100 Avenue Road

Overheating Assessment

February 2025

REGAL

WHITECODE
CONSULTING

OVERHEATING ASSESSMENT

100 Avenue Road

CIBSE TM59:2017

Part O of the Building Regulations

Prepared for Regal Avenue Road Ltd.

Report No. 12077-WCL-ZZ-ZZ-RP-SS-0003

Revision P03

13 February 2025

Contents

Revisions:

Rev No:	Date:	Status/Comments:	Prepared by:	Checked by:
P01	Dec 2024	Preliminary report for comment	EH	AW
P02	Jan 2025	Updated to comments	EH	AW
P03	Feb 2025	Updated site plan	KV	EH

Executive Summary

This overheating report has been prepared by Whitecode Consulting Ltd on behalf of Regal Avenue Road Limited ('the Applicant') in support of an application a s.73 Amendment Application for the redevelopment of 100 Avenue Road ('the Site') within the London Borough of Camden ('LBC').

The description of development is as follows:

"Demolition of the existing building and redevelopment comprising residential units (Class C3) and flexible commercial, business and service use (Class E) and community use (Class F2(b)) with associated works including enlargement of the existing basement level to contain disabled car parking spaces and cycle parking, landscaping and access improvements."

The development provides 1187m^2 Class E commercial floorspace and 1372m^2 Class F2(b) community floorspace along with 237 residential units. There are two building proposed for the site comprising 'the Tower' which is 25 storeys and 'the Lower Block' which is part 7 storey and part 5 storey.

Policy SI 4 Managing Heat Risk of the London Plan requires that major developments reduce potential overheating through the cooling hierarchy, and reliance on air conditioning systems, through passive measures.

The following criteria is set out in CIBSE Technical Memorandum 59 – Design methodology for the assessment of overheating risk in homes (TM59:2017), for predominantly naturally ventilated rooms. Compliance is based on passing **both** criteria below.

Criterion 1 - for living rooms, kitchens and bedrooms

- A limit is set for the number of hours that the operative temperature can exceed the maximum adaptive temperature. A temperature difference greater than or equal to 1K shall not exceed **3%** of the occupied hours of a typical summer (1st May to 30th September).

Criterion 2 - for bedrooms only

- To guarantee comfort during the sleeping hours the operative temperature in the bedroom from 10pm to 7am shall not exceed 26°C for more than 1% of annual hours (1% of the annual hours between 10pm to 7am for bedrooms is **32 hours**).

Homes which have restricted window openings, due to noise or pollution reasons, must be assessed against the CIBSE fixed temperature test.

CIBSE fixed temperature test

- All occupied rooms should not exceed an operative temperature of 26°C for more than **3%** of the annual occupied hours

Integrated Environmental Solutions Virtual Environmental (IES VE) software, version 2024.0.1.0, was used to assess the dwellings using the latest CIBSE Design Summer Year (DSY1) weather file for London Heathrow, for the 2020s, high emissions, 50% percentile scenario. This site has been assessed by a qualified acoustician and the report recommends that bedroom windows are shut overnight for acoustic reasons. Part O allows bedroom windows to be open during the day, and living room windows day and night, providing security measures are met.

In line with the cooling hierarchy the majority of the scheme fully complies with passive measures alone when no acoustic constraints are assumed. These passive measures are; low g-value glazing, deep reveals, and external shading from balconies. When windows are shut due to acoustic constraints, 77 of 78 rooms in the model fail, therefore further mitigation strategies are required to comply with Part O, this is to be expected and is inline with similar projects where acoustics affect window openings.

Where windows are unable to open, either due to acoustic or security reasons, either MVHR with tempered air or ambient loop cooling has been proposed to mitigate the overheating risk. The flow rates are detailed further in this report.

Option	Compliance with CIBSE TM59 / Part O
Passive measures alone	Most units comply
Acoustic constraints (windows shut overnight)	77 out of 78 FAIL
With acoustic constraints & MVHR tempered air/ambient loop	Full Compliance

CIBSE TM59:2017 recommends that the risk of summer overheating is assessed in common areas where community heating pipework runs through them. There is no mandatory target to meet for common areas, but if an internal operative temperature of 28°C is exceeded for more than 3% of the total annual hours then this should be identified. 3% of the total annual hours is 262 hours.

The London Plan requires the common commercial areas to be assessed against CIBSE TM52. CIBSE guide TM52, entitled 'The Limits of Thermal Comfort: Avoiding Overheating in European Buildings', contains guidance on the limits of thermal comfort. This provides guidance on predicting overheating in buildings. It is intended to inform designers, developers, and others responsible for defining the indoor environment in buildings and should be considered when carrying out dynamic thermal modelling.

The results for the commercial areas show they are compliant against the TM52 criteria, with cooling added.

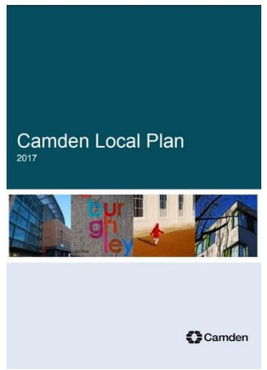
The overheating strategy for 100 Avenue Road is deemed compliant for both the residential and commercial areas. It follows the cooling hierarchy by prioritising passive design measures such as deep reveals and low g-value. The acoustic report has required all bedroom windows to be shut overnight, therefore either MVHR tempered air or cooling from the ambient loop has been implemented, allowing full compliance with Planning Policy and Approved Document O.

1. Introduction

The purpose of this report is to show how the client can address the risk of overheating in the student accommodation and residential dwellings at 100 Avenue Road, Camden.

1.1. Planning Policy and Regulations

The National Planning Policy Framework (NPPF) was updated in December 2024, which re-emphasises the Government's commitment to sustainable development and states the need for planning authorities to take an approach based on integrating the four aims of sustainable development.



The proposed development lies in the London Borough of Camden; therefore, the applicable Regional Spatial Strategy is the London Plan (March 2021) and the Local Planning Policy is the Camden Local Plan 2017.

Policy SI 4 requires all major development proposals to demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the cooling hierarchy.

The London Plan requires the common areas to be assessed against CIBSE TM52. CIBSE guide TM52, entitled 'The Limits of Thermal Comfort: Avoiding Overheating in European Buildings', contains guidance on the limits of thermal comfort. This provides guidance on predicting overheating in buildings. It is intended to inform designers, developers, and others responsible for defining the indoor environment in buildings and should be considered when carrying out dynamic thermal modelling.

The policy below relates to mitigation of the impacts of climate change.

- Policy CC1: Climate change adaptation
- Policy CC2: Climate change mitigation

Since the implemented Permission for the site was approved there have been significant changes to the policy affecting overheating mitigation. The design team have worked hard to ensure the scheme will meet the requirements of the new Part O regulations, and provide a highly sustainable building which will be comfortable to live in. Part O of the Building Regulations is now in place and relevant to all Planning applications approved after 15th June 2022. All projects commencing construction after 15th June 2023 will need to demonstrate compliance with CIBSE TM59 methodology for predicting overheating.

Part O refers to TM59 for guidance when carrying out thermal modelling of a dwelling but goes on to set limits against the identified risk that the design methodology produces. A key difference between TM59 and Part O is that the new regulation will not allow for the effect of internal blinds to be considered when assessing the risk of overheating, nor will dynamic shading be deemed acceptable. Only fixed and passive shading devices are compliant. Additionally, there are slightly different requirements on how the openings should be modelled.

The results of the Part O assessment have implications on window design, openings and MEP design.

1.2. Overheating in dwellings

There are many factors that will determine indoor summer temperatures in dwellings in the UK. These factors include the following:

Current modelling-based evidence suggests that the South of the UK is likely to face the largest risk of indoor overheating. It was suggested that comfort targets will not be met in naturally ventilated buildings in London by the middle of the century without some form of mechanical cooling unless some additional adaption measures are carried out (CIBSE 2005). In contrast, it was estimated that Manchester and Edinburgh buildings will only encounter minor overheating problems within the same time frame.

An unintended consequence of improved building fabric of newly built dwellings may be an increased risk of overheating. Newly constructed highly insulated dwellings were found to have the potential to be at higher risk of overheating than older, less insulated dwellings.

There are a variety of methods that can be used to reduce the risk of indoor overheating and are split into what can be regulated and what cannot be regulated. These are shown in the tables below:

What can be regulated	
Air movement	Moving air feels a couple of degrees cooler than still air.
Insulation	Insulation is usually connected with winter warmth, but just as a thermos flask can keep drinks either hot or cold, insulated walls can help homes stay cool. However, insulation won't cool dwellings down if they overheat.
Shading	Strong sunlight through glazing can heat up dwellings. Awnings and internal or external shutters on south and west facing glazing provide shade.
Cooling devices	Evaporative coolers and air conditioners can be installed relatively cheaply. However, unlike the passive measures above, these require power, thereby increasing the carbon footprint of the dwelling and contributing to climate change. They also pump waste heat into their surroundings, making the surrounding area even hotter.
Low energy	Use low energy light bulbs and appliances.
Ventilation	Replacing the warm air in dwellings with cooler air.
Roofs	As with walls, insulation can help keep dwellings cool in summer. Improving loft insulation is one method, but green roofs are also an option. These use a base layer on which plants can grow, creating biodiversity space for plants and animals and providing a layer of roof insulation.
Outside	Water features help keep surroundings cool by evaporation, and trees provide shade in the summer. Deciduous trees are best, as the leaves drop off in the winter, allowing extra light into your home.
Glazing	Reducing the g-value of the glazing to reduce the amount of sunlight that can pass through

What cannot be regulated	
Reducing heat gain	Heat doesn't just come from the sun. Home devices and appliances such as televisions, computers and light bulbs also make a significant contribution. Turning the kitchen fan on while cooking will help.
Windows	Open windows when it's cooler outside than inside, especially at night.
Curtains and blinds	Close curtains, blinds or shutters during the day, or use awnings to shade the glazing.
Fans	Use desk or ceiling fans to create a cooling breeze.

1.3 TM59 Thermal Design Criteria

The following criteria is set out in CIBSE Technical Memorandum 59 – Design methodology for the assessment of overheating risk in homes (TM59:2017), for predominantly naturally ventilated rooms. Compliance is based on passing **both** criteria below.

Criterion 1 - for living rooms, kitchens and bedrooms

- A limit is set for the number of hours that the operative temperature can exceed the maximum adaptive temperature. A temperature difference greater than or equal to 1K shall not exceed **3%** of the occupied hours of a typical summer (1st May to 30th September).

Criterion 2 - for bedrooms only

- To guarantee comfort during the sleeping hours the operative temperature in the bedroom from 10pm to 7am shall not exceed 26°C for more than 1% of annual hours (1% of the annual hours between 10pm to 7am for bedrooms is **32 hours**).

CIBSE TM59:2017 states that "the inclusion of corridors in the overheating analysis is mandatory where community heating pipework runs through them". There is no mandatory target to meet for common areas, but if an internal operative temperature of 28°C is exceeded for more than 3% of the total annual hours then this should be identified. 3% of the total annual hours is 262 hours.

2. The Development

The description of development is as follows:

"Demolition of the existing building and redevelopment comprising residential units (Class C3) and flexible commercial, business and service use (Class E) and community use (Class F2(b)) with associated works including enlargement of the existing basement level to contain disabled car parking spaces and cycle parking, landscaping and access improvements."

The development provides 1187m^2 Class E commercial floorspace and 1372m^2 Class F2(b) community floorspace along with 237 residential units. There are two building proposed for the site comprising 'the Tower' which is 25 storeys and 'the Lower Block' which is part 7 storey and part 5 storey.

A sample of the dwellings have been investigated across a number of different levels and orientations. These are representative of all unit types in the scheme, and consider worst case scenarios, and is the accepted method of analysis inline with London Plan, TM59 and Part O guidance.

2.1. Site Constraints

There are acoustic constraints on the site which will require bedroom windows to remain shut overnight for overheating purposes. The results of the acoustic report produced by RBA indicates that all facades require bedroom windows to be shut overnight.

This has been incorporated into the overheating model, all bedroom windows are not openable for overheating purposes overnight.

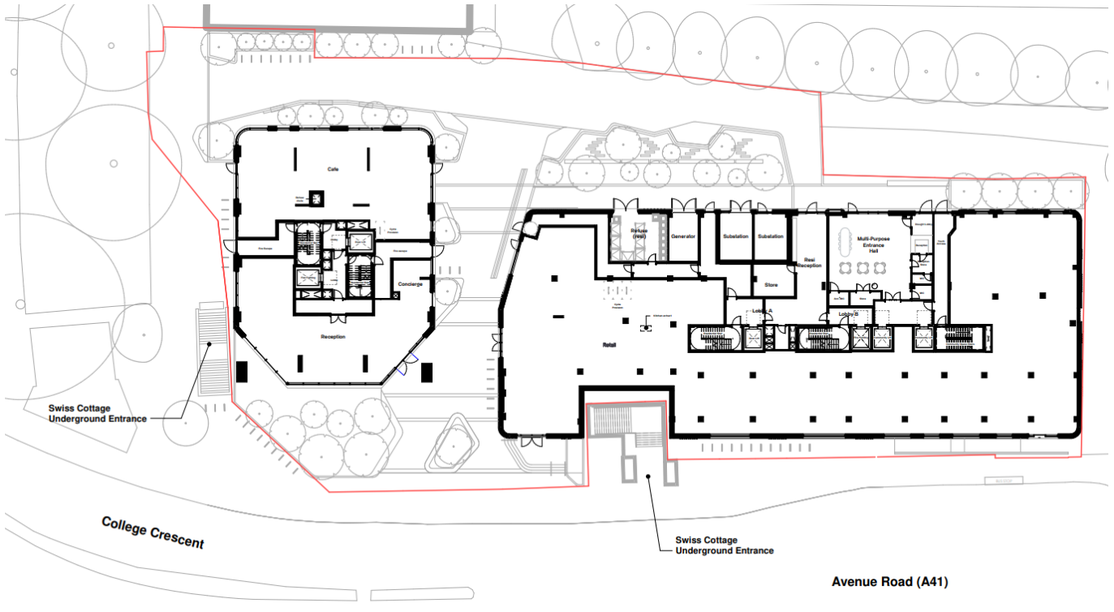


Figure 2.1 100 Avenue Road Site Plan

3. Orientation

The orientation of the building can have a big effect on the solar gains within a dwelling. South facing facades are more likely to overheat in the summer months as they are subject to the sun for longer periods of the day. East and West facades also are subject to the sun, the East facing in the morning, and the West in the afternoon. This means that they are also subject to solar gain during the day. The North façade will have little exposure to the sun; therefore, will not suffer from solar gains. The sun path diagram below confirms the above:

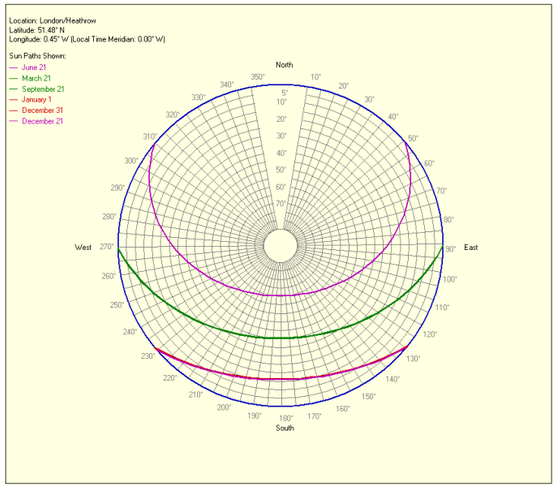


Figure 3.1 Sun-path Diagram

4. The Model

A dynamic 3D model of 100 Avenue Road development was completed.

To calculate the internal operative temperatures of the dwellings and common areas at different times of day, a model was built using Integrated Environmental Solutions Virtual Environment (IES VE) software, version 2024.0.1.0. This model takes into account a range of issues that could have an impact on the building's performance, including building fabric, orientation and external conditions.

The first stage of building the model was to produce a 2D template of each floor being assessed. The templates were created using floor plans issued by Cartwright Pickard.

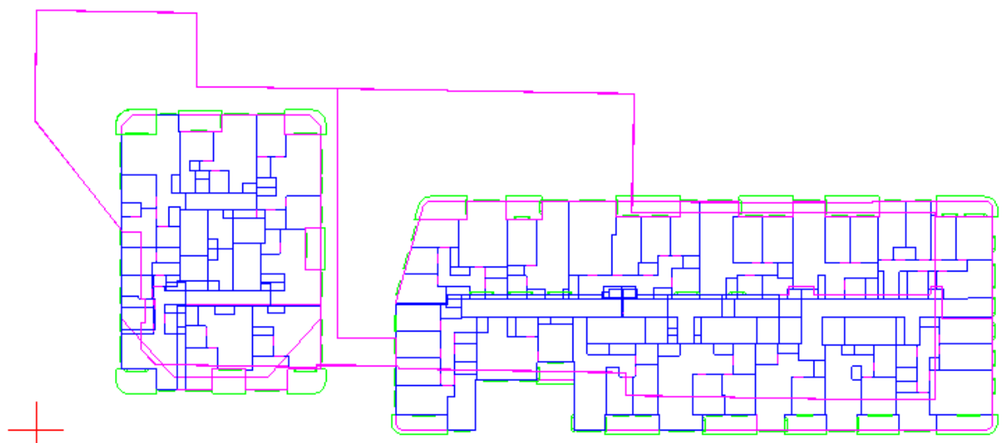


Figure 4.1 2D Layout

The next stage was to use the templates in IES VE and elevations issued by Cartwright Pickard to create the 3D model of each floor culminating in the complete model as shown below:

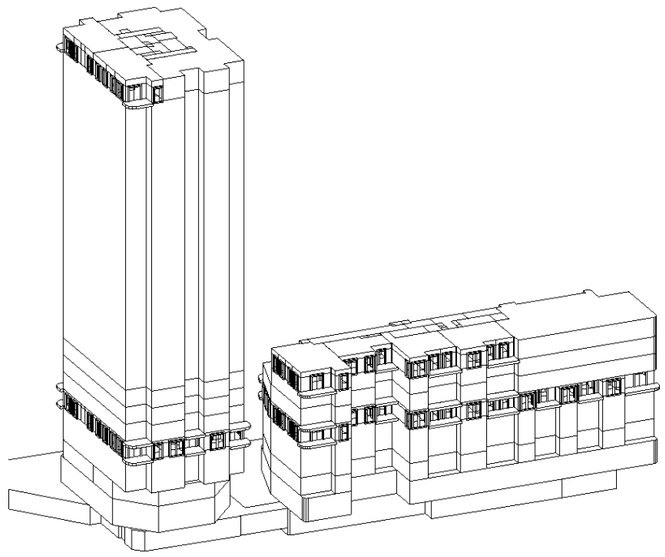


Figure 4.2 3D Layout

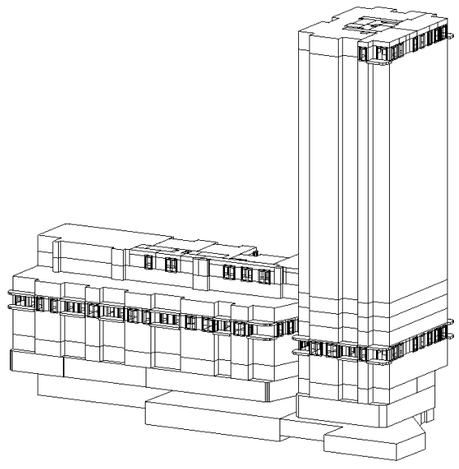


Figure 4.3 3D Layout

The rooms shown in Figure 4.2 and 4.3 were modelled to give a good indication of the thermal make-up of the building. The local shading and adjacent buildings were modelled for shading purposes.

4.1. Building Fabric

The following building fabric specification was used for the thermal model, based on information taken from the buildups provided by Cartwright Pickward.

Element	Thermal Transmittance (W/m^2K)
Exposed Floor	0.12
External Wall	0.15
Common Area Wall	0.18
Roof	0.11
Glazing	1.20
Internal Front Doors	1.10

Table 4.2 Building Fabric U-values

The glazing g-value is 0.40 to the residential areas and 0.3 to commercial areas. This allows it to let a good amount of solar gain into the rooms, without causing a large overheating effect. Any lower could affect lighting levels in the room, and cause for more artificial lighting to be used. The building's thermal mass is assessed and factored into the calculations. It has been found that although the building does absorb the heat into the structure, this offsets temperatures when the building becomes cooler at a later stage.

4.2. Mechanical Ventilation

It is proposed that all the dwellings will be fitted with MVHR (mechanical ventilation with heat recovery). The lower block will have MVHR with tempered air.

4.3. Purge Ventilation

Purge ventilation provision is required in each habitable room to comply with Part F of the Building Regulations. This should be capable of extracting a minimum of 4ach-1, per room directly to outside. The 4ach-1 is a minimum air change rate set out in the Building Regulations and is likely to be exceeded in reality through the opening of glazing.

4.4. Natural Ventilation

The IES VE software also incorporates opening glazing into the calculations with the use of Macroflo. Although the Building Regulations give a fixed air change rate, the Macroflo software allows for all variables such as area of openable glazing, distance glazing can open and external conditions. This gives more accurate results regarding natural ventilation.

Part O requires that CIBSE TM59:2017 is used in conjunction the Building Regulation and has set the following conditions for occupancy and when glazing and internal doors can be assumed to be open:

When a room is occupied during the day (8am to 11pm), openings should be modelled to do all the following.

i. Start to open when the internal temperature exceeds 22°C.
ii. Be fully open when the internal temperature exceeds 26°C.
iii. Start to close when the internal temperature falls below 26°C.
iv. Be fully closed when the internal temperature falls below 22°C.

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 easily accessible.
ii. The internal temperature exceeds 23°C at 11pm.

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.

An entrance door should be included, which should be shut all the time.

Internal doors within the dwellings are assessed to be fully open when the occupants are assumed to be awake (6am to 10pm). Window sills must be a minimum of 1.1m when used for overheating purposes.

The table below summarises the window opening assumed within the dynamic simulation:

	Opening	
	Angle of opening (inward)	Profile applied
Internal doors	90	Open from 6am – 10pm Closed overnight
Side hung bedroom door	90	ADO.Section_26a
Side hung living room door	90	ADO.Section_26ab
Side hung bedroom window	90	ADO.Section_26a
Side hung living room window	20	ADO.Section_26ab

4.5. Infiltration

Infiltration is the uncontrolled exchange of air between inside a building and outside through cracks, porosity, and other unintentional openings in the building, caused by the pressure difference effects of the wind and/or stack effect. This has been included as a constant value in the model inline with the proposed air permeability of $3m^3(h.m^2)$ @50Pa taken from the energy strategy. This is measured at the end of the build through the air pressure test.

4.6. Occupancy profiles and internal equipment gains

CIBSE TM59:2017 sets out proposed people and internal equipment gains that should be used for dynamic simulations, when assessing the risk of overheating in homes. The proposed gains are shown in Tables 5.2 and 5.3 below:

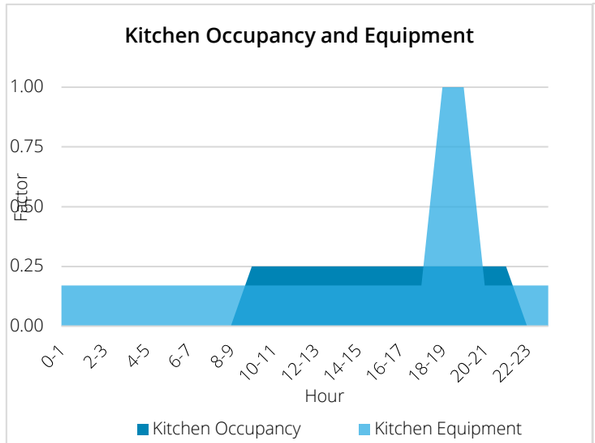
Dwelling Type and Room:	People Gains:		
	No. of People:	Sensible Peak Load ((W):	Latent Peak Load (W):
Single bedroom	1	75	55
Double bedroom	2	150	110
Studio	1	75	55
1 bed – living and kitchens	1	75	55
2 bed – living and kitchens	2	150	110
3 bed – living and kitchens	3	225	165

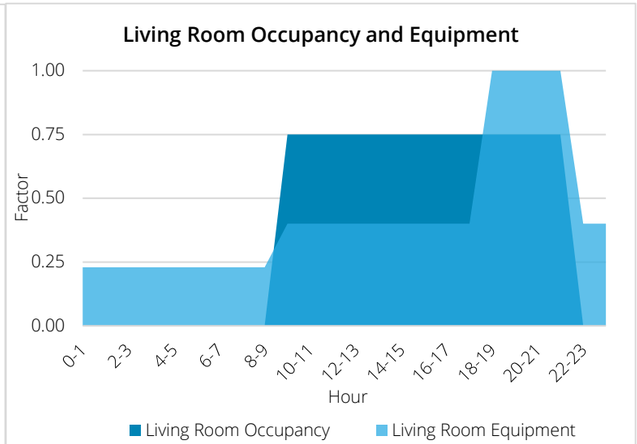
Table 5.2 People gains for each room type

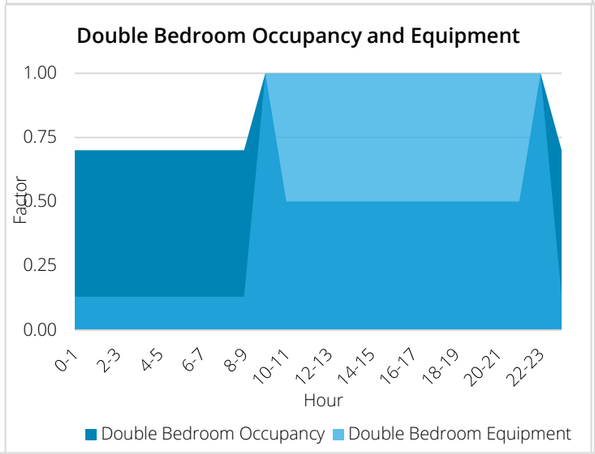
Description:	Room Type:						
	Single Bedroom	Double Bedroom	Living & Kitchen	Living Room	Kitchen	Common Area	Studio
Equipment gains (W)	80	80	450	150	300	N/A	450
Lighting profile (W/m^2)	2	2	2	2	2	2	2

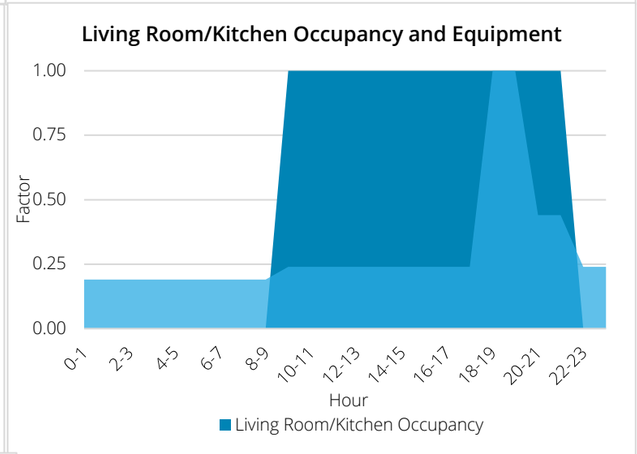
Table 5.3 Equipment gains and lighting profile

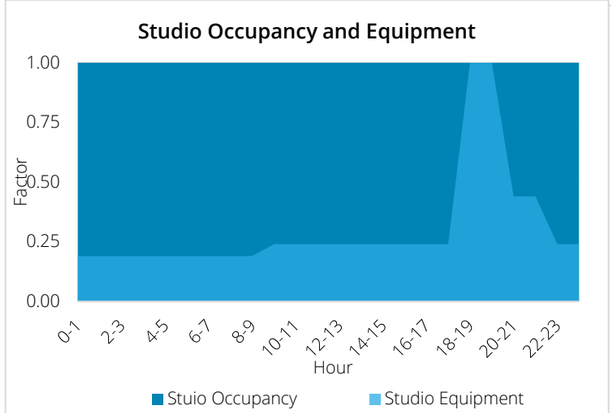
The following graphs show the time periods and factors that are to be applied for the people and internal gains for each room type:

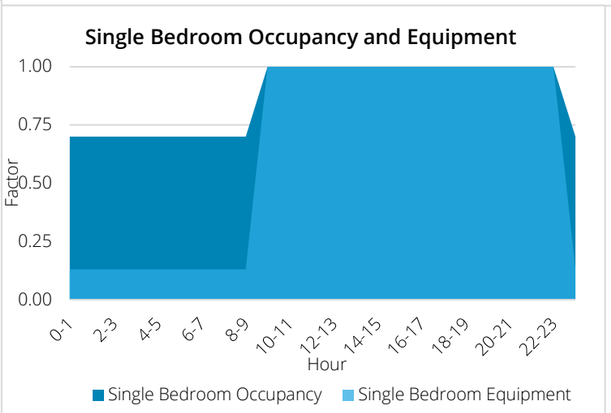












4.7. Shading and obstructions

Radiant heat from the sun passes through glass and is absorbed by building elements and furnishings which re-radiate heat back into the space. Re-radiated heat has a longer wavelength and cannot pass back through the glass as easily, thus trapping the radiant heat causing heat gains in the dwelling.

A g-value of 0.40 has been assumed at 100 Avenue Road, which reduces the solar gains through the glazing. This g-value is a good balance between reducing solar gains but also allowing useful winter gains and daylighting levels. Shading and obstructions have been added to the model. A g-value of 0.30 has been specified to commercial areas.

4.8 Weather files

CIBSE released a new set of weather files for London in the middle of 2016. This included weather sets for three Design Summer Years (DSY) – 1976, 1989 and 2003. The current DSY1 is 1989 which represents a moderately warm summer. 1976 (DSY2) is a more extreme year with a long period of persistent warmth and 2003 (DSY3) is another extreme year which has a more intense single warm spell.

CIBSE Technical Memorandum 49, 2014 – Design Summer Years for London, provides guidance for which weather files are to be used. The current DSY (1989) is suitable for assessing buildings under the current climate.

Data from three weather stations have been examined and are available for use in simulation. London Heathrow Airport (LHR) is a representative of intermediate urban and suburban locations. London Gatwick Airport (GTW) and London Weather Centre (LWC) provide representative sites for rural and inner urban locations, respectively. As the proposed development is located in the urban location of London, the London Heathrow weather profile will be applied.

CIBSE TM59:2017 and TM52:2013 requires the DSY most appropriate to the location of the development to be used, for the 2020s with high emissions and 50% percentile scenario. The 2020s period is of particular interest as this relates to the period 2011-2040, which is the period we are now in. The 50% percentile changes are viewed as the 'best guess' level of change.

The results are shown in Appendix A.

5. Strategy to Comply and Results

Initially passive measures are being proposed to reduce the risk of overheating within occupied spaces by reducing solar gains and improving ventilation.

As natural ventilation is not proposed due to opening limitations, applicants are required to submit two separate overheating analyses: one with openable windows and one with closed windows. This will ensure that passive measures have been maximised, and the façade design has been optimised regardless of the constraints posed by the site's location.

In instances where security, air quality or noise concerns pose limitations to the opening of windows, applicants will be required to demonstrate that all passive design measures have been thoroughly investigated. This includes technical and cost feasibility assessments of the following fixed shading devices: external shutters, external blinds, awnings, and ventilated louvres. The feasibility assessment is explored in Appendix C.

Openable window simulations – Criterion 1 and 2

A simulation was completed whereby rooms were assumed to have openable glazing and standard MVHR. Below shows what has been assumed in the initial simulation.

- G-value 0.40 on all facades
- Windows are enabled to be fully openable (inward opening 90 degrees)
- Night time cooling (NTC) enabled to all bedrooms and living rooms
- Standard ventilation rate of 0.3l/s/m^2

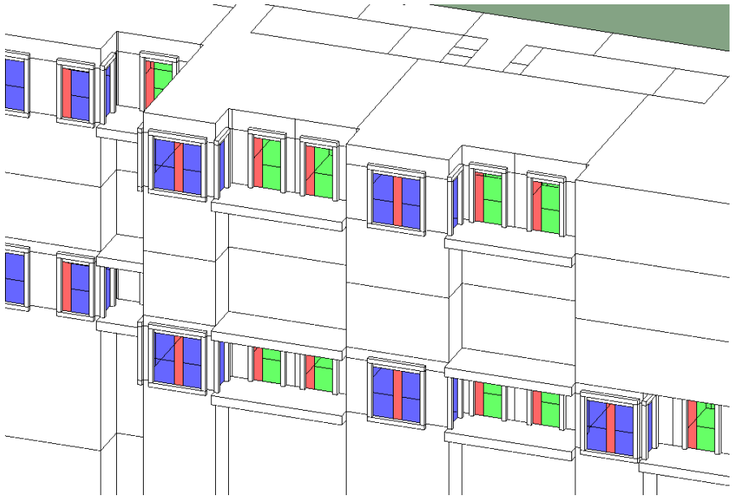
When allowing the windows to be openable (specification above), all rooms comply with TM59, under DSY1, and therefore compliance with Part O.

Internal blinds have not been included in the dynamic modelling, as per the Part O and the London Plan guidance.

There have been a number of passive measures implemented to ensure compliance.

The windows are recessed and this has been included in the model. Following investigations with the design team, the glazing area was reduced by making some of the fixed glazing opaque which reduces solar gains.

The red highlighted windows have been entered as opaque glazing, to reduce the solar gains.



This has allowed 58 out of the sample of 78 units tested to comply passively. The remaining 20 which are failing are living rooms which are slightly exceeding the requirement for Criterion 1. It is worth noting that the Implemented Permission did not have a planning requirement for overheating and the design team have worked hard to improve the glazing to achieve passive compliance for the s.73 Amendment Application, achieving a 74% passive compliance of the sample tested.

As per the GLA and Part O guidance, where there are acoustic and security constraints, bedroom/studio windows are restricted in opening overnight and MVHR tempered air will be installed in the lower block with cooling from the ambient loop to the tower block. Once this has been included in the model ALL units comply with TM59 and Part O requirements,

Strategy to comply with Part O – with acoustic constraints

G-value of 0.40 to all residential windows, 0.3 to commercial windows

Windows can open inwards to an angle of 90°
Doors can open to an angle of 90°

No NTC to all bedroom windows due to acoustic constraints

Use of ambient loop cooling in tower block and MVHR with tempered air in lower block to mitigate overheating when windows are shut overnight due to acoustic constraints

MVHR with tempered air

The strategy for compliance in the lower block when there are acoustic constraints applied to the bedroom windows is to introduce MVHR with tempered air. The total flow rate of 90l/s has been assumed for each apartment, with the flow rate split between living rooms and bedrooms accordingly. The majority of apartments have required a split as follows:

Living room: 30l/s

Bedroom: 15l/s

The MVHR with tempered air is capable of achieving a 14ºC offset from external air temperature. Final flow rates will be confirmed at detailed design stage.

Common Areas

CIBSE TM59:2017 recommends that the risk of summer overheating is assessed in common areas where community heating pipework runs through them. There is no mandatory target to meet for common areas, but if an internal operative temperature of 28°C is exceeded for more than 3% of the total annual hours then this should be identified. 3% of the total annual hours is 262 hours.

The strategy applied to the common areas was for natural ventilation to all corridors, assuming 1ach. All but one common areas comply with the requirements at 28°C.

Commercial Areas - TM52 Simulation

The commercial areas were investigated against the TM52 criteria to reduce the risk of overheating. The results show that all areas comply.

Cooling has been specified to the commercial areas. The London Plan requires the applicant to reduce the actual cooling demand below that of the notional for each of the non-residential spaces in the development where an active cooling load exists. This is demonstrated in the relevant format within the energy statement '*12077-WCL-ZZ-ZZ-RP-Y-0001*. The area weighted average actual and notional cooling demands for all non-residential areas are reported.

6. Conclusion

This overheating report shows that when including the passive and mechanical updates discussed in section 5.0 that all the rooms are compliant with the CIBSE TM59 Criteria and Part O.

The cooling hierarchy has been followed, and the results in the appendix show that if windows could be fully open, the majority of the scheme would comply passively. The Implemented Permission did not have a planning requirement for overheating and the design team have worked hard to improve the glazing to achieve passive compliance for the s.73 Amendment Application, achieving a 74% passive compliance of the sample tested.

The acoustic report advised that all units in the residential block are affected by acoustic constraints. A simulation was completed with the windows shut overnight, which showed that 77 out of 78 rooms sampled would fail without implementing a mitigation measure.

The strategy for the tower block to comply, is that the ambient loop will be used to provide cooling, with a setpoint temperature. This will be activated when the temperature inside the dwelling exceeds 23°C, to assist with reducing the risk of overheating. In the lower block, there will be MVHR with tempered air which will provide overheating mitigation.

Overall, it has been confirmed that the development at 100 Avenue Road complies with Policy SI2 of the London Plan, TM59 and Part O of the Building Regulations.

Appendix A – Overheating results – passive measures

Room Name:	Criteria 1	Criteria 2	Pass/Fail
LB.04.01 - Bed 1	1.8	24	PASS
LB.04.01 - Bed 2	1.8	23	PASS
LB.04.01 - Living/Kitchen	3.4		FAIL
LB.04.02 - Bed 1	1.6	26	PASS
LB.04.02 - Living/Kitchen	3.8		FAIL
LB.04.03 - Bed 1	1.5	25	PASS
LB.04.03 - Bed 2	1.5	25	PASS
LB.04.03 - Bed 3	1.6	24	PASS
LB.04.03 - Kitchen	3.5		FAIL
LB.04.03 - Living	3.7		FAIL
LB.04.04 - Bed 1	1.2	25	PASS
LB.04.04 - Bed 2	1.1	25	PASS
LB.04.04 - Bed 3	1.4	23	PASS
LB.04.04 - Living/Kitchen	2.5		PASS
LB.04.05 - Bed 1	1.3	24	PASS
LB.04.05 - Living/Kitchen	2.3		PASS
LB.04.06 - Bed 1	1.1	26	PASS
LB.04.06 - Bed 2	1.2	26	PASS
LB.04.06 - Bed 3	1.1	26	PASS
LB.04.06 - Living/Kitchen	2.4		PASS
LB.04.07 - Bed 1	1.3	24	PASS
LB.04.07 - Bed 2	1.4	24	PASS
LB.04.07 - Living/Kitchen	2.3		PASS
LB.04.08 - Bed 1	1.4	25	PASS
LB.04.08 - Bed 2	1.5	24	PASS
LB.04.08 - Living/Kitchen	2.3		PASS
LB.04.09 - Bed 1	1.4	28	PASS
LB.04.09 - Bed 2	1.5	27	PASS
LB.04.09 - Bed 3	1.6	26	PASS
LB.04.09 - Kitchen	3.1		FAIL
LB.04.09 - Living	3.6		FAIL
LB.04.10 - Bed 1	3	23	PASS
LB.04.10 - Bed 2	1.9	32	PASS
LB.04.10 - Bed 3	1.7	27	PASS
LB.04.10 - Living/Kitchen	3.7		FAIL
LB.04.11 - Bed 1	2.6	21	PASS
LB.04.11 - Living/Kitchen	3.6		FAIL
LB.04.12 - Bed 1	2	24	PASS
LB.04.12 - Living/Kitchen	3.8		FAIL
LB.04.13 - Bed 1	1.8	24	PASS
LB.04.13 - Bed 2	1.6	23	PASS
LB.04.13 - Living/Kitchen	3.3		FAIL
LB.07.01 - Bed 2	1.6	28	PASS
LB.07.01 - Bed 2	1.6	24	PASS
LB.07.01 - Bed 3	1.7	23	PASS
LB.07.01 - Kitchen	3.6		FAIL
LB.07.01 - Living	5		FAIL
LB.07.02 - Bed 1	2.2	26	PASS
LB.07.02 - Living/Kitchen	4.2		FAIL
LB.07.03 - Bed 1	2.3	23	PASS
LB.07.03 - Bed 2	2.5	23	PASS
LB.07.03 - Living/Kitchen	3.7		FAIL
LB.07.04 - Bed 1	2.3	25	PASS
LB.07.04 - Bed 2	2.3	23	PASS
LB.07.04 - Living/Kitchen	3.5		FAIL
T.04.01 - Studio	1.6	20	PASS
T.04.02 - Bed 1	2.8	23	PASS
T.04.02 - Living/Kitchen	3.1		FAIL
T.04.03 - Bed 1	2.9	22	PASS
T.04.03 - Living/Kitchen	3.1		FAIL
T.04.04 - Bed 1	1.5	27	PASS
T.04.04 - Bed 2	1.8	24	PASS
T.04.04 - Bed 3	2	22	PASS
T.04.04 - Living/Kitchen	3.6		FAIL
T.04.05 - Bed 1	1.5	25	PASS
T.04.05 - Bed 2	1.7	23	PASS
T.04.05 - Living/Kitchen	2.7		PASS
T.04.06 - Bed 1	1.6	32	PASS
T.04.06 - Living/Kitchen	2.5		PASS
T.04.07 - Bed 1	1.7	22	PASS
T.04.07 - Bed 2	1.7	25	PASS
T.04.07 - Living/Kitchen	3.1		FAIL
T.25.01 - Bed 1	1.4	23	PASS
T.25.01 - Bed 2	1.9	23	PASS
T.25.01 - Living/Kitchen	4.3		FAIL
T.25.02 - Bed 1	1.5	22	PASS
T.25.02 - Bed 2	1.7	23	PASS
T.25.02 - Living/Kitchen	2.9		PASS
Number of Rooms Failing (out of 78):			**20**

Acoustic constraints (windows shut overnight) and no enhanced ventilation

Room Name:	Criteria 1	Criteria 2	Pass/Fail
LB.04.01 - Bed 1	2.6	215	FAIL
LB.04.01 - Bed 2	2.6	199	FAIL
LB.04.01 - Living/Kitchen	4.2		FAIL
LB.04.02 - Bed 1	2.5	262	FAIL
LB.04.02 - Living/Kitchen	4.6		FAIL
LB.04.03 - Bed 1	2.2	196	FAIL
LB.04.03 - Bed 2	2.2	159	FAIL
LB.04.03 - Bed 3	2.1	97	FAIL
LB.04.03 - Kitchen	4.3		FAIL
LB.04.03 - Living	4.2		FAIL
LB.04.04 - Bed 1	2.2	246	FAIL
LB.04.04 - Bed 2	2.2	220	FAIL
LB.04.04 - Bed 3	2.3	200	FAIL
LB.04.04 - Living/Kitchen	3.7		FAIL
LB.04.05 - Bed 1	2.7	248	FAIL
LB.04.05 - Living/Kitchen	3.7		FAIL
LB.04.06 - Bed 1	3	308	FAIL
LB.04.06 - Bed 2	3	315	FAIL
LB.04.06 - Bed 3	2.4	276	FAIL
LB.04.06 - Living/Kitchen	3.7		FAIL
LB.04.07 - Bed 1	3.1	301	FAIL
LB.04.07 - Bed 2	3.2	308	FAIL
LB.04.07 - Living/Kitchen	3.8		FAIL
LB.04.08 - Bed 1	3	291	FAIL
LB.04.08 - Bed 2	3.2	300	FAIL
LB.04.08 - Living/Kitchen	3.7		FAIL
LB.04.09 - Bed 1	2.4	237	FAIL
LB.04.09 - Bed 2	2.5	235	FAIL
LB.04.09 - Bed 3	2.4	203	FAIL
LB.04.09 - Kitchen	4.3		FAIL
LB.04.09 - Living	3.9		FAIL
LB.04.10 - Bed 1	3.7	138	FAIL
LB.04.10 - Bed 2	2.9	434	FAIL
LB.04.10 - Bed 3	2.3	138	FAIL
LB.04.10 - Living/Kitchen	4.1		FAIL
LB.04.11 - Bed 1	3.3	183	FAIL
LB.04.11 - Living/Kitchen	4.8		FAIL
LB.04.12 - Bed 1	3.1	267	FAIL
LB.04.12 - Living/Kitchen	5		FAIL
LB.04.13 - Bed 1	2.6	234	FAIL
LB.04.13 - Bed 2	2.5	228	FAIL
LB.04.13 - Living/Kitchen	4.6		FAIL
LB.07.01 - Bed 2	2.6	251	FAIL
LB.07.01 - Bed 2	2.4	193	FAIL
LB.07.01 - Bed 3	2.3	124	FAIL
LB.07.01 - Kitchen	4.6		FAIL
LB.07.01 - Living	5.4		FAIL
LB.07.02 - Bed 1	4.3	440	FAIL
LB.07.02 - Living/Kitchen	6		FAIL
LB.07.03 - Bed 1	3.7	289	FAIL
LB.07.03 - Bed 2	3.6	276	FAIL
LB.07.03 - Living/Kitchen	4.7		FAIL
LB.07.04 - Bed 1	3.6	284	FAIL
LB.07.04 - Bed 2	3.5	284	FAIL
LB.07.04 - Living/Kitchen	5.2		FAIL
T.04.01 - Studio	1.7	30	PASS
T.04.02 - Bed 1	3.3	91	FAIL
T.04.02 - Living/Kitchen	3.4		FAIL
T.04.03 - Bed 1	3.4	82	FAIL
T.04.03 - Living/Kitchen	3.4		FAIL
T.04.04 - Bed 1	2	148	FAIL
T.04.04 - Bed 2	2.3	113	FAIL
T.04.04 - Bed 3	2.6	76	FAIL
T.04.04 - Living/Kitchen	4.1		FAIL
T.04.05 - Bed 1	2	107	FAIL
T.04.05 - Bed 2	2.1	86	FAIL
T.04.05 - Living/Kitchen	3.2		FAIL
T.04.06 - Bed 1	3.2	321	FAIL
T.04.06 - Living/Kitchen	3.7		FAIL
T.04.07 - Bed 1	2.3	138	FAIL
T.04.07 - Bed 2	2.2	98	FAIL
T.04.07 - Living/Kitchen	3.8		FAIL
T.25.01 - Bed 1	1.9	105	FAIL
T.25.01 - Bed 2	2.3	84	FAIL
T.25.01 - Living/Kitchen	4.6		FAIL
T.25.02 - Bed 1	2	93	FAIL
T.25.02 - Bed 2	2.1	81	FAIL
T.25.02 - Living/Kitchen	3.2		FAIL
Number of Rooms Failing (out of 78):			**77**

Acoustic constraints and addition of MVHR tempered air or ambient loop cooling

Room Name:	Criteria 1	Criteria 2	Pass/Fail
LB.04.01 - Bed 1	1	10	PASS
LB.04.01 - Bed 2	1	10	PASS
LB.04.01 - Living/Kitchen	2.3		PASS
LB.04.02 - Bed 1	1	12	PASS
LB.04.02 - Living/Kitchen	2.6		PASS
LB.04.03 - Bed 1	0.8	17	PASS
LB.04.03 - Bed 2	0.9	14	PASS
LB.04.03 - Bed 3	0.9	11	PASS
LB.04.03 - Kitchen	1.7		PASS
LB.04.03 - Living	2.4		PASS
LB.04.04 - Bed 1	0.7	11	PASS
LB.04.04 - Bed 2	0.7	11	PASS
LB.04.04 - Bed 3	0.7	9	PASS
LB.04.04 - Living/Kitchen	2		PASS
LB.04.05 - Bed 1	0.9	10	PASS
LB.04.05 - Living/Kitchen	1.9		PASS
LB.04.06 - Bed 1	0.5	13	PASS
LB.04.06 - Bed 2	0.5	10	PASS
LB.04.06 - Bed 3	0.5	12	PASS
LB.04.06 - Living/Kitchen	1.9		PASS
LB.04.07 - Bed 1	0.8	11	PASS
LB.04.07 - Bed 2	0.9	10	PASS
LB.04.07 - Living/Kitchen	1.9		PASS
LB.04.08 - Bed 1	0.9	10	PASS
LB.04.08 - Bed 2	1	9	PASS
LB.04.08 - Living/Kitchen	1.9		PASS
LB.04.09 - Bed 1	0.7	13	PASS
LB.04.09 - Bed 2	0.8	12	PASS
LB.04.09 - Bed 3	1.1	9	PASS
LB.04.09 - Kitchen	1.9		PASS
LB.04.09 - Living	2.5		PASS
LB.04.10 - Bed 1	1.7	17	PASS
LB.04.10 - Bed 2	1.2	26	PASS
LB.04.10 - Bed 3	1.1	14	PASS
LB.04.10 - Living/Kitchen	2.5		PASS
LB.04.11 - Bed 1	1.4	12	PASS
LB.04.11 - Living/Kitchen	2.2		PASS
LB.04.12 - Bed 1	1.2	11	PASS
LB.04.12 - Living/Kitchen	2.4		PASS
LB.04.13 - Bed 1	1	11	PASS
LB.04.13 - Bed 2	1	10	PASS
LB.04.13 - Living/Kitchen	2.1		PASS
LB.07.01 - Bed 2	1	20	PASS
LB.07.01 - Bed 2	1	17	PASS
LB.07.01 - Bed 3	1	13	PASS
LB.07.01 - Kitchen	2.1		PASS
LB.07.01 - Living	3		PASS
LB.07.02 - Bed 1	1.2	15	PASS
LB.07.02 - Living/Kitchen	2.6		PASS
LB.07.03 - Bed 1	1.2	9	PASS
LB.07.03 - Bed 2	1.2	9	PASS
LB.07.03 - Living/Kitchen	2.2		PASS
LB.07.04 - Bed 1	1.2	10	PASS
LB.07.04 - Bed 2	0	0	PASS
LB.07.04 - Living/Kitchen	0		PASS
T.04.01 - Studio	0	0	PASS
T.04.02 - Bed 1	0	0	PASS
T.04.02 - Living/Kitchen	0		PASS
T.04.03 - Bed 1	0	0	PASS
T.04.03 - Living/Kitchen	0		PASS
T.04.04 - Bed 1	0	0	PASS
T.04.04 - Bed 2	0	0	PASS
T.04.04 - Bed 3	0	0	PASS
T.04.04 - Living/Kitchen	0		PASS
T.04.05 - Bed 1	0	0	PASS
T.04.05 - Bed 2	0	0	PASS
T.04.05 - Living/Kitchen	0		PASS
T.04.06 - Bed 1	0	0	PASS
T.04.06 - Living/Kitchen	0		PASS
T.04.07 - Bed 1	0	0	PASS
T.04.07 - Bed 2	0	0	PASS
T.04.07 - Living/Kitchen	0		PASS
T.25.01 - Bed 1	0	0	PASS
T.25.01 - Bed 2	0	0	PASS
T.25.01 - Living/Kitchen	0		PASS
T.25.02 - Bed 1	0	0	PASS
T.25.02 - Bed 2	0	0	PASS
T.25.02 - Living/Kitchen	0		PASS
Number of Rooms Failing (out of 78):			**0**

DSY2 – including ambient loop and MVHR tempered air

Room Name:	Criteria 1	Criteria 2	Pass/Fail
LB.04.01 - Bed 1	1.7	29	PASS
LB.04.01 - Bed 2	1.7	27	PASS
LB.04.01 - Living/Kitchen	3.5		FAIL
LB.04.02 - Bed 1	1.7	38	FAIL
LB.04.02 - Living/Kitchen	3.7		FAIL
LB.04.03 - Bed 1	1.5	38	FAIL
LB.04.03 - Bed 2	1.5	35	FAIL
LB.04.03 - Bed 3	1.5	26	PASS
LB.04.03 - Kitchen	2.9		PASS
LB.04.03 - Living	3.7		FAIL
LB.04.04 - Bed 1	1.3	31	PASS
LB.04.04 - Bed 2	1.3	29	PASS
LB.04.04 - Bed 3	1.5	23	PASS
LB.04.04 - Living/Kitchen	3.3		FAIL
LB.04.05 - Bed 1	1.6	29	PASS
LB.04.05 - Living/Kitchen	3.2		FAIL
LB.04.06 - Bed 1	1.3	40	FAIL
LB.04.06 - Bed 2	1.4	31	PASS
LB.04.06 - Bed 3	1.3	37	FAIL
LB.04.06 - Living/Kitchen	3		PASS
LB.04.07 - Bed 1	1.6	34	FAIL
LB.04.07 - Bed 2	1.6	31	PASS
LB.04.07 - Living/Kitchen	3.1		FAIL
LB.04.08 - Bed 1	1.6	28	PASS
LB.04.08 - Bed 2	1.6	27	PASS
LB.04.08 - Living/Kitchen	3.1		FAIL
LB.04.09 - Bed 1	1.5	36	FAIL
LB.04.09 - Bed 2	1.6	35	FAIL
LB.04.09 - Bed 3	1.6	27	PASS
LB.04.09 - Kitchen	3.3		FAIL
LB.04.09 - Living	3.8		FAIL
LB.04.10 - Bed 1	2.3	40	FAIL
LB.04.10 - Bed 2	2	64	FAIL
LB.04.10 - Bed 3	1.9	39	FAIL
LB.04.10 - Living/Kitchen	3.6		FAIL
LB.04.11 - Bed 1	2	37	FAIL
LB.04.11 - Living/Kitchen	3.5		FAIL
LB.04.12 - Bed 1	1.9	31	PASS
LB.04.12 - Living/Kitchen	3.5		FAIL
LB.04.13 - Bed 1	1.7	30	PASS
LB.04.13 - Bed 2	1.7	28	PASS
LB.04.13 - Living/Kitchen	3.3		FAIL
LB.07.01 - Bed 2	1.6	47	FAIL
LB.07.01 - Bed 2	1.6	35	FAIL
LB.07.01 - Bed 3	1.6	27	PASS
LB.07.01 - Kitchen	3.3		FAIL
LB.07.01 - Living	3.9		FAIL
LB.07.02 - Bed 1	1.9	33	FAIL
LB.07.02 - Living/Kitchen	3.6		FAIL
LB.07.03 - Bed 1	1.9	24	PASS
LB.07.03 - Bed 2	1.9	23	PASS
LB.07.03 - Living/Kitchen	3.4		FAIL
LB.07.04 - Bed 1	1.9	28	PASS
LB.07.04 - Bed 2	1.9	23	PASS
LB.07.04 - Living/Kitchen	3.3		FAIL
T.04.01 - Studio	0	0	PASS
T.04.02 - Bed 1	0	0	PASS
T.04.02 - Living/Kitchen	0		PASS
T.04.03 - Bed 1	0	0	PASS
T.04.03 - Living/Kitchen	0		PASS
T.04.04 - Bed 1	0	0	PASS
T.04.04 - Bed 2	0	0	PASS
T.04.04 - Bed 3	0	0	PASS
T.04.04 - Living/Kitchen	0		PASS
T.04.05 - Bed 1	0	0	PASS
T.04.05 - Bed 2	0	0	PASS
T.04.05 - Living/Kitchen	0		PASS
T.04.06 - Bed 1	0	0	PASS
T.04.06 - Living/Kitchen	0		PASS
T.04.07 - Bed 1	0	0	PASS
T.04.07 - Bed 2	0	0	PASS
T.04.07 - Living/Kitchen	0		PASS
T.25.01 - Bed 1	0	0	PASS
T.25.01 - Bed 2	0	0	PASS
T.25.01 - Living/Kitchen	0		PASS
T.25.02 - Bed 1	0	0	PASS
T.25.02 - Bed 2	0	0	PASS
T.25.02 - Living/Kitchen	0		PASS
Number of Rooms Failing (out of 78):			**33**

DSY 3 – including ambient loop and tempered air MVHR

Room Name:	Criteria 1	Criteria 2	Pass/Fail
LB.04.01 - Bed 1	2.7	42	FAIL
LB.04.01 - Bed 2	2.9	41	FAIL
LB.04.01 - Living/Kitchen	5.8		FAIL
LB.04.02 - Bed 1	2.5	59	FAIL
LB.04.02 - Living/Kitchen	6		FAIL
LB.04.03 - Bed 1	2.5	61	FAIL
LB.04.03 - Bed 2	2.6	51	FAIL
LB.04.03 - Bed 3	2.7	41	FAIL
LB.04.03 - Kitchen	4.4		FAIL
LB.04.03 - Living	5.5		FAIL
LB.04.04 - Bed 1	2.1	48	FAIL
LB.04.04 - Bed 2	2	45	FAIL
LB.04.04 - Bed 3	2.3	33	FAIL
LB.04.04 - Living/Kitchen	5.1		FAIL
LB.04.05 - Bed 1	2.5	47	FAIL
LB.04.05 - Living/Kitchen	4.7		FAIL
LB.04.06 - Bed 1	2.2	66	FAIL
LB.04.06 - Bed 2	2.2	49	FAIL
LB.04.06 - Bed 3	2.2	58	FAIL
LB.04.06 - Living/Kitchen	5		FAIL
LB.04.07 - Bed 1	2.7	53	FAIL
LB.04.07 - Bed 2	2.7	51	FAIL
LB.04.07 - Living/Kitchen	5.2		FAIL
LB.04.08 - Bed 1	2.7	45	FAIL
LB.04.08 - Bed 2	2.8	45	FAIL
LB.04.08 - Living/Kitchen	5.2		FAIL
LB.04.09 - Bed 1	2.6	55	FAIL
LB.04.09 - Bed 2	2.8	54	FAIL
LB.04.09 - Bed 3	2.9	46	FAIL
LB.04.09 - Kitchen	5.3		FAIL
LB.04.09 - Living	5.6		FAIL
LB.04.10 - Bed 1	3.6	56	FAIL
LB.04.10 - Bed 2	3.2	106	FAIL
LB.04.10 - Bed 3	2.8	53	FAIL
LB.04.10 - Living/Kitchen	5.7		FAIL
LB.04.11 - Bed 1	3.3	50	FAIL
LB.04.11 - Living/Kitchen	5.7		FAIL
LB.04.12 - Bed 1	3	44	FAIL
LB.04.12 - Living/Kitchen	5.8		FAIL
LB.04.13 - Bed 1	2.6	42	FAIL
LB.04.13 - Bed 2	2.5	42	FAIL
LB.04.13 - Living/Kitchen	5.5		FAIL
LB.07.01 - Bed 2	2.7	74	FAIL
LB.07.01 - Bed 2	2.8	54	FAIL
LB.07.01 - Bed 3	2.8	42	FAIL
LB.07.01 - Kitchen	5		FAIL
LB.07.01 - Living	6.4		FAIL
LB.07.02 - Bed 1	3.2	54	FAIL
LB.07.02 - Living/Kitchen	5.9		FAIL
LB.07.03 - Bed 1	3	37	FAIL
LB.07.03 - Bed 2	3.1	30	FAIL
LB.07.03 - Living/Kitchen	5.6		FAIL
LB.07.04 - Bed 1	3	42	FAIL
LB.07.04 - Bed 2	3	36	FAIL
LB.07.04 - Living/Kitchen	5.2		FAIL
T.04.01 - Studio	0	0	PASS
T.04.02 - Bed 1	0	0	PASS
T.04.02 - Living/Kitchen	0		PASS
T.04.03 - Bed 1	0	0	PASS
T.04.03 - Living/Kitchen	0		PASS
T.04.04 - Bed 1	0	0	PASS
T.04.04 - Bed 2	0	0	PASS
T.04.04 - Bed 3	0	0	PASS
T.04.04 - Living/Kitchen	0		PASS
T.04.05 - Bed 1	0	0	PASS
T.04.05 - Bed 2	0	0	PASS
T.04.05 - Living/Kitchen	0		PASS
T.04.06 - Bed 1	0	0	PASS
T.04.06 - Living/Kitchen	0		PASS
T.04.07 - Bed 1	0	0	PASS
T.04.07 - Bed 2	0	0	PASS
T.04.07 - Living/Kitchen	0		PASS
T.25.01 - Bed 1	0	0	PASS
T.25.01 - Bed 2	0	0	PASS
T.25.01 - Living/Kitchen	0		PASS
T.25.02 - Bed 1	0	0	PASS
T.25.02 - Bed 2	0	0	PASS
T.25.02 - Living/Kitchen	0		PASS
Number of Rooms Failing (out of 78):			**55**

Future weather: 2050 – including ambient loop and tempered air MVHR

Room Name:	Criteria 1	Criteria 2	Pass/Fail
LB.04.01 - Bed 1	2.3	40	FAIL
LB.04.01 - Bed 2	2.4	40	FAIL
LB.04.01 - Living/Kitchen	4.8		FAIL
LB.04.02 - Bed 1	2.2	42	FAIL
LB.04.02 - Living/Kitchen	4.7		FAIL
LB.04.03 - Bed 1	2.2	46	FAIL
LB.04.03 - Bed 2	2.3	46	FAIL
LB.04.03 - Bed 3	2.3	44	FAIL
LB.04.03 - Kitchen	4.1		FAIL
LB.04.03 - Living	4.6		FAIL
LB.04.04 - Bed 1	1.7	38	FAIL
LB.04.04 - Bed 2	1.6	40	FAIL
LB.04.04 - Bed 3	1.9	38	FAIL
LB.04.04 - Living/Kitchen	4.4		FAIL
LB.04.05 - Bed 1	2.1	40	FAIL
LB.04.05 - Living/Kitchen	4.5		FAIL
LB.04.06 - Bed 1	1.8	46	FAIL
LB.04.06 - Bed 2	1.8	38	FAIL
LB.04.06 - Bed 3	1.8	42	FAIL
LB.04.06 - Living/Kitchen	4.3		FAIL
LB.04.07 - Bed 1	2.2	44	FAIL
LB.04.07 - Bed 2	2.2	40	FAIL
LB.04.07 - Living/Kitchen	4.4		FAIL
LB.04.08 - Bed 1	2.2	38	FAIL
LB.04.08 - Bed 2	2.3	38	FAIL
LB.04.08 - Living/Kitchen	4.5		FAIL
LB.04.09 - Bed 1	2.2	48	FAIL
LB.04.09 - Bed 2	2.2	46	FAIL
LB.04.09 - Bed 3	2.4	38	FAIL
LB.04.09 - Kitchen	4.5		FAIL
LB.04.09 - Living	5.5		FAIL
LB.04.10 - Bed 1	3.2	50	FAIL
LB.04.10 - Bed 2	2.6	68	FAIL
LB.04.10 - Bed 3	2.5	48	FAIL
LB.04.10 - Living/Kitchen	5.2		FAIL
LB.04.11 - Bed 1	2.9	44	FAIL
LB.04.11 - Living/Kitchen	4.7		FAIL
LB.04.12 - Bed 1	2.6	42	FAIL
LB.04.12 - Living/Kitchen	4.8		FAIL
LB.04.13 - Bed 1	2.4	40	FAIL
LB.04.13 - Bed 2	2.3	40	FAIL
LB.04.13 - Living/Kitchen	4.5		FAIL
LB.07.01 - Bed 2	2.4	58	FAIL
LB.07.01 - Bed 2	2.4	48	FAIL
LB.07.01 - Bed 3	2.4	46	FAIL
LB.07.01 - Kitchen	4.5		FAIL
LB.07.01 - Living	5.2		FAIL
LB.07.02 - Bed 1	2.7	52	FAIL
LB.07.02 - Living/Kitchen	4.7		FAIL
LB.07.03 - Bed 1	2.6	40	FAIL
LB.07.03 - Bed 2	2.6	38	FAIL
LB.07.03 - Living/Kitchen	4.7		FAIL
LB.07.04 - Bed 1	2.7	40	FAIL
LB.07.04 - Bed 2	2.6	40	FAIL
LB.07.04 - Living/Kitchen	4.4		FAIL
T.04.01 - Studio	0	0	PASS
T.04.02 - Bed 1	0	0	PASS
T.04.02 - Living/Kitchen	0		PASS
T.04.03 - Bed 1	0	0	PASS
T.04.03 - Living/Kitchen	0		PASS
T.04.04 - Bed 1	0	0	PASS
T.04.04 - Bed 2	0	0	PASS
T.04.04 - Bed 3	0	0	PASS
T.04.04 - Living/Kitchen	0		PASS
T.04.05 - Bed 1	0	0	PASS
T.04.05 - Bed 2	0	0	PASS
T.04.05 - Living/Kitchen	0		PASS
T.04.06 - Bed 1	0	0	PASS
T.04.06 - Living/Kitchen	0		PASS
T.04.07 - Bed 1	0	0	PASS
T.04.07 - Bed 2	0	0	PASS
T.04.07 - Living/Kitchen	0		PASS
T.25.01 - Bed 1	0	0	PASS
T.25.01 - Bed 2	0	0	PASS
T.25.01 - Living/Kitchen	0		PASS
T.25.02 - Bed 1	0	0	PASS
T.25.02 - Bed 2	0	0	PASS
T.25.02 - Living/Kitchen	0		PASS
Number of Rooms Failing (out of 78):			**55**

Future weather: 2080 – including ambient loop and tempered air MVHR

Room Name:	Criteria 1	Criteria 2	Pass/Fail
LB.04.01 - Bed 1	4.5	112	FAIL
LB.04.01 - Bed 2	4.7	104	FAIL
LB.04.01 - Living/Kitchen	9.6		FAIL
LB.04.02 - Bed 1	3.9	123	FAIL
LB.04.02 - Living/Kitchen	9.6		FAIL
LB.04.03 - Bed 1	4.1	129	FAIL
LB.04.03 - Bed 2	4.1	119	FAIL
LB.04.03 - Bed 3	4.1	106	FAIL
LB.04.03 - Kitchen	7.3		FAIL
LB.04.03 - Living	9.3		FAIL
LB.04.04 - Bed 1	3.5	111	FAIL
LB.04.04 - Bed 2	3.5	110	FAIL
LB.04.04 - Bed 3	3.6	90	FAIL
LB.04.04 - Living/Kitchen	8.2		FAIL
LB.04.05 - Bed 1	4.1	111	FAIL
LB.04.05 - Living/Kitchen	7.9		FAIL
LB.04.06 - Bed 1	3.6	135	FAIL
LB.04.06 - Bed 2	3.6	115	FAIL
LB.04.06 - Bed 3	3.5	128	FAIL
LB.04.06 - Living/Kitchen	8.3		FAIL
LB.04.07 - Bed 1	4.2	121	FAIL
LB.04.07 - Bed 2	4.3	115	FAIL
LB.04.07 - Living/Kitchen	8.5		FAIL
LB.04.08 - Bed 1	4.2	111	FAIL
LB.04.08 - Bed 2	4.3	110	FAIL
LB.04.08 - Living/Kitchen	8.7		FAIL
LB.04.09 - Bed 1	4	127	FAIL
LB.04.09 - Bed 2	4.1	120	FAIL
LB.04.09 - Bed 3	4.3	105	FAIL
LB.04.09 - Kitchen	8.8		FAIL
LB.04.09 - Living	9.8		FAIL
LB.04.10 - Bed 1	6.6	129	FAIL
LB.04.10 - Bed 2	5.3	220	FAIL
LB.04.10 - Bed 3	4.7	128	FAIL
LB.04.10 - Living/Kitchen	10		FAIL
LB.04.11 - Bed 1	5.9	118	FAIL
LB.04.11 - Living/Kitchen	9.5		FAIL
LB.04.12 - Bed 1	5	114	FAIL
LB.04.12 - Living/Kitchen	9.5		FAIL
LB.04.13 - Bed 1	4.3	113	FAIL
LB.04.13 - Bed 2	4.2	110	FAIL
LB.04.13 - Living/Kitchen	8.6		FAIL
LB.07.01 - Bed 2	4.3	162	FAIL
LB.07.01 - Bed 2	4.3	127	FAIL
LB.07.01 - Bed 3	4.3	111	FAIL
LB.07.01 - Kitchen	8.6		FAIL
LB.07.01 - Living	10.5		FAIL
LB.07.02 - Bed 1	5.2	134	FAIL
LB.07.02 - Living/Kitchen	9.6		FAIL
LB.07.03 - Bed 1	5	104	FAIL
LB.07.03 - Bed 2	5.2	94	FAIL
LB.07.03 - Living/Kitchen	9.3		FAIL
LB.07.04 - Bed 1	5	111	FAIL
LB.07.04 - Bed 2	5	103	FAIL
LB.07.04 - Living/Kitchen	8.6		FAIL
T.04.01 - Studio	0	0	PASS
T.04.02 - Bed 1	0	0	PASS
T.04.02 - Living/Kitchen	0		PASS
T.04.03 - Bed 1	0	0	PASS
T.04.03 - Living/Kitchen	0		PASS
T.04.04 - Bed 1	0	0	PASS
T.04.04 - Bed 2	0	0	PASS
T.04.04 - Bed 3	0	0	PASS
T.04.04 - Living/Kitchen	0		PASS
T.04.05 - Bed 1	0	0	PASS
T.04.05 - Bed 2	0	0	PASS
T.04.05 - Living/Kitchen	0		PASS
T.04.06 - Bed 1	0	0	PASS
T.04.06 - Living/Kitchen	0		PASS
T.04.07 - Bed 1	0	0	PASS
T.04.07 - Bed 2	0	0	PASS
T.04.07 - Living/Kitchen	0		PASS
T.25.01 - Bed 1	0	0	PASS
T.25.01 - Bed 2	0	0	PASS
T.25.01 - Living/Kitchen	0		PASS
T.25.02 - Bed 1	0	0	PASS
T.25.02 - Bed 2	0	0	PASS
T.25.02 - Living/Kitchen	0		PASS
Number of Rooms Failing (out of 78):			**55**

Appendix B – Common Area Overheating Results

	Internal Temperatures >28°C					Internal Temperatures >30°C				Internal Temperatures >32°C			
Level/Room Name:	No. of hours >28°C	>1% of annual hours	>2% of annual hours	>3% of annual hours	Pass/Fail to CIBSE TM59:2017	No. of hours >30°C	>1% of annual hours	>2% of annual hours	>3% of annual hours	No. of hours >32°C	>1% of annual hours	>2% of annual hours	>3% of annual hours
LB.04 - CAC 1	97	Yes	No	No	PASS	25	No	No	No	0	No	No	No
LB.04 - CAC 2	80	No	No	No	PASS	12	No	No	No	0	No	No	No
LB.04 - CAC 3	180	Yes	Yes	No	PASS	38	No	No	No	0	No	No	No
LB.04 - CAC 4	74	No	No	No	PASS	11	No	No	No	0	No	No	No
LB.04 - CAC 5	112	Yes	No	No	PASS	30	No	No	No	0	No	No	No
LB.04 - Staircore 1	0	No	No	No	PASS	0	No	No	No	0	No	No	No
LB.04 - Staircore 2	124	Yes	No	No	PASS	0	No	No	No	0	No	No	No
LB.04 - Staircore 3	0	No	No	No	PASS	0	No	No	No	0	No	No	No
LB.07 - CAC 1	248	Yes	Yes	No	PASS	49	No	No	No	5	No	No	No
LB.07 - CAC 2	102	Yes	No	No	PASS	21	No	No	No	0	No	No	No
LB.07 - CAC 3	241	Yes	Yes	No	PASS	44	No	No	No	2	No	No	No
LB.07 - CAC 4	563	Yes	Yes	Yes	FAIL	50	No	No	No	0	No	No	No
LB.07 - Staircore 1	0	No	No	No	PASS	0	No	No	No	0	No	No	No
LB.07 - Staircore 2	8	No	No	No	PASS	0	No	No	No	0	No	No	No
T.04 - CAC 1	50	No	No	No	PASS	0	No	No	No	0	No	No	No
T.04 - CAC 2	25	No	No	No	PASS	0	No	No	No	0	No	No	No
T.04 - Lobby 1	54	No	No	No	PASS	1	No	No	No	0	No	No	No
T.04 - Lobby 2	58	No	No	No	PASS	2	No	No	No	0	No	No	No
T.04 - Staircore 1	0	No	No	No	PASS	0	No	No	No	0	No	No	No
T.04 - Staircore 2	0	No	No	No	PASS	0	No	No	No	0	No	No	No
T.25 - CAC 1	172	Yes	No	No	PASS	31	No	No	No	0	No	No	No
T.25 - CAC 2	35	No	No	No	PASS	0	No	No	No	0	No	No	No
T.25 - Lobby 1	52	No	No	No	PASS	2	No	No	No	0	No	No	No
T.25 - Lobby 2	52	No	No	No	PASS	2	No	No	No	0	No	No	No
T.25 - Staircore 1	0	No	No	No	PASS	0	No	No	No	0	No	No	No
T.25 - Staircore 2	0	No	No	No	PASS	0	No	No	No	0	No	No	No

Appendix C – External shading feasibility study

The London Plan requires in the instance where proposed developments have security, air quality or noise concerns that pose limitations to the opening of windows, the applicant will be required to include technical and cost feasibility assessments of the following fixed shading devices: external shutters, external blinds, awnings and ventilated louvres.

The below table provides insight into the cost and feasibility of the various fixed shading devices.

Fixed Shading Devices	O&M impacts	Aesthetic impact	Site feasibility	Cost	Comments
Ventilated Louvres	Med	High	Med	High	Not adopted – visual impact High cost
Acoustic Louvres	High	High	Low	High	Not adopted - due to lack of space to accommodate, walls are not thick enough for the louvre thickness required
External Shutters	Med	Med-High	Med	High	Not adopted – visual impact, cost
External Blinds	Med	Med-High	High	Med	Not adopted – visual impact, cost Durability issue
Interstitial Blinds	Low	Low	Low	High	Not adopted – high cost
Awnings	Low	High	Low	Low	Not adopted – visual impact, site too enclosed Durability issue
Deep reveals and balcony shading	Low	Med	High	Low	Adopted

Appendix D – GHA Overheating tool

EARLY STAGE OVERHEATING RISK TOOL

Version 1.0, July 2019

This tool provides guidance on how to assess overheating risk in residential schemes at the early stages of design. It is specifically a pre-detail design assessment intended to help identify factors that could contribute to or mitigate the likelihood of overheating.

The questions can be answered for an overall scheme or for individual units. Score zero wherever the question does not apply. Additional information is provided in the accompanying guidance, with examples of scoring and advice on next steps.

Find out more information and download accompanying guidance at goodhomes.org.uk/overheating-in-new-homes.

Good Homes Alliance

KEY FACTORS INCREASING THE LIKELIHOOD OF OVERHEATING	KEY FACTORS REDUCING THE LIKELIHOOD OF OVERHEATING

Geographical and local context

#1 Where is the scheme in the UK? See guidance for map	South east	4	4
	Northern England, Scotland & NI	0	
	Rest of England and Wales	2	
#2 Is the site likely to see an Urban Heat Island effect? See guidance for details	Central London (see guidance)	3	3
	Grtr London, Manchester, B'ham	2	
	Other cities, towns & dense sub-urban areas	1	

#8 Do the site surroundings feature significant blue/green infrastructure? Proximity to green spaces and large water bodies has beneficial effects on local temperatures; as guidance, this would require at least 50% of surroundings within a 100m radius to be blue/green, or a rural context		1	1

Site characteristics

#3 Does the site have barriers to windows opening? - Noise/Acoustic risks - Poor air quality/smells e.g. near factory or car park or very busy road - Security risks/crime - Adjacent to heat rejection plant	**Day** - reasons to keep all windows closed	8	4
	Day - barriers some of the time, or for some windows e.g. on quiet side	4	
	Night - reasons to keep all windows closed	8	4
	Night - bedroom windows OK to open, but other windows are likely to stay closed	4	

#9 Are immediate surrounding surfaces in majority pale in colour, or blue/green? Lighter surfaces reflect more heat and absorb less so their temperatures remain lower; consider horizontal and vertical surfaces within 10m of the scheme		1	1
#10 Does the site have existing tall trees or buildings that will shade solar-exposed glazed areas? Shading onto east, south and west facing areas can reduce solar gains, but may also reduce daylight levels		1	0

Scheme characteristics and dwelling design

#4 Are the dwellings flats? Flats often combine a number of factors contributing to overheating risk e.g. dwelling size, heat gains from surrounding areas; other dense and enclosed dwellings may be similarly affected - see guidance for examples		3	3
#5 Does the scheme have community heating? i.e. with hot pipework operating during summer, especially in internal areas, leading to heat gains and higher temperatures		3	0

#11 Do dwellings have high exposed thermal mass AND a means for secure and quiet night ventilation? Thermal mass can help slow down temperature rises, but it can also cause properties to be slower to cool, so needs to be used with care - see guidance		1	0
#12 Do floor-to-ceiling heights allow ceiling fans, now or in the future? Higher ceilings increase stratification and air movement, and offer the potential for ceiling fans	>2.8m and fan installed	2	2
	> 2.8m	1	

Solar heat gains and ventilation

#6 What is the estimated average glazing ratio for the dwellings? (as a proportion of the facade on solar-exposed areas i.e. orientations facing east, south, west, and anything in between). Higher proportions of glazing allow higher heat gains into the space	>65%	12	4
	>50%	7	
	>35%	4	
#7 Are the dwellings single aspect? Single aspect dwellings have all openings on the same facade. This reduces the potential for ventilation	Single-aspect	3	0
	Dual aspect	0	

#13 Is there useful external shading? Shading should apply to solar exposed (E/S/W) glazing. It may include shading devices, balconies above, facade articulation etc. See guidance on "full" and "part". Scoring depends on glazing proportions as per **#6**		Full	Part	6
	>65%	6	3	
	>50%	4	2	
	>35%	2	1	

#14 Do windows & openings support effective ventilation? Larger, effective and secure openings will help dissipate heat - see guidance		Openings compared to Part F purge rates		3
		= Part F minimum required	+50%	+100%
	Single-aspect		3	4
	Dual aspect		2	3

TOTAL SCORE	9	=	Sum of contributing factors:	22	*minus*	Sum of mitigating factors:	13

High 12 Medium 8 Low

score >12: Incorporate design changes to reduce risk factors and increase mitigation factors AND Carry out a detailed assessment (e.g. dynamic modelling against CIBSE TM59)	**score between 8 and 12:** Seek design changes to reduce risk factors and/or increase mitigation factors AND Carry out a detailed assessment (e.g. dynamic modelling against CIBSE TM59)	**score <8:** Ensure the mitigating measures are retained, and that risk factors do not increase (e.g. in planning conditions)

Contact details:

Whitecode Consulting Ltd
26-27 The Hill
Northfleet Gravesend
Kent
DA11 9EU

t: 01322 289977

e: design@whitecode.co.uk