24 JOHN STREET

OVERHEATING REPORT FOR PLANNING WITH TM59 ANALYSIS – REV 04

(INCLUDING INTERNAL BLINDS)

Allwood Design

06/12/24 Rev 04

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EXECUTIVE SUMMARY

Revision 04 Summary - Following comments on the planning submission, the model has been updated to include internal blinds in each occupied space. The model has also been updated to accurately reflect the internal heat gains in the study, which is used workspace. In this scenario, the bedrooms on the upper floors and the study fail to pass the industry standards TM59 and TM52. Active cooling is required to provide a comfortable living and working environment.

A refurbishment is planned at 24 John Street, a Georgian Grade II listed townhouse in Bloomsbury. The works will improve the fabric of the property, reduce energy usage, and increase the occupants' comfort. It will do this whilst being sensitive to the heritage of the listed building, enhancing its character and protecting its longevity.

As part of the work, an analysis was completed to assess the overheating risk. The analysis aligns with the Chartered Institute of Building Services Engineer's (CIBSE) guidance for domestic properties; TM 59. It also follows the requirements of the Camden Local Plan and the London Plan.

The analysis has demonstrated that, after following the requirements of the Cooling Hierarchy, the building is failing TM 59 as all bedrooms on the two upper floors will overheat unless Active Cooling is introduced. Therefore, active cooling is proposed to maintain comfortable internal temperatures throughout the year and to mitigate against the risk of future climate change in the Master Bedroom and Bedrooms 1-3. Active cooling is not proposed in the Study as it is now shown to pass TM59.

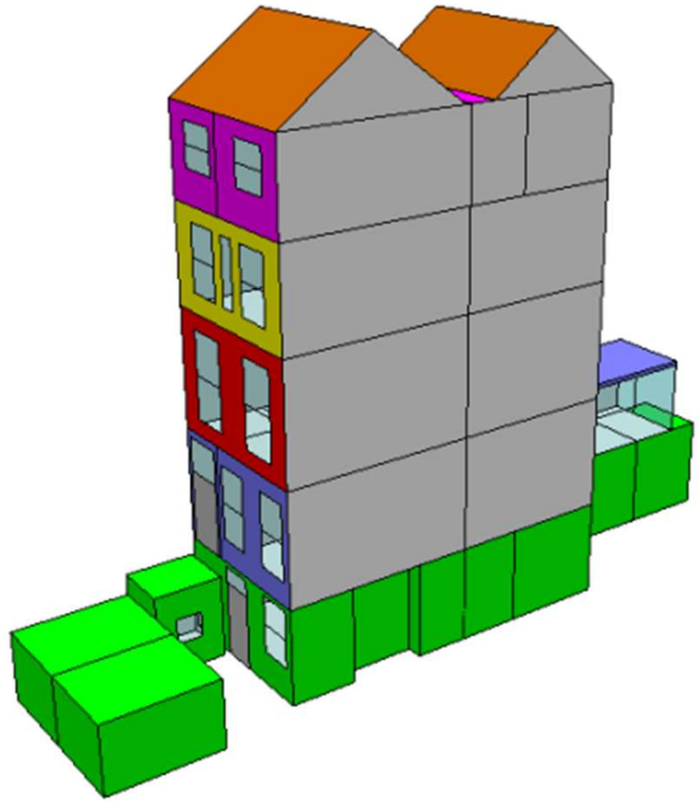


Figure I: IES model screenshot of the proposed development

RESULTS SUMMARY

The results of the analysis are shown in the four tables shown opposite.

Table 4.1.1 shows that with the passive measures and natural ventilation, all spaces are failing TM52 and TM59, except the basement kitchen and living space. The building does not meet the industry standard comfort criteria.

Table 4.2.1 shows that once mechanical ventilation is included, whilst there is some improvement on the TM52 criteria, the same spaces still fail TM59. The building does not meet the industry standard comfort criteria and further measures are required.

Table 4.3.1 shows the results once internal blinds are introduced, as required by the planners. In this scenario, whilst there are improvements against the TM52 standards, the bedrooms all fail the crucial TM59 criteria. The study now passes the TM59 criteria but still fails the TM52 criteria, which as a workspace it is required to pass. The building does not meet the industry standard comfort criteria and further measures are required.

Table 4.4.1 shows that only once active cooling is introduced into the bedrooms and study do they pass the TM59/52 criteria, as such active cooling is proposed in the Master Bedroom, Bedrooms 1, 2 and 3 and the study. Only then will the property meet the required industry standard comfort criteri.

4.1.1 Results – DSY1 2020 Weather Data – Natural Ventilation

	TM52				TM59	
	Criterion 1	Criterion 2	Criterion 3	Pass/ Fail	Bedrooms Only Criterion	Pass/ Fail
1F - Main Living	25.5	61	6	FAIL	N/A	FAIL
1F - Study	56	87	12	FAIL	N/A	N/A
2F - Master Bedroom	6.8	52	4	FAIL	277	FAIL
3F - Bedroom 1	4.7	46	5	FAIL	385	FAIL
3F - Bedroom 2	3.9	42	4	FAIL	349	FAIL
3F - Bedroom 3	10.4	83	6	FAIL	520	FAIL
GF - Dining	17.8	51	5	FAIL	N/A	FAIL
GF - Kitchen	27.1	63	7	FAIL	N/A	FAIL
GF - Sun Room	8.1	49	7	FAIL	N/A	FAIL
LGF - Bedroom	1.3	21	3	PASS	169	FAIL
LGF - Kitchen	0.3	2	1	PASS	N/A	PASS
LGF - Living Room	1	7	1	PASS	N/A	PASS

Table 3: *TM59 Results Using DSY1 2020 Weather Data, Natural Ventilation*

4.2.1 Results – DSY1 2020 Weather Data – Natural & Mechanical Ventilation

	TM52				TM59	
	Criterion 1	Criterion 2	Criterion 3	Pass/ Fail	Bedrooms Only Criterion	Pass/ Fail
1F - Main Living	13	45	5	FAIL	N/A	FAIL
1F - Study	35.7	66	10	FAIL	N/A	N/A
2F - Master Bedroom	3.3	32	4	FAIL	141	FAIL
3F - Bedroom 1	3.2	36	4	FAIL	263	FAIL
3F - Bedroom 2	2.2	31	4	PASS	206	FAIL
3F - Bedroom 3	6.9	60	5	FAIL	362	FAIL
GF - Dining	8.6	39	5	FAIL	N/A	FAIL
GF - Kitchen	16.5	48	6	FAIL	N/A	FAIL
GF - Sun Room	7.7	46	6	FAIL	N/A	FAIL
LGF - Bedroom	1	20	3	PASS	101	FAIL
LGF - Kitchen	0.3	2	1	PASS	N/A	PASS
LGF - Living Room	0.8	5	1	PASS	N/A	PASS

Table 4: *TM59 Results Using DSY1 2020 Weather Data, Natural & Mechanical Ventilation*

4.3.1 Results – DSY1 2020 Weather Data – Natural & Mechanical Ventilation with Blinds

	TM52				TM59	
	Criterion 1	Criterion 2	Criterion 3	Pass/ Fail	Bedrooms Only Criterion	Pass/ Fail
1F - Main Living	5	29	4	FAIL	N/A	FAIL
1F - Study	9.2	27	6	FAIL	N/A	N/A
2F - Master Bedroom	0.4	7	1	PASS	64	FAIL
3F - Bedroom 1	1.2	22	3	PASS	135	FAIL
3F - Bedroom 2	0.8	18	3	PASS	107	FAIL
3F - Bedroom 3	1.4	24	3	PASS	157	FAIL
GF - Dining	4.1	27	4	FAIL	N/A	FAIL
GF - Kitchen	8.5	31	5	FAIL	N/A	FAIL
GF - Sun Room	3.1	30	4	FAIL	N/A	FAIL
LGF - Bedroom	0.5	13	2	PASS	65	FAIL
LGF - Kitchen	0.1	1	1	PASS	N/A	PASS
LGF - Living Room	0.1	2	1	PASS	N/A	PASS

Table 5: *TM59 Results Using DSY1 2020 Weather Data, Natural & Mechanical Ventilation*

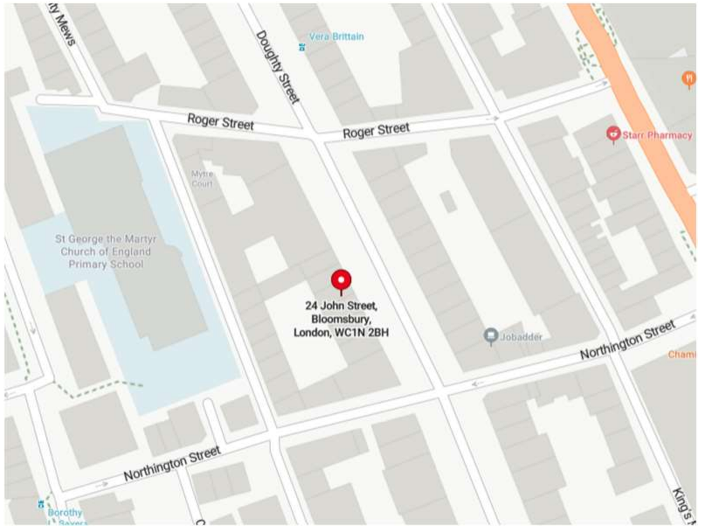
4.4.1 Results – DSY1 2020 Weather Data – Natural & Mechanical Ventilation with Cooling

	TM52				TM59	
	Criterion 1	Criterion 2	Criterion 3	Pass/ Fail	Bedrooms Only Criterion	Pass/ Fail
1F - Main Living	0	0	0	PASS	N/A	PASS
1F - Study	0	0	0	PASS	N/A	N/A
2F - Master Bedroom	0	0	0	PASS	0	PASS
3F - Bedroom 1	0	0	0	PASS	0	PASS
3F - Bedroom 2	0	0	0	PASS	0	PASS
3F - Bedroom 3	0	0	0	PASS	0	PASS
GF - Dining	0	0	0	PASS	N/A	PASS
GF - Kitchen	0	0	0	PASS	N/A	PASS
GF - Sun Room	2.8	17	4	PASS	N/A	PASS
LGF - Bedroom	0	0	0	PASS	2	PASS
LGF - Kitchen	0	0	0	PASS	N/A	PASS
LGF - Living Room	0.1	2	1	PASS	N/A	PASS

Table 6: *TM59 Results Using DSY1 2020 Weather Data, Natural & Mechanical Ventilation with Cooling*

PROJECT CONTEXT

Allwood Design Ltd was appointed to conduct an overheating analysis at 24 John Street. The property is a Grade II listed townhouse in the heart of Bloomsbury. Hugh Cullum Architects are designing a sensitive refurbishment of the property to improve the living accommodation whilst retaining the heritage and respecting the building’s listing.



An important part of the work is improving the comfort of the home. The bedrooms on the top floors and the study overheat significantly in the summer months, and portable AC units have been required to make them usable spaces. Given the impact of climate change, this issue is only likely to worsen without adaptation and intervention.

Significant improvements and restoration are planned for the building's fabric and photovoltaic panels are proposed; however, given the project's heritage nature, limited impact can be made on heat gain and overheating risk. The overheating hierarchy has been followed, and an overheating analysis has been carried out, demonstrating a need for cooling. An active cooling system is proposed for the four bedrooms on the upper floors and the Study. The Study is used as a place of work and TM52 criteria apply.

It is proposed to locate the external unit for the cooling system on the property’s roof, hidden from view and shielded to avoid acoustic issues. There is good access to the roof from an existing staircase for unit maintenance.

PLANNING POLICY

The following planning policies from the Camden Local Plan and the London Plan apply to the overheating analysis:

Camden Local Plan, Policy CC2 Adapting to Climate Change, Clause d, 8.41-8.43

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.

London Plan, Policy SI 4 Managing heat risk, B, adherence to the 'Cooling Hierarchy'

Policy SI 4 Managing heat risk

A Development proposals should minimise adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure.

B Major development proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with 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.

9.4.1 Climate change means London is already experiencing higher than historic average temperatures and more severe hot weather events. This, combined with a growing population, urbanisation and the urban heat island effect, means that **London must manage heat risk** in new developments, using the cooling hierarchy set out above. Whilst the cooling hierarchy applies to major developments, the principles can also be applied to minor development.

9.4.2 In managing heat risk, new developments in London face two challenges – the need to ensure London does not overheat (the urban heat island effect) and the need to ensure that individual buildings do not overheat. **The urban heat island effect** is caused by the extensive built up area absorbing and retaining heat during the day and night leading to parts of London being several degrees warmer than the surrounding area. This can become problematic on the hottest days of the year as daytime temperatures can reach well over 30°C and not drop below 18°C at night. These circumstances can lead many people to feel too hot or not be able to sleep, but for those with certain health conditions, and 'at risk' groups such as some young or elderly Londoners, the effects can be serious and worsen health conditions. Green infrastructure can provide some mitigation of this effect by shading roof surfaces and through evapotranspiration. Development proposals should incorporate green infrastructure in line with Policy G1 Green infrastructure and Policy G5 Urban greening.

9.4.3 Many aspects of building design can lead to increases in overheating risk, including high proportions of glazing and an increase in the air tightness of buildings. Single-aspect dwellings are more difficult to ventilate naturally and are more likely to overheat, and should normally be avoided in line with Policy D6 Housing quality and standards. There are a number of low-energy measures that can **mitigate overheating risk**. These include solar shading, building orientation and solar-controlled glazing. Occupant behaviour will also have an impact on overheating risk. The Mayor's London Environment Strategy sets out further detail on actions being taken to address this.

9.4.4 Passive ventilation should be prioritised, taking into account external noise and air quality in determining the most appropriate solution. The increased use of **air conditioning systems** is not desirable as these have significant energy requirements and, under conventional operation, expel hot air, thereby adding to the urban heat island effect. If active cooling systems, such as air conditioning systems, are unavoidable, these should be designed to reuse the waste heat they produce. Future district heating networks are expected to be supplied with heat from waste heat sources such as building cooling systems.

9.4.5 The Chartered Institution of Building Services Engineers (CIBSE) has produced **guidance on assessing and mitigating overheating risk in new developments**, which can also be applied to refurbishment projects. TM 59 should be used for domestic developments and TM 52 should be used for non-domestic developments. In addition, TM 49 guidance and datasets should also be used to ensure that all new development is designed for the climate it will experience over its design life. Further information will be provided in guidance on how these documents and datasets should be used.

RESPONSE TO PLANNING POLICY

In line with the planning policy, the principles of the cooling hierarchy have been applied:

1) Minimise external heat entering

Whilst the orientation and massing of the building cannot be changed, insulation is being added to the loft to minimise heat loss and gain. Windows will be refurbished and draught-proofed. The modelling has also included secondary glazing to demonstrate that even with it included the building spaces do not pass TM59/52.

An external roller blind was proposed for planning to the rear window on the outrigger; however, this proposal was not accepted based on the heritage nature of the building. External blinds are therefore not proposed.

Internal blinds have now been included in the model in all spaces. Venetian-type blinds have been modelled to allow the ventilation air path to be retained whilst the blinds are shut as required.

2) Minimise Internal Heating Gain

Energy-efficient appliances and LED lighting will be used to minimise internal heat gains.

3) Exposed Thermal Mass and Ceiling Heights

No change can be made to the orientation, thermal mass and ceiling heights

4) Passive Ventilation

Whilst the ventilation openings cannot be increased, the existing sash windows are being refurbished to ensure the opening mechanisms provide the maximum level of passive ventilation

5) Mechanical Ventilation

Localised mechanical ventilation upgrades are provided to WCs, Kitchens and humid spaces as required. Centralised Mechanical Ventilation with Heat Recovery is not feasible for the main house as part of the scheme as the duct route cannot be accommodated in the existing listed building.

6) Active Cooling

The measures 1-5 above have been modelled in the overheating analysis. Even once these improvements are made, the building is shown to be failing TM 59 and TM52. This is demonstrated in detail in the overheating thermal model carried out by Sustainable Construction Design and appended to this report.

The results demonstrate that after following the Energy Hierarchy, Active cooling is required to provide a comfortable living and working environment.

APPENDIX – OVERHEATING ANALYSIS

The following overheating analysis has been carried out by Sustainable Construction Design. It is carried out to TM 59 as required for Domestic properties by the London Plan. It demonstrates that the property maintains a comfortable temperature only after introducing active cooling.

Following comments on the planning application , the modelling has been updated to include internal blinds in all occupied spaces.

24 John St., Camden

Thermal Comfort Report

SCS Ref: 32430

For:

Allwood Design

Prepared by:

Colin Ryan

Sustainable Construction Services

Revision record

Description	Version	Date	By	Reviewed
Thermal Comfort Report	V1	02/02/24	CR	AW
Thermal Comfort Report	V2	07/02/24	CR	AW
Thermal Comfort Report	V3	28/10/24	CR	AW
Thermal Comfort Report	V4	03/12/24	CR	LT
Thermal Comfort Report	V5	05/12/24	CR	LT

TABLE OF CONTENTS

1. INTRODUCTION

The purpose of this report is to convey the results from the analysis of the thermal comfort performance of a Grade II listed Georgian Townhouse within 24 John St., London. Specifically this report summarises the work undertaken to review the level of overheating that may occur in spaces that are regularly occupied for significant periods of time. This report also includes further iterations modelling internal blinds and their impact on compliance within the assessment.

The proposed development comprises a four storey dwelling. The temperature conditions occurring in these spaces have been compared against the standards described in the CIBSE TM59 document 'methodology for the assessment of overheating risk in homes'. The analysis has been carried out on behalf of Allwood Design

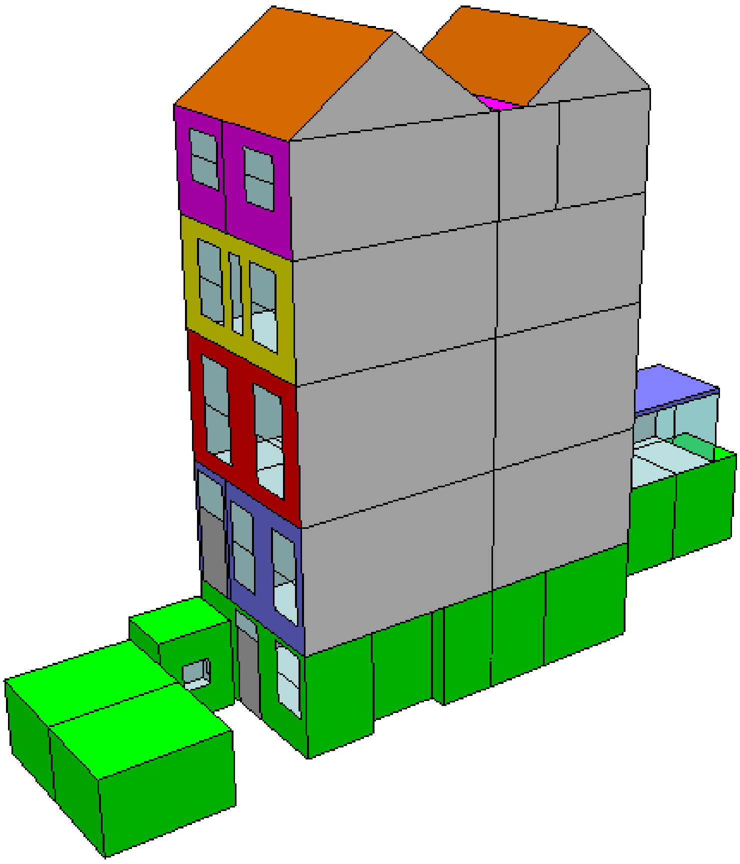


Figure 1: IES model screenshot of the proposed development

2. METHODOLOGY

2.1 SOFTWARE

The analysis summarised in this report has been performed using IES software which provides full dynamic thermal analysis. This analysis has been carried out in accordance with user instructions set out in IES manuals and CIBSE AM11 Building Energy and Environmental Modelling.

Where possible, modelling data and inputs have been taken from the architectural drawings, supplementary data (detailing the construction materials and the ventilation strategy) or written instructions from the design team. Where no data has been provided, outline estimations have been made and recorded in this document for review and analysis.

This analysis has been undertaken using the detailed dynamic thermal simulation program ApacheSIM (IESVE, 2023) to predict the building's environmental performance.

Solar Penetration Analysis was performed using Suncast (IESVE, 2023). Suncast enhances the thermal analysis by its prediction of solar gains, using the geometric relationship between the proposed building and the sun. Suncast also takes into consideration and shading associated with adjacent buildings and landscape features.

Bulk airflow models (Macroflo), within the IES software suite, were used to predict ventilation rates from openable windows.

2.2 WEATHER FILE SELECTION

The latest CIBSE weather files have been selected based on TM59 recommended 2020's CIBSE Design Summer Year (DSY) dataset. As part of this dataset there are three separate DSY scenarios available for various sites in the UK which represent the following:

- DSY 1 – Moderate
  - Represents a moderately warm summer year.
- DSY 2 – Intense
  - Represents a warming event about the same length as the moderate summer year but with a greater intensity.
- DSY 3 – Long
  - Represents a year with a less intense extreme than the DSY 2 but more intense extreme than DSY 1 and lasting for a longer duration.

Best guidance suggests that for the purposes of modelling currently proposed developments as a minimum the DSY1 2020's weather files should be tested against.

TM59 states that the minimum requirement is that a DSY1 weather file should be used. This is the primary condition modelled in this study.

Guidance in TM59 suggests modelling of future weather files should only occur in circumstances where the client deems it appropriate, or they have a particular concern such as vulnerable occupants.

As a requirement of the Greater London Authority (GLA) as a minimum the DSY1 2020's weather files should be tested against and achieve compliance with CIBSE TM52 and TM59 criteria. The London Heathrow weather file was used for the development, in line with CIBSE TM49.

DSY2 and DSY3 2020 weather files are also required to be tested against for the purposes of reporting to the GLA, however compliance with CIBSE TM52 and TM59 criteria is not necessary.

2.3 CIBSE TM59 GUIDANCE / APPROVED DOCUMENT PART O

The 2017 CIBSE TM59 document 'Design methodology for the assessment of overheating risk in homes' is the main point of reference for establishing the overheating criteria used in this report. The contents of this document set out a standardised approach to predicting overheating risk for residential building design using dynamic thermal analysis.

This document provides a few assumptions associated with internal gains and occupancy usage patterns to enable a common approach across the industry. The details modelled in this study relating these aspects are provided for reference in this report (see Section 3 & Appendix 2).

TM59 sets out different thermal comfort assessment criteria depending on the room function type and the ventilation strategy in each space. The different criteria are set out below:

2.3.1 Criteria for Homes Predominantly Naturally Ventilated

a) For living rooms, kitchens and bedrooms: the number of hours during which operative temperature is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3 per cent of occupied hours. (CIBSE TM52 Criterion 1: Hours of exceedance).(see section 2.4 for more detail)

a) 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. (Note: 1% of the annual hours between 22:00 and 07:00 for bedrooms is 32 hours, so 33 or more hours above 26 °C will be recorded as a fail).

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.

2.3.2 Criteria for Homes Predominantly Mechanically Ventilated

For homes with restricted window openings, the CIBSE fixed temperature test must be followed, i.e. all occupied rooms should not exceed an operative temperature of 26 ˚C for more than 3% of the annual occupied annual hours (CIBSE Guide A [2015a]).

2.3.3 Criteria for Corridors

TM59 states that the overheating test for corridors should be based on the number of annual hours for which an operative temperature of 28 °C is exceeded. Whilst there is no mandatory target, if an operative temperature of 28 °C is exceeded for more than 3% of total annual hours, this should be flagged as a significant risk within the report.

2.3.4 Approved Document Part O – Limits on TM59

Approved Document Part O assessment is a new Building Regulation requirement for residential developments which sets the following limits along with TM59:

The limits on CIBSE TM59 modelling are detailed below:

'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°.

ii. Be fully open when the internal temperature exceeds 26°.

iii. Start to close when the internal temperature falls below 26°.

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 on 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.

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 at all time.'

Additionally, internal blinds and curtains should not be included in the Part O assessment, however Camden Council have requested that internal blinds are included in this iteration of the model and report.

2.4 TM52: ADAPTIVE THERMAL COMFORT CRITERIA

Overheating within the occupied spaces in this building have been evaluated against the first criterion set out within CIBSE TM52 'The Limits of Thermal Comfort: Avoiding Overheating in European Buildings'.

Rather than purely focussing on the number of hours 'out of range', TM52 looks at how likely someone is to be "comfortable". Simplistically this is trying to estimate what most people might feel, most of the time. All 'occupied' rooms within the proposed building have been analysed in this study occupied rooms are typically those occupied for more than 30 minutes at a time.

Although there are three criteria that CIBSE TM52 assesses, section 4.2 of TM59 states that compliance only needs to be met with TM52 Criterion 1, a description of this criterion is provided below:

A brief description of each of the three TM52 criteria are as follows:

2.4.1 Criterion 1

The first criterion sets a limit for the number of hours that the operative temperature can exceed the threshold comfort temperature (upper limit of the range of comfort temperature) by 1 K (i.e. 1 °C) or more during the occupied hours of a typical non-heating season (1 May to 30 September).

2.4.2 Criterion 2

The second criterion deals with the severity of overheating within any one day, which can be as important as its frequency, the level of which is a function of both temperatures rise and its duration. This criterion sets a daily limit for acceptability. This performance is calculated using a non-linear, non-unitised calculation that is derived from each day's temperature data. The calculation produces a score, and if this score is below the numerical number of six, compliance with this criterion is achieved.

The figure of six was derived from research and statistical analysis of the data to define what most people thought was acceptable most of the time.

2.4.3 Criterion 3

The third criterion sets an absolute maximum daily temperature for a room, beyond which the level of overheating is unacceptable.

2.5 PLANNING AND LOCAL POLICIES

Under legislation establishing the GLA, a London Spatial Development Strategy known as the London plan is an overall strategic plan for London that sets out an integrated economic, environmental, transport and social framework for the development of London. In accordance with the legislation the Plan regards to climate change and the consequence of climate change, and sustainable infrastructure.

Several policies are outlined in the London Plan, with Policy SI 4 Managing heat risk relevant to this development assessment. Policy SI 4 Managing heat risk requires that developments should minimise adverse impacts on the urban heat island through good design and construction practices. It suggests that major developments demonstrate reduction of potential overheating in accordance with the cooling hierarchy, shown below:

- Reduction in the amount of heat entering a building through use of orientation, shading, materials, fenestration, insulation or green infrastructure
- Minimisation of internal heat generation
- Management of heat within the building through use of exposed internal mass and high ceilings.
- Passive ventilation
- Mechanical ventilation
- Active cooling

The Camden Local Plan also sets out the Council's planning policies and replaces the Core Strategy and Development Policies adopted in 2010, with the goal of ensuring Camden has a robust, effective, and up-to-date planning policies. It is also in general conformity with the London Plan.

To achieve its aim of making Camden a better borough, the Camden Local Plan contains a set of strategic objectives and planning policies. Strategic Objective 9, ensuring the development in Camden is designed to adapt to the effects of climate change, is identified as relevant to this assessment, along with The Camden Local Plan Policy CC2 Adapting to climate change.

Within Plan Policy CC2, overheating is a key risk identified which requires adaptation measures. Policy CC2 Adapting to climate change suggests that all developments adopt adaptation measures to reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy.

3. MODELLING DATA

3.1 MODEL IMAGES

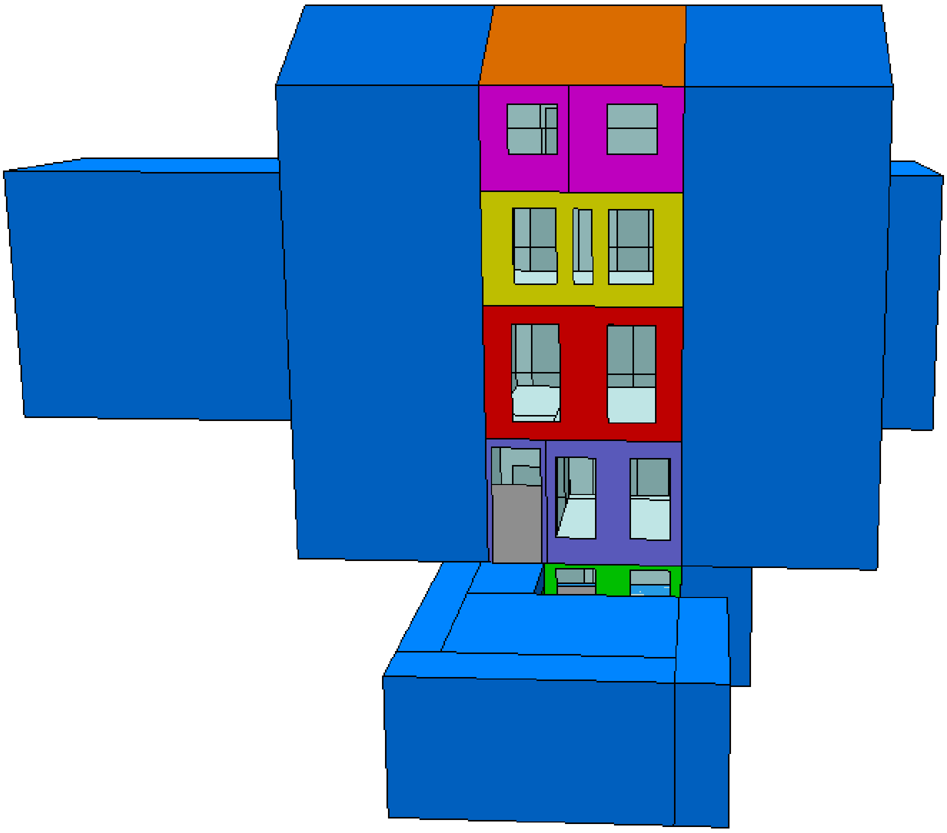


Figure 2: IES model screenshot

3.2 BASIC THERMAL MODELLING ASSUMPTIONS

3.2.1 Spaces assessed

The proposed development contains five bedrooms, two living rooms, a dining room, sun room, two kitchens, a study, bathroom and circulation spaces. All spaces, bar circulation and bathrooms, have been assessed under thermal comfort criteria laid out in TM52 and TM59.

3.2.2 Internal Gains

A number of internal gains have been applied to the spaces within our model. Refer to Appendix 1 of this document where a summary of the details associated with each gain type and how they have been incorporated into the model have been placed in a table.

The information relating to these internal gains, including the occupancy profiles associated with each, have been derived by either appropriate industry conventions (i.e. TM59), experience on modelling buildings of a similar type, or from information provided by the design team.

It is important to note that although best practice TM59 guidelines regarding occupancy usage profiles have been followed in this study, this cannot accurately reflect likely occupancy patterns across the flats in reality. For example TM59 recommends that a 24-hour occupancy profile is applied in bedrooms, although this allows for continual internal gains occurring in the space, it also means that an occupant is present to open and close the windows. In reality it is likely that bedrooms could remain completely unoccupied during the day with the windows closed.

It is difficult to account for every eventuality in computer modelling, however logic dictates that if any occupant enters a space that is perceived as too warm they will subsequently open windows to alleviate the situation.

3.2.3 Openings

Another important aspect of the model relates to profiles and openable areas that have been set for the windows and doors. Following CIBSE TM59 guidance and discussions with the architect, we created the different window profiles shown below.

Firstly recessed windows will not provide the same degree of free openable area when compared with windows flush to the façade and this must be considered when reading this report. As the diagram below illustrates, this recess could significantly lower the total effective free area of a window. To incorporate this a percentage reduction will be added to the opening area for windows and doors based on the extent of the reveals and other obstructions.

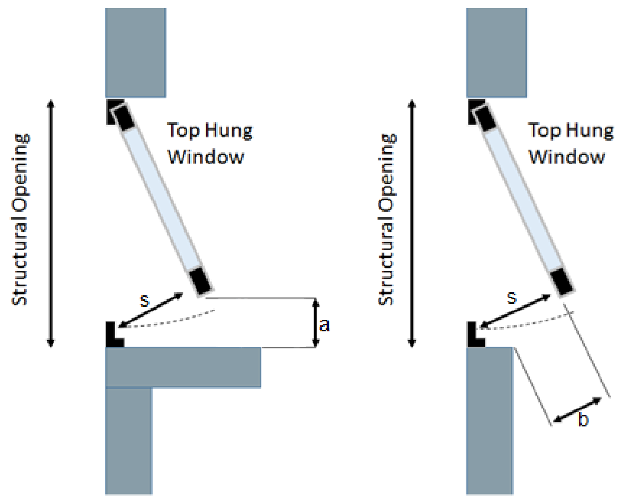


Figure 3: Example of effective free opening area reduced by protrusion of window sill (from BB101 figure 8-1).

The equivalent area of the windows was calculated using the BB101 discharge coefficient calculator, in line with Part O guidance, Appendix D. As it states that the equivalent area of a window can be calculated using one of the following.

a. The discharge coefficient calculator, available online at: https://www.gov.uk/government/publications/classvent-and-classcool-school-ventilation-design-tool.

b. Tables D1 to D9 in Approved Document O: Overheating.

In line with Part L, Part O and Part K, openable windows below 1100mm would need to be restricted. Along with this restriction, due to the existence of the Grade II listed Georgian façade, many of the glazed panel designs contain secondary glazing, which can reduce available opening area further.

Opening Type Ref	Width (mm)	Height (mm)	Area (m^2)	Opening Restriction mm	Openable Area %	Profile Active Hours
LGF 1100x900 sash bottom	1100	900	0.99	-	60.00	0000 to 0900 –0% 0900 to 2200 –100% ** 2200-2400 –0%
LGF Door	1550	2100	3.26	-	60.00	0000 to 0900 –0% 0900 to 2200 –100% ** 2200-2400 –0%
GF 1100x1150 sash bottom	1100	1150	1.27	100	10.50	0000 to 0900 –0% 0900 to 2200 –100% ** 2200-2400 –0%
GF 1550x1200 sash bottom	1550	1200	1.86	100	10.00	0000 to 0900 –0% 0900 to 2200 –100% ** 2200-2400 –0%
1F 1300x1350 sash bottom	1300	1350	1.76	100	8.70	0000 to 0900 –0% 0900 to 2200 –100% ** 2200-2400 –0%
1F 1500x1500 sash bottom	1500	1500	2.25	100	7.70	0000 to 0900 –0% 0900 to 2200 –100% ** 2200-2400 –0%
2F 1150x1000 sash bottom	1150	1000	1.15	100	12.50	0000 to 0800 –100% * 0800 to 2300 –100% ** 2300-2400 –100% *
2F 320x900 sash bottom slim	320	900	0.29	100	14.30	0000 to 0900 –0% 0900 to 2200 –100% ** 2200-2400 –0%
2F 900x900 sash bottom middle	900	900	0.81	100	14.30	0000 to 0900 –0% 0900 to 2200 –100% ** 2200-2400 –0%

Opening Type Ref	Width (mm)	Height (mm)	Area (m^2)	Opening Restriction mm	Openable Area %	Profile Active Hours
3F 1300x650 sash bottom	1300	650	0.85	-	60.00	0000 to 0800 –100% * 0800 to 2300 –100% ** 2300-2400 –100% *
3F 1200x750 sash bottom	1200	750	0.90	-	60.00	0000 to 0800 –100% * 0800 to 2300 –100% ** 2300-2400 –100% *

* Open when internal temperature exceed 23°C and internal temperature is greater than outdoor temperature

** Start opening when internal temp exceeds 22°C and be fully open at 26°C; and close in a similar manner

Table 1: Window opening types and assumptions

These windows were set to open as per the guidance detailed in section 2.3.4. Windows were only modelled as being openable when the rooms in question are occupied over the course of any given day and in reality these will be manually openable by occupants.

The location of each window type used in the model is outlined in Appendix 2.

3.2.4 Mechanical Ventilation

Mechanical ventilation is considered and assessed where natural ventilation is not sufficient to provide thermal comfort compliance.

Where applied, the set back flow rate for the kitchens, living rooms, study and sun room is modelled at 13 l/s, with a boost rate at 19.5 l/s. Bathrooms are modelled with a set back flow rate of 8 l/s, 12l/s boosted. Bedrooms are modelled with 0.3 $l/s/m^2$ and 0.45 $l/s/m^2$. , set back and boost rates, respectively.

It should be noted these values are input as per Part L 2021 ventilation rates, and are not with consideration to other mechanical engineering requirements or acoustic compliance.

3.2.5 Shading

Immediate buildings to the south west of site, as well as the lower ground floor room locations provide some passive shading to the dwelling.

3.2.7 Infiltration Rate

Based on an agreed air leakage rate with the wider design team, and the guidance in CIBSE Guide A Table 4.24, an average infiltration rate of 0.6 air changes per hour has been applied throughout the modelled areas.

3.3 BASIC BUIDLING FABRIC DETAILS

Correspondence with the design team confirmed the following design intent relating to the buildings' fabric thermal performance. A breakdown of the building fabric build ups and the thermal performance of each element are provided in Table 2 below.

Model Element	Input Used	Evidence Reference
Opaque Building Fabric Details - External Walls		
Solid Wall, 2 brick - 1.2u - U Value (W/m^2.K)	1.2	As per Energy Section Drawings Proposed, dated 22/11/22
Solid Wall, 2 brick - 1.2u - Fabric	BRICKWORK (OUTER LEAF) 225.0mm, BRICKWORK (INNER LEAF) 225.0mm, Plasterboard 12.5mm	SCS assumption of construction buildup
Solid Wall, 1 brick - 1.8u - U Value (W/m^2.K)	1.8	As per Energy Section Drawings Proposed, dated 22/11/22
Solid Wall, 1 brick - 1.8u - Fabric	BRICKWORK (OUTER LEAF) 225.0mm, Plasterboard 12.5mm	SCS assumption of construction buildup
Modern Cavity wall - 0.4u - U Value (W/m^2.K)	0.4	As per Energy Section Drawings Proposed, dated 22/11/22
Modern Cavity wall - 0.4u - Fabric	CONCRETE BLOCK (MEDIUM) 102.5mm, Cavity 50.0mm, POLYURETHANE BOARD 100.0mm, CONCRETE BLOCK (MEDIUM) 102.5mm, Plasterboard 12.5mm	SCS assumption of construction buildup
Opaque Building Fabric Details - Ground/Exposed Floors		
Solid Concrete Slab; Uninsulated - 0.8u - U Value (W/m^2.K)	0.8	As per Energy Section Drawings Proposed, dated 22/11/22
Solid Concrete Slab; Uninsulated - 0.8u - Fabric	Reinforced Concrete 200.0mm	SCS assumption of construction buildup

Model Element	Input Used	Evidence Reference
Opaque Building Fabric Details - Roofs		
Modern flat roof - 0.4u - U Value (W/m^2.K)	0.4	As per Energy Section Drawings Proposed, dated 22/11/22
Modern flat roof - 0.4u - Fabric	Insulation 154.4mm, Membrane 0.1mm, Concrete Deck 100.0mm, Cavity 50.0mm, Plasterboard 12.5mm	SCS assumption of construction buildup
Loft pitched roof; insulation between rafters; uneven - 0.5u - U Value (W/m^2.K)	0.5	As per Energy Section Drawings Proposed, dated 22/11/22
Loft pitched roof; insulation between rafters; uneven - 0.5u - Fabric	Membrane 0.1mm, Insulation 350.0mm, Cavity 50.0mm, Plasterboard 12.5mm	SCS assumption of construction buildup
Opaque Building Fabric Details - Exterior Doors/Opaque Panels		
External Door - 1.6u - U Value (W/m^2.K)	1.6	Agreed fabric performance and construction input with Allwood Designs, 09/01/24. Performance assumption based off of Part L minimum requirements.
Opaque Door - 0.7 - Fabric	Plywood 37mm	
Opaque Building Fabric Details - Internal Walls		
2013 Internal Partition - U Value (W/m^2.K)	1.79	Software generated value
2013 Internal Partition - Fabric	Plasterboard 12.5mm, Cavity 50.0mm, Plasterboard 12.5mm	SCS assumption of construction buildup
Transparent Building Fabric Elements - External Glazing - Window - 1F sash - 2u/0.6g/0.7VLT/18FF		
U Value (W/m^2.K) (including frame)	2	As per Energy Section Drawings Proposed, dated 22/11/22
Frame Percentage (%)	18	SCS calculation of frame factor
G Value (SHGC)	0.6	Agreed fabric performance input with Allwood Designs, 09/01/24.
Light Transmittance Factor	0.7	
Transparent Building Fabric Elements - External Glazing - Window - 1F back sash/2F sash - 2u/0.6g/0.7VLT/26FF		
U Value (W/m^2.K) (including frame)	2	As per Energy Section Drawings Proposed, dated 22/11/22
Frame Percentage (%)	26	SCS calculation of frame factor

Model Element	Input Used	Evidence Reference
G Value (SHGC)	0.6	Agreed fabric performance input with Allwood Designs, 09/01/24.
Light Transmittance Factor	0.7	
Transparent Building Fabric Elements - External Glazing - Window - 2F slim sash - 2u/0.6g/0.7VLT/32FF		
U Value (W/m².K) (including frame)	2	As per Energy Section Drawings Proposed, dated 22/11/22
Frame Percentage (%)	32	SCS calculation of frame factor
G Value (SHGC)	0.6	Agreed fabric performance input with Allwood Designs, 09/01/24.
Light Transmittance Factor	0.7	
Transparent Building Fabric Elements - External Glazing - Window - 2F back sash - 2u/0.6g/0.7VLT/30FF		
U Value (W/m².K) (including frame)	2	As per Energy Section Drawings Proposed, dated 22/11/22
Frame Percentage (%)	30	SCS calculation of frame factor
G Value (SHGC)	0.6	Agreed fabric performance input with Allwood Designs, 09/01/24.
Light Transmittance Factor	0.7	
Transparent Building Fabric Elements - External Glazing - Window - 3F sash with 2ndry glazing - 1.8u/0.6g/0.7VLT/19FF		
U Value (W/m².K) (including frame)	1.8	As per Energy Section Drawings Proposed, dated 22/11/22
Frame Percentage (%)	19	SCS calculation of frame factor
G Value (SHGC)	0.6	Agreed fabric performance input with Allwood Designs, 09/01/24.
Light Transmittance Factor	0.7	
Transparent Building Fabric Elements - External Glazing - Window - 3F back sash - 2u/0.6g/0.7VLT/22FF		
U Value (W/m².K) (including frame)	2	As per Energy Section Drawings Proposed, dated 22/11/22
Frame Percentage (%)	22	SCS calculation of frame factor
G Value (SHGC)	0.6	Agreed fabric performance input with Allwood Designs,

Model Element	Input Used	Evidence Reference
Light Transmittance Factor	0.7	09/01/24.
Transparent Building Fabric Elements - External Glazing - Glazed door - LGF - 1.6u/0.6g/0.7VLT/30FF		
U Value (W/m^2.K) (including frame)	1.6	Agreed fabric performance input with Allwood Designs, 09/01/24. Performance assumption based off of Part L minimum requirements.
Frame Percentage (%)	30	Agreed input with Allwood Designs, 09/01/24. Assumption based off of SAP10 conventions
G Value (SHGC)	0.6	Agreed fabric performance input with Allwood Designs, 09/01/24.
Light Transmittance Factor	0.7	
Transparent Building Fabric Elements - External Glazing - Window - LGF kitchen porthole - 1.6u/0.6g/0.7VLT/30FF		
U Value (W/m^2.K) (including frame)	1.6	Agreed fabric performance input with Allwood Designs, 09/01/24. Performance assumption based off of Part L minimum requirements.
Frame Percentage (%)	30	Agreed input with Allwood Designs, 09/01/24. Assumption based off of SAP10 conventions
G Value (SHGC)	0.6	Agreed fabric performance input with Allwood Designs, 09/01/24.
Light Transmittance Factor	0.7	
Transparent Building Fabric Elements - External Glazing - Window - LGF 2 panel sash - 2u/0.6g/0.7VLT/21FF		
U Value (W/m^2.K) (including frame)	2	As per Energy Section Drawings Proposed, dated 22/11/22
Frame Percentage (%)	21	SCS calculation of frame factor
G Value (SHGC)	0.6	Agreed fabric performance input with Allwood Designs, 09/01/24.
Light Transmittance Factor	0.7	
Transparent Building Fabric Elements - External Glazing - Window - LGF Overdoor - 2u/0.6g/0.7VLT/41FF		
U Value (W/m^2.K) (including frame)	2	As per Energy Section Drawings Proposed, dated 22/11/22

Model Element	Input Used	Evidence Reference
Frame Percentage (%)	41	SCS calculation of frame factor
G Value (SHGC)	0.6	Agreed fabric performance input with Allwood Designs, 09/01/24.
Light Transmittance Factor	0.7	
Transparent Building Fabric Elements - External Glazing - Glazed door - LGF backdoor - 2u/0.6g/0.7VLT/33FF		
U Value (W/m^2.K) (including frame)	2	As per Energy Section Drawings Proposed, dated 22/11/22
Frame Percentage (%)	33	SCS calculation of frame factor
G Value (SHGC)	0.6	Agreed fabric performance input with Allwood Designs, 09/01/24.
Light Transmittance Factor	0.7	
Transparent Building Fabric Elements - External Glazing - Window - LGF over backdoor - 2u/0.6g/0.7VLT/48FF		
U Value (W/m^2.K) (including frame)	2	As per Energy Section Drawings Proposed, dated 22/11/22
Frame Percentage (%)	48	SCS calculation of frame factor
G Value (SHGC)	0.6	Agreed fabric performance input with Allwood Designs, 09/01/24.
Light Transmittance Factor	0.7	
Transparent Building Fabric Elements - External Glazing - Window - GF overdoor - 2u/0.6g/0.7VLT/38FF		
U Value (W/m^2.K) (including frame)	2	As per Energy Section Drawings Proposed, dated 22/11/22
Frame Percentage (%)	38	SCS calculation of frame factor
G Value (SHGC)	0.6	Agreed fabric performance input with Allwood Designs, 09/01/24.
Light Transmittance Factor	0.7	
Transparent Building Fabric Elements - External Glazing - Window - GF sash - 1.8u/0.6g/0.7VLT/29FF		
U Value (W/m^2.K) (including frame)	2	As per Energy Section Drawings Proposed, dated 22/11/22
Frame Percentage (%)	29	SCS calculation of frame factor

Model Element	Input Used	Evidence Reference
G Value (SHGC)	0.6	Agreed fabric performance input with Allwood Designs, 09/01/24.
Light Transmittance Factor	0.7	
Transparent Building Fabric Elements - External Glazing - Window - GF back sash - 2u/0.6g/0.7VLT/11FF		
U Value (W/m^2.K) (including frame)	2	As per Energy Section Drawings Proposed, dated 22/11/22
Frame Percentage (%)	11	SCS calculation of frame factor
G Value (SHGC)	0.6	Agreed fabric performance input with Allwood Designs, 09/01/24.
Light Transmittance Factor	0.7	
Transparent Building Fabric Elements - External Glazing - Window - GF sunroom 1 large - 2u/0.6g/0.7VLT/7F		
U Value (W/m^2.K) (including frame)	2	As per Energy Section Drawings Proposed, dated 22/11/22
Frame Percentage (%)	7	SCS calculation of frame factor
G Value (SHGC)	0.6	Agreed fabric performance input with Allwood Designs, 09/01/24.
Light Transmittance Factor	0.7	
Transparent Building Fabric Elements - External Glazing - Window - GF sunroom 2 small - 2u/0.6g/0.7VLT/12F		
U Value (W/m^2.K) (including frame)	2	As per Energy Section Drawings Proposed, dated 22/11/22
Frame Percentage (%)	12	SCS calculation of frame factor
G Value (SHGC)	0.6	Agreed fabric performance input with Allwood Designs, 09/01/24.
Light Transmittance Factor	0.7	

Table 2: Construction build ups and thermal performances of building fabric

4. RESULTS

4.1 THERMAL COMFORT COMPLIANCE – NATURAL VENTILATION

The below results are modelled in natural ventilation mode only.

4.1.1 Results – DSY1 2020 Weather Data – Natural Ventilation

	TM52				TM59	
	Criterion 1	Criterion 2	Criterion 3	Pass/ Fail	Bedrooms Only Criterion	Pass/ Fail
1F - Main Living	25.5	61	6	FAIL	N/A	FAIL
1F - Study	56	87	12	FAIL	N/A	N/A
2F - Master Bedroom	6.8	52	4	FAIL	277	FAIL
3F - Bedroom 1	4.7	46	5	FAIL	385	FAIL
3F - Bedroom 2	3.9	42	4	FAIL	349	FAIL
3F - Bedroom 3	10.4	83	6	FAIL	520	FAIL
GF - Dining	17.8	51	5	FAIL	N/A	FAIL
GF - Kitchen	27.1	63	7	FAIL	N/A	FAIL
GF - Sun Room	8.1	49	7	FAIL	N/A	FAIL
LGF - Bedroom	1.3	21	3	PASS	169	FAIL
LGF - Kitchen	0.3	2	1	PASS	N/A	PASS
LGF - Living Room	1	7	1	PASS	N/A	PASS

Table 3: *TM59 Results Using DSY1 2020 Weather Data, Natural Ventilation*

From the table above, it is seen that when the whole building employs a natural ventilation strategy, only the Lower Ground Floor kitchen and living room spaces are compliant with thermal comfort criteria. This is likely due to the reduced solar gains from penetration through glazing due to shading, along with openings serving those spaces being unrestricted as there is no risk of falling from height.

Spaces failing thermal comfort criteria are further assessed in section 4.2 with mechanical ventilation with rates applied as described in section 3.2.4.

4.2 THERMAL COMFORT COMPLIANCE – NATURAL & MECHANICAL VENTILATION

The below results are modelled with natural and mechanical ventilation present.

4.2.1 Results – DSY1 2020 Weather Data – Natural & Mechanical Ventilation

	TM52				TM59	
	Criterion 1	Criterion 2	Criterion 3	Pass/ Fail	Bedrooms Only Criterion	Pass/ Fail
1F - Main Living	13	45	5	FAIL	N/A	FAIL
1F - Study	35.7	66	10	FAIL	N/A	N/A
2F - Master Bedroom	3.3	32	4	FAIL	141	FAIL
3F - Bedroom 1	3.2	36	4	FAIL	263	FAIL
3F - Bedroom 2	2.2	31	4	PASS	206	FAIL
3F - Bedroom 3	6.9	60	5	FAIL	362	FAIL
GF - Dining	8.6	39	5	FAIL	N/A	FAIL
GF - Kitchen	16.5	48	6	FAIL	N/A	FAIL
GF - Sun Room	7.7	46	6	FAIL	N/A	FAIL
LGF - Bedroom	1	20	3	PASS	101	FAIL
LGF - Kitchen	0.3	2	1	PASS	N/A	PASS
LGF - Living Room	0.8	5	1	PASS	N/A	PASS

Table 4: *TM59 Results Using DSY1 2020 Weather Data, Natural & Mechanical Ventilation*

From the table above, it is seen that when the whole building employs a mixed ventilation strategy of natural and mechanical, many spaces fail thermal comfort compliancy criteria. Along with previously compliant LGF spaces, several bedrooms are compliant with TM52 criteria but fail the TM59 night-time criteria. This is likely due to reduced opening areas of glazing due to panel restrictions resulting in reduced purge ventilation values in the night-time.

Spaces failing thermal comfort criteria are further assessed in section 4.3 with internal blinds applied.

4.3 THERMAL COMFORT COMPLIANCE – NATURAL & MECHANICAL VENTILATION WITH BLINDS

The below results are modelled with natural and mechanical ventilation present along with blinds applied to spaces that failed in section 4.3.

Blinds are applied on a conditional operational profile according to space occupancy outlined in Appendix 1 as well as with reference to internal daylight levels, where lux levels exceed 3000 (for reference peak daylight levels are round 10000 lux, with internal spaces usually between 100 to 1000 lux depending on space usage type) blinds are applied.

4.3.1 Results – DSY1 2020 Weather Data – Natural & Mechanical Ventilation with Blinds

	TM52				TM59	
	Criterion 1	Criterion 2	Criterion 3	Pass/ Fail	Bedrooms Only Criterion	Pass/ Fail
1F - Main Living	5	29	4	FAIL	N/A	FAIL
1F - Study	9.2	27	6	FAIL	N/A	N/A
2F - Master Bedroom	0.4	7	1	PASS	64	FAIL
3F - Bedroom 1	1.2	22	3	PASS	135	FAIL
3F - Bedroom 2	0.8	18	3	PASS	107	FAIL
3F - Bedroom 3	1.4	24	3	PASS	157	FAIL
GF - Dining	4.1	27	4	FAIL	N/A	FAIL
GF - Kitchen	8.5	31	5	FAIL	N/A	FAIL
GF - Sun Room	3.1	30	4	FAIL	N/A	FAIL
LGF - Bedroom	0.5	13	2	PASS	65	FAIL
LGF - Kitchen	0.1	1	1	PASS	N/A	PASS
LGF - Living Room	0.1	2	1	PASS	N/A	PASS

Table 5: *TM59 Results Using DSY1 2020 Weather Data, Natural & Mechanical Ventilation*

From the table above, it is seen that when the whole building employs a mixed ventilation strategy of natural and mechanical along with blinds, many spaces still fail thermal comfort compliancy criteria. While the Study area has benefitted from the application of internal blinds, it still fails compliance criteria by a large margin. The previously compliant LGF spaces and several bedrooms are compliant with TM52 criteria but however, fail the TM59 night-time criteria. This is likely due to reduced opening areas of glazing due to panel restrictions resulting in reduced purge ventilation values in the night-time rather than compliance being driven by solar gain reduction from internal blinds usage during the day-time hours.

Spaces failing thermal comfort criteria are further assessed in section 4.4 with active cooling applied.

4.4 THERMAL COMFORT COMPLIANCE – NATURAL & MECHANICAL VENTILATION, AND ACTIVE COOLING

The below results are modelled with natural and mechanical ventilation present, along with an active cooling system present.

A 1 kW fixed cooling capacity cooling system is applied to each space not complaint with thermal comfort criteria in section 4.3. A 4 kW fixed cooling capacity system is applied to the sunroom space.

4.4.1 Results – DSY1 2020 Weather Data – Natural & Mechanical Ventilation with Cooling

	TM52				TM59	
	Criterion 1	Criterion 2	Criterion 3	Pass/ Fail	Bedrooms Only Criterion	Pass/ Fail
1F - Main Living	0	0	0	PASS	N/A	PASS
1F - Study	0	0	0	PASS	N/A	N/A
2F - Master Bedroom	0	0	0	PASS	0	PASS
3F - Bedroom 1	0	0	0	PASS	0	PASS
3F - Bedroom 2	0	0	0	PASS	0	PASS
3F - Bedroom 3	0	0	0	PASS	0	PASS
GF - Dining	0	0	0	PASS	N/A	PASS
GF - Kitchen	0	0	0	PASS	N/A	PASS
GF - Sun Room	2.8	17	4	PASS	N/A	PASS
LGF - Bedroom	0	0	0	PASS	2	PASS
LGF - Kitchen	0	0	0	PASS	N/A	PASS
LGF - Living Room	0.1	2	1	PASS	N/A	PASS

Table 6: *TM59 Results Using DSY1 2020 Weather Data, Natural & Mechanical Ventilation with Cooling*

From the table above, it is seen that when the whole building employs a mixed ventilation strategy of natural and mechanical, along with active cooling, all spaces are complaint and pass TM52 and TM59 thermal comfort criteria.

The above described model variant is assessed in alternate future weather scenarios in the following sections. These scenarios are not required to be complaint with thermal comfort criteria, however it is a requirement that their results are reported upon.

4.4.2 Results – DSY2 2020 Weather Data – Natural & Mechanical Ventilation with Cooling

	TM52				TM59	
	Criterion 1	Criterion 2	Criterion 3	Pass/ Fail	Bedrooms Only Criterion	Pass/ Fail
1F - Main Living	0	0	0	PASS	N/A	PASS
1F - Study	3	12	4	PASS	N/A	N/A
2F - Master Bedroom	0	0	0	PASS	0	PASS
3F - Bedroom 1	0	0	0	PASS	0	PASS
3F - Bedroom 2	0	0	0	PASS	0	PASS
3F - Bedroom 3	0	3	1	PASS	0	PASS
GF - Dining	0	0	0	PASS	N/A	PASS
GF - Kitchen	0	0	0	PASS	N/A	PASS
GF - Sun Room	7.2	61	9	FAIL	N/A	FAIL
LGF - Bedroom	0	7	2	PASS	2	PASS
LGF - Kitchen	0	9	2	PASS	N/A	PASS
LGF - Living Room	0.1	15	3	PASS	N/A	PASS

Table 7: *TM59 Results Using DSY2 2020 Weather Data, Natural & Mechanical Ventilation with Cooling*

4.4.3 Results – DSY3 2020 Weather Data – Natural & Mechanical Ventilation with Cooling

	TM52				TM59	
	Criterion 1	Criterion 2	Criterion 3	Pass/ Fail	Bedrooms Only Criterion	Pass/ Fail
1F - Main Living	0	0	0	PASS	N/A	PASS
1F - Study	3.1	13	4	FAIL	N/A	N/A
2F - Master Bedroom	0	0	0	PASS	0	PASS
3F - Bedroom 1	0	0	0	PASS	0	PASS
3F - Bedroom 2	0	0	0	PASS	0	PASS
3F - Bedroom 3	0	0	0	PASS	0	PASS
GF - Dining	0	0	0	PASS	N/A	PASS
GF - Kitchen	0	0	0	PASS	N/A	PASS
GF - Sun Room	10.5	64	8	FAIL	N/A	FAIL
LGF - Bedroom	0.1	2	1	PASS	2	PASS
LGF - Kitchen	1.4	14	3	PASS	N/A	PASS
LGF - Living Room	1.5	17	2	PASS	N/A	PASS

Table 8: *TM59 Results Using DSY3 2020 Weather Data, Natural & Mechanical Ventilation with Cooling*

5. CONCLUSION

In summary, based on the details modelled in this report, and a typical summer scenario, compliance with TM59 targets have not been met for the relevant spaces when assessed against the DSY1 2020 50% high emissions scenario, with a natural or mixed ventilation strategy used in the proposed development.

This is likely due to limits on fabric improvements due to the nature of the development being a listed heritage building. The reduced opening areas of the glazed panels also due to restrictions, along with many fabric elements of the retained building having a relatively high u-value, result in a combination of higher heat gains with reduced capacity of purging through natural ventilation.

In the above scenarios only two lower ground floor areas are compliant, likely due to reduced solar gains and larger opening areas for purge ventilation.

When applying active cooling to assessed spaces, the proposed development is compliant with thermal comfort criteria in the DSY1 scenario. Within the DSY2 and DSY3 scenarios, it is only the sunroom which remains non-complaint.

However, it should be noted the usage of a conservatory/sunroom is considered atypical in its room usage, TM52/TM59 requirements and user thermal comfort levels.

Relating to the London Plan and Camden Local Plan, the assessment follows the cooling hierarchy. As this is an existing listed development, opportunities to reduce heat entering the development through design measures are limited. Internal heat generation is likely minimal as it is a residential dwelling and will likely not have any installed plant that generates large amount of heat in its operation.

The use of exposed thermal mass and high ceilings is incorporated into the building design, however as per the results in section 4 this is alone is not enough to provide adequate thermal comfort levels, due to the nature of the listed development it is understood as well that opportunities for external shading are limited.

Passive and active ventilation strategies are assessed with results in sections 4.1 and 4.2 respectively, along with the application of blinds in section 4.3. It is seen in section 4.4 that active cooling provides adequate thermal comfort levels to avoid overheating, compliant with TM59 criteria.

It should be noted that cooling is not the only method to achieve thermal comfort compliance; external shading elements or low-e glazing are also effective methods to achieve thermal comfort levels. However, due to the nature of the listed façade, it is understood that there are design limitations.

At the request of Camden Council internal blinds have now been included in thermal model. However, while the Study area still fails the TM52 criteria due to high internal gains and requires active cooling.

In general (and if safe to do so), curtains and windows should be left open at night to allow cooler, night time air to flow freely and reduce the air temperature of the rooms to as low as possible by morning. Curtains should then be closed when occupants wake to minimise solar gains that enter the flats from that point forward.

If the building is to be unoccupied during the day, closing the windows as well as the blinds early in the morning might help to preserve the cooler, night time air and keep out the warmer external air, thus resulting in lower temperatures when the occupant returns later in the day.

If the building is to be occupied during the day, keeping internal doors open during day time hours is advisable to facilitate cross ventilation. In addition, air movement speed can be a significant factor in occupant perception of temperature. During heat waves, we would recommend that occupants have access to localised fans.

There are a number of limitations in the modelling associated with the outputs in this report. In some cases window openings have been set to open at a given temperature, where in reality, their ability to open is solely reliant upon the occupants in the room. It is highly likely that some windows will be opened sooner and some will be opened later. Computer modelling cannot truly represent the actions (or inaction) of people.

Finally, it is important to consider that benchmarks set out in the legislation referred to in analysis cannot truly measure whether an individual will be "comfortable". The analysis can only ever be read as guidance and should never be seen as an absolute guarantee of either performance or comfort. At best is should be seen as an indicator of what many people might think, most of the time.

Therefore, it is recommended that the client for this project should try to understand this report, seek advice from the design team and review their own thoughts on comfort levels. Only once this has occurred will the client be in a position to decide on whether the level of comfort indicated in this report is likely to be acceptable once the building is in operation.

APPENDICES

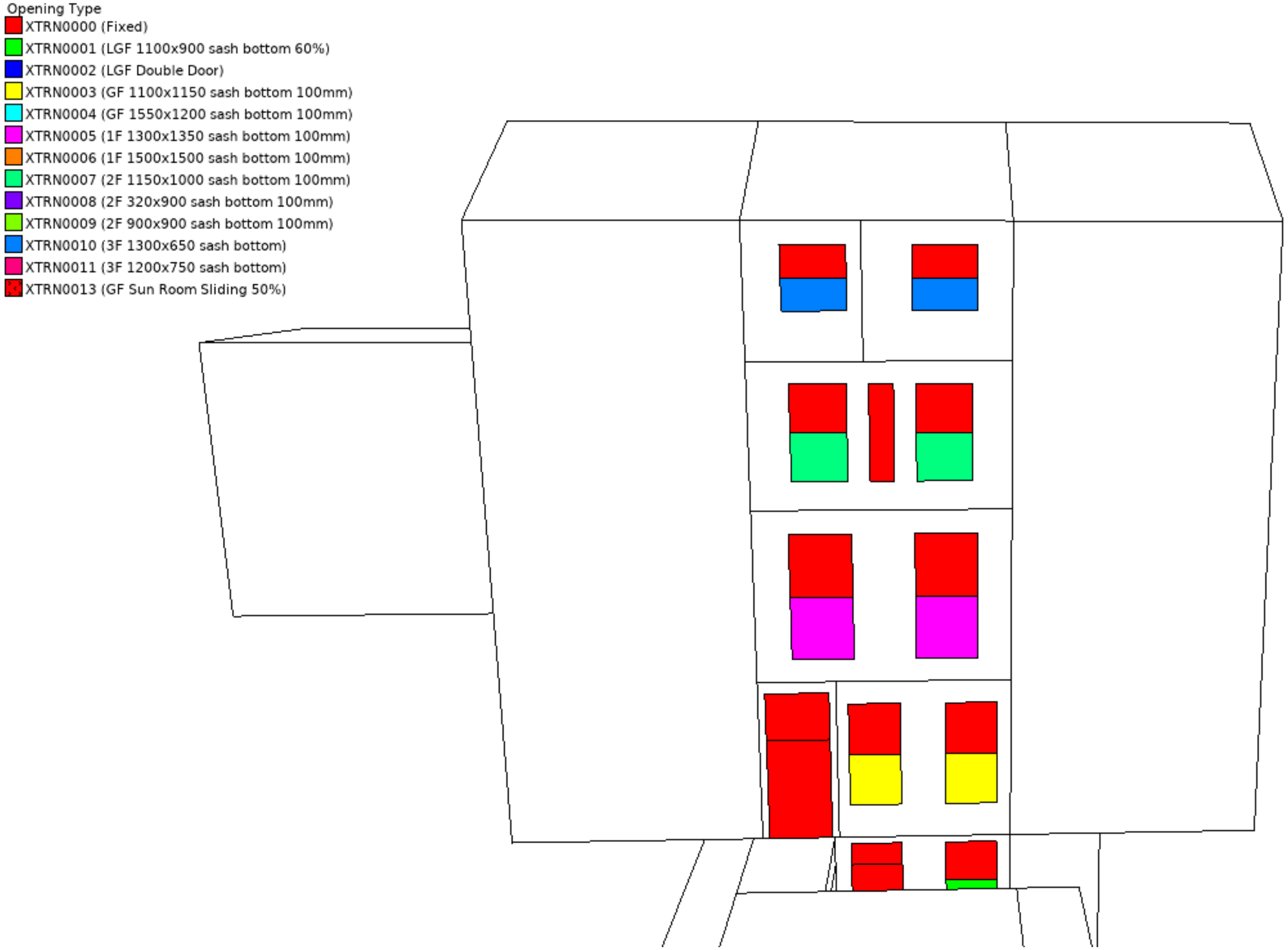
APPENDIX 1 - INTERNAL GAINS

TM59 Specific Table – Profiles and gains sourced directly from relevant guidance found in TM59.

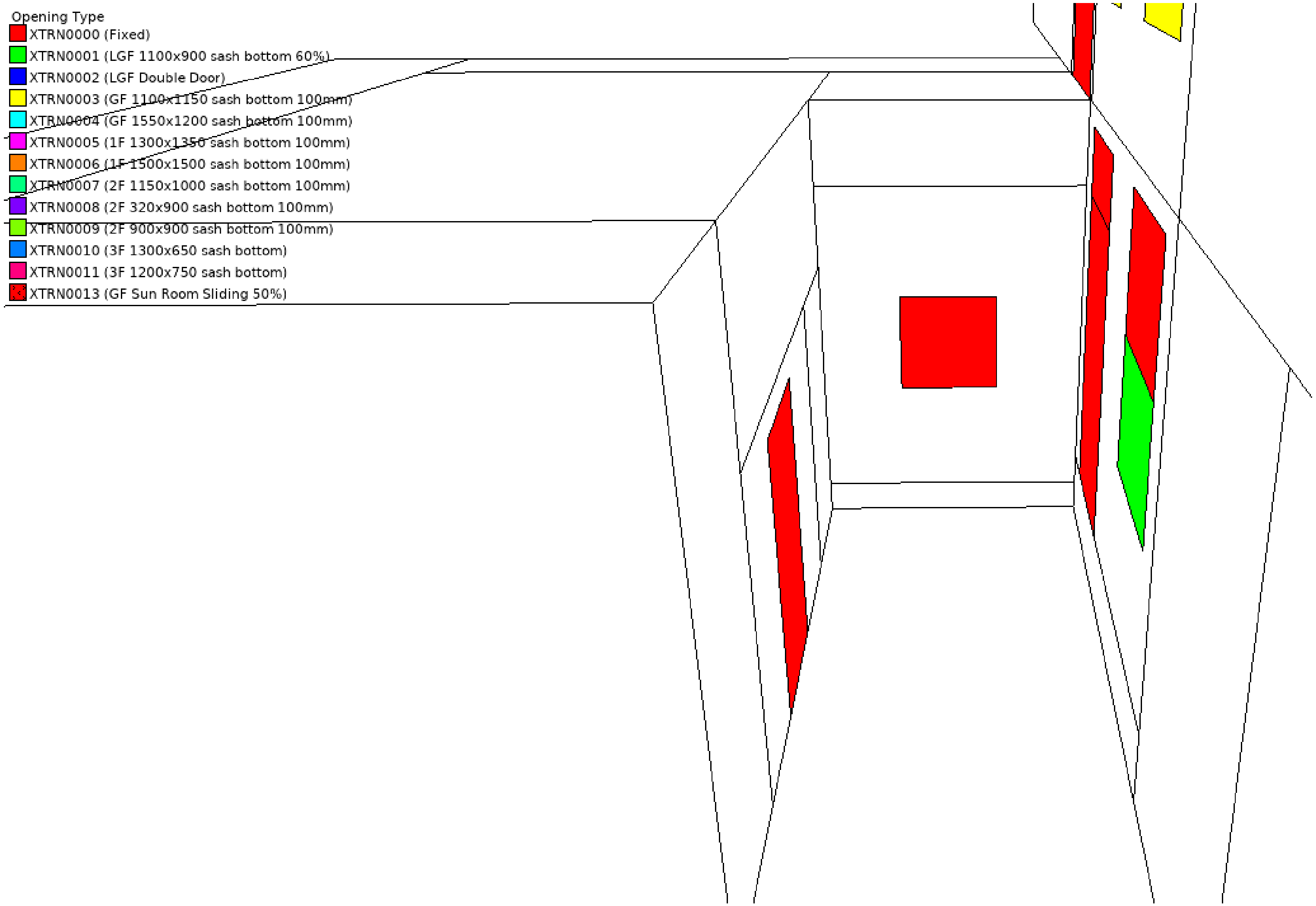
Room Type	Internal Gain Type	Maximum Sensible Gain	Maximum Latent Gain	Maximum Occupancy	Profile
Kitchen	People	75 W	55 W	3	25% from 9am to 10pm
	Lighting	2 W/m^2			On from 6pm to 11pm
	Equipment	300 W			100% from 6pm to 8pm 17% from 8pm to Midnight 17% from Midnight to 6pm
Living room/Dining	People	75 W	55 W	4	75% from 9am to 10pm
	Lighting	2 W/m^2			On from 6pm to 11pm
	Equipment	150 W			40% from 9am to 6pm 100% from 6pm to 10pm 40% from 10pm to 12pm 23% from Midnight to 9am
Sunroom	People	75 W	55 W	3	75% from 9am to 10pm
	Lighting	2 W/m^2			On from 6pm to 11pm
Study	People	75 W	55 W	1	100% from 8am to 7pm
	Lighting	2 W/m^2			On from 6pm to 11pm
	Equipment	1000 W			40% from 9am to 6pm 100% from 6pm to 10pm 40% from 10pm to 12pm 23% from Midnight to 9am

Room Type	Internal Gain Type	Maximum Sensible Gain	Maximum Latent Gain	Maximum Occupancy	Profile
Double Bedrooms	People	75 W	55 W	2	70% from 11pm to 8am 100% from 8am to 9am and from 10pm to 11pm 50% from 9am to 10pm
	Lighting	2 W/m^2			On from 6pm to 11pm
	Equipment	80 W			80 W from 8am to 11pm 10 W during sleeping hours
Laundry	Lighting	2 W/m^2			On from 8am to 6pm
	Equipment	75 W	25 W		On from 8am to 6pm
Bathroom/Circulation	Lighting	2 W/m^2			On from 6pm to 11pm

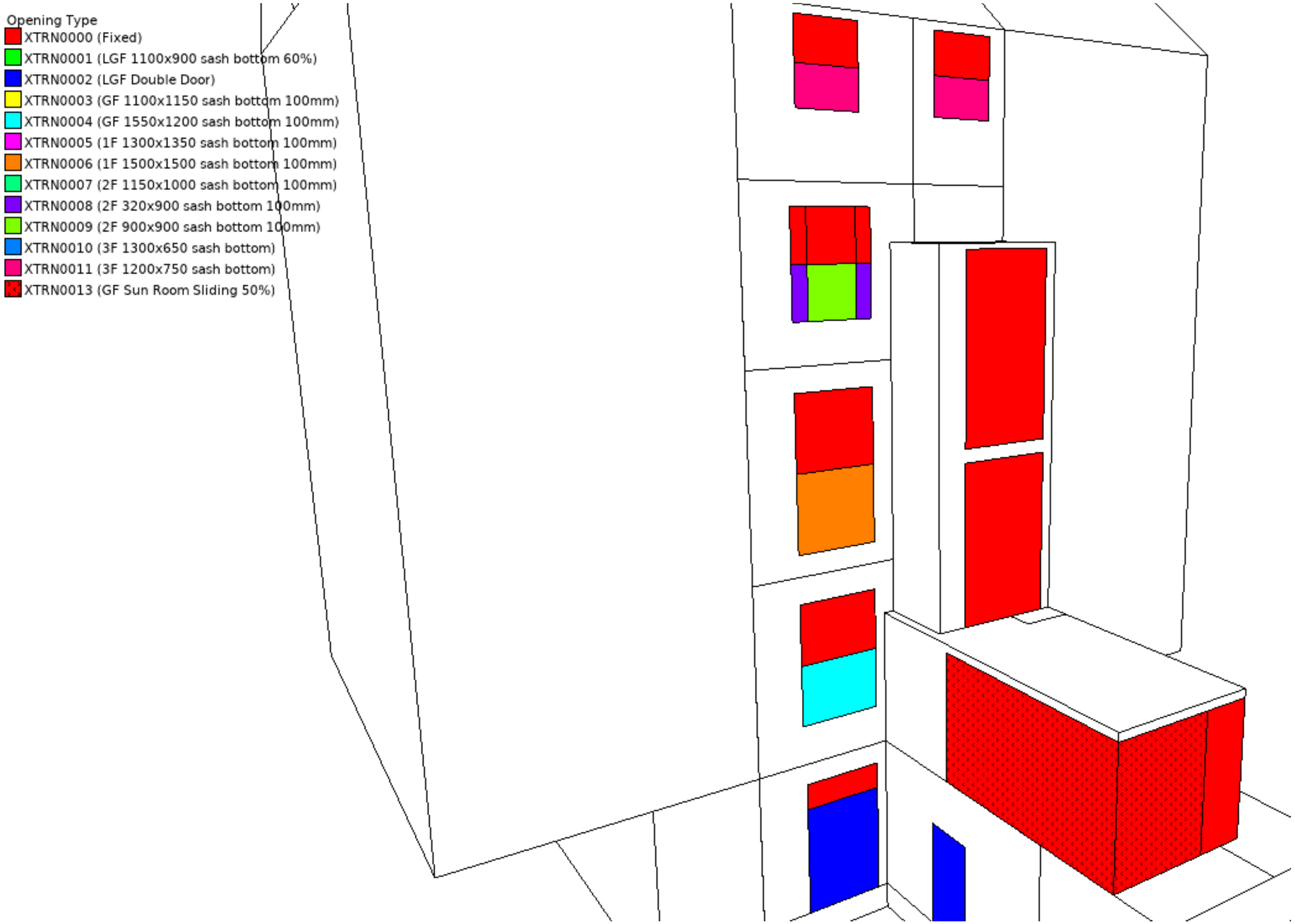
APPENDIX 2 – WINDOW OPENINGS FOR SAMPLED SPACES



North-East Elevation



Lower Ground Floor Roadside



South-West terrace area