38 Chester Terrace

Overheating Risk Assessment

Private Client

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P01	04 June 2021	Draft Issue for Comment
P02	20 October 2021	Updated to address comments
P03	17 December 2021	Updated to include internal blinds

Document Validation (latest issue)

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Principal author	Checked by	Verified by
Signed by: Krania, Angeliki	Signed by: Correia, Nuno	

Executive Summary

Dynamic Simulation Modelling (DSM) has been conducted for the residential dwelling 38 Chester Terrance in London to determine the likelihood of overheating if the dwelling were to rely solely upon passive ventilation (opening windows).

Analysis was conducted under the CIBSE TM59 overheating methodology for homes, which specifies standardised internal gains, profiles, and opening criteria.

All occupied spaces have been assessed against the projected climate change London weather files DSY1, DSY2 and DSY3 for medium and high emissions scenarios. Based on TM59 guidance, compliance is only required with the London_LWC_DSY1_2020High50_.epw that represents a high emissions scenario for a 'moderately warm summer'.

As part of the design proposals full consideration has been given the cooling hierarchy following the guidance set out in Camden's local plan. This looked to limit the heat entering the occupied rooms, limit internal heat generation, utilise passive & mechanical ventilation and then as a last resort consider active cooling.

The results of the assessment show that all but two rooms fail to meet the TM59 criteria with the design outlined in this report for the compliance weather file London_LWC_DSY1_2020High50_.epw based on the TM59 guidance. All rooms fail for all future weather files simulated.

Weather files	Type of Rooms	Pass TM59 Criteria (number of rooms)
London_LWC_DSY1_2020High50_.epw (Moderately warm summer) – Compliance Weather File based on TM59 Guidance	Kitchen/ Living Rooms/ Other	2 out of 6
	Bedrooms	0 out of 4
London_LWC_DSY1_2050High50_.epw (Moderately warm summer)	Kitchen/ Living Rooms/ Other	0 out of 6
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London_LWC_DSY1_2080High50_.epw (Moderately warm summer)	Kitchen/ Living Rooms/ Other	0 out of 6
	Bedrooms	0 out of 4
London_LWC_DSY2_2020High50_.epw (Short, intense warm spell)	Kitchen/ Living Rooms/ Other	0 out of 6
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	Bedrooms	0 out of 4
London_LWC_DSY3_2050High50_.epw (Long, less intense warm spell)	Kitchen/ Living Rooms/ Other	0 out of 6
	Bedrooms	0 out of 4
London_LWC_DSY3_2080High50_.epw (Long, less intense warm spell)	Kitchen/ Living Rooms/ Other	0 out of 6
	Bedrooms	0 out of 4

It should be further noted that the results of the simulations undertaken within this report reflect the risk of overheating under the conditions and assumptions listed within this report, including, but not limited to:

- Fabric performance
- Occupancy
- Internal gain
- Weather data
- Ventilation rates
- Façade design
- Window opening configuration
- Orientation and overshadowing

Changes to any of the listed assumptions will invalidate the results of the study and will require a new risk assessment against the TM59 overheating criteria.

Since natural ventilation is inadequate to ensure the development does not overheat, active cooling is required. However, occupiers will be educated to use natural ventilation as much as possible and to only use cooling during periods of peak temperatures.

Contents

1.0 Introduction

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This study evaluates the current Chester Terrace design for its ability to avoid overheating. Results were generated through Dynamic Thermal Simulation (DSM), using industry validated software IES Virtual Environment 2019. All occupied spaces have been assessed against CIBSE 'TM59: 2017 - Design methodology for the assessment of overheating risk in homes'.

1.1 TM59 assessment criteria

Thermal comfort is a complex phenomenon as people will have a perception of their thermal comfort based on a range of factors including clothing, activity, outdoor temperatures, and recent experience: for this reason, a single absolute temperature value cannot always define occupant comfort.

To address the dynamic nature of thermal comfort, CIBSE TM59 outlines two criteria to assess overheating for homes, which are predominantly naturally ventilated. The criteria are based on operative temperature, which can be considered as a simple representation of the temperature experienced by occupants; operative temperature considers the impact of dry bulb air temperature, mean radiant temperature, and air speed in the space.

Criterion one relates to ΔT, which is the difference between the actual operative temperature in the room at any time (T_{op}) and the limiting maximum acceptable temperature (T_{max}):

$$\Delta T = T_{op} - T_{max} \text{ (K)}$$

ΔT is rounded to the nearest degree (K) (i.e. for ΔT between 0.5 and 1.4 the value used is 1K, for 1.5 to 2.4 the value used is 2K and so on)

Criterion two assesses the overnight operative temperature within bedrooms.

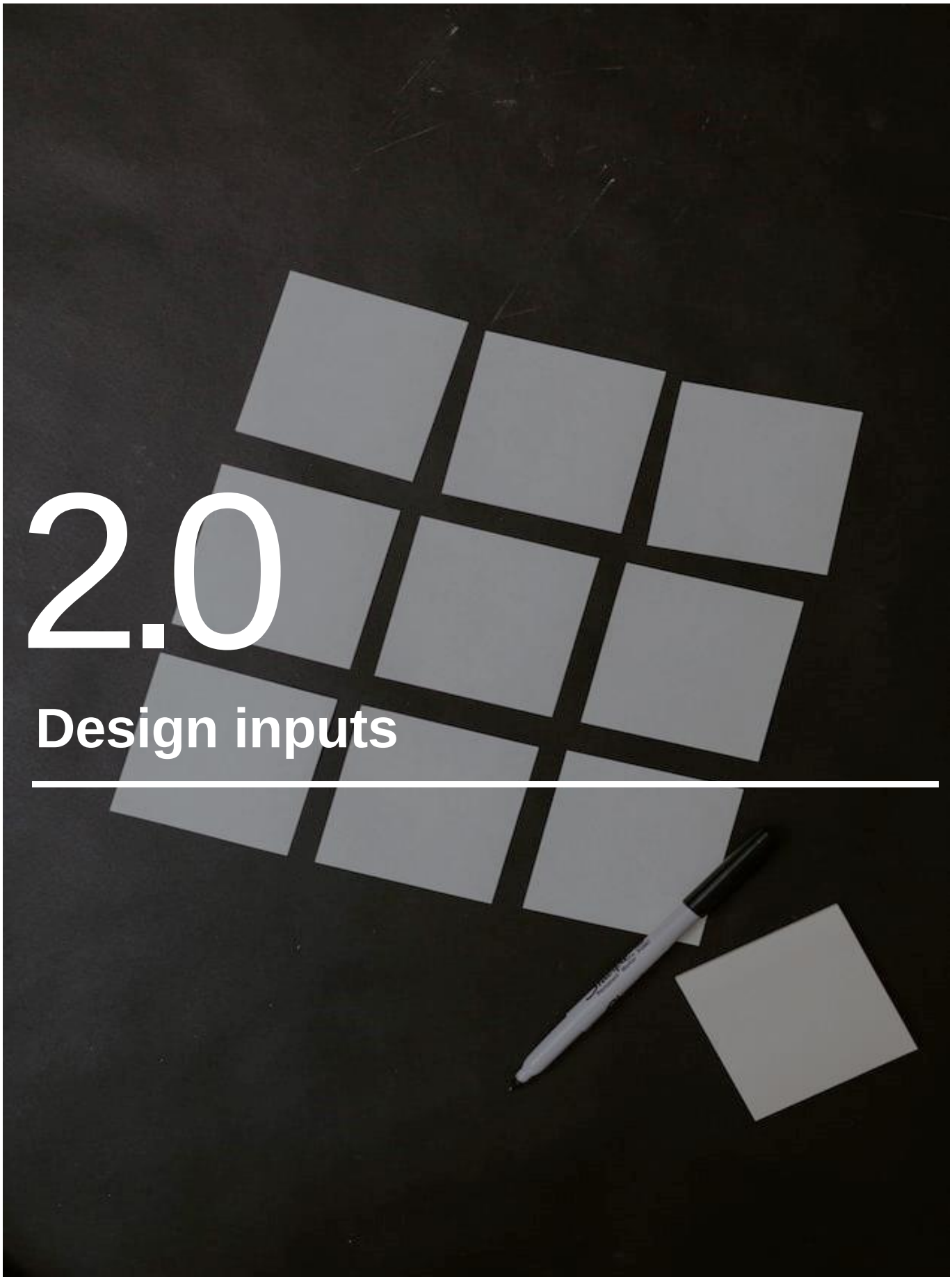
The building will be deemed to fail the overheating design criteria if either of the following two criteria are exceeded:

Criterion one (for living rooms, kitchens and bedrooms)

- The number of hours during which ΔT is greater than or equal to one degree (K), during the period May to September inclusive, shall not be more than 3% of occupied hours.

Criterion two (for bedrooms only):

- To guarantee comfort during the sleeping hours the operative temperature in the bedroom from 10 pm to 7am shall not exceed 26°C for more than 1% (33 hours) of annual hours.



2.0
Design inputs

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2.1 Geometry

Example floor plans of the development are shown in the following figures:

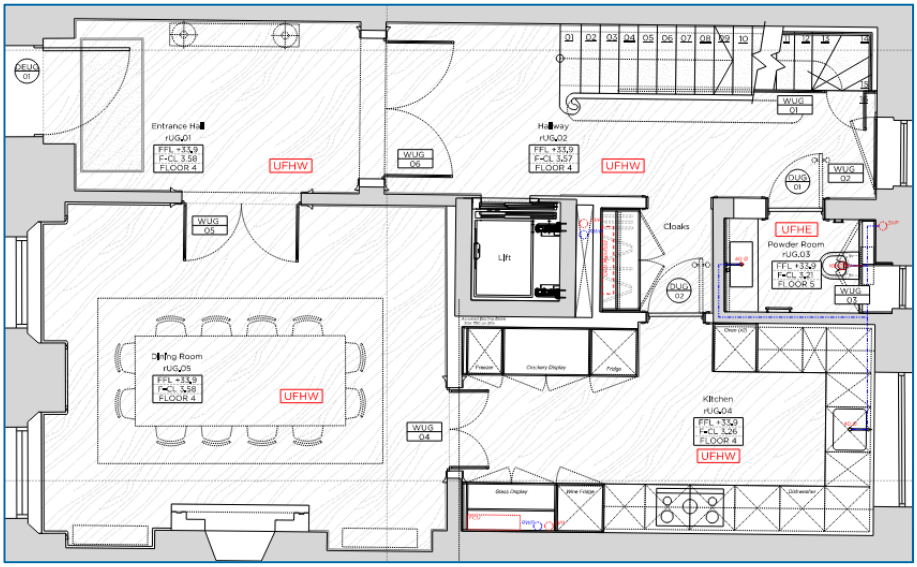

Figure 2.1: Upper Ground Floor GA plan

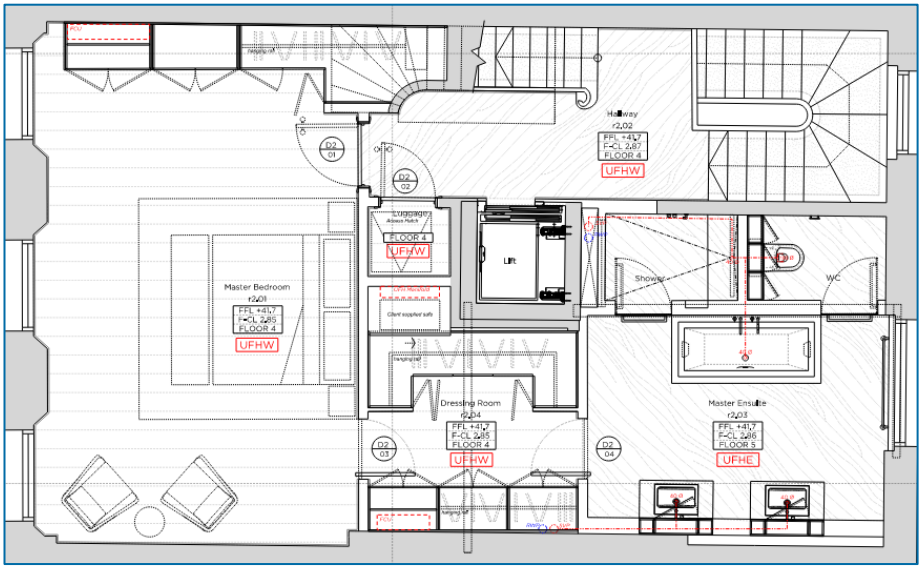

Figure 2.2: First floor GA plan

The model has been constructed according to the following architect drawings dated January – February 2021.

Drawing Name	Drawing No.	Date
Proposed Lower Ground Floor Plan	A1999	Feb 2021
Proposed Upper Ground Floor Plan	A2000	Feb 2021
Proposed First Floor Plan	A2001	Feb 2021
Proposed Second Floor Plan	A2002	Feb 2021

Drawing Name	Drawing No.	Date
Proposed Third Floor Plan	A2003	Feb 2021
Proposed Lift Floor Plan	A2004	Feb 2021
Proposed Roof Floor Plan	A2005	Feb 2021
Proposed Section BB	A2201	Jan 2021
Proposed Section CC	A2202	Jan 2021
Proposed Front (West) Lightwell Elevation	A2101	Jan 2021
Proposed Rear (East) Elevation	A2102	Jan 2021

Table 2-1: Architectural Drawings

A 3D representation of the model as constructed in IES is shown in the next figure.

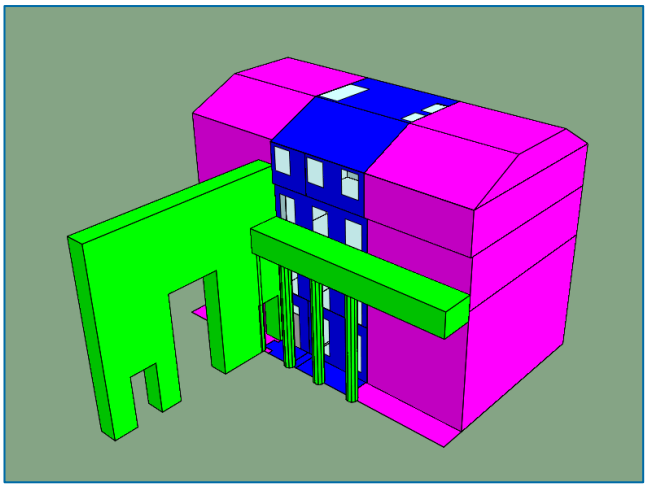

Figure 2.3: 3D model in IES VE 2019

2.2 Fabric parameters

The table below outlines the modelled material and construction properties that have an impact on thermal conditions within a space, and therefore on occupant comfort. The fabric inputs are based on be default values for age of building.

Element	Value	Comments
External wall U-value (W/m^2.K)	1.7	Default SBEM value
Ground floor U-value (W/m^2.K)	0.58	Default SBEM value
Roof U-value (W/m^2.K)	2.8	Default SBEM value
Windows U-value (W/m^2.K)	4.95	Default SBEM value
Windows G-value (%)	85%	Default SBEM value
Windows frame factor	10%	Assumption
Air permeability (m^3/hr/m^2)	10.00	Assumption based on age of building
Infiltration (ACH)	0.40	As per CIBSE Guide A for given air permeability

Table 2-2: Fabric details

2.3 Solar control

An iteration with internal blinds has been carried out.

2.4 Gain profiles

TM59 specifies standardised usage profiles for each apartment size and space type. These aim to reflect typical to worst case occupancy, lighting and equipment patterns throughout the day. The lighting profiles run from 18:00 to 23:00 in all spaces. The occupancy and equipment profiles used in the modelling can be found in **Appendix A**.

2.5 Internal gains

Internal gains are modelled as per the requirements prescribed by TM59. These are summarised below:

Zones	Occupancy			Lighting (W/m²)	Equipment (Peak - W)
	People	Sensible/person (W)	Latent/person (W)		
Bedrooms - Double	2	75	55	2	80
Kitchen – 4 Bed Apartment	4	75	55	2	300
Living room – 4 Bed Apartment	4	75	55	2	150
Gym	2	105	160	2	250
Laundry room	0	-	-	2	56
Corridor areas	0	-	-	2	0
WCs	0	-	-	-	1.75 W/m^2

Table 2-3: Internal gains

2.6 Weather files

CIBSE TM59 guidance requires that developments refer to the latest CIBSE Design Summer Year (DSY) weather files. Developments are required to pass the DSY1 file most appropriate for the site location for the 2020s, high emissions, 50th percentile scenario[1]. The appropriate nearest available weather file location is the London Weather Centre file. The analysis has been carried out using the following weather files:

- London_LWC_DSY1_2020High50_.epw – Compliance weather file based on TM59 guidance
- London_LWC_DSY1_2050High50_.epw
- London_LWC_DSY1_2080High50_.epw
- London_LWC_DSY2_2020High50_.epw
- London_LWC_DSY2_2050High50_.epw
- London_LWC_DSY2_2080High50_.epw
- London_LWC_DSY3_2020High50_.epw
- London_LWC_DSY3_2050High50_.epw
- London_LWC _DSY3_2080High50_.epw

[1] DSY weather files represent a 'near extreme' warm summer period for the purposes of simulating overheating in buildings. In developing these files, analysis was undertaken by CIBSE on historical summer weather data to identify years in which summer was particularly warm. One way of stating the data selected for the DSY1 file is that it represents conditions that recur (statistically speaking) every 8 years. The weather patterns derived from historical data were then adjusted to account for the predicted impact of climate change. The 2020s, high emissions, 50th percentile scenario can be considered as a statistical prediction of weather patterns in the decade 2020 assuming carbon dioxide equivalent emissions continue as per the IPCC 'high' forecast, with the 50th percentile range of forecast temperatures used.

2.7 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 2.4: Typical window restrictor

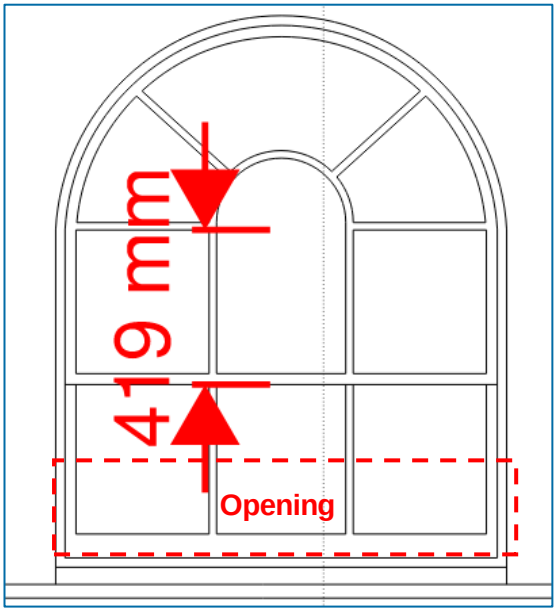

Figure 2.5: Elevation of above window

Figure 2.6: Typical window restrictor

2.8 Control Profiles

The window openings are manually operated by occupants in response to internal temperatures. The window profile used for the assessment is based on the TM59 guidance and operates when internal dry bulb temperature is higher than 22°C and higher than the outside air temperature.

2.9 Implementation of the cooling hierarchy

As per the Camden Local Plan (2012) and industry best practice the cooling hierarchy has been implemented to look to limit the risk of overheating utilising the less energy/carbon intensive measures as a priority. Only once all measures have been exhausted then can reliance on active cooling be accommodated.

Cooling hierarchy – Steps	Intervention/ submission narrative
Minimise internal heat generation through energy efficient design	Given the listed nature of the development opportunities to alter the internal layout are extremely limited. All new service equipment, including the lighting will be low energy consuming, limiting the internal heat build up in the space. (NB. The CIBSE TM59 mandates the internal gains and variation profile)

Cooling hierarchy – Steps	Intervention/ submission narrative
Reduce the amount of heat entering a building in summer:	The orientation of the existing building is fixed so we are unable to re-position the rooms. External shading is already provided on the existing building at some levels and goes some way to limiting the solar gains. The neighbouring building have been taken account in the modelling and provide some level of shading. The proximity of the park with high levels of greening will help regulated temperatures locally. The listed nature of the building means that it is not an option to alter the façade and windows therefore the glazing g-value remains as per existing. Blind and curtains are likely to be installed following the refurbishment, however shutting these may conflict with the window opening and block out natural light therefore increasing the use of artificial lighting. The assessment has been carried out for both scenarios; with and without internal blinds.
Manage the heat within the building through exposed internal thermal mass and high ceilings	The rooms already have good ceiling heights so will provide a large volume of space to manage heat in the space. The servicing strategy will look to limit unwanted heat gains in summer by suitably insulating the domestic hot water pipework in the dwelling.
Passive ventilation	Background fresh air has been designed to be provided via the opening of windows to all areas where sufficient window openings exists. In some rooms due to low windowsills, restrictors are required to manage the risks of potential falls. Given the listed nature of the building significant changes to the layout and configuration of the space are not possible. The openable windows at higher levels, demanding upon security considerations, can be left open over night to purge spaces of heat that built-up in the day.
Mechanical ventilation	Additional background ventilation via mechanical systems is being included in the gym space to provide further fresh air into the space. The background fresh air requirements for this space cannot be met through the opening of windows in this space. Domestic scale mechanical ventilation systems are unlikely to provide the necessary ventilation rate to fully mitigate the risk of overheating, but it can limit it to some extent.
Active cooling	Active cooling is only being considered if the above strategies fail to fully limit the risk of overheating following the TM59 modelling criteria and standard. Should active cooling be provided then the most energy efficient option shall be provided. As part of the handover guidance will be provided to the occupants on how to utilise any active cooling in an energy efficient manner.

3.0 Results

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The following table shows the number of rooms that pass the TM59 criteria against all the future weather files tested.

Weather files	Type of Rooms	Pass TM59 Criteria (number of rooms)
London_LWC_DSY1_2020High50_.epw (Moderately warm summer) – Compliance Weather File based on TM59 Guidance	Kitchen/ Living Rooms/ Other	2 out of 6
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The following table shows the number of rooms that pass the TM59 criteria against all the future weather files tested after the addition of internal blinds to the spaces.

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	Bedrooms	0 out of 4
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4.0 Conclusion

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Dynamic Simulation Modelling (DSM) has been conducted for the residential dwelling 38 Chester Terrace to determine the likelihood of overheating under the current design.

Analysis was conducted under the CIBSE TM59 overheating methodology for homes, which specifies standardised internal gains, profiles and opening criteria.

The results of the assessment show that all but two rooms fail to meet the TM59 criteria with the design outlined in this report for the compliance weather file London_LWC_DSY1_2020High50_.epw based on the TM59 guidance. All rooms fail for all future weather files simulated.

Since natural ventilation is inadequate to ensure the development does not overheat, active cooling is required. This is also the case when internal blinds are taken into consideration. However, occupiers will be educated to use natural ventilation as much as possible and to only use cooling during periods of peak temperatures.

It should be further noted that the results of the simulations undertaken within this report reflect the risk of overheating under the conditions and assumptions listed herewith, including, but not limited to:

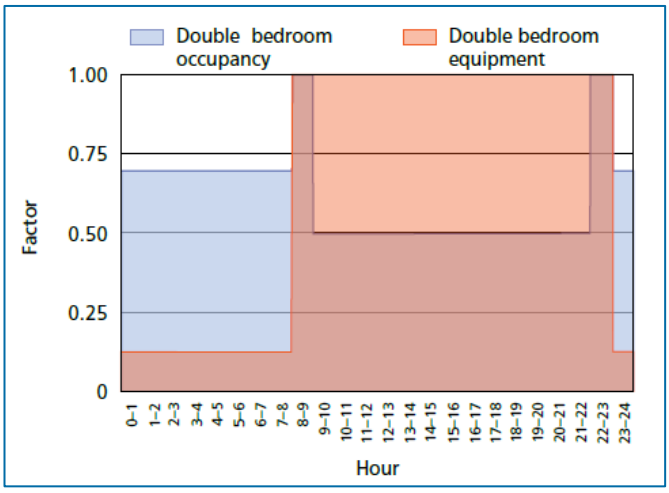
- Fabric performance
- Occupancy
- Internal gains
- Weather data
- Ventilation rates
- Façade design
- Window opening configuration
- Orientation and overshadowing

Changes to any of the listed assumptions will invalidate the results of the study and will require a new risk assessment against the TM59 overheating criteria.

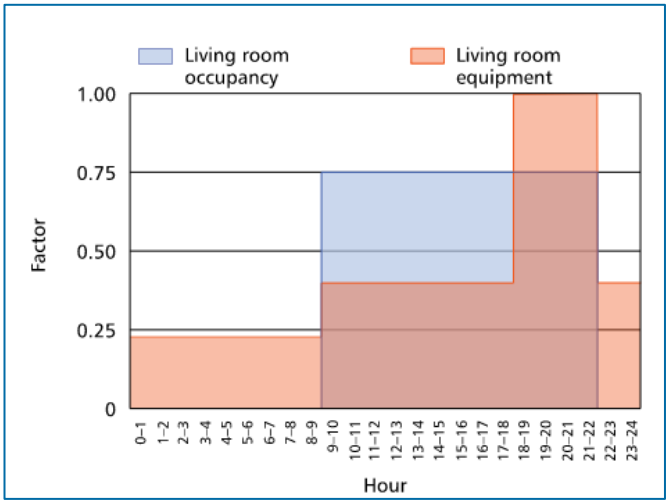
5.0 Appendices

Appendix A – TM59 Profiles

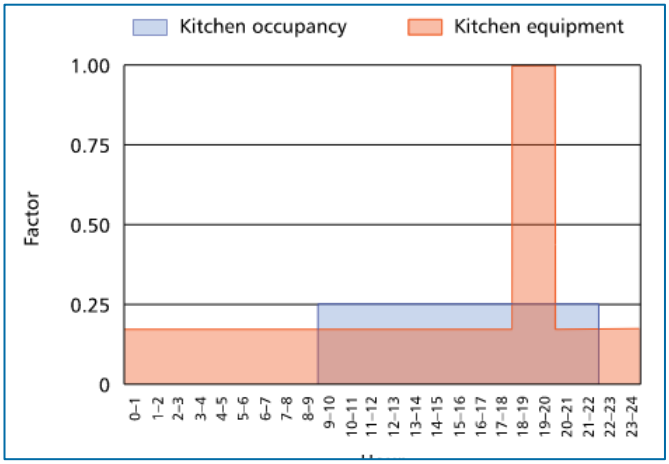
Heat gain profile: double bedroom:



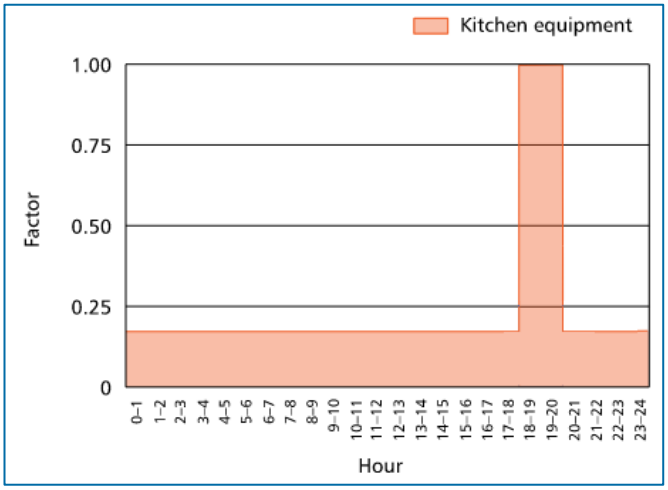
Heat gain profile: living room/gym:



Heat gain profile: kitchen:



Heat gain profile: laundry room:



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