elevation details provided by the architect. However, the scheme has been modelled with the assumption that the opening windows will be limited to approximately 100mm opening for safety and security reasons. This has the effect of significantly reducing the discharge coefficient rate of the windows. The windows were assumed to be opened when the internal temperature is above 24°C and when the rooms are occupied.

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Summary of results
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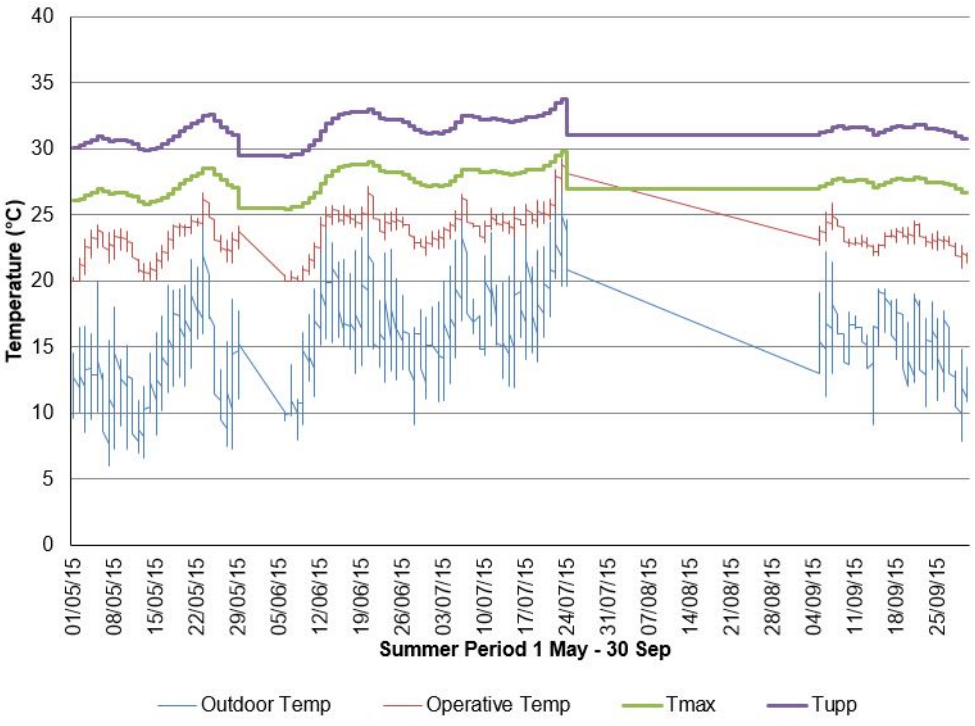
Overview of Results

The bedroom, the dining/living rooms below have been taken as representative of the whole scheme as these rooms are deemed to be most occupied. The graphs below show the outdoor and indoor temperature of these rooms. 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)

3rd_Bedroom 3203 Temperature Graph



Room	Criterion 1	Criterion 2	Criterion 3	Compliance
Bedroom 3203	0.0%	0.00	0	PASS

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Summary of results
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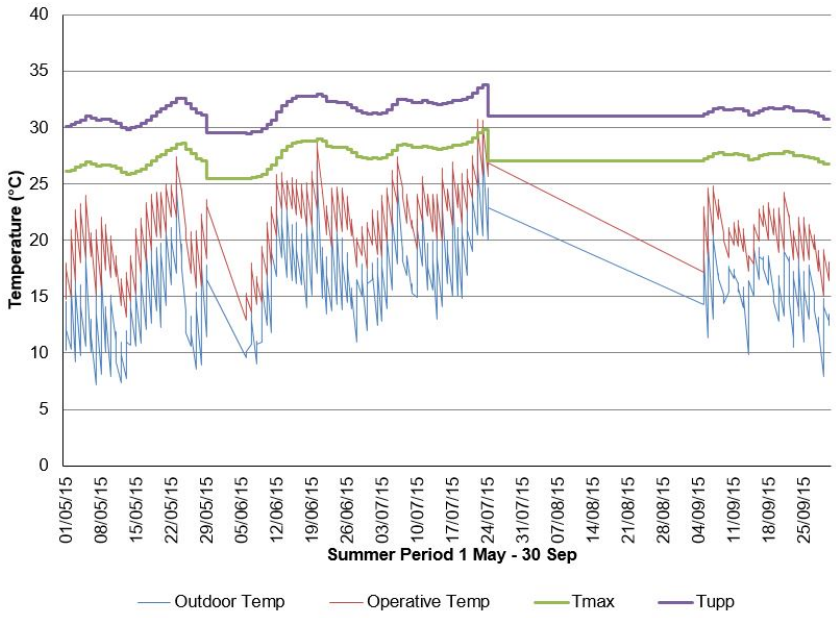
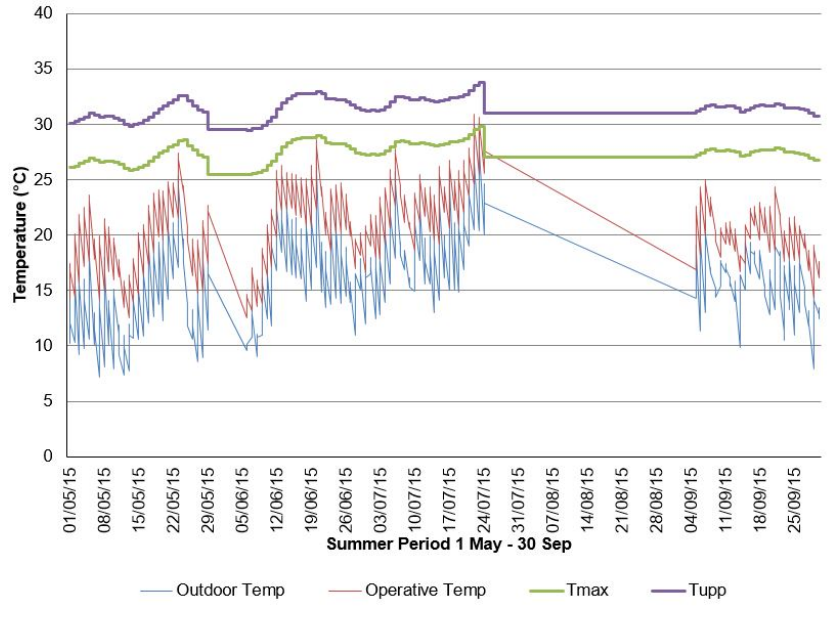
4th_Common room
Temperature Graph



Room	Criterion 1	Criterion 2	Criterion 3	Compliance
Common Room	2.5%	21.20	0	PASS

3rd_Common room 2
Temperature Graph



Room	Criterion 1	Criterion 2	Criterion 3	Compliance
Common Room	2.5%	20.26	0	PASS

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Summary of results
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Summary of Results	Room	Criterion 1	Criterion 2	Criterion 3	Compliance
	3rd_Bedroom 3101	0.0%	0.00	0	PASS
	3rd_Bedroom 3102	0.0%	0.00	0	PASS
	3rd_Bedroom 3103	0.0%	0.00	0	PASS
	3rd_Bedroom 3104	0.0%	0.00	0	PASS
	3rd_Bedroom 3105	0.0%	0.00	0	PASS
	3rd_Bedroom 3106	1.0%	3.18	0	PASS
	3rd_Common Room 1	2.8%	22.34	0	PASS
	3rd_Bedroom 3201	1.0%	3.99	0	PASS
	3rd_Bedroom 3202	0.2%	0.59	0	PASS
	3rd_Bedroom 3203	0.0%	0.00	0	PASS
	3rd_Bedroom 3204	0.0%	0.00	0	PASS
	3rd_Bedroom 3205	0.1%	0.06	0	PASS
	3rd_Bedroom 3206	1.2%	5.91	0	PASS
	3rd_Common Room 2	2.5%	20.26	0	PASS
	4th_Bedroom 4101	0.0%	0.00	0	PASS
	4th_Bedroom 4102	0.0%	0.00	0	PASS
	4th_Bedroom 4103	0.2%	0.52	0	PASS
	4th_Bedroom 4104	0.5%	2.05	0	PASS
	4th_Bedroom 4105	0.4%	1.02	0	PASS
	4th_Bedroom 4106	0.5%	1.68	0	PASS
	4th_Common Room	2.5%	21.20	0	PASS

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Summary of results
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Explanation of Results

Criterion 1 shows that the scheme will experience temperatures above the thermal comfort T_{max} for less than 3% of the total summer occupied hours. This value is within the acceptable range.

Criterion 2 shows that the maximum weighted exceedance is up to 22.34 within one day (this value is a function of temperature rise and its duration). According to CIBSE Guide no one day should have a weighted exceedance more than 6. It is expected that the common rooms with highly glazed areas would fail in this criterion as they experience severe fluctuations in the interior temperature because of their sensitivity to solar gains.

Criterion 3 shows than there are no 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. All the assessed rooms comply with the requirements, although some rooms exceed the maximum weighted exceedance of 6 (criterion 2).

It should be noted that the temperature graphs show flat lines of no data. This is because TM52 requires analysis for occupied hours only. The NCM methodology assumes that the building is not occupied during July and August as this is the educational summer holidays. If the building is to be occupied to the same levels as during term time then further analysis should be undertaken.

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Conclusions
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Conclusions

The proposal has responded to CIBSE TM52 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. The analysis focussed on the fourth and third floors primarily, as these are the worst-case areas for risk of overheating because of the levels of solar gains these spaces receive. Floors below these of the same layout and specification will also comply with the overheating requirements.

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 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 and 0.25 will help to keep the heat out of the building;
- Fixed shading and overhangs as per architectural drawings;
- Internal shading devices to further limit solar gains;
- Mechanical ventilation with heat recovery and summer bypass to provide fresh air and purge the heat out;
- Natural ventilation supply fresh air to the building through openable windows (as per ventilation rates section within this report)

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.

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 additional cooling measures were implemented.