6 BRIARY CLOSE

LONDON

NW3 3JZ

DYNAMIC SIMULATION MODELLING - COOLING HIERARCHY COMPLIANCE

For:

Marylebone Interiors London Ltd

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Project no. 19198

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REVISION	DATE	PREPARED BY	REVIEWED BY	COMMENTS
0	09/2024	DC	C80	For Issue

The results generated and analysed in this report are based upon complex arithmetical calculation that takes into consideration a number of design criteria and evaluations in a dynamic simulation. It gives an indication of the predicted environmental conditions based on climatic data and anticipated operating strategies of the building.

The predicted simulated internal temperatures may also not meet the actual internal air temperatures due to several reasons, namely change in space function, use of equipment, natural wear and tear of building elements, global climate change and meteorological changes, change in operational management of apertures etc.

C80 Solutions cannot be held liable for temperatures that vary from the simulated results as these have been calculated in a controlled virtual environment.

Contents

1 Introduction

1.1 About C80 Solutions Ltd

C80 Solutions are independent Sustainability and Energy Consultants providing carbon reduction solutions to help the UK achieve its carbon emission reduction target of 100% by 2050 - as set out in the Government's Climate Change Act 2008.

Our range of affordable but comprehensive solutions for the construction industry are broken down into two sectors: i) Building Compliance and ii) Consultancy.

Building Compliance:

Our Building Compliance services include Code for Sustainable Homes Assessments, SAP Calculations, On Construction Energy Performance Certificates, Water Efficiency Calculations, SBEM Calculations, Commercial EPCs, BREEAM assessments, Thermal comfort analysis, Air Tightness Testing and Sound Testing.

Consultancy:

Our experience and exposure to building compliance combined with previous experience and IEMA accredited training means we have built up a vast amount of knowledge which enables us to provide our clients with invaluable advice. Our Consultancy services include Renewable Energy Feasibility Reports, Energy Statements for planning, Sustainability Statements and Building Compliance Advisory Reports.

1.2 Executive Summary

C80 Solutions have been instructed by Marylebone Interiors London to prepare a cooling hierarchy report for a proposed development at 6 Briary Close, London.

The project assessed anticipates the provision of cooling within the dwelling in addition to extension works proposed at the premises.

This report outlines the cooling hierarchy considerations for the proposed development. The aim is to minimise the risk of overheating and reduce reliance on active cooling systems by adhering to the Camden Planning Guidance on energy efficiency and adaptation. Given the existing structure of the property, built circa 1960s and constructed primarily of brick, specific limitations and considerations are addressed. Homes from this era often have less insulation, outdated glazing and inefficient ventilation, which can contribute to overheating, especially during summer months. If the building has not been retrofitted with modern materials like high-performance glazing or improved ventilation systems, it could be more susceptible to heat retention, exacerbating the risk of overheating during warmer periods.

Simulations have been undertaken for 6 Briary Close using Designbuilder EnergyPlus, which is a dynamic simulation modelling software that can accurately simulate predicted internal environments and temperatures for the purposes of identifying area which are at a risk of overheating and will therefore benefit from the use of cooling. The same model can then be used to simulate multiple iterations of the proposed building, to account for stages within the cooling hierarchy.

The dynamic modelling simulations have been used to identify the operative temperatures within the building and to ascertain the requirement for cooling after the various stages of the cooling hierarchy have been considered where applicable to the building.

The plan of the proposed development can be seen in Figures 1-3 below:

Figure 1: BRY P -100: Proposed Floor Plans

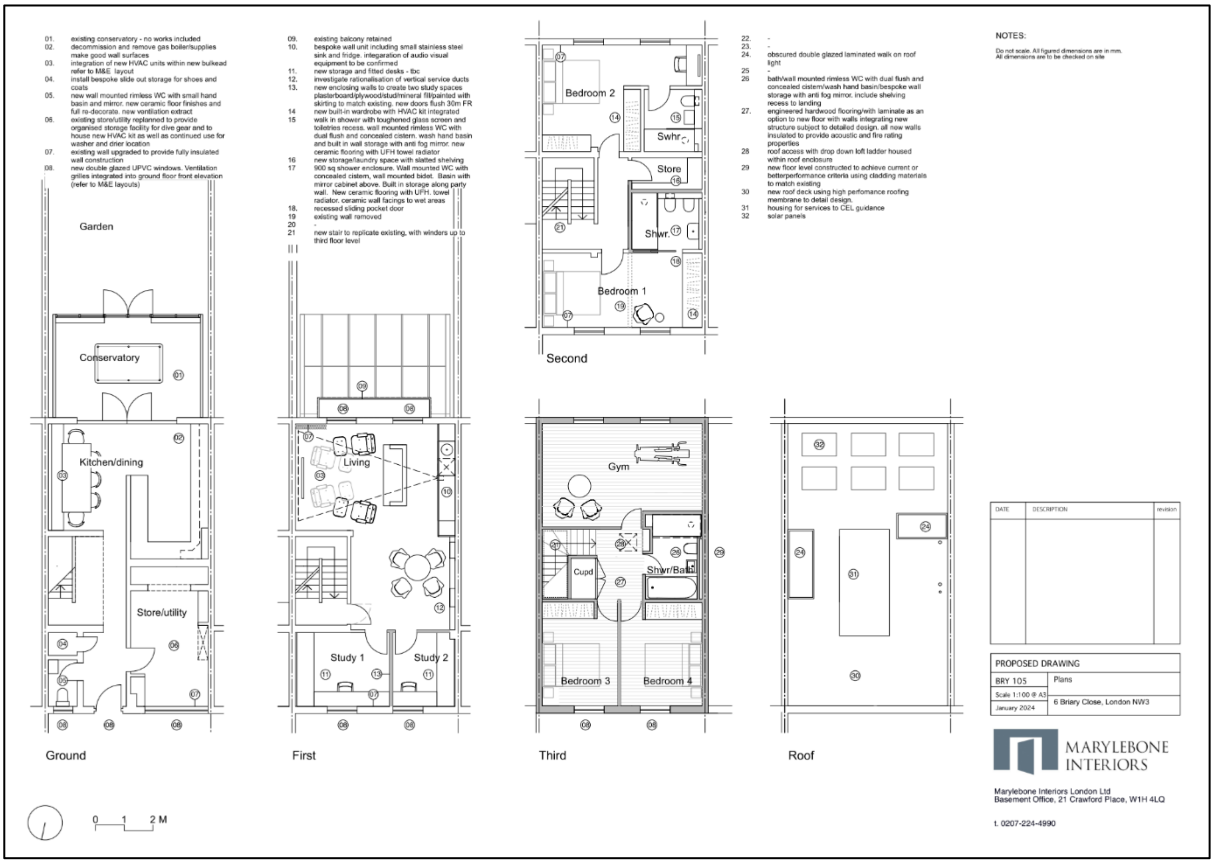
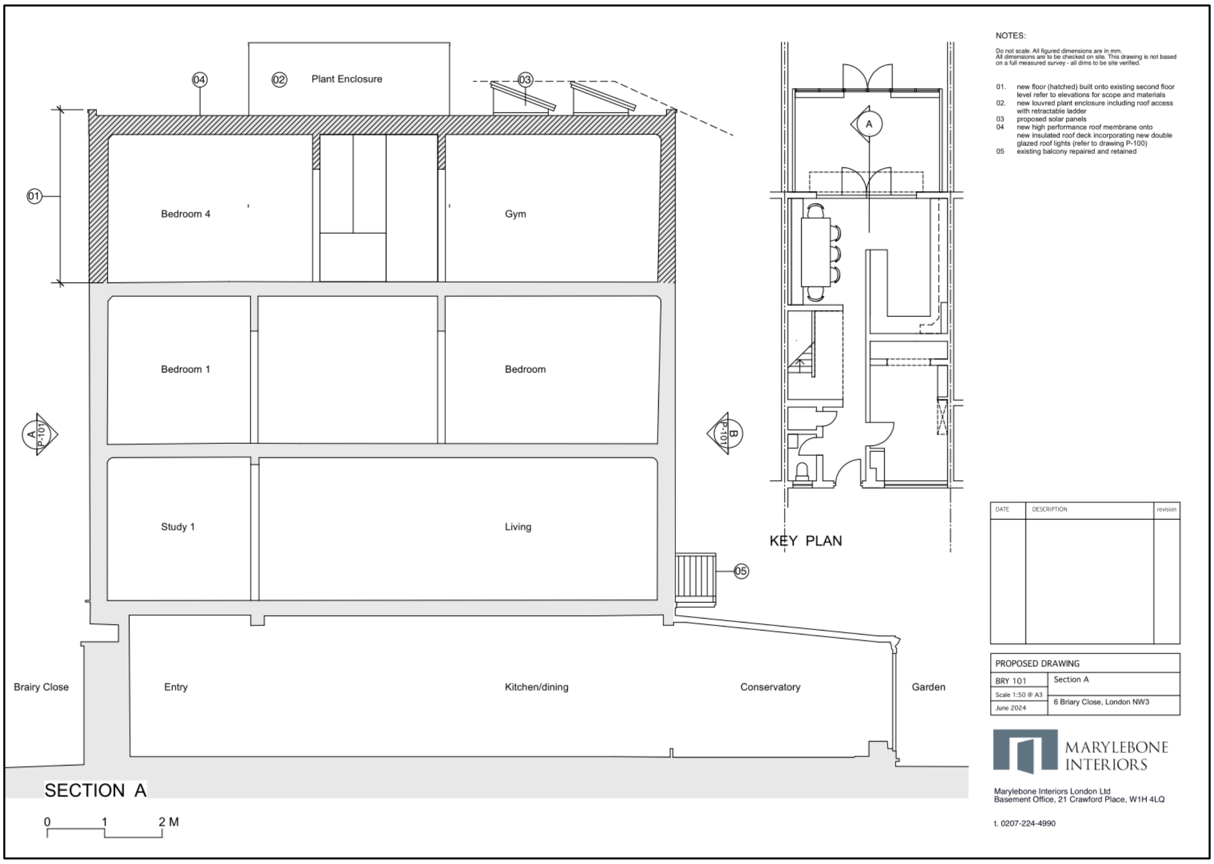


Figure 2: BRY P -101: Proposed Elevation Plans

Figure 3: BRY P -102: Proposed Section Plans



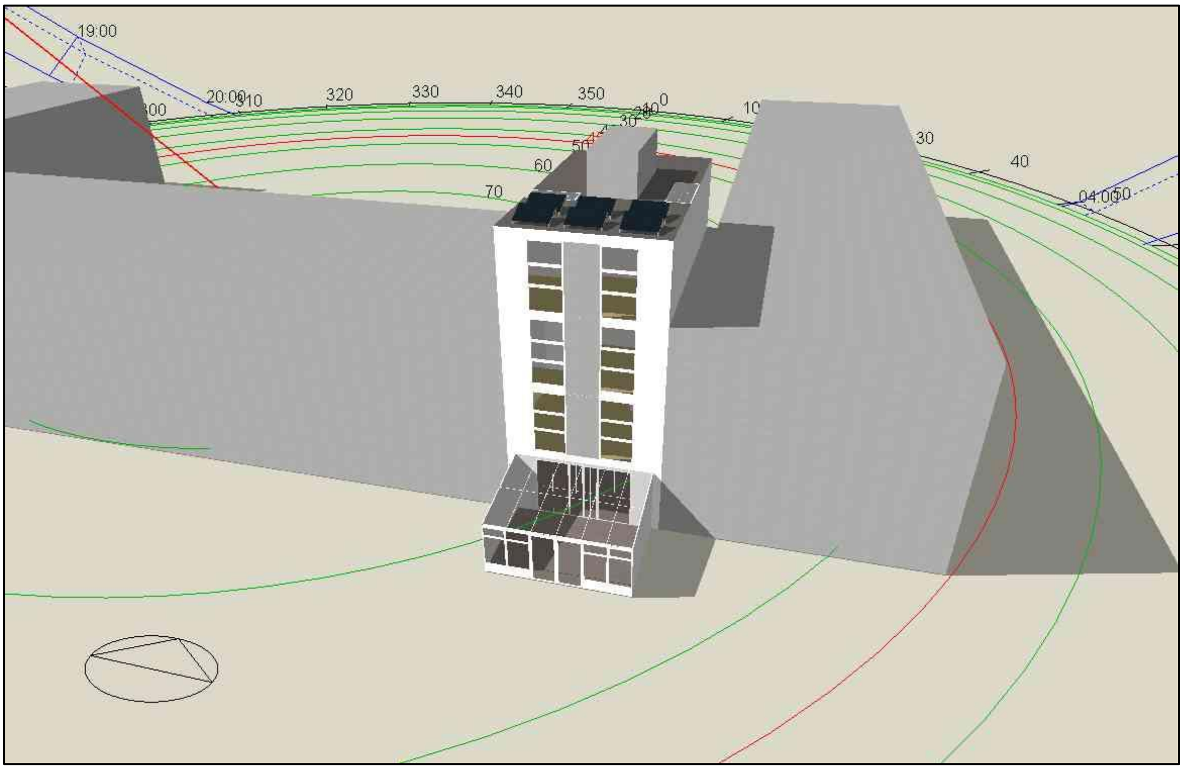
2 Software Calculation Specification

This analysis was conducted using the Designbuilder EnergyPlus software package.

Calculation Engine: DesignBuilder EnergyPlus

Calculation Engine Version: v9.4

Model image



2.1 Weather File Detail

As outlined within CIBSE Technical Memorandum 52, CIBSE DSY weather files are used to replicate the weather data most applicable to the site, the DSY1 weather file for the most appropriate location nearest to the development has been used for this development.

The DSY represents warmer than typical year and is used to evaluate overheating risk within buildings.

The specific weather location chosen for this assessment was London weather centre DSY.

3 Cooling Hierarchy Planning Policies

3.1 London Plan – Greater London Authority

Chapter 9 of the London plan states that Major developments should reduce the risk of potential overheating and therefore dependence on air-conditioning systems using the following cooling hierarchy:

1. reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure
2. minimise internal heat generation through energy efficient design
3. manage the heat within the building through exposed internal thermal mass and high ceilings
4. provide passive ventilation
5. provide mechanical ventilation
6. provide active cooling systems.

Where the above hierarchy applies to major developments, it can still be adapted and used on minor developments.

3.2 Camden Council

Following the Policies applicable within the Greater London Authority, Camden Council requires that all developments follow the cooling hierarchy approach.

The policy applicable to this can be found within Chapter 10 of the Camden Planning Guidance; Energy Efficiency and adaptation document, specifically 10.7.

Cooling hierarchy 10.7 All developments should follow the cooling hierarchy outlined below, to reduce the risk of overheating and subsequent reliance on active cooling:

1. Minimise internal heat generation through energy efficient design, considering the following:
- Layout and uses: locate any spaces that need to be kept cool or that generate heat on cooler sides of developments.
- Reducing heat gains e.g. including low energy lighting.
- Seal/ insulate heat generating processes.
- Reduce the distance heat needs to travel and insulate pipework.
- Design layouts to promote natural ventilation e.g. shallow floor plans and high floor to ceiling heights.
- Consider evaporation cooling which cools air through the evaporation of water.
- Consider ‘free cooling’ or ‘night cooling’, which uses the cooling capacity of ambient air to directly cool the space.

2. Reduce the amount of heat entering a building in summer:
- Consider the angle of the sun and optimum daylight and solar gain balance.
- Orientate and recess windows and openings to avoid excessive solar gain.

- Consider low g-values and the proportion, size and location of windows.
- Make use of shadowing from other buildings.
- Include adequate insulation. Camden Planning Guidance I Energy efficiency and adaptation 52
- Design in shading: e.g. include internal courtyards, large shade-providing trees and vegetation, balconies, louvers, internal or external blinds, and shutters.
- Make use of the albedo effect (use light coloured or reflective materials to reflect the sun's rays).
- Include green infrastructure e.g. green wall, green/blue roofs and landscaping, to regulate temperatures.
- Reduce the amount of heat entering a building in summer.

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

4. Passive ventilation:
- Natural ventilation, openable windows, the 'stack effect' system (see Chapter 3 of this guidance).
- Design layouts to promote natural ventilation e.g. shallow floor plans and high floor to ceiling heights.
- Consider evaporation cooling which cools air through the evaporation of water. Consider 'free cooling' or 'night cooling' which uses the cooling capacity of ambient air to directly cool the space

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

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

4 Design compliance of development

4.1 Design Principles

Existing Conditions and Limitations

The existing building structure, being a typical mid 20th-century brick house, presents several limitations:

The existing structure has inherent limitations in thermal performance, common to many older UK properties, resulting in higher susceptibility to overheating.

The design and layout of the existing building with the proposed extension do well to naturally support effective cross-ventilation as well as is possible with a largely existing structure.

1. Minimise Internal Heat Generation

Minimising internal heat generation through energy-efficient design is crucial for preventing overheating. The following provides commentary alongside each point within the "Minimise Internal heat generation" aspect of the cooling hierarchy; this style of commentary will be replicated at each step of the cooling hierarchy assessment. The following key strategies were taken into consideration and are to be implemented where they do not currently form part of the dwelling design. Where applicable these have all been accounted for within the thermal modelling analysis:

- **Layout and Uses:** There is limited scope to optimise the layout of the building as the structure is largely existing with just a single floor being added to the existing 3 floors, however, it is proposed the bedroom spaces on this floor have been located on the north facing side of the building, ensuring that solar gains into the space are limited as much as is possible.

  The gym is likely to contain equipment that will potentially increase heat gains within the zone and is likely to suffer most from solar gains within the new floor due to its glazing orientation, however, the infrequent use of this room in comparison to the bedrooms spaces on this floor means that it is better placed on the warmer side of the building.

- **Reducing Heat Gains:** Low-energy lighting solutions, such as LED fixtures, are employed throughout the extension and existing property to reduce the internal heat load. This choice not only mitigates heat generation but also enhances energy efficiency.

- **Insulation of Pipework:** Insulating hot water pipes and other heat-conducting elements is crucial in minimizing heat loss and preventing heat from spreading into living areas. This approach helps maintain a cooler indoor environment. However, when assessing the current thermal performance through modelling, it is acknowledged that there are constraints due to the available information on heat gains from internal pipework and equipment within an existing structure. Assumptive gains based on CIBSE guidance are utilised to estimate these factors. However, this approach is inherently limited and does not necessarily ensure that it is possible to capture all nuances of the existing building's performance.

Whilst not forming part of the initial modelling, the proposal to remove the gas central heating system in favour of air to air system will ensure that gains from pipework will be kept at minimal levels; heat loss from domestic hot water being the only remaining gains from the pipework, which will be insulated as far as reasonably practical to ensure low gains are maintained and efficient delivery of hot water to point of use.

- **Promoting Natural Ventilation:** The design includes features to facilitate natural ventilation, such as openable windows and cross ventilation when internal doors are open, ensuring effective air circulation throughout the property. However, it is noted that noise can become an issue during busy periods of local traffic, making the use of window openings impractical at times. Additionally, internal blinds are primarily used to reduce heat gains into the property, as closing the blinds has been shown to provide more benefit in real-world conditions, particularly when outdoor wind speeds limit the natural purging of air.

  As can be expected, the simultaneous use of open windows and closed blinds is not practical, as internal blinds severely restrict airflow into the property. Within the assessment, windows were utilised in combination with openable internal doors to encourage natural ventilation during periods of higher wind speeds. While closing blinds might help reduce solar gains, they also act as a barrier. Moreover, increased wind speeds can cause the blinds to move erratically, potentially causing damage to the surrounding window reveals or the blinds themselves due to their constant motion and impact.

- **Evaporation and Free Cooling:** Although evaporative cooling is not a practical solution for this residential setting, particularly due to the humid climate, natural ventilation and night cooling strategies will be employed. These strategies involve using cooler nighttime air to flush out warm air accumulated during the day, helping to reduce indoor temperatures without the need for active cooling systems.

  However, the effectiveness of night cooling can be limited by the common practice of closing blinds and curtains at night. While these coverings are often used to reduce solar gains during the day, they are typically closed at night for privacy and security, which restricts airflow into the property. As a result, the ability to fully take advantage of cooler outdoor air is reduced, diminishing the overall efficiency of night cooling in real-life situations.

2. Reduce Heat Entry in Summer

To further manage heat within the building during summer, several design features are incorporated:

- **Solar Gain Management:** The building's existing structure presents limitations, and the planned extension is further restricted by both local planning regulations and the estate management body. Many of the current windows and openings are double-glazed units, which are proposed to be replaced during the extension works. The new windows in the building will incorporate low g-value glazing, designed to reduce heat entry while still allowing adequate natural light to enter the space. This approach helps balance the need for daylight while minimising unwanted solar gains, making it suitable for both energy efficiency and comfort.

  Most structural openings within the dwelling are existing, the issue of limitations and the requirement of keeping the building in keeping with adjacent and surrounding properties means the only course of action is to replace the glazing units with a modernised equivalent.

  The conservatory space is a particularly difficult point of discussion on this dwelling. It could be argued that the roof could be replaced with a more traditional slate/tile roof, however, this will severely impact the spaces directly adjacent deeper within the dwelling, namely the kitchen and dining space within the ground floor which does not benefit from any other sources of natural daylight.

- **Insulation and Shading:** While the modelling does not currently allow for louvres, external blinds, or other external shading devices, the property takes advantage of shading from existing structures and surrounding vegetation. However, it is acknowledged that relying on surrounding trees for shade is not feasible due to their unprotected status and/or unpredictable growth patterns.

  Louvres, external blinds, and other external shading devices can significantly limit the amount of natural daylight entering the property. This reduction in natural light can create an environment with inadequate daylight during peak sunlight hours, negatively impacting the occupants' health and wellbeing. Natural daylight is essential for maintaining circadian rhythms and overall mental health.

  Additionally, in dwellings such as this one the use of shading devices often necessitates the increased use of artificial lighting to compensate for the reduced natural light. This not only increases energy consumption but also introduces additional heat gains from the artificial lighting, severely restricts airflow from any windows that are opened, thereby counteracting the benefits of the shading devices.

  In some cases, external shading devices can block daylight completely, especially when improperly designed or used. This can lead to darker indoor environments and a higher dependence on artificial lighting.

  We must consider the building being in keeping with the surrounding adjacent properties, maintaining the character of the existing building and considering any stipulations by any relevant party that has an interest in the development and proposals, as such fixed external shading devices are considered out of place and detrimental to the overall appearance of the development and are not being adopted as part of the design strategy.

- **Usage Profiles:** The effectiveness of blinds relies heavily on their proper use by occupants, which can be inconsistent. Over-reliance on blinds also detracts from more sustainable, passive design measures that inherently regulate temperatures without occupant intervention.

  However, it is noted from a real-world usage perspective that closing the blinds does a better job of maintaining a comfortable indoor temperature for occupants compared to the use of openable windows, as it effectively blocks out excessive heat from direct sunlight, whereas the benefits of using open windows are less noticeable. Thus, further promoting the use of mechanical systems so that the occupants may take advantage of the additional cooling in the spaces allowing less frequent use of the blinds during daylight hours.

- **Reflective Materials:** Light-coloured or reflective materials are to be used for the roofing and exterior surfaces of the extension, which will be in keeping with the existing design of the building, to take advantage of the albedo effect, reflecting more of the sun's rays and reducing heat absorption.

- **Include green infrastructure e.g. green wall, green/blue roofs and landscaping, to regulate temperatures:** Despite the benefits of green infrastructure, such as green walls, green/blue roofs, and landscaping in regulating temperatures, these solutions are not suitable for this development.

  To adhere to planning constraints and the requirement to maintain the character of the building and adjacent properties being imposed on the dwelling by third parties with involved interest in the development, proposal of a green roof has not been considered. Additionally, the existing three floors and adjacent terraced dwellings present significant structural limitations that make the integration of green infrastructure challenging.

  Furthermore, the flat roof, which could potentially support a green or blue roof, is designated for the installation of plant equipment and solar panels as part of the proposed works.

  This allocation of space for essential equipment further restricts the feasibility of incorporating green infrastructure. Therefore, while green solutions offer numerous advantages, they are not practical for this development due to structural constraints, planned usage of available roof space, and the need to comply with planning and management requirements.

3. Manage Internal Heat

The internal thermal mass and design features of the extension are optimised to manage heat effectively:

- **Thermal Mass Utilisation:** The existing building does not significantly benefit from thermal mass, and any enhancements in the new extension are limited by the overall impact of the existing structure. Thus, while accounted for in the simulations; thermal mass considerations are not a primary strategy.
- **Passive Ventilation:** Within the calculations Natural ventilation is maximised through openable windows and the stack effect, which uses temperature differences between indoor and outdoor air to drive ventilation. This method provides a continuous supply of fresh air while removing excess heat.

4. Mechanical Ventilation

Mechanical ventilation was considered as part of the overheating strategy but ultimately discounted due to its limited effectiveness and the intent to minimise energy use:

- **Efficient Systems:** Simulations for MVHR systems indicated that while they provide fresh air, their capacity to address overheating in peak conditions is limited. The primary function of MVHR systems is to enhance air quality rather than directly cool indoor spaces. During periods of high outdoor temperatures, MVHR systems do not significantly lower internal temperatures, as they do not actively cool the air.
- **Exclusion of MVHR:** In light of the simulations, MVHR systems were excluded from the final proposal. This decision was based on their limited effectiveness in mitigating overheating and the desire to minimise energy use. Alternative cooling solutions, which offer better performance in high-temperature conditions, would ensure a more effective and energy-efficient cooling strategy.

5. Active Cooling

While the preference is to avoid active cooling due to its energy demands, certain unavoidable circumstances necessitate its use.

- **Low Carbon Options:** Investigation into active cooling systems has been undertaken and systems have been selected based on their carbon footprint, ensuring that they are as energy efficient as possible. The proposed systems are Air Source Heat Pumps (ASHPs) capable of reverse operation for cooling in addition to heating in the winter months and are considered to provide a low-carbon alternative.

- **Plant Equipment Placement:** The proposed placement of plant equipment, as outlined in the development drawings, has been carefully considered to avoid any obstruction to potential areas that could be utilised for photovoltaic panels. In planning the layout, specific attention was given to ensuring that the plant equipment does not interfere with the available roof space that could otherwise accommodate a solar installation. As a result, sufficient and well-positioned space has been allocated within the proposed development to support the installation of an optimal photovoltaic array. This ensures that the energy generation potential of the site is fully maximised, while maintaining efficient organisation of plant equipment.

- **Proposed cooling systems and benefits:** The heat pump system which has been chosen for this development omits the use of any refrigerant within the pipework inside of the home, the system instead runs water through the internal pipework to the internal units, which is then used to condition the internal environment.
  Given the installation of the new HVAC system and the substantial number of alterations to the dwelling, it is justifiable to commission a new hot water system within the dwelling, therefore allowing all pipework for this system to be insulated, maintaining efficiency and minimising heat loss.

Conclusion

Given the existing structure and the design limitations, the proposed cooling measures for 6 Briary Close aim to balance energy efficiency with occupant comfort. The strategies outlined align with Camden's cooling hierarchy while addressing the unique challenges posed by the existing building. The careful placement of systems and the focus on passive cooling measures underscore a commitment to minimising energy consumption and environmental impact. Traditional passive cooling strategies are prioritised to maintain comfortable indoor conditions, with active cooling considered only as a last resort.

The existing ground floor will see the replacement of windows with modern, high-performance units, aimed at enhancing thermal efficiency and controlling solar gains. This update aligns with the overall goal of improving energy performance while preserving the current layout and structure. The existing design remains intact to maintain the building's original character and functionality, supporting effective energy management within the constraints of the existing layout.

Both the first and second floors will retain their original structure and layout, with planned window replacements serving to improve energy efficiency. This approach ensures that heat entry is minimised and ventilation potential is optimised without altering the core configuration of the spaces. These updates are consistent with the intent to enhance performance while respecting the established character of the property.

The new third-floor extension is designed with advanced energy efficiency features, including low g-value glazing to reduce solar heat gains. Bedrooms on this level are positioned to minimise heat exposure, and the gym is strategically placed on the warmer side due to its occasional use.

Additionally, the. The flat roof will accommodate essential plant equipment and solar panels, optimising the space for both energy generation and mechanical needs. This addition is carefully designed to enhance performance and align with modern sustainability standards.

5 Results and final conclusion

Results using design principles outlined within section 4, where not discounted:

Block	Zone	Criterion A (%)	Criterion B (hr)	Pass/Fail
0	CONSERVATORY	56.29	N/A	Fail
0	KITCHENDINING	0.00	N/A	Pass
1	LIVING	1.83	N/A	Pass
2	BEDROOM1	0.53	46.50	Fail
2	BEDROOM2	2.76	128.33	Fail
2	LIVING	65.74	N/A	Fail
3	BEDROOM3	0.85	88.17	Fail
3	BEDROOM4	0.84	91.17	Fail

Further Results using design principles outlined within section 4 incorporating MVHR systems:

Block	Zone	Criterion A (%)	Criterion B (hr)	Pass/Fail
0	CONSERVATORY	55.64	N/A	Fail
0	KITCHENDINING	0.00	N/A	Pass
1	LIVING	1.59	N/A	Pass
2	BEDROOM1	0.52	45.83	Fail
2	BEDROOM2	2.47	111.17	Fail
2	LIVING	19.82	N/A	Fail
3	BEDROOM3	0.83	85.17	Fail
3	BEDROOM4	0.81	87.50	Fail

Dynamic thermal comfort modelling has been undertaken on the development and simulations have been completed on the building with the details specified within section 4 of this report including all the proposed design principles.

The reasoning behind completing these simulations was to investigate the results to ascertain whether the building would overheat, however, to show this, the building should comply with the all the required criteria set out in CIBSE TM59.

The results of the dynamic thermal comfort modelling indicate that the spaces do not comply with the thermal comfort requirements set out within CIBSE TM59 and would therefore likely overheat and present uncomfortable operative temperatures for occupants. The results show that in all bedroom spaces, the number of hours the temperature exceeds the 26°C is more than double 32 hours which is the absolute maximum upper threshold under CIBSE guides, with numerous events in which the temperature exceeds 30°C

As cooling is recommended on this development to keep comfortable temperatures within the building, to comply with the final part of the cooling hierarchy, the proposal is to install an air-to-air source heat pump system, replacing the existing gas central heating to offer a more efficient and lower-carbon heating solution.

While MVHR was considered, the focus shifted towards more effective cooling solutions, including air-to-air source heat pumps, which provide both heating and cooling capabilities. This approach aligns with the aim of enhancing overall energy efficiency and addressing cooling needs in a more sustainable manner.