SYNTEGRA CONSULTING

21 Chalcot Square, London, NW1 8YA

Part O Overheating Assessment

October 2022

Ref 22-9726

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Date	13/10/2022	19/10/2022		
Prepared by	K. Yahia	K. Yahia		
Checked by	L. Arez	L. Arez		
Authorised by	M. Standen	M. Standen		

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1.0 Executive Summary

Syntegra Consulting has assessed the overheating risk for the proposed development at **21 Chalcot Square, London, NW1 8YA**. The proposed development is a refurbishment of the existing dwelling **within** the London **Borough of Camden.** This report outlines the inputs and the results of the overheating analysis for occupied commercial and residential floorspaces within the development to satisfy CIBSE TM52 and TM59 requirements.

Dynamic overheating modelling using IES-VE 2022 has been carried out in line with CIBSE TM 52 (The Limits of Thermal Comfort) and TM59 (Design Summer Years for London). The overheating criteria set by TM52 and Design Summer Years (DSY) set by TM59 can be found in the following sections of this report. The assessment results are summarised as follows.

- **CIBSE TM52 & TM59 Compliance**

To meet the compliance requirements and minimise the risk of overheating in extreme weather conditions, the feasibility of natural ventilation, passive cooling measures and mechanical comfort cooling has been tested. According to the cooling hierarchy, passive cooling measures have been prioritised first, then active measures have been investigated further. It was concluded that to fully mitigate the overheating risk within the habitable spaces mechanical comfort cooling will be required.

More details of the used measures in the table 1 below are explained further in the following sections of the report.

Assessment scenario	TM52 Criteria			Assessment
Criteria type	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Results
Strategy	adopting internal translucent white curtain			Fail
	External Glazing G-value improve from 0.85 to 0.60			Fail
	adopting internal Blind for solar gains above 250 W/m2			Fail
	adopting internal curtain + external louvers for solar gains above 250 W/m2			Fail
	adopting mechanical comfort cooling using ASHP			Pass

Table 1, Overheating risk mitigation measures

2.0 LONDON LOCAL POLICIES

2.1 The London Plan: Policy 5.9 Overheating and Cooling

Strategic

The mayor seeks to reduce the impact of the urban heat island effect in London and encourages the design of places and spaces to avoid overheating and excessive heat generation, and to reduce overheating due to the impacts of climate change and the urban heat island effect on an area wide basis.

Planning Decisions

A. Major development proposals should reduce potential overheating and reliance on air conditioning systems and demonstrate this in accordance with the following cooling hierarchy:
    1. minimise internal heat generation through energy efficient design
    2. reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls
    3. manage the heat within the building through exposed internal thermal mass and high ceilings
    4. passive ventilation
    5. mechanical ventilation
    6. active cooling systems (ensuring they are the lowest carbon options).

B. Major development proposals should demonstrate how the design, materials, construction, and operation of the development would minimise overheating and also meet its cooling needs. New development in London should also be designed to avoid the need for energy intensive air conditioning systems as much as possible. Further details and guidance regarding overheating and cooling are outlined in the London Climate Change Adaptation Strategy.

London local polices have a similar though more stringent policy regarding CO_2 emissions and overheating. In particular, it recommends the use of predicted weather files for the 2050 and 2080 years as detailed in the local policy below.

2.2 Local Policy

Overheating mitigation

- Requires all developments to demonstrate that it is designed to be adapted to climate change, particularly through design which minimises overheating and incorporates sustainable drainage systems (SUDS).
- Sets out a sequential cooling hierarchy requirement for internal temperature modelling

climate change through design which minimises overheating. Developments are required to demonstrate how the proposed design has maximised incorporation of passive design measures to control heat gain and to deliver passive cooling, following the sequential cooling hierarchy, below:

1 **Passive design** to minimise unwanted heat gain and manage heat – for example by using building orientation, reduced fenestration, external shading (including from vegetation), a well-insulated and airtight building envelope, exposed thermal mass (e.g. aim for a minimum of $1m^2$ of room exposed thermal mass - walls and ceilings - per m^2 of floor area), green roof, high albedo surfaces and energy efficient lighting and equipment.

2 **Passive/natural cooling –** use outside air (perhaps pre-cooled by soft landscaping, a green roof, or by passing it underground to ventilate and cool a building without the use of a powered system, for example by maximising cross ventilation, passive stack and wind-driven ventilation and enabling night-time purge ventilation. Single aspect and deep plan developments are discouraged as effective passive ventilation can be difficult or impossible to achieve. Windows and/or ventilation panels should be designed to allow effective and secure ventilation.

3 **Mixed mode cooling** with local mechanical ventilation/cooling provided where required in order to supplement the above measures using (in order of preference): i. Low energy mechanical cooling (e.g. fan-powered ventilation with/without evaporative cooling or ground coupled cooling) ii. Air conditioning (not a preferred approach as these systems are energy intensive)

4 **Full building mechanical ventilation/cooling system** using (in order of preference): i. Low energy mechanical cooling. ii. Air conditioning.

Measures at the highest possible level of the above cooling hierarchy should be utilised to the fullest extent possible before the next level of the hierarchy is utilised. Use of technologies from lower levels of the hierarchy shall not be supported unless evidence is provided to demonstrate that technologies from higher levels of the hierarchy cannot deliver sufficient heat control.

Where mechanical ventilation/cooling systems are required, the location(s) for dumping heat into the outside air should be carefully considered to minimise negative impacts on pedestrians, biodiversity and external air being drawn into buildings.

All major developments shall be designed and built to comply with CIBSE overheating standards. The methodology to deliver the cooling of the development should be in line with the cooling hierarchy above.

Overheating analysis should be carried out using dynamic simulation modelling software approved by the Building Energy Calculation Software Approval Scheme for use with the revision of The Building Regulations Part L in force at the time of the application. Modelling results should be provided for a representative sample of rooms with no active cooling (in accordance with the cooling hierarchy, the aim should be to minimise and where possible avoid the need for active cooling). Overheating calculations shall be carried out using both (i) a primary Design Summer Year (DSY) against which buildings have to be modelled to demonstrate overheating has been designed out, and (ii) a secondary DSY against which designers must make specific provision for the inclusion of further design elements (which may not be present in the original design) to ensure that overheating does not become an issue.

2.3 Building Categories

Category	Explanation	Suggested Acceptable Range (K)
Category I	High level of expectation only used for spaces occupied by a sensitive and fragile person.	**2**
Category II	Normal expectation (for new buildings and renovations)	**3**
Category III	A moderate expectation (used for existing buildings)	**4**

Table 2, buildings categories and suggested

3.0 CIBSE TM52: 2013 – OVERVIEW

In order to assess the overheating for the proposed development the methodology outlined in the **CIBSE Technical Memorandum 52**has been followed.

"Overheating has become a key problem for building design. The need to reduce energy consumption whilst dealing with global climate change has reduced the options available for building comfortable, low-energy buildings. Research has been directed towards methods for increasing indoor winter temperatures, but this can lead to lightweight, highly insulated buildings that respond poorly in the summer".

One problem for designers has been the absence of an adequate definition of overheating in naturally ventilated buildings. In the past overheating has been defined as a number of hours over a particular temperature, irrespective of conditions outside the building. Recent work embodied in European standards suggests that the temperature that occupants will find uncomfortable changes with the outdoor conditions in a predictable way. This research informs the CIBSE guidance presented in this Technical Memorandum (TM). The meaning of the research and the link with overheating are explained and a series of criteria by which the risk of overheating can be assessed or identified are suggested."

Adaptive Comfort Criteria

The following three criterias, taken together, are used to assess the risk of overheating of buildings in the UK and Europe. A room or building that fails any two of the three criteria is classed as overheating.

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 1K or more during the occupied hours of a typical non-heating season (1st May to 30th September). For new buildings, major refurbishments and adaptations strategies CIBSE recommends to conform to building Category II in BS EN 15251 (BSI, 2007). For these type category of buildings the limit for the number of hours exceeding the upper limit temperature is set to 3% of the occupied hours.*
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 temperature rise and itsduration. This criterion sets a daily limit for acceptability.*
3. ***The third criterion*** *sets an absolute maximum daily temperature for a room, beyond which the level of overheating is unacceptable. This criterion for building Category II is set to 4K. This means that if the internal operative temperature is 4K above the upper limit of comfort temperature the building fails the third criterion.*

For Category II type of buildings, the maximum acceptable temperature (T_{max}) can be calculated from the running mean of the outdoor temperature (T_{rm}) using the formula:

$$T_{max} = 0.33\, T_{rm} + 21.8$$

Where T_{max} is the maximum acceptable temperature (°C). It should be noted that for buildings that have a higher level of expectation in respect to spaces that are occupied by very sensitive and vulnerable persons. More demanding standards suggested for Category I (more restrictive) can be agreed with the client if required. This sets the maximum acceptable temperature (T_{max}) at 1 K less than the above recommendation.

The criteria are all defined in terms of ΔT the difference between the actual operative temperature in the room at any time (T_{op}) and T_{max} the limiting maximum acceptable temperature. ΔT is calculated as:

$$\Delta T = T_{op} - T_{max}$$

ΔT is rounded to the nearest whole degree (i.e. for ΔT between 0.5 and 1.5 the value used is 1 K; for 1.5 to 2.5 the value used is 2 K, and so on).

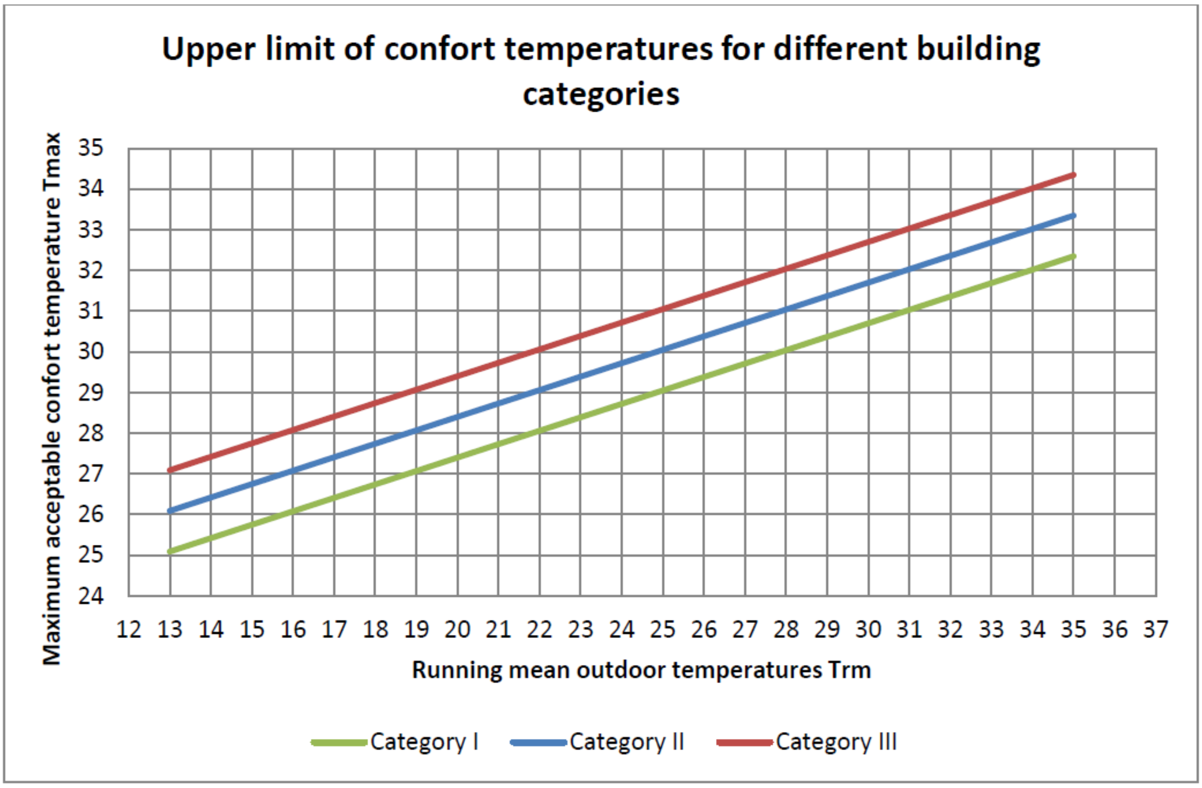


Figure 1, maximum acceptable temperature

4.0 CIBSE TM59: 2017 - OVERVIEW

In April 2017 the Chartered Institution of Building Services engineers (CIBSE) published this Technical Memorandum to provide guidance when evaluating dwellings for overheating assessment. This document provides a set of profiles that represent reasonable usage patterns for a home suitable for evaluating overheating risk. The heat gains are taken, when possible, from CIBSE guide A. This guidance is the first attempt to try to standardise overheating assessments however further work is needed and the use is intended in the interim.

This methodology is based on the use of dynamic thermal modelling for the treatment and assessment of overheating risk in residential buildings. This methodology is proposed for all residences and should especially be considered for:

- *large developments*
- *developments in urban areas, particularly in southern England*
- *blocks of flats*
- *dwellings with high levels of insulation and air-tightness*
- *single aspect flats.*

Individual houses and developments with a low risk of overheating may not require the use of dynamic thermal modelling. Professional judgement must be used when taking the decision to omit dynamic thermal modelling to test overheating.

<u>The assessment should follow the following steps:</u>

1. A suitable sample of units within a development should be selected, i.e. - These are likely to be those (a) with large glazing areas, (b) on the topmost floor, (c) having less shading, (d) having large, sun-facing windows, (e) having a single aspect, or (c) having limited opening windows.
2. Zoning: all sample units should be zoned into the separate rooms including kitchens, living rooms, bedrooms, bathrooms and halls.
3. Building constructions should be modelled as proposed, accurately reflecting thermal properties such as thermal mass, insulation and solar transmittance for glazing.
4. Standard profiles should be applied for occupancy, lighting and equipment gains.
5. Guidance on the treatment of communal corridors should be followed.
6. Pipework and equipment, e.g. heat interface unit gains from community heating system.
7. Operable windows should be included in the model and follow the guidance given in this guide.
8. Any internal or external shading provision should be included in the model and follow the guidance included.
9. Additional mechanical ventilation including mechanical ventilation with heat recovery (MVHR) or extract systems should be included in the model.
10. Air speed assumptions should be based on this guidance.
11. The weather file used for the methodology should be the DSY1 (design summer year) file most appropriate for the site location for the 2020s, high emissions, 50% percentile scenario.
12. The assessment should be undertaken using hourly dynamic simulation modelling, which includes all the relevant features of the building.

Criteria for domestic developments predominantly naturally ventilated

Compliance is based on passing both of the following two criteria:

a. For living rooms, kitchens and bedrooms: the number of hours during which DT 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).

b. 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.

Criteria for domestic developments 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)).

Adjustments for homes with vulnerable occupants

Care homes and accommodation for vulnerable occupants, which are predominantly naturally ventilated (see definition above), should use criteria (a) and (b) from section above but should assume Type I occupancy (see CIBSE TM52 (2013) for description).

If they are predominantly mechanically ventilated (see definition above), the fixed temperature method should be used.

Where there is particular concern of high risk of overheating in accommodation for vulnerable occupants, a heatwave strategy should also be developed using additional weather files (see section 3.2) to explore performance and for demonstrating mitigation options under extreme events (e.g. heatwaves).

Corridors: assessment criteria

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.

5.0 DESIGN SUMMER YEAR WEATHER FILES

The updated DSYs for London (summer 2016) were selected using the statistic Weighted Cooling Degree Hours (WCDH) metric for 3 locations within the city. These locations consist of some of the warmest in the UK with a high probability of this overheating metric being exceeded. In fact, each year contained some degree of overheating which will not necessarily be true of locations further north where the maximum temperatures are usually much cooler. To ensure the overheating metric is representative of each location, a number of metrics are considered with results compared in addition to the WCDH as described above.

In accordance with TM59 the development requires to pass the overheating criteria using the DSY1 weather file for the most appropriate location as shown in Figure 2. Now, for London there are three weather files each one representing different area within Greater London.

- Central Activity Zone: London Weather Central weather file (LWC)
- Inner London: London Heathrow weather file (LHW)
- Outer London: London Gatwick weather file (LGW)

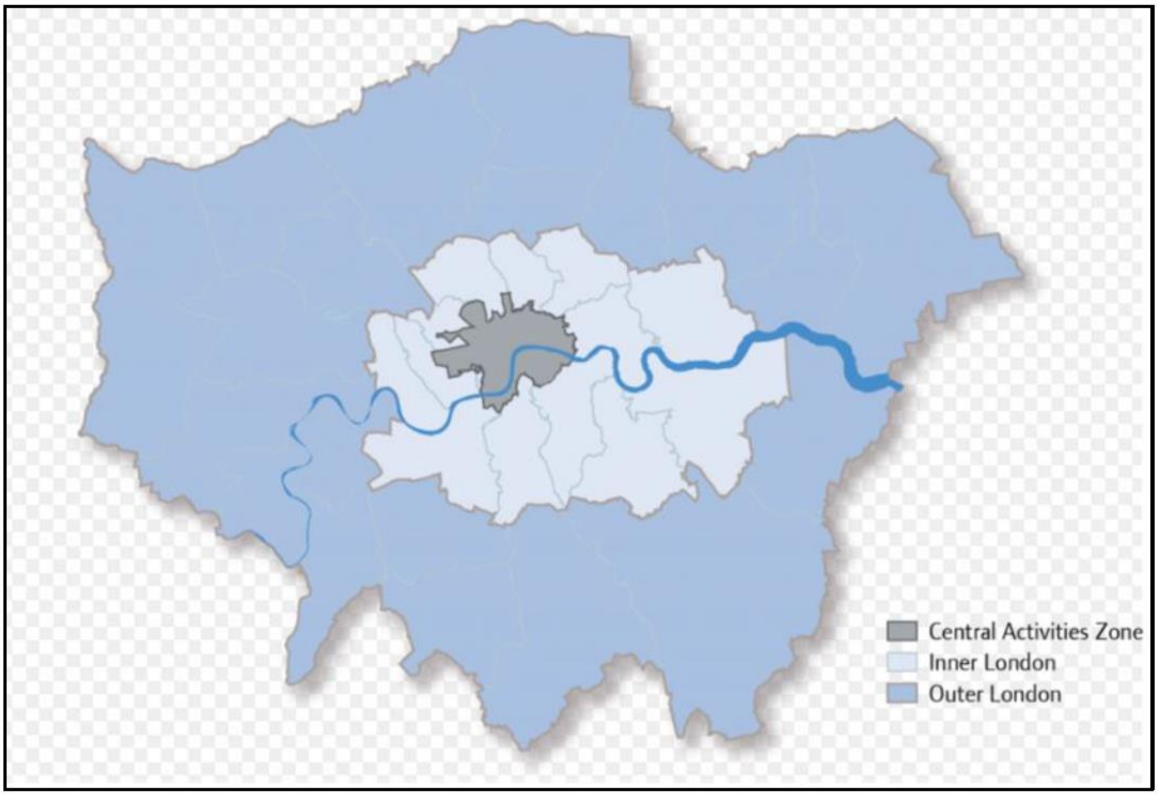


Figure 2, Different Areas of Greater London

6.0 MODEL INPUTS

The input parameters detailed in this Chapter have been extrapolated from CIBSE TM59: Design methodology for the assessment of overheating risk in homes guide.

6.1 Heat Gains and Air Permeability Parameters

For the purpose of the overheating assessment the following parameters and profiles have been used for each building in accordance with TM59. Typical heat gains for people at different activities are given in CIBSE Guide A. The occupancy density in terms of area per person (m^2/person) has been calculated from the layout drawings. The parameters valid for each building are detailed in the tables below.

People Gains	
Max Sensible Gain – **1-bed Kitchen/Living room**	75 W
Max latent Gain – 1-bed Kitchen/Living room	55 W
Occupants -1-bed Kitchen/Living room	1 person
Max Sensible Gain – **single Bedrooms**	75 W
Max Latent Gain - Bedrooms	55 W
Occupants -Bedrooms	1 person
Max Sensible Gain – **double Bedrooms**	150 W
Max Latent Gain - Bedrooms	111 W
Occupants -Bedrooms	2 people

Table 3 – People Heat Gains

Lighting heat gains have been included in accordance with TM59.

Lighting Gains	
Max Sensible Gain	2 W/m^2
Radiant Fraction	0.45

Table 4 – Lighting Heat Gains

Miscellaneous Equipment Gains	
Max Sensible Gain **– Single bedroom**	80 W
Max Sensible Gain **– Double bedroom**	80 W
Max Sensible Gain **– Living/kitchen**	450 W

Table 5 – Lighting Heat Gains

The infiltration is based on values given in CIBSE guidelines while the ventilation values are based on Building Regulations Approved Document F. For dwellings the guide suggests 21 l/s based on two occupants in the main bedroom and a single occupant in all other bedrooms. However, if greater level of occupancy is expected add 4 l/s per person.

Infiltration and Ventilation		
Type	Infiltration	MVHR or CME depending on external conditions
Variation profile	On continuously	On continuously
Adjacent Condition	External air	External air
Max flow	0.89 l/(s*m^2) equivalent at 3.5m^3/h m^2	0.29 l/(s*m^2) based on Approved Document F

Table 6 – Air Exchanges figures

6.2 Building Fabric Parameters

Passive Measures	U-values *(W/m^{2}K)*
External Walls	1.70
Exposed Ground	0.58
Exposed Roof	2.80
Windows	4.95
Windows G-values	0.85
Doors	2.20
Thermal bridging	Accredited Construction Details
Ventilation	Natural Vent + MVHR
Low energy lighting	LED 100%

Table 7– Prepared U-values and Other Parameters

6.3 Occupancy Profiles

The daily occupancy profiles for each space type have been extrapolated again from TM59 guidance. The occupancy profile is quite important as has a great impact on the overheating results. Figure 3 and 4 show the kitchen/living/dining/Bedroom room profile for a typical weekday.

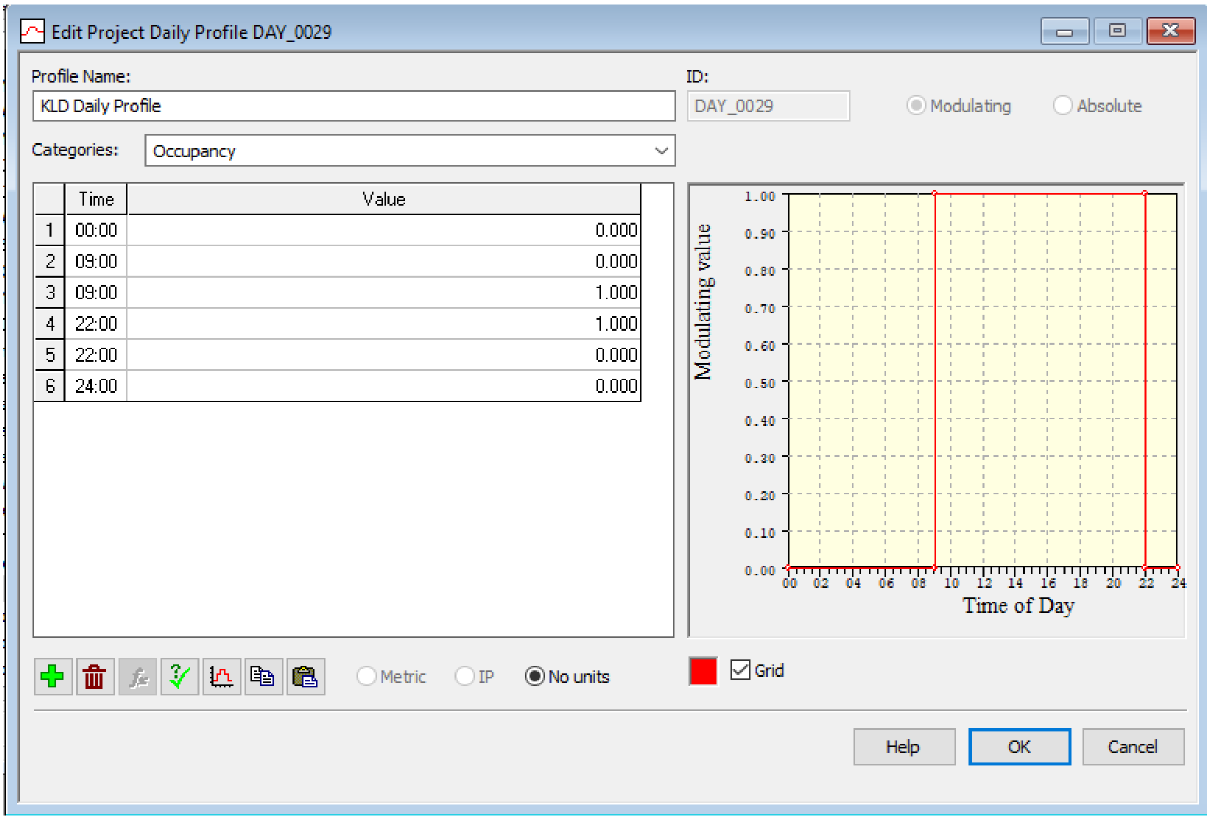
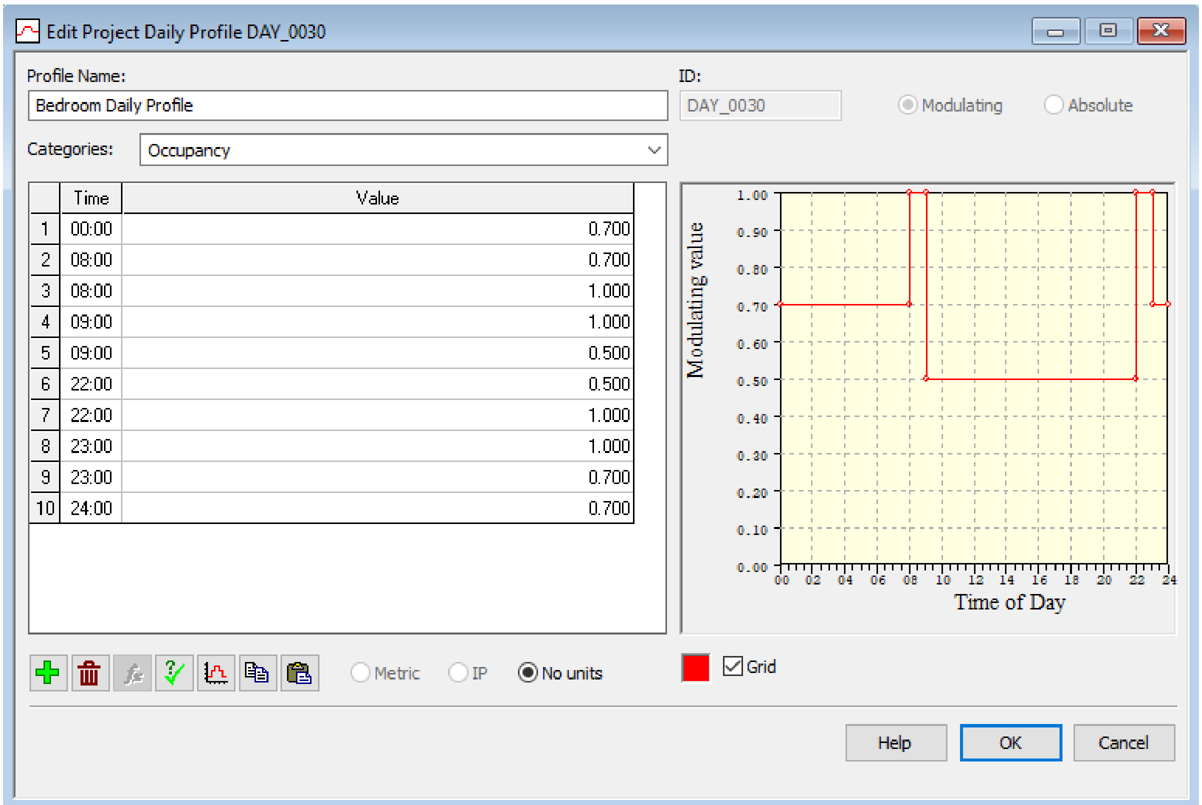
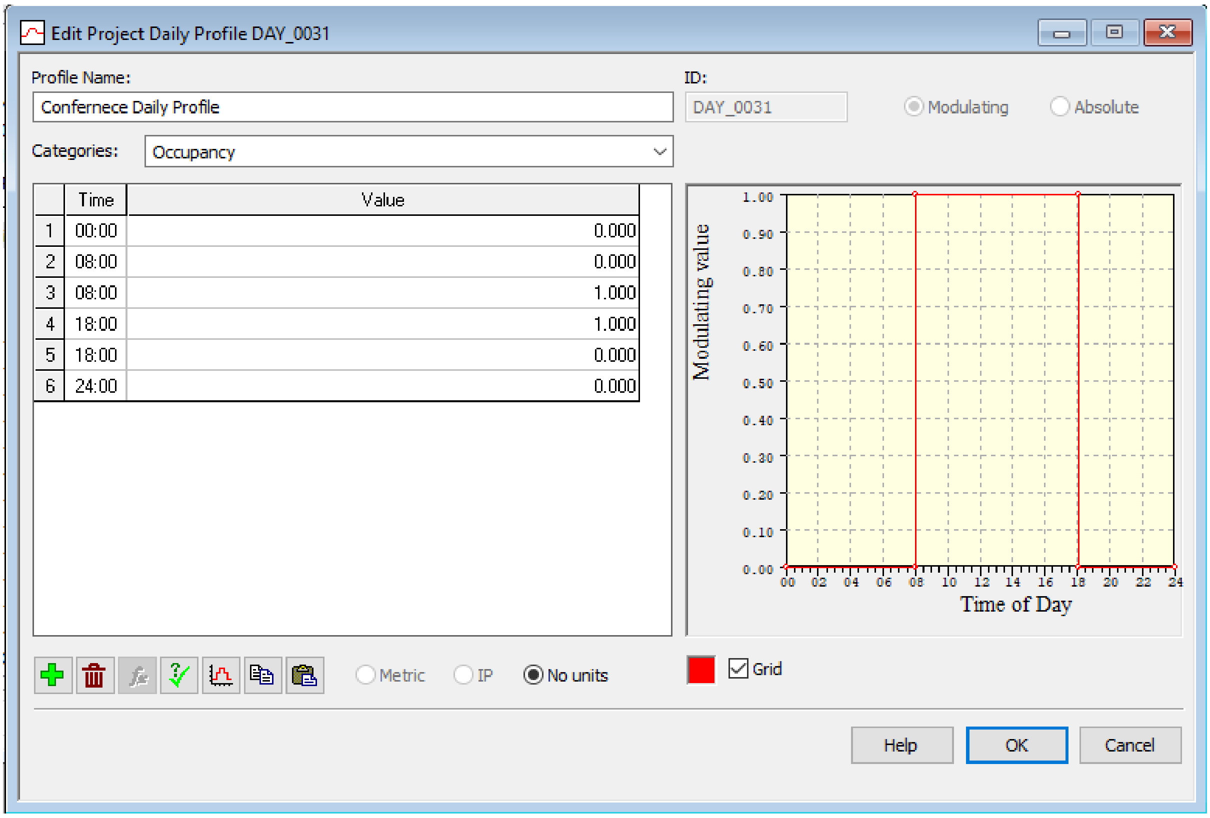


Figure 3, occupancy profile for the KLD room



	Time	Value
1	00:00	0.700
2	08:00	0.700
3	08:00	1.000
4	09:00	1.000
5	09:00	0.500
6	22:00	0.500
7	22:00	1.000
8	23:00	1.000
9	23:00	0.700
10	24:00	0.700

Figure 4, occupancy profile for bedroom



	Time	Value
1	00:00	0.000
2	08:00	0.000
3	08:00	1.000
4	18:00	1.000
5	18:00	0.000
6	24:00	0.000

Figure 5, occupancy profile for Conference

6.4 Ventilation openings

Modelling of the natural ventilation was based on the elevations and photos captured of the site. No mechanical ventilation has been allowed for as part this modelling exercise. Photos (see below) of the existing building indicated windows are sash and restricted. The window restrictors appear to be placed half-way up the second pane of glass on the photo below, and therefore the windows were assumed to open approximately 20cm in accordance with the height of the glass measured on the elevations. This was applied to all openable windows.

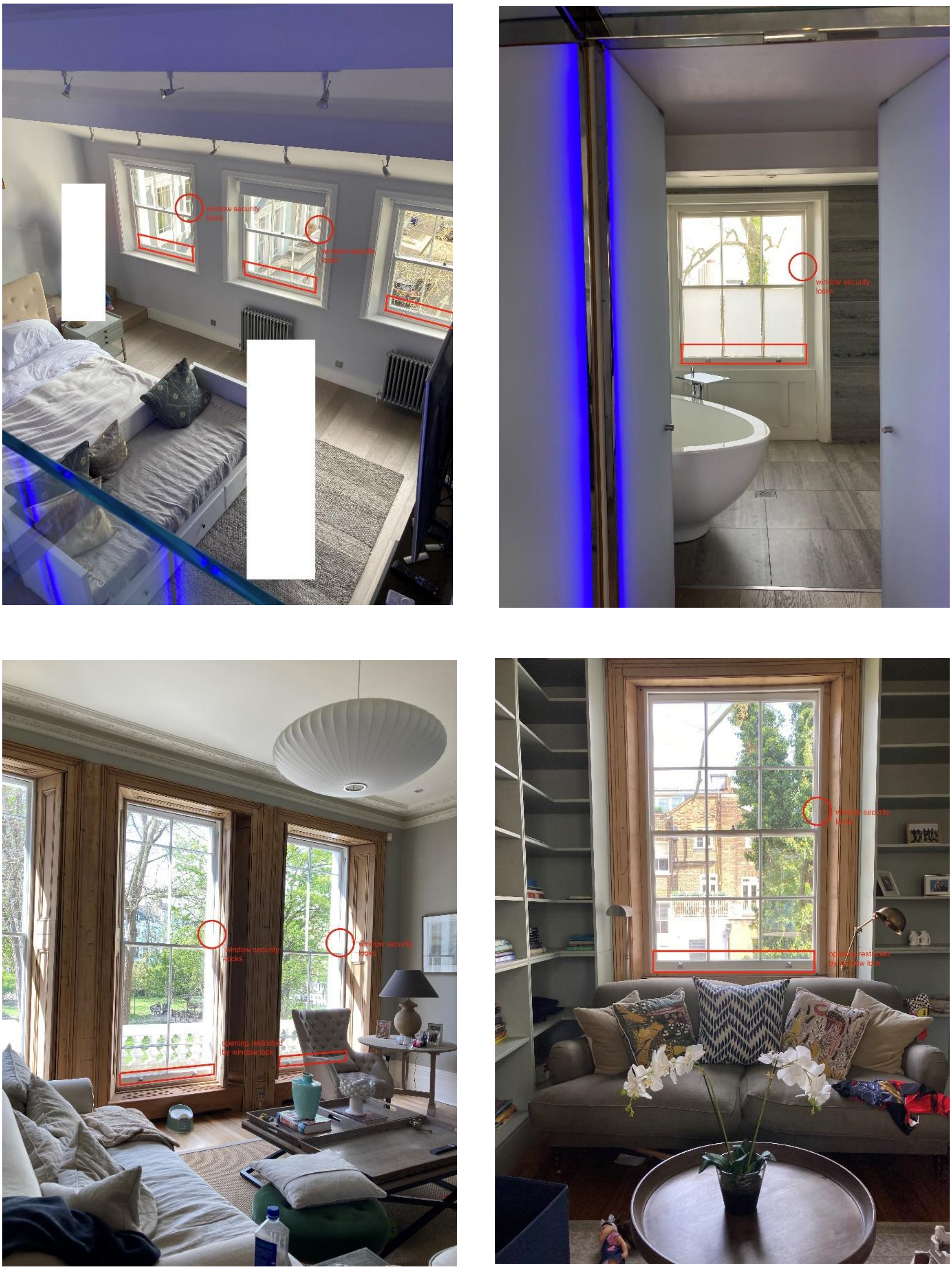


Figure 7.1: Typical window restrictor

6.5 Opening Profiles

Selected windows opening profiles are shown below.

Rooms external windows opening

- Exposure type: dependent on building height
- Opening category: dependent on windows type
- Openable area: Secured sash 100 mm of each window type
- Crack length: 0% of opening perimeter – the infiltration has been considered in another section
- Opening profile: Opening profile (see Figure 7)

Figure 7 shows the opening profile for windows installed in the bedrooms. From 0000hrs to 2400hrs windows are fully open if indoor temperature is higher than 18˚C and indoor temperature is higher than outdoor temperature.

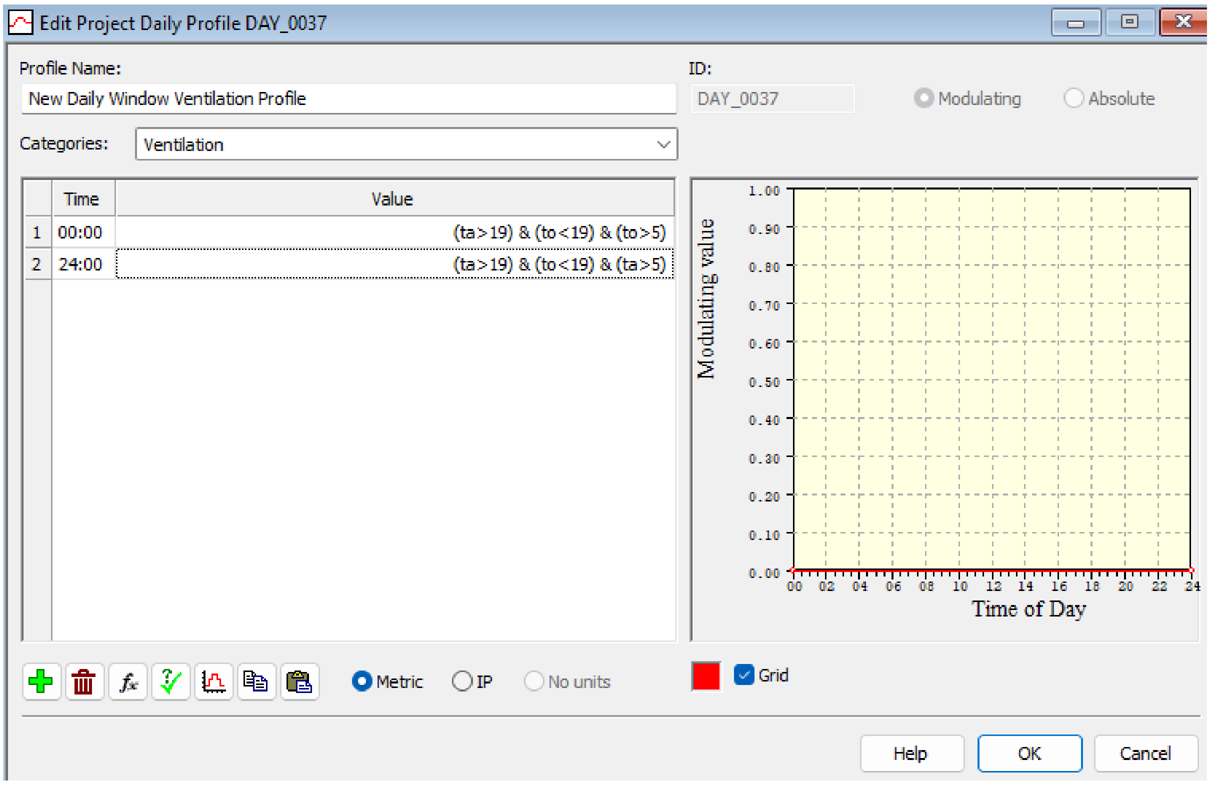


Figure 7.2 – Opening Profile Applied to Bedrooms Windows

7.0 OVERHEATING ANALYSIS RESULTS

The analysis was executed using IES Virtual Environment 2021 which has embedded a module to estimate the adaptive comfort according to the latest CIBSE guide TM52. For new buildings and renovations, the building **category III** has been selected.

Category	Explanation	Suggested Acceptable Range(K)
Category I	High level of expectation only used for spaces occupied by very sensitive and fragile persons.	**2**
Category II	Normal expectation (for new buildings and renovations)	**3**
Category III	A moderate expectation (used for existing buildings)	**4**

Table 8, Building Categories

In collaboration with UK Climate Impacts Programme (UKCIP), the Chartered Institute of Building Services Engineers (CIBSE) has produced a set of weather files for different locations which incorporate weather data projections to account for climate change. Different weather files are available for different locations in the UK. In this study, the London DSY1 file has been used. The Design Summer Year or simply DSY weather file consists of an actual 1-year set of hourly data from the 18-year period mentioned above to represent a year with a hot but not extreme summer. CIBSE Guide A suggests the use of the Design Summer Year weather files when carrying out overheating studies.

It is important to point out that the temperatures embedded in the weather file adopted are already quite high (the peak temperature is achieved on the 22nd of July with a temperature of 33.6°C) greatly contributing to increase the indoor temperatures.

7.1 Summary of Criteria Thresholds Accordingly to TM52: 2013

The following three criteria, taken together, provide a robust yet balanced assessment of the risk of overheating of buildings in the UK and Europe. Please note that accordingly to CIBSE TM52 a room or building that fails any two of the three criteria is classed as overheating.

Criteria 1

This displays the percentage hours when the difference in operative temperature minus the maximum acceptable temperature is greater than or equal to 1K. Hence, if the operative temperature is equal or above 1K respects the maximum acceptable temperature for more or equal than 3% during the occupied hours the room is failing this criterion.

Criteria 2

This displays the maximum daily degree hours found for the space. This fails if it is greater than 6K.

Criteria 3

This displays the maximum ΔT for the space. If it is greater than or equal to 4K respect the maximum acceptable temperature the room fails this criterion.

For the purpose of the analysis the overheating has been assessed using the methodology outlined in CIBSE Guide TM52 and TM59.

7.2 Overheating Occupied Room Results – DSY1

CIBSE released updated DSY 1, 2 and 3 weather files towards the end of August 2016 which made amendments to the warmth and length of the summer months used for overheating assessments, however it's not yet mandatory to use them. The warm year is selected from an 18-year baseline 2003 – 2020 and the 3 DSYs available per location represent summers with different types of hot events:

- **DSY1:** LWC2003_2020High50pct.epw
- **DSY2:** LWC2003_2050High50pct.epw
- **DSY3:** LWC2003_2080High50pct.epw

The CIBSE TM59; 2017 guide states the minimum requirement to pass the overheating assessment is to satisfy two of the three criteria using the single DSY1 file and that it is not mandatory to pass using the DSY2 and DSY3 weather files.

SCENARIO 1

Strategy	Considering Nat Ventilation with no passive measures 15% openable windows				
Assessment scenario	**TM52 Criteria**				**Assessment**
Room Name	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing	Results
B:03 Study Room	53.5	242	21	1 & 2 & 3	Fail
B:05 Guest Suite	25.8	240	23	1 & 2 & 3	Fail
Dining + Kitchen	15.7	193	15	1 & 2 & 3	Fail
1:01 Reception room + 1:02 Library	39.2	199	22	1 & 2 & 3	Fail
2:01 Front Room	26.2	267	25	1 & 2 & 3	Fail
3:01 Front Room	43.4	202	17	1 & 2 & 3	Fail
3:02 Rear Room	37	164	19	1 & 2 & 3	Fail

Strategy	Adopting 15% openable windows			
Assessment scenario	**TM59 Criteria B (Bedrooms only)**			Assessment
	Operative temperature (TM 52/CIBSE) (°C) - hours in range	Operative temperature (TM 52/CIBSE) (°C) - hours in range	Operative temperature (TM 52/CIBSE) (°C) - hours in range	Result
Location	(10:00 pm to 00:00 am) > 26.00	(00:00 am to 07:00 am) > 26.00	(10:00pm to 07:00 am) > 26.01	
B:05 Guest Suite	113	120	233	Fail
2:01 Front Room	90	110	200	Fail

SCENARIO 2

Strategy	Considering Nat Ventilation with no passive measures 25% openable windows				
Assessment scenario	**TM52 Criteria**				**Assessment**
Room Name	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing	Results
B:03 Study Room	44.8	241	21	1 & 2 & 3	Fail
B:05 Guest Suite	23.7	240	23	1 & 2 & 3	Fail
Dining + Kitchen	14.5	192	15	1 & 2 & 3	Fail
1:01 Reception room + 1:02 Library	37.6	199	22	1 & 2 & 3	Fail
2:01 Front Room	25	266	25	1 & 2 & 3	Fail
3:01 Front Room	40.1	202	17	1 & 2 & 3	Fail
3:02 Rear Room	35	164	19	1 & 2 & 3	Fail

Strategy	**Adopting 25% openable windows**

Assessment scenario	**TM59 Criteria B (Bedrooms only)**			Assessment
	Operative temperature (TM 52/CIBSE) (°C) - hours in range	Operative temperature (TM 52/CIBSE) (°C) - hours in range	Operative temperature (TM 52/CIBSE) (°C) - hours in range	Result
Location	(10:00 pm to 00:00 am) > 26.00	(00:00 am to 07:00 am) > 26.00	(10:00pm to 07:00 am) > 26.01	
B:05 Guest Suite	96	109	205	Fail
2:01 Front Room	86	106	192	Fail

SCENARIO 3

Strategy	adopting internal translucent white curtain				
Assessment scenario	**TM52 Criteria**				**Assessment**
Room Name	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing	Results
B:03 Study Room	22.2	143	13	1 & 2 & 3	Fail
B:05 Guest Suite	8.2	125	11	1 & 2 & 3	Fail
Dining + Kitchen	4.1	98	8	1 & 2 & 3	Fail
1:01 Reception room + 1:02 Library	10.1	107	11	1 & 2 & 3	Fail
2:01 Front Room	9.5	144	12	1 & 2 & 3	Fail
3:01 Front Room	21.4	135	13	1 & 2 & 3	Fail
3:02 Rear Room	17.6	119	13	1 & 2 & 3	Fail

Strategy	Adopting internal translucent white curtain			
Assessment scenario	**TM59 Criteria B (Bedrooms only)**			Assessment
	Operative temperature (TM 52/CIBSE) (°C) - hours in range	Operative temperature (TM 52/CIBSE) (°C) - hours in range	Operative temperature (TM 52/CIBSE) (°C) - hours in range	Result
Location	(10:00 pm to 00:00 am) > 26.00	(00:00 am to 07:00 am) > 26.00	(10:00pm to 07:00 am) > 26.01	
B:05 Guest Suite	69	82	151	Fail
2:01 Front Room	50	71	121	Fail

SCENARIO 4

Strategy **External Glazing G-value improve from 0.86 to 0.60**

Assessment scenario	TM52 Criteria				Assessment
Room Name	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing	Results
B:03 Study Room	22.2	143	13	1 & 2 & 3	Fail
B:05 Guest Suite	8.2	125	11	1 & 2 & 3	Fail
Dining + Kitchen	4.1	98	8	1 & 2 & 3	Fail
1:01 Reception room + 1:02 Library	10.1	107	11	1 & 2 & 3	Fail
2:01 Front Room	9.5	144	12	1 & 2 & 3	Fail
3:01 Front Room	21.4	135	13	1 & 2 & 3	Fail
3:02 Rear Room	17.6	119	13	1 & 2 & 3	Fail

Strategy **External Glazing G-value improve from 0.85 to 0.60**

Assessment scenario	TM59 Criteria B (Bedrooms only)			
	Operative temperature (TM 52/CIBSE) - hours in range	Operative temperature (TM 52/CIBSE) - hours in range	Operative temperature (TM 52/CIBSE) (°C) - hours in range	Assessment
Location	(10:00 pm to 00:00 am) > 26.00	(00:00 am to 07:00 am) > 26.00	(10:00pm to 07:00 am) > 26.01	Result
B:05 Guest Suite	69	82	151	Fail
2:01 Front Room	50	71	121	Fail

SCENARIO 5

Strategy **adopting internal Blind for solar gains above 250 W/m2**

Assessment scenario	**TM52 Criteria**				**Assessment**
Room Name	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing	Results
B:03 Study Room	22.2	143	13	1 & 2 & 3	Fail
B:05 Guest Suite	8.2	125	11	1 & 2 & 3	Fail
Dining + Kitchen	4.1	98	8	1 & 2 & 3	Fail
1:01 Reception room + 1:02 Library	10.1	107	11	1 & 2 & 3	Fail
2:01 Front Room	9.5	144	12	1 & 2 & 3	Fail
3:01 Front Room	21.4	135	13	1 & 2 & 3	Fail
3:02 Rear Room	17.6	119	13	1 & 2 & 3	Fail

Strategy **adopting internal Blind for solar gains above 250 W/m2**

Assessment scenario	**TM59 Criteria B (Bedrooms only)**			Assessment
	Operative temperature (TM 52/CIBSE) (°C) - hours in range	Operative temperature (TM 52/CIBSE) (°C) - hours in range	Operative temperature (TM 52/CIBSE) (°C) - hours in range	Result
Location	(10:00 pm to 00:00 am) > 26.00	(00:00 am to 07:00 am) > 26.00	(10:00pm to 07:00 am) > 26.01	
B:05 Guest Suite	69	82	151	Fail
2:01 Front Room	50	71	121	Fail

SCENARIO 6

Strategy	adopting internal curtain + external louvers for solar gains above 250 W/m2				
Assessment scenario	**TM52 Criteria**				**Assessment**
Room Name	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing	Results
B:03 Study Room	19.2	131	13	1 & 2 & 3	Fail
B:05 Guest Suite	6.3	114	10	1 & 2 & 3	Fail
Dining + Kitchen	3.3	90	8	1 & 2 & 3	Fail
1:01 Reception room + 1:02 Library	8.1	93	9	1 & 2 & 3	Fail
2:01 Front Room	7.2	131	11	1 & 2 & 3	Fail
3:01 Front Room	19.1	128	13	1 & 2 & 3	Fail
3:02 Rear Room	15.3	113	12	1 & 2 & 3	Fail

Strategy	adopting internal curtain + external louvers for solar gains above 250 W/m2			
Assessment scenario	**TM59 Criteria B (Bedrooms only)**			
	Operative temperature (TM 52/CIBSE) (°C) - hours in range	Operative temperature (TM 52/CIBSE) (°C) - hours in range	Operative temperature (TM 52/CIBSE) (°C) - hours in range	Assessment
Location	(10:00 pm to 00:00 am) > 26.00	(00:00 am to 07:00 am) > 26.00	(10:00pm to 07:00 am) > 26.01	Result
B:05 Guest Suite	61	78	139	Fail
2:01 Front Room	46	65	111	Fail

SCENARIO 7

Strategy	adopting mechanical comfort cooling using ASHP

Assessment scenario	TM52 Criteria				Assessment
Room Name	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing	Results
B:03 Study Room	0	0	0	-	Pass
B:05 Guest Suite	0	0	0	-	Pass
Dining + Kitchen	0	0	0	-	Pass
1:01 Reception room + 1:02 Library	0	0	0	-	Pass
2:01 Front Room	0	0	0	-	Pass
3:01 Front Room	0	0	0	-	Pass
3:02 Rear Room	0	0	0	-	Pass

Strategy	adopting mechanical comfort cooling using ASHP			
Assessment scenario	**TM59 Criteria B (Bedrooms only)**			Assessment
	Operative temperature (TM 52/CIBSE) (°C) - hours in range	Operative temperature (TM 52/CIBSE) (°C) - hours in range	Operative temperature (TM 52/CIBSE) (°C) - hours in range	Result
Location	(10:00 pm to 00:00 am) > 26.00	(00:00 am to 07:00 am) > 26.00	(10:00pm to 07:00 am) > 26.01	
B:05 Guest Suite	0	0	0	Pass
2:01 Front Room	0	0	0	Pass

Concluding this TM52 Overheating analysis along with the cooling hierarchy exercise indicate that cooling is required in order for all habitable rooms to achieve comfortable internal temperatures and comply with CIBSE TM52 Overheating analysis.

8.0 CONCLUSIONS

The overheating analysis has been carried out according to CIBSE TM52: 2013 and TM59:2017 for the proposed development to assess the risk of overheating during the summer season.

The CIBSE TM59; 2017 guide states the minimum requirement to pass the overheating assessment is to satisfy two of the three criteria using the single DSY1 file and that it is not mandatory to pass using the DSY2 and DSY3 weather files.

- **CIBSE TM52 & TM59 Compliance**

To meet the compliance requirements and minimise the risk of overheating in extreme weather conditions, the feasibility of natural ventilation, passive cooling measures, and mechanical comfort cooling have been tested. According to the cooling hierarchy, passive cooling measures have been prioritised first, then active measures have been investigated further. It was concluded that to fully mitigate the overheating risk within the habitable spaces mechanical comfort cooling will be required.