WEBB YATES ENGINEERS

Overheating Study

J3988 Shelton Street

Ref: J3988-B-RP-0001
Revision: 04
Status: S5

Webb Yates Engineers Ltd
48-50 Scrutton Street
London. EC2A 4HH
020 3696 1550
london@webbyates.com
www.webbyates.com

Registered in England & Wales No.: 5393930

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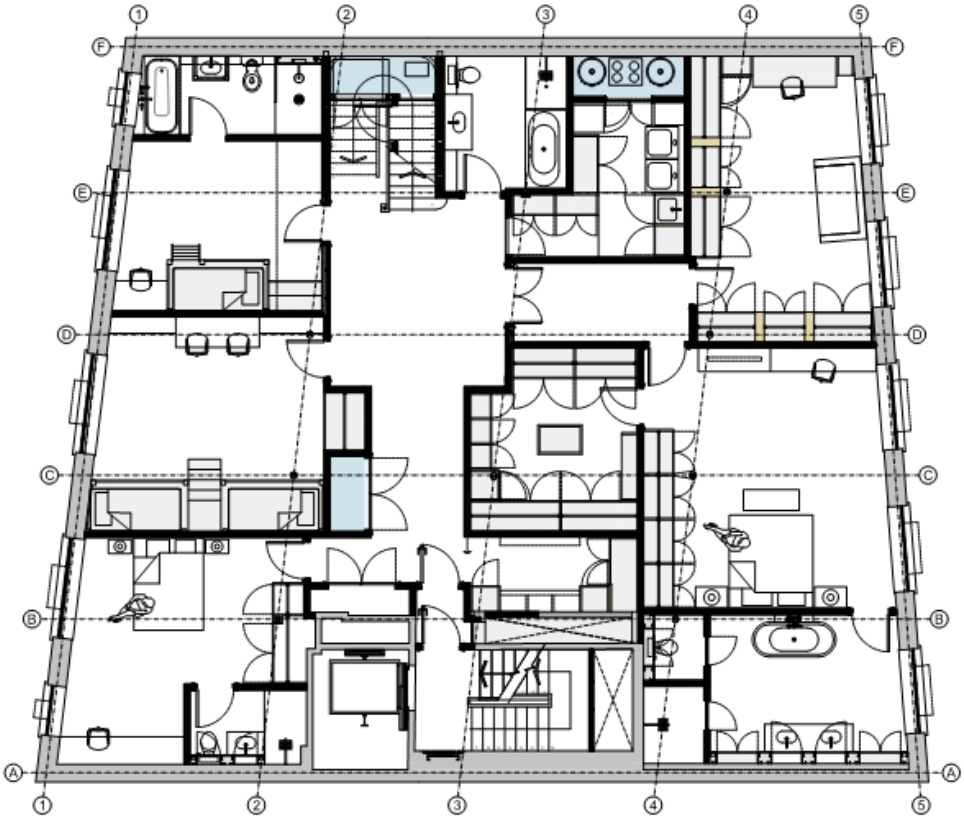
REVISION HISTORY

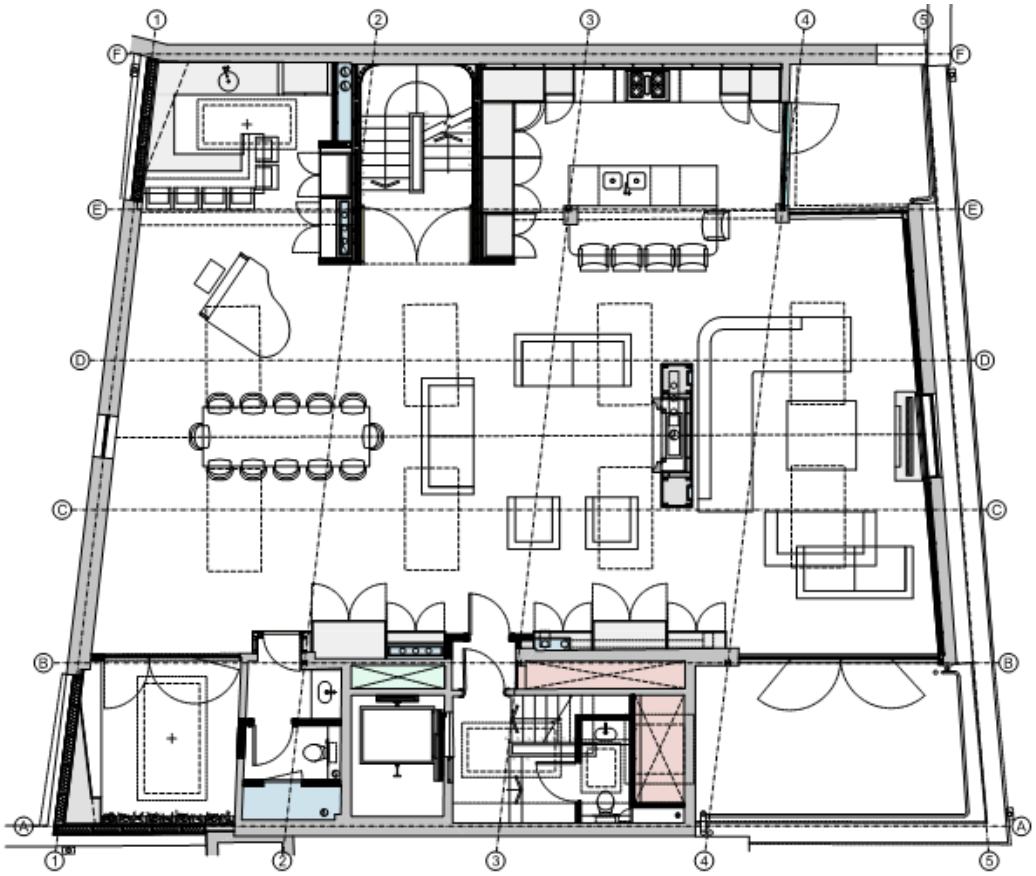
Revision	Status	Date	Author	Reviewer	Approver
00	S4 – For information	04.04.2022	AE	PD	PD
01	S4 – For information	07.04.2022	AE	PD	PD
02	S4 – For information	12.04.2022	AE	PD	PD
03	S4 – For information	27.04.2022	AE	PD	PD
04	S4 – For information	04.10.2022	AE	PD	PD
05	S4 – BC Comments Response	21.10.2022	AE	PD	PD

1. INTRODUCTION

This report summarizes the findings from the assessment of overheating risk based on CIBSE thermal comfort **metric TM59: Design methodology for the assessment of overheating risk in homes** for the development of 25 Shelton Street. Testing has been carried out in support of Planning Application ref PP-10440208v1. This report demonstrates how following the steps of the cooling hierarchy of London Plan Policy SI.4, as outlined in the previously issued report *Proposed Overheating and Cooling Statement* (02.03.2022), has been tested using a dynamic thermal model as evidence for the need of mechanical cooling within the development. As results show, having followed the steps of the cooling hierarchy, mechanical cooling is still required in order to ensure all habitable rooms meet TM59 criteria. It is therefore proposed to utilise the highly efficient Mitsubishi PUMY-P200YKM2 air source heat pumps, selected to decarbonise the existing heating system, in cooling mode during summer months. Testing has been carried out using TAS modelling software.

The project consists of the refurbishment of a two-storey flat located in Covent Garden, London. The 5th floor houses the bedrooms, which faces south east onto Shelton Street and north west onto an internal courtyard. On the 6th floor is the open-plan living area.

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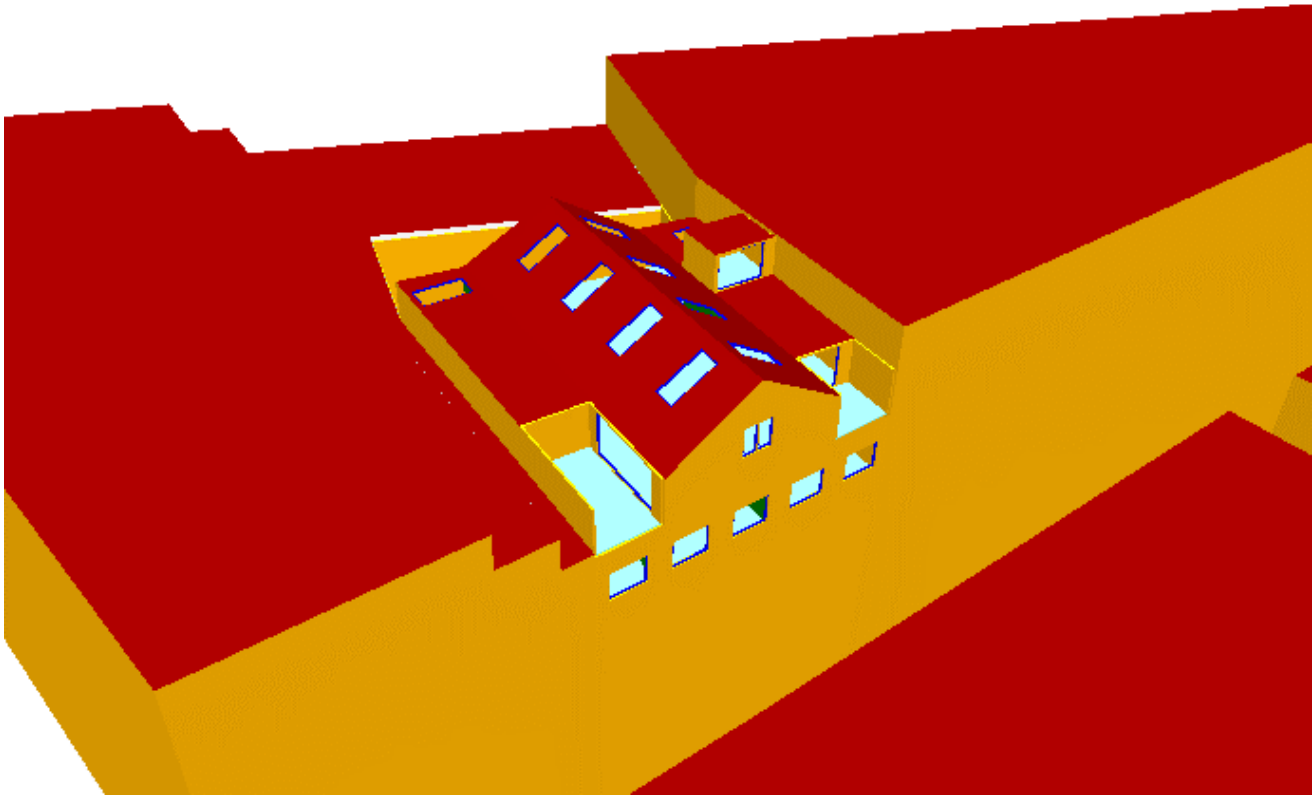
2. MODEL ASSUPTIONS

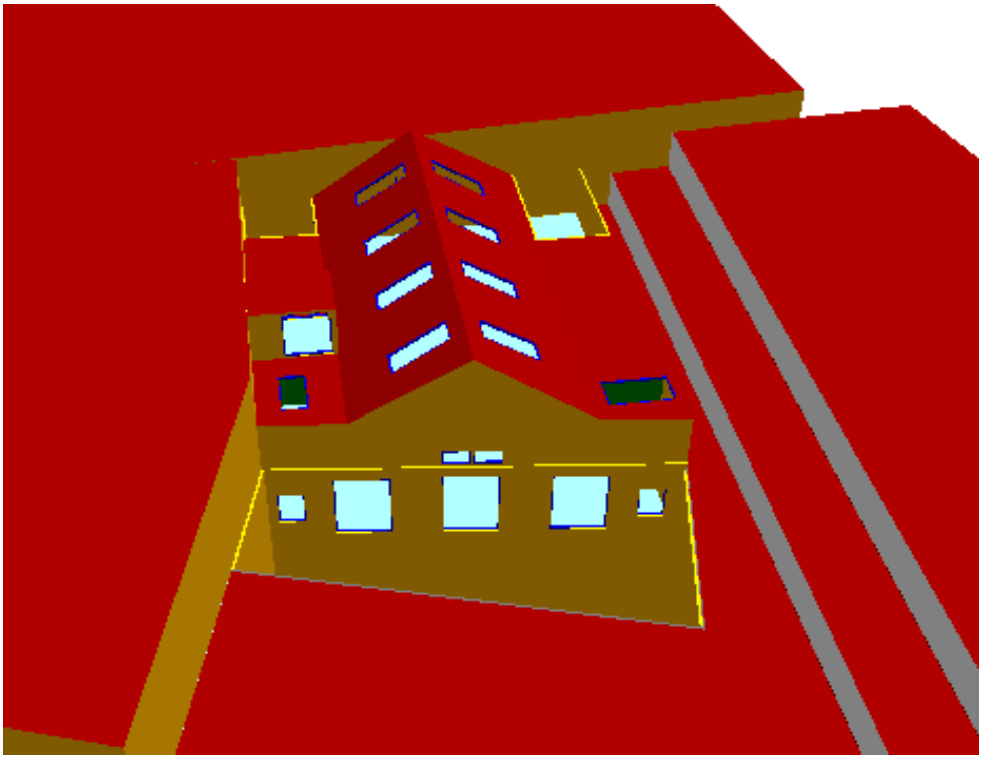
Layout and dimensions along with thermal fabric performance have been based on drawings and information received from theme2architects. External shading, such as overhangs, and surrounding architecture that will impact solar exposure have been included in the model. It is assumed with the refurbishment works carried out to improve the thermal fabric, no thermal mass is present within the development. Party walls and floors to neighbouring properties have been modelled as having an adiabatic interface meaning there is no heat transfer at these surfaces.

Glazing properties have been based on glazing specification received from the architect. It has been confirmed that, with the exception of terrace windows, all vertical windows are existing units and are not to be replaced. The existing windows have been assigned the same properties as the new double-glazed windows to be installed at terrace and balcony areas.

Building Element	**U-value (W/m^2K)**
External Wall	0.75
Roof	0.18

Glazing	**U_g-value (W/m^2K)**	**G-value**	**LT-value**
Double Glaze Windows	1.496	0.66	0.78
Rooflight	1.10	0.55	0.78





3. OVERHEATING

3.1. Relevant Policy

The planning requirements for developments in London to prevent overheating are set out in the London Plan. The London Plan states that residential developments should be assessed based **CIBSE thermal comfort metric TM59: Design methodology for the assessment of overheating risk in homes**. Compliance is based on passing both of the following two criteria:

1. The number of hours during which ΔT of indoor air temperature to outdoor is greater than or equal to one degree (K) during the period of May to September shall not exceed 3% of occupied hours.
2. For bedrooms only: to guarantee comfort during the sleeping hours the operative temperature in the bedroom from 10 pm to 7 am shall not exceed 26 °C for more than 1% of annual hours.

3.2. Climate Data

TM49: Design Summer Years for London, a predictive weather set based on an urban environment within London, adjusted for climate change has been used to model the selected apartments and investigate their future performance. The design summer years (DSY) for 2020 at a scenario of high emissions rate and 50th percentile have been used as the basis for testing. In certain cases. There are three weather files that represent different types of summers summarised as follows;

- DSY1: Moderately warm summer
- DSY2: Intense single warm spell
- DSY3: Long period of persistent warmth

3.3. Overheating Analysis

The development needs to comply with CIBSE TM59 criteria for DSY1 2020 50th percentile high emissions scenario. DSY2 and DSY3 for the same year and scenario have additionally been tested in order to determine their overheating resilience for a variety of summer heatwave types. The living/kitchen, reading room and bedrooms will need to show compliance by achieving Criteria 1 as previously stated. Additionally, the bedrooms will need to achieve Criteria 2.

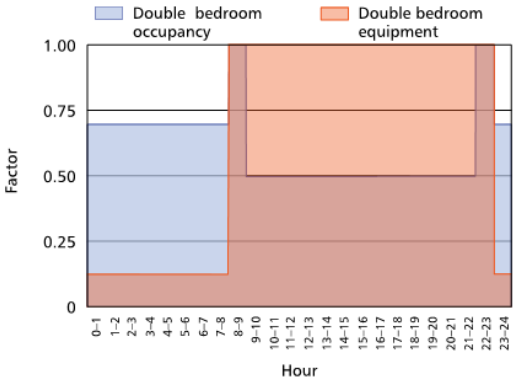
Occupancy and internal gains for the rooms tested have been based on TM59 profiles.

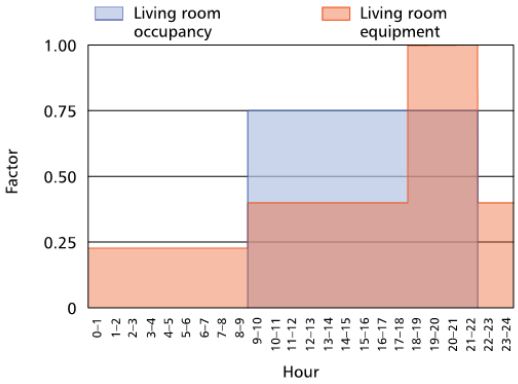
All bedrooms are modelled as double bedrooms. They are occupied by 2 people during night-time hours, during the day they are occupied by one individual. Occupancy gains are at 70% during sleeping hours due to the lower level of physical activity.

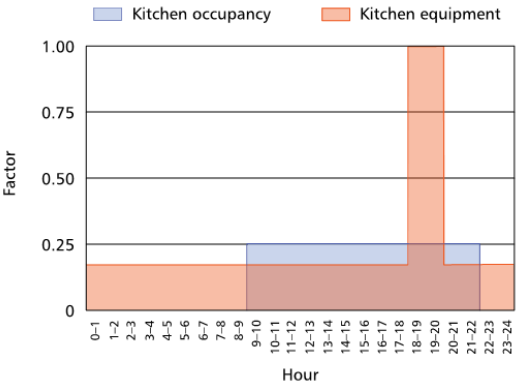
The open plan living/kitchen area has been modelled as a 5-bed apartment living/kitchen. This area has a maximum equipment gain of 450 W. The space is occupied by 5 people between 9am and 10pm.

The reading room has been modelled as occupied by 1 person throughout the day with a low and continuous equipment gain as seen in bedrooms.

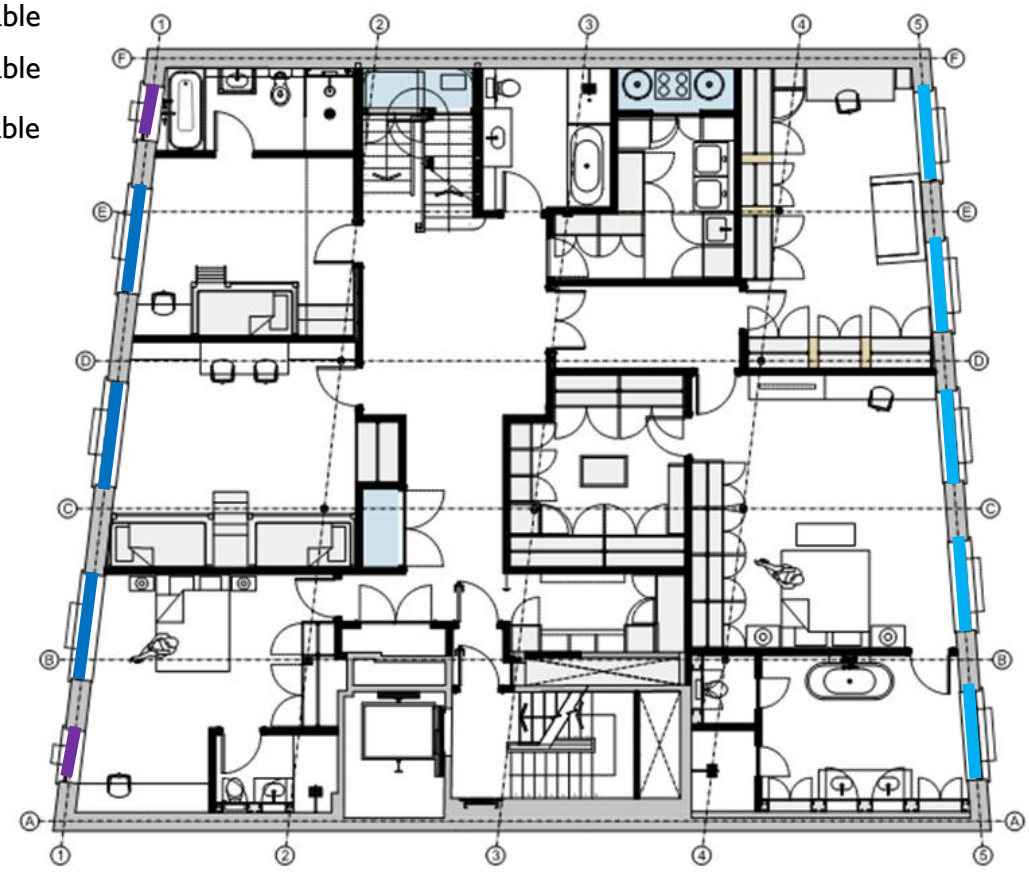
Glazing opening areas have been based on architectural drawings along with restrictions based on external noise and high drafts that would be caused by fully opening windows, especially at 6th floor. These opening equates to approximate openable area percentages on each elevation as shown in the figure below. The rooflights have been modelled as 15% openable. The windows have been modelled as being openable only during occupied hours for security reasons and when the internal temperature is above 22° C. The windows have been modelled as closed during night-time, in line with recommendations of the acoustic report produced for the project.



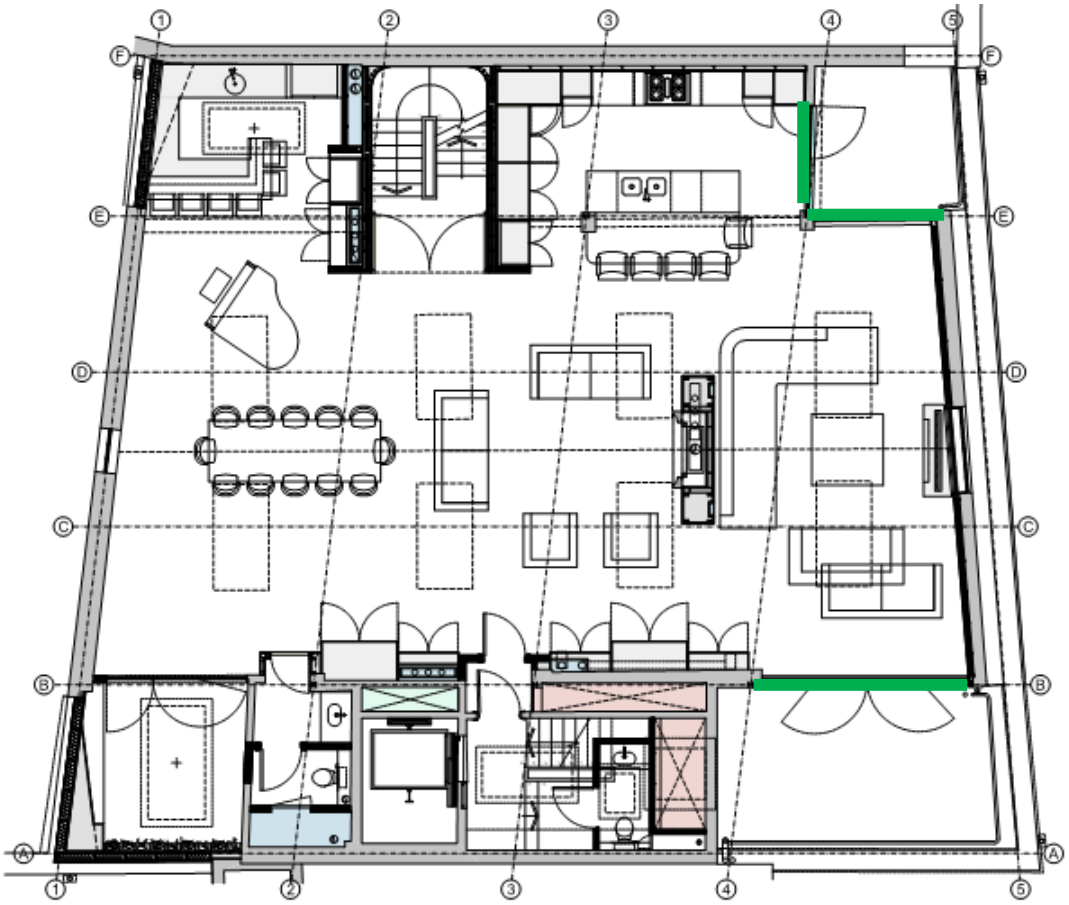




- 40% Openable
- 24% Openable
- 15% Openable



- 15% Openable



4. COOLING HIERARCHY

The development has been designed in line with the cooling hierarchy outlined in Policy SI4 Managing heat risk in the New London Plan. The following measures have been taken at each stage of the hierarchy in order to reduce the demand for cooling. Features of the site that will affect vulnerability to overheating have also been identified here.

Minimising Internal Heat Gains

Stage one of the Cooling Hierarchy is to minimise internal heat generation through energy efficient design.

Heat distribution infrastructure will be designed to minimise pipe lengths, ensuring pipework is well insulated and that pipe configurations minimise heat loss. Good daylighting and high efficiency light fittings with controls will also help to reduce excess heat gains from artificial lighting.

Reducing Heat Entering the Building

Due to it being an existing building the massing and location of glazing is already set. Rooflights and terrace windows will be improved and thermal fabric will be upgraded which will help reduce heat entering the building. Shading elements have been provided to the terraces limiting solar gains. The windows and rooflights shall make use of internal blinds in order to further reduce solar gains wherever possible.

Passive Ventilation

All habitable rooms have openable windows. The open plan living area will allow sufficient natural cross ventilation during occupied hours. The bedrooms are all single aspect units which will limit the effectiveness of natural ventilation. As previously stated, security and acoustic requirements will limit the reliance on natural ventilation. Bedrooms will not be able to keep windows open at night due to noise disturbance. The windows to the 6th floor living areas will need to remain closed during unoccupied hours for security and insurance reasons. Windows on the 6th floor can only be partially opened in order to avoid cross drafts within the space.

Mechanical Ventilation

The MVHR is to employ a summer bypass mode in order to maintain a comfortable internal environment.

Active Cooling

Due to the nature of the building and its use, the measures taken in the previous steps will not fully negate the need for active cooling as results show. It is therefore proposed to allow for mechanical cooling using the highly efficient Mitsubishi PUMY-P200YKM2 air source heat pumps in summer months.

5. RESULTS

As shown, the base model was tested for DSY 2020 weather scenarios. All living areas need to achieve an exceeded hours value of 59 or below, while bedrooms need to be below 110 hours to meet Criteria 1. The bedrooms need to additionally not exceed 32 hours for Criteria 2.

As can be seen, with the proposed design all rooms currently fail to achieve TM59 overheating criteria. This can be explained by the development's exposed setting and lack of thermal mass. The bedroom windows have relatively small openable areas and receive a high degree of afternoon sun. The rooms cannot utilise natural ventilation during night-time hours which explain their high rate of failure.

	DSY1 2020	
	Criteria 1	Criteria 2
	Hours Exceeded	Hours Exceeded
Living/Kitchen	257	-
Reading Room	445	-
Bedroom 1	580	663
Bedroom 2	402	627
Bedroom 3	406	623
Bedroom 4	407	591
Study Bedroom 5	273	-

The spaces have been further tested in accordance with the cooling hierarchy in order to determine if TM59 criteria can be met via passive measures alone. As seen, proposed improvements can help reduce overheating risk but not fully negate it due restrictions of window opening areas and schedule.

	Baseline		Internal Blinds	
	Criteria 1	Criteria 2	Criteria 1	Criteria 2
	Hours Exceeded	Hours Exceeded	Hours Exceeded	Hours Exceeded
Living/Kitchen	251	-	233	-
Reading Room	442	-	443	-
Bedroom 1	607	678	519	640
Bedroom 2	404	630	390	618
Bedroom 3	427	636	396	619
Bedroom 4	506	670	457	647
Study Bedroom 5	682	720	614	696

6. SUMMARY

Extensive testing has given a clear indication of each room's susceptibility to overheating. Due to the area of vertical glazing and rooflights, all areas are currently at risk of overheating.

Following the energy hierarchy, improvements have been considered which will help reduce overheating risk. However, the results show that with the potential improvements available, all rooms will still fail TM59 criteria. This is partly due the limitations of reliance on natural ventilation due to security and external noise risks. As also previously mentioned, it is believed that the overheating model does not account for heat rising up the building from apartments below and therefore underestimates the overheating risk in the living areas on the 6th floor and overheating risk would in reality be worse than what the already failing model is demonstrating.

Based on TM59 results, it is shown that all bedrooms will require mechanical cooling in order to ensure a comfortable indoor environment. Using internal blinds will help reduce overheating but all bedrooms fail Criteria 2 by a significant degree as night-time ventilation cannot be utilised. Overheating risk cannot be mitigated through passive measures for the upper floor living areas through passive measures alone. This is further highlighted when considering more onerous weather scenarios.

It is therefore necessary to allow for mechanical cooling in all habitable rooms to achieve a comfortable indoor environment and ensure the spaces will be able to cope with future summer temperatures. Cooling will be provided for the limited summer periods when it is needed using the proposed and highly efficient air source heat pumps installed to provide low-carbon heating.

7. APPENDIX

Overheating Results: Baseline

Domestic Overheating (CIBSE TM59)

Project Details

Building Designer File (.tbd): J3988 - Shelton Street_London_LWC_DSY1_2020High50.tbd

Simulation Results File (.tsd): J3988 - Shelton Street_London_LWC_DSY1_2020High50.tsd

Date: 21 October 2022

Building Category: Category II

Natural Ventilation Overheating Results

Zone Name	Room Use	Wind Speed (m/s)	Occupied Summer Hours	Max. Exceedable Hours	Criterion 1: #Hours Exceeding Comfort Range	Annual Night Occupied Hours for Bedroom	Max Exceedable Night Hours	Criterion 2: Number of Night Hours Exceeding 26 °C for Bedrooms .	Result
5th - Ante Room	Other	0.1	0	0	0	N/A	N/A	N/A	Pass
5th - Bathroom 01	Other	0.1	0	0	0	N/A	N/A	N/A	Pass
5th - Bathroom 03	Other	0.1	0	0	0	N/A	N/A	N/A	Pass
5th - Bathroom 04	Other	0.1	0	0	0	N/A	N/A	N/A	Pass
5th - Bedroom 01	Bedroom	0.1	3672	110	607	3285	32	678	Fail
5th - Bedroom 02	Bedroom	0.1	3672	110	404	3285	32	630	Fail
5th - Bedroom 03	Bedroom	0.1	3672	110	427	3285	32	636	Fail
5th - Bedroom 04	Bedroom	0.1	3672	110	506	3285	32	670	Fail
5th - Boot Room	Other	0.1	0	0	0	N/A	N/A	N/A	Pass
5th - Dressing Room	Other	0.1	0	0	0	N/A	N/A	N/A	Pass
5th - Entrance Hall	Other	0.1	0	0	0	N/A	N/A	N/A	Pass
5th - Inner Hall	Other	0.1	0	0	0	N/A	N/A	N/A	Pass
5th - Laundry Utility	Other	0.1	0	0	0	N/A	N/A	N/A	Pass
5th - Plant	Other	0.1	0	0	0	N/A	N/A	N/A	Pass
5th - Shower Room 02	Other	0.1	0	0	0	N/A	N/A	N/A	Pass
5th - Study Bedroom 05	Bedroom	0.1	3672	110	682	3285	32	720	Fail
6th - Circulation	Other	0.1	0	0	0	N/A	N/A	N/A	Pass
6th - Living/Kitchen	Other	0.1	1989	59	251	N/A	N/A	N/A	Fail
6th - Plant	Other	0.1	0	0	0	N/A	N/A	N/A	Pass
6th - Reading Room	Other	0.1	1989	59	442	N/A	N/A	N/A	Fail
6th - Staircase 02	Other	0.1	0	0	0	N/A	N/A	N/A	Pass
6th - WC	Other	0.1	0	0	0	N/A	N/A	N/A	Pass
7th - Staircore 02	Other	0.1	0	0	0	N/A	N/A	N/A	Pass

*Zone names that have an orange coloured font are bedrooms which do not have 24/7 365 days a year occupancy, as per the TM59 guidance.

Overheating Results: Internal Blinds

Domestic Overheating (CIBSE TM59)

Project Details

Building Designer File (.tbd): J3988 - Shelton Street_London_LWC_DSY1_2020High50.tbd

Simulation Results File (.tsd): J3988 - Shelton Street_London_LWC_DSY1_2020High50.tsd

Date: 21 October 2022

Building Category: Category II

Natural Ventilation Overheating Results

Zone Name	Room Use	Wind Speed (m/s)	Occupied Summer Hours	Max. Exceedable Hours	Criterion 1: #Hours Exceeding Comfort Range	Annual Night Occupied Hours for Bedroom	Max Exceedable Night Hours	Criterion 2: Number of Night Hours Exceeding 26 °C for Bedrooms .	Result
5th - Ante Room	Other	0.1	0	0	0	N/A	N/A	N/A	Pass
5th - Bathroom 01	Other	0.1	0	0	0	N/A	N/A	N/A	Pass
5th - Bathroom 03	Other	0.1	0	0	0	N/A	N/A	N/A	Pass
5th - Bathroom 04	Other	0.1	0	0	0	N/A	N/A	N/A	Pass
5th - Bedroom 01	Bedroom	0.1	3672	110	519	3285	32	640	Fail
5th - Bedroom 02	Bedroom	0.1	3672	110	390	3285	32	618	Fail
5th - Bedroom 03	Bedroom	0.1	3672	110	396	3285	32	619	Fail
5th - Bedroom 04	Bedroom	0.1	3672	110	457	3285	32	647	Fail
5th - Boot Room	Other	0.1	0	0	0	N/A	N/A	N/A	Pass
5th - Dressing Room	Other	0.1	0	0	0	N/A	N/A	N/A	Pass
5th - Entrance Hall	Other	0.1	0	0	0	N/A	N/A	N/A	Pass
5th - Inner Hall	Other	0.1	0	0	0	N/A	N/A	N/A	Pass
5th - Laundry Utility	Other	0.1	0	0	0	N/A	N/A	N/A	Pass
5th - Plant	Other	0.1	0	0	0	N/A	N/A	N/A	Pass
5th - Shower Room 02	Other	0.1	0	0	0	N/A	N/A	N/A	Pass
5th - Study Bedroom 05	Bedroom	0.1	3672	110	614	3285	32	696	Fail
6th - Circulation	Other	0.1	0	0	0	N/A	N/A	N/A	Pass
6th - Living/Kitchen	Other	0.1	1989	59	233	N/A	N/A	N/A	Fail
6th - Plant	Other	0.1	0	0	0	N/A	N/A	N/A	Pass
6th - Reading Room	Other	0.1	1989	59	443	N/A	N/A	N/A	Fail
6th - Staircase 02	Other	0.1	0	0	0	N/A	N/A	N/A	Pass
6th - WC	Other	0.1	0	0	0	N/A	N/A	N/A	Pass
7th - Staircore 02	Other	0.1	0	0	0	N/A	N/A	N/A	Pass

*Zone names that have an orange coloured font are bedrooms which do not have 24/7 365 days a year occupancy, as per the TM59 guidance.