Thermal Model & Overheating Analysis

31 Elsworthy Road, London NW3 3BT

March 2025
revC

E & S Bristol Ltd
info@eandsbristol.co.uk
www.eandsbristol.co.uk

Contents

Document Control

Prepared By:	Marcus Eves	Signed:	
Checked By:	Graham Suttill	Signed:	

Revision History

Revision	Date	Details
-	13/12/2022	First issue
A	09/09/2024	Revised calculations following layout changes
B	11/02/2025	Updated report following design team comments
C	18/03/2025	Dynamic Simulation models updated following window condition survey

Disclaimer

This report has been prepared for the exclusive use and benefit of Carnell Warren Associates solely for the purpose for which it is provided. Unless we provide express prior written consent, no part of this report should be reproduced, distributed or communicated to any third party. Data has been gathered from the client CIBSE Guide A, CIBSE Guide F, SAP Appendix S and NCM BRE Methodology. This data set which is outlined in the report has been used to predict the heating and cooling loads. Any deviation from the specific conditions modelled in this report will have an impact on the results.

This report estimates the thermal behaviour of 31 Elsworthy Road using detailed thermal modelling methods. Assumptions are made within this process, which may not occur in practice. Whilst E & S Bristol take great care in assembling simulations which provide an accurate depiction of reality, certain variables are difficult to predict, in particular the weather. Higher or lower temperatures than those simulated may occur if weather conditions or internal behaviours deviate sufficiently from those modelled.

1. Executive Summary

1.1 E & S Bristol has been commissioned by Carnell Warren Associates to carry out a dynamic thermal simulation of the proposed residential extension and refurbishment at 31 Elsworthy Road, London NW3 3BT. This report details the results of the thermal comfort analysis completed in order to demonstrate the requirement or otherwise for active cooling within the building. This has been carried out in accordance with CIBSE TM59 guidance related to overheating in homes.

1.2 Despite following the cooling hierarchy wherever possible, including passive and mechanical ventilation measures, three rooms still fail the overheating assessment and therefore active cooling is required to the;

Basement Study/Homework room.
Bedroom 02 on First floor.
Bedroom 05 on Second floor.

2. Introduction

2.1 The following works to the existing property at 31 Elsworthy Road consists of:

- Excavation of a single storey basement under the footprint of the existing property and to the front and rear garden including a lightwell
- Single storey rear extension at ground floor to the kitchen / reception room, creating new garden room
- Infilling of existing windows opening at ground floor to the side elevation and creation of a new window opening
- Changes to rear fenestration
- Replacement of the existing garage door
- Partial refurbishment of the existing property including replacement of heating and hot water services, external fabric.

2.2 The new basement extension is proposed to contain a living room / games room, wine cellar, utility room, plant room, playroom, guest toilet, pool plant room, swimming pool, changing facilities, sauna and a study/homework room. The pool and study/homework room both open onto the rear lightwell. Large windows will face into the rear lightwell to maximise the natural light received by these rooms.

2.3 The purpose of the analysis is to establish whether the internal temperatures simulated within the model achieve the requirements of the CIBSE thermal comfort metric TM59. The CIBSE TM59 overheating metric is aimed specifically at residential buildings. The results of the analysis will be used to assist the ventilation and cooling strategy of the development.

2.4 The calculations have been carried out using Dynamic Simulation Modelling, whereby the whole dwelling has been incorporated into the calculations. DSM building analysis is based on the CIBSE admittance method. This method uses idealised (sinusoidal) weather and thermal response factors (admittance, decrement factor and surface factor) that are based on a 24-hour frequency.

2.5 The dynamic thermal model was created using IES Virtual Environment 2024 in accordance with CIBSE AM11: Building Energy and Environmental Modelling. The model has been created using detailed drawings and information supplied by Carnell Warren Associates.

2.6 The modelling has incorporated inputs provided within the TM59 methodology guidance, information provided by the architect and M&E consultant which includes:

a. Building construction type and thermal performance;
b. Occupancy, lighting, equipment heat gains and profiles;
c. Heat losses and gains from plant rooms;
d. Infiltration and mechanical ventilation designed strategy;
e. Passive ventilation strategy through openable windows and doors;
f. External air speed assumptions.

2.7 CIBSE weather data has been used based on geographical location of the site. CIBSE TM59 requires that simulations be tested using DSY1 2020 High 50th Percentile weather data. CIBSE DSY1 represents a moderately warm summer.

2.8 This simulation has been used the London_Weather_Centre_DSY1_2020High50.epw.

2.9 In order to reduce overheating and reliance on air conditioning, the design of the basement has followed the Cooling Hierarchy;

1) Minimise internal heat generation through energy efficient design;
2) Reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation 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.

3. Compliance Requirements

Camden Local Plan Policy CC1 Climate Change Mitigation

3.1 Camden Local Plan Policy CC1 is outlined below;

The Council will require all development to minimise the effects of climate change and encourage all developments to meet the highest feasible environmental standards that are financially viable during construction and occupation.

We will:

a. promote zero carbon development and require all development to reduce carbon dioxide emissions through following the steps in the energy hierarchy;

b. require all major development to demonstrate how London Plan targets for carbon dioxide emissions have been met;

c. ensure that the location of development and mix of land uses minimise the need to travel by car and help to support decentralised energy networks;

d. support and encourage sensitive energy efficiency improvements to existing buildings;

e. require all proposals that involve substantial demolition to demonstrate that it is not possible to retain and improve the existing building; and

f. expect all developments to optimise resource efficiency.

For decentralised energy networks, we will promote decentralised energy by:

g. working with local organisations and developers to implement decentralised energy networks in the parts of Camden most likely to support them;

h. protecting existing decentralised energy networks (e.g. at Gower Street, Bloomsbury, King's Cross, Gospel Oak and Somers Town) and safeguarding potential network routes; and

i. requiring all major developments to assess the feasibility of connecting to an existing decentralised energy network, or where this is not possible establishing a new network.

To ensure that the Council can monitor the effectiveness of renewable and low carbon technologies, major developments will be required to install appropriate monitoring equipment.

Policy CC2 Adapting to climate change

The Council will require development to be resilient to climate change.

All development should adopt appropriate climate change adaptation measures such as:

a. the protection of existing green spaces and promoting new appropriate green infrastructure;

b. not increasing, and wherever possible reducing, surface water runoff through increasing permeable surfaces and use of Sustainable Drainage Systems;

c. incorporating bio-diverse roofs, combination green and blue roofs and green walls where appropriate; and *d. measures to reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy.*

Any development involving 5 or more residential units or 500 sqm or more of any additional floorspace is required to demonstrate the above in a Sustainability Statement.

Sustainable design and construction measures

The Council will promote and measure sustainable design and construction by:

e. ensuring development schemes demonstrate how adaptation measures and sustainable development principles have been incorporated into the design and proposed implementation;

f. encourage new build residential development to use the Home Quality Mark and Passivhaus design standards;

g. encouraging conversions and extensions of 500 sqm of residential floorspace or above or five or more dwellings to achieve "excellent" in BREEAM domestic refurbishment; and

h. expecting non-domestic developments of 500 sqm of floorspace or above to achieve "excellent" in BREEAM assessments and encouraging zero carbon in new development from 2019.

Cooling

8.41 All new developments will be expected to submit a statement demonstrating how the London Plan's 'cooling hierarchy' has informed the building design. Any development that is likely to be at risk of overheating (for example due to large expanses of south or south west facing glazing) will be required to complete dynamic thermal modelling to demonstrate that any risk of overheating has been mitigated.

8.42 Active cooling (air conditioning) will only be permitted where dynamic thermal modelling demonstrates there is a clear need for it after all of the preferred measures are incorporated in line with the cooling hierarchy.

8.43 The cooling hierarchy includes:

- *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.*

Building Regulations: Part O (2021)

3.2 The Building Regulations Part O1 was introduced in 2022. The aim of requirement O1 is to protect the health and welfare of occupants of the building by reducing the occurrence of high indoor temperatures.

3.3 The requirement O1 is met by designing and constructing the building to achieve both of the following.

a) Limiting unwanted solar gains in summer
b) Providing an adequate means of removing excess heat from the indoor environment

3.4 Compliance with requirement O1 can be demonstrated by using one of the following methods.

a) The simplified method for limiting solar gains and providing a means of removing excess heat
b) The dynamic thermal modelling method

Part O Simplified Method

3.5 The Simplified Method requires the limit of solar gains and maximise natural ventilation potential through window sizing and window design.

3.6 Using the Simplified Method, designers are required to limit the amount of glazing on the south, west and east facades whilst ensuring there is sufficient openable window area. Details about the glazed area and opening area of every single window are required to complete the calculations.

3.7 In order to achieve compliance the total glazed area within the dwelling must not exceed a limit based on the floor area and orientation of the most glazed facade and the total area in the most glazed room should not exceed a percentage limit which is based on the floor area of that room.

3.8 Factors such as the possibility of cross ventilation will affect the allowable glazed area and Approved Document O also takes into account the differences between dwellings in urban locations and more rural dwellings.

3.9 If using the simplified method and the building is in a high risk area, such as London, shading should be provided by one of the following means between compass points north-east and north-west via south;

a. External shutters with means of ventilation.
b. Glazing with a maximum g-value of 0.4 and a minimum light transmittance of 0.7.
c. Overhangs with 50 degrees altitude cut-off on due south-facing façades only.

Part O Dynamic Thermal Modelling Method

3.10 The Dynamic Thermal Modelling Method is based on CIBSE's TM59 design methodology. This models heat flows through the building and is more complex provide more flexibility in possible approaches to mitigating overheating than the Simplified Method.

CIBSE TM59 (2017) Assessment Criteria: Dwellings

3.11 Overheating in dwellings is assessed using CIBSE TM59:2017, Design methodology for the assessment of overheating risk in homes. The following two criteria, taken together, provide a robust yet balanced assessment of the risk of overheating of buildings in the UK and Europe.

3.12 This is a standardised approach to predict overheating risk for residential building designs using a dynamic thermal analysis. It provides a baseline which includes specific weather files, defined internal gains and a set of profiles that represent reasonable usage patterns for a home suitable for evaluating overheating risk.

3.13 Table 1 below provides a summary of the assessment criteria outlined in CIBSE TM59.

Scenario	CIBSE TM59 Compliance Requirement's
Predominantly Naturally Ventilated Dwelling	Criteria (a) 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% of occupied hours. (CIBSE TM52 Criterion 1: Hours of exceedance, which is the number of hours during which the difference between the actual operative temperature and maximum acceptable temperature); Criteria (b) for bedrooms only: to guarantee comfort during sleeping hours the operative temperature in the bedroom from 22:00 to 07:00 shall not exceed 26 °C for more than 1% of annual hours. (Note: 1% of the annual hours between 22:00 and 07:00 for bedrooms is 32 hours, therefore 33 or more hours above 26 °C will be recorded as a fail); Note: Criteria 2 and 3 of CIBSE TM52 may fail to be met, but both (a) and (b) above must be passed for all relevant rooms.
Predominantly Mechanically Ventilated Dwelling	CIBSE Guide A Temperature Test: Occupied spaces should not exceed operative temperature of 26°C for more than 3% of annual occupied hours.
Communal Corridors (Where communal heating present)	CIBSE Guide A fixed temperature test: a) Where corridors should not exceed operative temperature of 28°C for total annual hours (262 hours or less)

Table 1: CIBSE TM59 Compliance Requirements

4. Dynamic Simulation Model

4.1 In order to provide a robust set of results and ensure overheating in the dwellings has been properly considered, it is proposed the development is assessed using the Dynamic Simulation Model rather than the simplified method.

4.2 CIBSE has undertaken considerable research on the impact of climate change on the indoor environment and weather data. CIBSE Guide A, Approved Document Part L, Approved Document Part F, Approved Document Part O and the National Calculation Methodology (NCM) Modelling Guide provides data on maximum average temperatures, ventilation rates and overheating criteria.

4.3 DSM building analysis is based on the CIBSE admittance method. This method uses idealised (sinusoidal) weather and thermal response factors (admittance, decrement factor and surface factor) that are based on a 24-hour frequency.

4.4 IESVE v.2024 has been used to carry out a dynamic simulation to analyse any potential overheating risks of the building, which is in accordance with CIBSE AM11: Building Energy and Environmental Modelling.

4.5 The full dynamic simulation is in accordance with CIBSE TM59:2017: Environmental Design that combines the effects of:

- CIBSE Design Summer Year1 (DSY1) weather data, (projected climate change environment)
- Equipment, lighting and people heat gains
- Fresh air supply
- Occupancy and variation
- Building fabric
- Solar heat gains and shading

5. Building Model

5.1 Part O and the TM59 methodology provides guidance for overheating risk assessment. In line with this methodology a full 3D Model of the building has been generated.

5.2 Shown below are screen shots of the building geometry viewed from within the IES software.

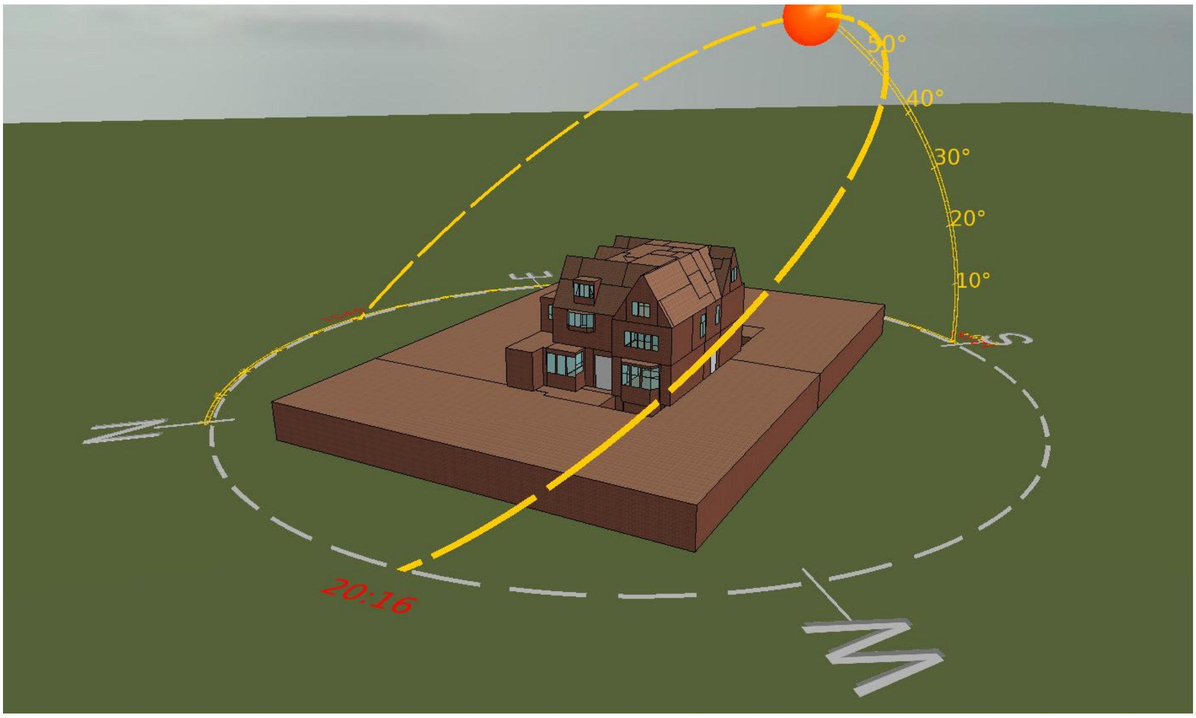

Figure 1: IES Model of Site viewed from North West (20th June 12pm)

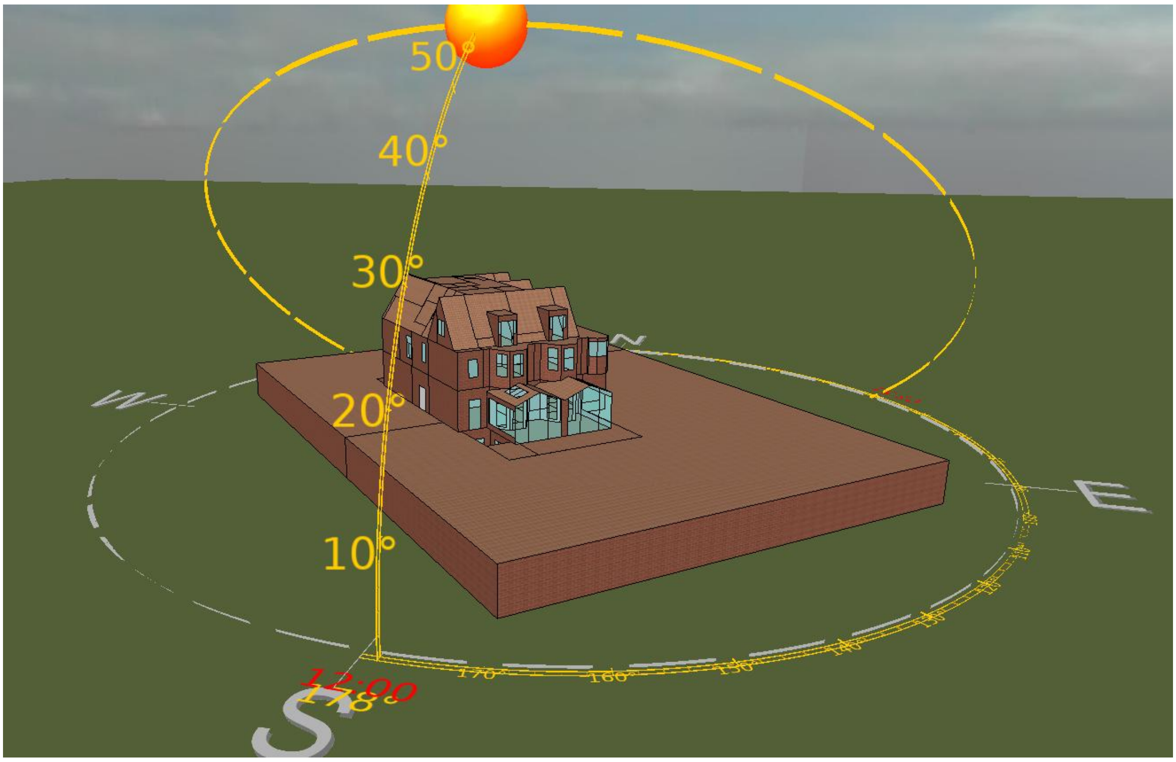

Figure 2: IES Model of the Site Viewed from the South East (20th June 12pm)

6. Methodology

Assessment Areas

6.1 CIBSE TM59 require all habitable spaces to be assessed for overheating risk to ensure occupant comfort. Habitable spaces are defined as rooms where individuals are expected to spend prolonged periods, such as living rooms, bedrooms, and other regularly occupied areas in residential buildings such as a study or gym.

6.2 Non-habitable spaces, such as corridors, bathrooms, and storage areas, are generally excluded from the assessment as they are not occupied for extended durations.

6.3 There is no set legal definition of a habitable room, however the building regulations set out the following;

Part B: A room used, or intended to be used, for dwellinghouse purposes (including for the purposes of Part B, a kitchen but not a bathroom).

Part F: A room used for dwelling purposes but which is not solely a kitchen, utility room, bathroom, cellar or sanitary accommodation.

Part M: a room used, or intended to be used, for dwelling purposes including a kitchen but not a bathroom or utility room.

6.4 A study/homework room is not mentioned in any of the exclusions as a habitable room, and therefore the services design of the property has taken into account that this is a habitable space, providing ventilation in accordance with Building Regulations Part F.

6.5 This room has access to the external lightwell for purge ventilation and natural daylight. It is reasonable to consider the potential for this room to be used as a living room, study or any other habitable space in the future.

6.6 In accordance with the CIBSE guides, the whole building has been assessed, including the existing bedrooms, proposed basement and rear garden room extension, with the overheating metrics applied to all habitable rooms.

Site External Weather Conditions

6.7 External temperatures and incidental solar gains are greatest during summer months, coinciding with periods of lower wind speeds. However, solar altitude is highest during summer months, increasing the effects of facade shading from balcony overhangs and window reveals. Such considerations should be accounted for when designing for overheating risk.

6.8 The effects of external conditions are vital in an overheating assessment as in particular they influence:

- Solar heat gains (a function of incident direct & diffuse solar radiation and solar altitude);
- Calculated natural ventilation rates (a function of external temperature, wind directions and speeds).

6.9 CIBSE weather data has been used based on geographical location of the site. CIBSE TM59 requires that simulations be tested using DSY1 2020 High 50th Percentile weather data. CIBSE DSY1 represents a moderately warm summer.

6.10 This simulation has been used the London Weather Centre DSY1 2020 High 50.epw.

Model Geometry and Local Shading

6.11 Solar control forms an integral part of overheating mitigation strategies. Horizontal shading devices such as balconies/overhangs are more efficient when applied in south oriented façades and during midday when the solar angle is high. Their role in reducing solar gains in the summer period is paramount.

6.12 Internal shading, such as blinds can function as a second layer of solar control. The use of internal blinds throughout the day is instrumental to block the sun and maintain G-values as high as possible to provide good levels of natural daylighting, while taking advantage of the winter solar gains.

6.13 Whilst TM59 does not prohibit the use of internal blinds to manage the incoming solar gain, Part O dictates they should not be taken into account when considering whether requirement O1 has been met.

6.14 The design proposal has no additional external shading and no blinds have been used in the model.

Natural Ventilation Strategy

6.15 Purge ventilation through openable windows is shown to have significant effect in reducing internal temperatures and limit overheating to acceptable levels as well as removing high concentrations of pollutants and water vapour.

6.16 In locations where external noise may be an issue, the overheating mitigation strategy should take account of the likelihood that windows will be closed during sleeping hours (11pm to 7am).

6.17 Part O States windows are likely to be closed during sleeping hours if noise within bedrooms exceeds the following limits.

a. *40dB LAeq,T, averaged over 8 hours (between 11pm and 7am).*
b. *55dB LAFmax, more than 10 times a night (between 11pm and 7am).*

6.18 There are no issues related to noise pollution or air quality which will limit the operation of the window opening profiles.

6.19 Natural ventilation will be achieved from the openable windows, which will only operate for a few hours a day.

6.20 The model follows the limits outlined in Part O;

A) When a room is occupied during the day (8am to 11pm), openings should be modelled to do all of the following.

i. *Start to open when the internal temperature exceeds 22°C.*
ii. *Be fully open when the internal temperature exceeds 26°C.*
iii. *Start to close when the internal temperature falls below 26°C.*
iv. *Be fully closed when the internal temperature falls below 22°C.*

B) At night (11pm to 8am), openings should be modelled as fully open if both of the following apply.

i. *The opening is on the first floor or above and not easily accessible.*
ii. *The internal temperature exceeds 23°C at 11pm.*

C) When a ground floor or easily accessible room is unoccupied, both of the following apply.

i. *In the day, windows, patio doors and balcony doors should be modelled as open, if this can be done securely, following the guidance in paragraph 3.7 below.*

ii. ii. At night, windows, patio doors and balcony doors should be modelled as closed.

D) An entrance door should be included, which should be shut all the time.

3.7) Open windows or doors can be made secure by using any of the following.

a. Fixed or lockable louvred shutters.

b. Fixed or lockable window grilles or railings.

6.21 All windows and doors to the basement and ground floor are assumed to be open during the day but closed during night time due to security risks. Windows to the first and second floor are assumed to be opened during the day as well as the night time.

7. Base Model Specification

Construction Fabric

7.1 Construction fabric used within the calculation is based upon architectural information provided by Carnell Warren. For existing elements SAP Appendix S U-Values have been used, based on the existing property age.

Element	Construction	U-Value ($W/m^2.K$)	Thermal Mass $KJ/(m^2.K)$
Existing Ground Floor	Uninsulated Concrete Slab	0.58	152
New Basement Slab	Screed, Insulation, Concrete Slab	0.18	75
Existing External Walls	As Existing Solid Brick Walls	1.70	55
Existing Dormer Walls	Timber Frame Walls Insulated Between Studs	0.55	30
New External Walls Above Ground	Brickwork, Cavity, Insulation, Blockwork, Dabs Cavity, Plasterboard	0.18	141
New Basement Walls	Concrete Retaining Wall, Internally Insulated	0.18	141
Existing Pitched Roofs & Dormer Roofs	Lightweight Construction, Insulation Through Joists	0.35	11
Existing Flat Roof	Lightweight Construction, Insulation Through Joists	0.35	11
New Flat Roof	Warm Flat Roof, Insulation Over Joists	0.12	8
Separating Floors	Timber Separating Floors	N/A	28
Lightweight Internal Walls	Plasterboard, Mineral Wool Between Studs, Plasterboard	0.30	9
Heavyweight Internal Walls	Dense Plasterboard On Concrete Blocks	1.2	122

Table 2: Thermal Envelope U-Values

Glazing Parameters

7.2 The glazing will be a mix of sash, side hung casements, single and double glazed timber frame.

7.3 The glazing parameters have been input based on the existing and proposed architectural window schedule drawings and information received from MorenoMasey. The U-Values and G-Values have been sourced from SAP 10 for existing buildings.

Glazing	U-Value ($W/m^2.K$)	Frame factor	G-Value	LT-Value (Light Transmittance
Existing Single Glazing	4.80	30%	0.85	0.80
Existing Double Glazing	2.80	30%	0.76	0.75
New Windows	1.40	30%	0.40	0.72
New Fully Glazed Doors	1.40	20%	0.40	0.72

Table 3: Glazing Parameters

Occupancy and Equipment

7.4 These are the gains associated with humans in the space. Based on CIBSE Guide A (2015a), a maximum sensible heat gain of 75 W/person and a maximum latent heat gain of 55 W/person are assumed in the living spaces. An allowance of 30% reduced gain during sleeping is based on Addendum G to ANSI/ASHRAE Standard 55-2010, Table 5.2.1.2 'Metabolic rates for typical tasks. Heat gains for the study/homework room and swimming pool are based on the National Calculation Methodology (NCM). The values used are summarised in the Table below.

Space	Maximum Sensible Gain (W/Person)	Maximum Latent Gain (W/Person)
Occupied Spaces	75	55
Study/homework room	102	198
Swimming Pool	55	105

Table 4: Occupancy Heat Gains

7.5 Table 5 shows the occupancy and equipment levels in each room. The profiles used to describe when the occupants will be present are shown in Appendix A were extracted from TM59 methodology.

Room Type	Occupancy	Equipment load
Kitchen / Living / Dining Room	3 people from 9am to 10pm; room is unoccupied for the rest of the day	Peak load of 450 W from 6 pm to 8 pm 200 W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day
Double Bedroom	2 people at 70% gains from 11pm to 8am; 2 people at full gains from 8am to 9am and from 10pm to 11pm; 1 person at full gain from 9am to 10pm.	Peak load of 80 W from 8 am to 11 pm Base load of 10 W during sleeping hours
Study/homework room	2 people maximum occupancy at full gains from 7am to 9am, 12pm to 2pm and 6pm to 8pm; unoccupied for the rest of the day	Peak Load at 50W/m^2 to follow occupancy profile
Swimming Pool	4 people at full gains from 9am to 10pm; unoccupied for the rest of the day	Swimming Pool gains at 65W/m^2 to maintain 28°C pool water temperature

Table 5: Occupancy and equipment gain description

Lighting Gains

7.6 Following CIBSE TM59 methodology, an internal lighting gain of 2.0 W/m² from 6pm to 11pm has been assumed to the living / dining / kitchen rooms and bedrooms, as acceptable daylight levels are available to these dwellings.

7.7 Swimming Pool and Study/homework room areas are set a 5.2 W/m².

Infiltration

7.8 The existing building areas have been simulated using an air permeability of 15m^3/hm^2 at 50Pa. The new building areas have been simulated using an air permeability of 5m^3/hm^2 at 50Pa. The corresponding infiltration rate for the Dwelling has been derived from CIBSE Guide A (2015a) Tables 4.16 - 4.24.

7.9 The model uses an infiltration rate into the existing areas at a rate of 0.75ACH

7.10 The model uses an infiltration rate into the new build areas at a rate of 0.25ACH

Internal Shading

7.11 TM59 methodology prescribes that internal blinds can be included for the analysis only if specifically included in the design, provided in the base build. In addition, blinds should not be used if they clash with the opening of windows.

7.12 No Internal shading has been modelled in the assessment.

8. Model Scenarios

8.1 An iterative approach has been taken in the assessment in line with the cooling hierarchy in order to ascertain how the building will perform throughout the year. This allows for the most appropriate solution to be progressed within the design. This is in line with Camden Planning Policies CC1 and CC2 and paragraphs 8.41 to 8.43 of the Camden Local Plan.

8.2 The following scenarios have been simulated;

Scenario 1

Passive ventilation with extract only

Scenario 2

Air handling unit with supply and extract mechanical ventilation

Scenario 3

Mechanical extract with heat recovery with supply and extract where possible and cooling to the bedrooms and the study/homework room which fall short of the CIBSE TM59 overheating criteria.

8.3 The cooling hierarchy also requires consideration of minimise internal heat generation through energy efficient design, reducing the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls and manage the heat within the building through exposed internal thermal mass and high ceilings.

8.4 As the development is an existing property and within a conservation area scope for passive and mechanical measures for the upper levels are restricted. The development also consists of the construction of a new basement under an existing property, there are restrictions to the passive measures that can be considered. Any fenestrations must be built with lightwells, and will need to be closed overnight owing to security concerns. Internal heat gain from solar radiation is however reduced as the majority of the basement development is underground.

8.5 The orientation and layout is dictated by the existing layout of the property. The basement has already been designed to optimise thermal mass and uses appropriate height ceilings throughout.

9. Overheating Results

Scenario 1: Natural Ventilation

9.1 The following tables show the results of the thermal modelling study using the design specification as detailed in this report, following stages 1 to 4 of the cooling hierarchy. The air speed has been set at 0.1m/s in line with the Part O and CIBSE TM59 requirements. Whilst the occupancy tables show reduced occupancy in line with CIBSE TM59, the results are based on a 24-hour frequency.

9.2 Criterion (a) applies to all habitable rooms and checks the number of hours during which ΔT is greater than or equal to one degree (K) during the period May to September inclusive. This cannot exceed 3% of occupied hours to comply with Part O.

9.3 Criteria (b) applies to bedrooms only, to guarantee comfort during sleeping hours the operative temperature in the bedroom from 22:00 to 07:00 cannot exceed 26 °C for more than 1% of annual hours.

9.4 Bedrooms must achieve both criteria in order to achieve a pass.

9.5 Table 6 below shows a summary of how the assessed habitable rooms have performed against CIBSE TM59.

Room Name	Criterion (a) result	Criterion (b) result	Overall TM59 result
Bedroom - Principal	Pass	Pass	Pass
Bedroom - Principal	Pass	Pass	Pass
Bedroom 02	Pass	Fail	Fail
Bedroom 03	Pass	Pass	Pass
Bedroom 04	Pass	Pass	Pass
Bedroom 05	Pass	Fail	Fail
Bedroom 06	Pass	Pass	Pass
Bedroom 07	Pass	Pass	Pass
Dining Room	Pass	NA	Pass
Study/homework room (Basement)	Fail	NA	Fail
K/L/D	Pass	NA	Pass
Kitchen	Pass	NA	Pass
Living Room / Games Room (Basement)	Fail	NA	Fail
Play Room (Basement)	Fail	NA	Fail
Office	Pass	NA	Pass
Garden Room	Pass	NA	Pass

Table 6: TM59 Criterion (a) and (b) Results for a natural ventilation scenario

9.6 Table 6 shows that all occupied spaces in the basement exceed the overheating criteria using a natural ventilation strategy. This is owing to the activity of the rooms, plus the limited ability to open windows, especially overnight due to security risks, as well as limitations of the fabric of the existing building.

9.7 Two of the existing bedrooms also fall short of the overheating metrics. Whilst they all pass on criterion A, bedrooms 02 and 05 fail on the night-time overheating target. A detailed summary of the results are shown in the tables below.

Criterion (a) Results Summary

9.8 Table 7 below shows a summary of how the assessed rooms have performed against CIBSE Criterion (a). Criterion (a) requires for all living rooms, kitchens, bedrooms, and other habitable spaces the number of hours during which ΔT is greater than or equal to 1^{o}K from May to September shall not exceed 3% of occupied hours.

Room	Occupied Hours	No. hours ΔT ≥ 1^{o}K	% Occupied hours ΔT ≥ 1^{o}K	Criteria 1 (% Hrs Top-Tmax>=1K)
Bedroom - Principal	3672	19	0.5	Pass
Bedroom - Principal	3672	19	0.5	Pass
Bedroom 02	3672	17	0.5	Pass
Bedroom 03	3672	15	0.4	Pass
Bedroom 04	3672	0	0	Pass
Bedroom 05	3672	11	0.3	Pass
Bedroom 06	3672	15	0.4	Pass
Bedroom 07	3672	14	0.4	Pass
Dining Room	1989	21	1.1	Pass
Study/homework room (Basement)	918	291	31.7	Fail
K/L/D	1989	15	0.8	Pass
Kitchen	1989	2	0.1	Pass
Living Room / Games Room (Basement)	1989	67	3.4	Fail
Play Room (Basement)	1989	64	3.2	Fail
Office	1989	18	0.9	Pass
Garden Room	1989	56	2.8	Pass

Table 7: TM59 Criteria A Results

Criterion (b) Results Summary

9.9 Table 8 overleaf shows a summary of how the assessed bedrooms rooms have performed against CIBSE Criterion (b). Criterion (b) states that the operative temperature of the bedrooms from 22:00-07:00 shall not exceed 26^{o}C for more than 1% of annual hours (33 hours is therefore recorded as a fail).

Room Name	Total hours > 26°C	Pass/Fail
Bedroom - Principal	12	Pass
Bedroom - Principal	13	Pass
Bedroom 02	41	Fail
Bedroom 03	20	Pass
Bedroom 04	30	Pass
Bedroom 05	33	Fail
Bedroom 06	24	Pass
Bedroom 07	24	Pass
Dining Room	NA	NA
Study/homework room (Basement)	NA	NA
K/L/D	NA	NA
Kitchen	NA	NA
Living Room / Games Room (Basement)	NA	NA
Play Room (Basement)	NA	NA
Office	NA	NA
Garden Room	NA	NA

Table 8: TM59 Criteria B Results

9.10 All options at stages 1 to 4 of the cooling hierarchy have been considered and implemented, this exhausts all natural and passive measures and the dwelling still fails to the targets.

9.11 Therefore stage 5 of the hierarchy, using mechanical measures of mitigating overheating will be explored.

Scenario 2: Mechanical Ventilation

9.12 The basement model has been updated with mechanical ventilation & heat recovery (MVHR). Air will be extracted from the living room, play room, changing room, pool and study/homework room, with supply ventilation provided back into these spaces.

9.13 The MVHR will operate with a summer bypass with a set point of 20°C; the system will automatically divert outgoing air around the heat recovery cell, so that the incoming air will no longer be warmed by the outgoing air. The mechanical ventilation is specified in the basement to support the humidity associated with the swimming pool.

9.14 Installation of MVHR has been considered to ensure the upper floor bedrooms meet the overheating metrics, however there are a number of issues with retrofitting MVHR into these spaces. In particular the installation of ductwork for an MVHR system to work effectively is particularly challenging.

9.15 The space between the existing ceiling joists is extremely limited, and does not offer sufficient space to install sufficient insulated ducting. Routing ducts through the existing walls and ceilings without compromising the integrity of the structure or disrupting the building's design features is not possible.

9.16 Additionally, the energy efficiency benefits of an MVHR system rely heavily on the airtightness of the building envelope. The upper floors of the house are not sufficiently airtight. Retrofitting the building to meet the necessary airtightness requirements for an MVHR system to function effectively would be difficult and intrusive. Without sufficient airtightness, the system cannot operate efficiently, leading to overall higher energy consumption, increased CO_2 production and reduced ventilation performance.

9.17 Lastly, installing an MVHR system will compromise the character of the original fabric owing to the number of penetrations through the walls. During MVHR installation, numerous holes are drilled into the walls, ceilings, and floors to route the necessary ducting and place vent outlets. These invasive penetrations disrupt the integrity of the original structure with external vent grilles becoming visible on the building's exterior which would be contrary to the aesthetics of the conservation area.

9.18 Therefore, the model has been updated with MVHR in the basement only, with the upper floors remaining as naturally ventilated only. The MVHR flow rates are summarised in the table below.

Room	Supply/Extract Flow Rate
Basement Living Room/Games	20 l/s
Basement Play Room	20 l/s
Changing Room	30 l/s
Study/homework room	50 l/s
Swimming Pool	150 l/s

Table 9: MVHR Extract Flow Rates

9.19 Table 10 overleaf shows a summary of how the assessed habitable rooms have performed against CIBSE TM59 when MVHR is incorporated.

Room Name	Criterion (a) result	Criterion (b) result	Overall TM59 result
Bedroom - Principal	Pass	Pass	Pass
Bedroom - Principal	Pass	Pass	Pass
Bedroom 02	Pass	Fail	Fail
Bedroom 03	Pass	Pass	Pass
Bedroom 04	Pass	Pass	Pass
Bedroom 05	Pass	Fail	Fail
Bedroom 06	Pass	Pass	Pass
Bedroom 07	Pass	Pass	Pass
Dining Room	Pass	NA	Pass
Study/homework room (Basement)	Fail	NA	Fail
K/L/D	Pass	NA	Pass
Kitchen	Pass	NA	Pass
Living Room / Games Room (Basement)	Pass	NA	Pass
Play Room (Basement)	Pass	NA	Pass
Office	Pass	NA	Pass
Garden Room	Pass	NA	Pass

Table 10: TM59 Criterion (a) and (b) Results for a natural ventilation scenario

9.20 Bedrooms 02 and 05 still result in failure due the restrictions on the installation of MVHR described above. Table 10 shows that when mechanical ventilation with heat recovery is incorporated into the basement, whilst the extent of overheating is considerably reduced and the living room and play room now comply with the targets, the study/homework room will still exceed the overheating metrics.

9.21 A detailed summary of the results are shown in the tables below.

Criterion (a) Results Summary

9.22 Table 7 below shows a summary of how the assessed rooms have performed against CIBSE Criterion (a). Criterion (a) requires for all living rooms, kitchens, bedrooms, and other habitable spaces the number of hours during which ΔT is greater than or equal to 1^{o}K from May to September shall not exceed 3% of occupied hours.

Room	Occupied Hours	No. hours ΔT ≥ 1^{o}K	% Occupied hours ΔT ≥ 1^{o}K	Criteria 1 (% Hrs Top-Tmax>=1K)
Bedroom - Principal	3672	19	0.5	Pass
Bedroom - Principal	3672	19	0.5	Pass
Bedroom 02	3672	17	0.5	Pass
Bedroom 03	3672	15	0.4	Pass
Bedroom 04	3672	0	0	Pass
Bedroom 05	3672	11	0.3	Pass
Bedroom 06	3672	15	0.4	Pass
Bedroom 07	3672	14	0.4	Pass
Dining Room	1989	21	1.1	Pass
Study/homework room	918	74	8.1	Fail
K/L/D	1989	13	0.7	Pass

Kitchen	1989	2	0.1	Pass
Living Room / Games Room (Basement)	1989	14	0.7	Pass
Play Room (Basement)	1989	11	0.5	Pass
Office	1989	18	0.9	Pass
Garden Room	1989	47	2.4	Pass

Table 11: TM59 Criteria A Results

Criterion (b) Results Summary

9.23 Table 12 below shows a summary of how the assessed bedrooms rooms have performed against CIBSE Criterion (b). Criterion (b) states that the operative temperature of the bedrooms from 22:00-07:00 shall not exceed 26^{o}C for more than 1% of annual hours (33 hours is therefore recorded as a fail).

Room Name	Total hours > 26^{o}C	Pass/Fail
Bedroom - Principal	12	Pass
Bedroom - Principal	13	Pass
Bedroom 02	41	Fail
Bedroom 03	20	Pass
Bedroom 04	30	Pass
Bedroom 05	33	Fail
Bedroom 06	24	Pass
Bedroom 07	24	Pass
Dining Room	NA	NA
Study/homework room	NA	NA
K/L/D	NA	NA
Kitchen	NA	NA
Living Room / Games Room (Basement)	NA	NA
Play Room (Basement)	NA	NA
Office	NA	NA
Garden Room	NA	NA

Table 12: TM59 Criteria B Results

9.24 All natural and mechanical ventilation strategies have been thoroughly explored in accordance with stages 1 to 5 of the cooling hierarchy. Despite these efforts, three habitable rooms still fail to meet the Part O overheating criteria.

9.25 As a result, to ensure compliance with TM59 targets, the consideration of mechanical cooling solutions will be necessary.

Scenario 3: Mechanical Ventilation and Cooling

9.26 As the study/homework room and two of the upper floor bedrooms do not meet the overheating metrics, the model has been updated in line with the cooling hierarchy to incorporate a cooling system specifically to these areas.

9.27 Cooling is a feasible option for the existing dwelling as refrigerant pipework is non-intrusive and requires no large visible penetrations through the building fabric. This allows the system to be installed without altering or compromising the existing building character and has minimal impact on a building's aesthetics. Discreet indoor units can be mounted on walls or ceilings and unlike MVHR there is no need for large ducts or visible vents.

9.28 Refrigerant cooling systems also offer flexibility in installation, the pipework can be routed through the existing ceiling voids without the need for extensive structural modifications.

9.29 Table 13 below shows a summary of how the assessed habitable rooms have performed against CIBSE TM59 when MVHR is corporate to the basement and cooling is provided in the study/homework room.

Room Name	Criterion (a) result	Criterion (b) result	Overall TM59 result
Bedroom - Principal	Pass	Pass	Pass
Bedroom - Principal	Pass	Pass	Pass
Bedroom 02	Pass	Pass	Pass
Bedroom 03	Pass	Pass	Pass
Bedroom 04	Pass	Pass	Pass
Bedroom 05	Pass	Pass	Pass
Bedroom 06	Pass	Pass	Pass
Bedroom 07	Pass	Pass	Pass
Dining Room	Pass	NA	Pass
Study/homework room (Basement)	Fail	NA	Pass
K/L/D	Pass	NA	Pass
Kitchen	Pass	NA	Pass
Living Room / Games Room (Basement)	Pass	NA	Pass
Play Room (Basement)	Pass	NA	Pass
Office	Pass	NA	Pass
Garden Room	Pass	NA	Pass

Table 13: TM59 Criterion (a) and (b) Results for a natural ventilation scenario

9.30 Table 13 shows that when mechanical ventilation with heat recovery is incorporated into the basement habitable spaces and cooling in the study/homework room and the bedrooms 02 and 05, all newbuild and exiting habitable rooms will meet the overheating metric.

9.31 A detailed summary of the results are shown in the tables below.

Criterion (a) Results Summary

9.32 Table 14 below shows a summary of how the assessed rooms have performed against CIBSE Criterion (a). Criterion (a) requires for all living rooms, kitchens, bedrooms, and other habitable spaces the number of hours during which ΔT is greater than or equal to 1ºK from May to September shall not exceed 3% of occupied hours.

Room	Occupied Hours	No. hours ΔT ≥ 1ºK	% Occupied hours ΔT ≥ 1ºK	Criteria 1 (% Hrs Top-Tmax>=1K)
Bedroom - Principal	3672	19	0.5	Pass
Bedroom - Principal	3672	19	0.5	Pass
Bedroom 02	3672	17	0	Pass
Bedroom 03	3672	15	0.4	Pass
Bedroom 04	3672	0	0	Pass
Bedroom 05	3672	11	0	Pass
Bedroom 06	3672	15	0.4	Pass
Bedroom 07	3672	14	0.4	Pass
Dining Room	1989	21	1.1	Pass
Study/homework room	918	0	0	Pass
K/L/D	1989	13	0.6	Pass
Kitchen	1989	2	0.1	Pass
Living Room / Games Room (Basement)	1989	14	0.7	Pass
Play Room (Basement)	1989	11	0.5	Pass
Office	1989	18	0.9	Pass
Garden Room	1989	47	2.3	Pass

Table 14: TM59 Criteria A Results

Criterion (b) Results Summary

9.33 Table 15 below shows a summary of how the assessed bedrooms rooms have performed against CIBSE Criterion (b). Criterion (b) states that the operative temperature of the bedrooms from 22:00-07:00 shall not exceed 26ºC for more than 1% of annual hours (33 hours is therefore recorded as a fail).

Room Name	Total hours > 26ºC	Pass/Fail
Bedroom - Principal	12	Pass
Bedroom - Principal	13	Pass
Bedroom 02	0	Pass
Bedroom 03	16	Pass
Bedroom 04	24	Pass
Bedroom 05	0	Pass
Bedroom 06	24	Pass
Bedroom 07	24	Pass
Dining Room	NA	NA
Study/homework room	NA	NA
K/L/D	NA	NA
Kitchen	NA	NA
Living Room / Games Room (Basement))	NA	NA
Play Room (Basement)		

Office	NA	NA
Garden Room	NA	NA

Table 15: TM59 Criteria B Results

9.34 Table 15 shows that when mechanical ventilation with heat recovery is incorporated alongside cooling, the habitable rooms in the basement and will meet the overheating criteria.

9.35 Furthermore, with cooling installed in bedrooms 02 and 05 all existing habitable spaces meet the overheating targets.

10. Results Summary

10.1 The assessment results indicate that, due to the specific activities and conditions in the basement, several spaces are predicted to exceed the overheating criteria outlined in CIBSE TM59.

10.2 Additionally, the study/homework room and living room/games room contain equipment that generates significant internal heat. With limited openable windows in these areas, the model predicts they will surpass the TM59 overheating thresholds.

10.3 This issue is compounded by the adjacent hallway spaces, which are also expected to overheat (the results of which are excluded from the reporting as they are not considered habitable spaces), further highlighting the thermal challenges in the basement.

10.4 While the introduction of a mechanical ventilation system significantly reduces internal temperatures and the extent of overheating, it does not sufficiently mitigate the issue in the study/homework room to meet compliance. Consequently, mechanical cooling is required in this space to achieve compliance and ensure thermal comfort.

10.5 As part of the assessment, the existing dwellings bedrooms, living spaces and new garden room extension were also evaluated. As these spaces benefit from adequate cross ventilation and openable windows, the majority of rooms meet the requirements outlined in CIBSE TM59 without additional mechanical ventilation or cooling measures. However two bedrooms also require active cooling in order to meet the overheating metrics.

11. Conclusions

11.1 This report provides a summary of the overheating risk assessment undertaken on the proposed renovation and basement development at 31 Elsworthy Road. As part of the basement assessment, consideration has been given to the existing living spaces and bedrooms.

11.2 The assessment has been undertaken using approved IES software. The model carried out in accordance with CISE AM11 incorporated inputs in line with the TM59 methodology guidance, and also based on information provided by the architects and mechanical and electrical consultants. All inputs and assumptions have been outlined within this report.

11.3 This overheating assessment demonstrates that the development at 31 Elsworthy Road has demonstrated compliance with:

- Camden Planning Policy on Overheating
- The London Plan Cooling Hierarchy
- Methodology as set out in CIBSE TM59 and complies with the overheating criteria

11.4 The calculations have been conducted in accordance with the cooling hierarchy outlined in the London Plan and Camdens Local Plan. Passive design measures, including enhanced natural ventilation (using openable windows, and open internal doors to maximise cross ventilation), solar control glazing, and optimized fabric performance, have been thoroughly evaluated and implemented where feasible. As detailed in the report, the results indicate that passive strategies alone are insufficient to mitigate overheating within the basement living room, study/homework room space, play room and 2 of the upper floor bedrooms.

11.5 Following the cooling hierarchy, a further set of calculations have been carried out using a mechanical ventilation and heat recovery system. This reduced the risk of overheating in the basement living room and play room to compliant levels, however the study/homework room space still falls short of the metrics. MVHR is has been deemed not suitable to retrofit into the existing dwelling bedrooms owing to the limited space for ductwork, lack of air tightness and the required penetrations in the existing fabric.

11.6 Given the high internal heat gains and usage patterns of the study/homework room, mechanical cooling is necessary to ensure thermal comfort and compliance with CIBSE TM59. In accordance with CIBSE guidelines, the study/homework room space can be classified as a *habitable space* due to its primary function as an area regularly occupied by individuals and therefore should be assessed for compliance against the overheating targets. Bedrooms 02 and 05 also require mechanical cooling to meet the overheating targets.

11.7 The building design and building services design have maximised all available measures to minimise heat generation within the dwelling, reduce the amount of heat entering the building, and use a mixture of passive, mechanical ventilation and cooling to the dwelling in line with the cooling hierarchy.

11.8 The risk of overheating in the building has been minimised to within acceptable levels as the following measures have been implemented upon construction.

- Following the cooling hierarchy
- Improved building fabric
- Provision of solar control glass with a g-value of 0.40 to all new glazing
- Provision of openable windows and doors to all habitable rooms
- Mechanical ventilation and heat recovery in the basement
- Cooling to the basement study/homework room, bedrooms 02 and 05
- Cold radiation from the thermal mass
- Stack ventilation through the central foyer

11.9 The majority of the existing dwelling and the ground floor extension fully comply with the mandatory criteria. Two existing bedrooms do not meet the TM59 overheating targets.

11.10 In order to achieve the overheating targets in the basement, mechanical ventilation with heat recovery is required in the living room and play room, while mechanical cooling is necessary in the study/homework room. In order to meet the overheating metrics in the bedrooms mechanical ventilation is not feasible and therefore active cooling is required.

11.11 This is primarily due to the high internal heat gains from equipment and occupant activity, also from the heat gains from the adjacent swimming pool. A combination of passive design measures and targeted mechanical strategies has been demonstrated to effectively meet the overheating targets, ensuring both compliance and occupant comfort.

11.12 Overall the development has followed the cooling hierarchy, and demonstrated compliance with Planning Policy CC1, CC2 and Paragraphs 8.41 – 8.43 of the Camden Local Plan.

11.13 Despite following the cooling hierarchy wherever possible, including passive and mechanical ventilation measures, three rooms still fail the overheating assessment and therefore active cooling is required to the;

Basement Study/Homework room.
Bedroom 02 on First floor.
Bedroom 05 on Second floor.