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OVERHEATING ASSESSMENT

9.370 – 330 GRAY'S INN ROAD

17/05/2021 *by CC, reviewed by NC/SG*

The following document provides a results summary for all overheating analysis carried out for the proposed development. The assessment includes a sample of worst-case dwellings across both residential blocks and have been simulated using DSY1 weather file as well as DSY2 and DSY3 scenarios.

EXECUTIVE SUMMARY

An overheating analysis has been conducted for the proposed development at 330 Gray's Inn Road, located in the London Borough of Camden. The purpose of this analysis is to test the design of the proposed scheme and ensure the mitigation of any overheating risk within the occupied zones across the development. This will ensure the comfort of the occupants as well as future-proof the scheme by taking into account projected increased ambient air temperatures from climate change.

In order to assess the thermal performance of the development, models were constructed within thermal simulation software. The internal gains (comprising of occupancy, equipment, and lighting gains) and ventilation conditions were estimated for all the habitable internal spaces in line with the TM59 guidelines and information provided by the design team where available.

With the aim of giving the most robust consideration, performance of the various occupied rooms was compared with CIBSE Technical Memorandum 59[1] performance recommendations. This includes rigorous targets that determine the acceptability of overheating based on the temperature differential between the internal and the external environment (ΔT), considering the frequency of high temperature difference beyond which the level of overheating is considered unacceptable. Specifically, for bedrooms, the methodology aims to evaluate comfort during the sleeping hours by setting a maximum number of hours for which the operative temperature can exceed 26°C. TM59 is currently the most appropriate assessment methodology for understanding overheating risk in residential properties in the UK.

A sample of residential dwelling types across both residential blocks were selected for the dynamic thermal model as a worst-case approach due to increased solar exposure (such as due to orientation and location on upper floors), including the following:

- 2 1bed apartments;
- 4 2bed apartments;
- 1 3 bed apartment;
- 2 3bed duplex apartments (Swinton Block A);
- 2 communal corridors;

In total, 28 residential habitable rooms were assessed, including 19 bedrooms and 9 living/kitchen/dining rooms.

[1] CIBSE TM59:2017 – Design Methodology for the assessment of overheating risk in homes

The Overheating Risk Assessment for the proposed development has been carried out via dynamic modelling in line with the methodology set out in CIBSE TM59 guidelines, which is a robust methodology for assessing overheating risk in dwellings. The mitigation strategies proposed were developed in liaison with the design team to provide a coordinated approach to achieve comfort for the occupants. The thermal simulations indicate the following:

- All habitable rooms in dwellings are predicted to satisfy the overheating risk criteria for the TM49 probabilistic Design Summer Year DSY1 (2020s, high emissions, 50% percentile scenario) weather data for London Weather Centre through the incorporation of MVHR with air tempering and solar control strategies including internal blinds and recessed windows.
- Enhanced solar glazing specification (g-value of 0.5) is recommended to the south facing facades where rooms have a high solar radiation due to its orientation.
- Due to window opening restrictions for acoustic reasons, dwellings will require air tempering to mitigate overheating risk for limited periods of time in the year. Openable windows are available for the occupants to use, but according to guidance from the acoustic consultant, should only be relied upon for purge ventilation conditions (e.g. to remove odour from painting and decorating or from burnt food).
- For communal corridors, it is recommended that external windows are openable to allow for purge ventilation to mitigate the overheating risk.

The assessment was done in close collaboration with the acoustic consultants and the architectural team, with a robust coordination of strategies to ensure the development will provide adequate thermal comfort conditions for future residents.

It should be noted that, if not subject to ventilation restrictions due to noise constraints, the residential sample modelled is expected to meet the overheating risk criteria through natural ventilation and solar control strategies. Results of the preliminary modelling carried out under those conditions is summarised on Table 10.

Based on the method of assessment adopted, XCO2 recommend the design team to consider incorporating the features that allow compliance with the CIBSE TM59 criteria for the London weather data for future DSY1.

METHODOLOGY

3D thermal models of the proposed scheme have been developed based on the planning architectural drawings by AHMM. In line with CIBSE TM59 guidelines, a sample of worst-case dwellings were selected based on orientation, location, size, and typology to provide accurate representations of overheating risks across the development. In total, 28 rooms, 19 bedrooms and 9 living/kitchen/dining room spaces were analysed.

The overheating risk of the spaces was assessed for future climate scenarios. Following the methodology set out in CIBSE TM49 Design Summer Years for London, the following years were selected to form the set of probabilistic design summer years (DSY) for the future weather scenarios:

- DSY1 (1989) for the 2020s, high emissions, 50% percentile scenario;
- DSY2 (2003) for the 2020s, high emissions, 50% percentile scenario;
- DSY3 (1976) for the 2020s, high emissions, 50% percentile scenario;

These files are climate-change adjusted versions of the current DSY. The first of these years, 1989, is the current DSY and represents a moderately warm summer, as is interpreted in current CIBSE guidance. The years 1976 and 2003 were chosen as more extreme years with different types of summer: the former is a year with a long period of persistent warmth, whereas the latter has a more intense single warm spell. The 2020 period is of particular interest as this relates to the period 2011-2040, which is the period we have now entered. For the 50% percentile changes, which may be viewed as the 'best guess' level of change.

Therefore, the DSY1 2020 high emissions, 50% percentile scenario relates to the time period that includes the predicted date of completion of proposed development and indicates the 'best guess' level of climate change. The London Weather Centre data set location was selected as it is the closest to the proposed development site and also incorporates for climate variations due to the Urban Heat Island effect, therefore, accounts for more extreme weather scenarios. Although, overheating assessments have to include DSY2 and DSY3 weather files, TM59 requirements state that the proposed dwellings are to only comply with DSY1.

The buildings have been modelled using dynamic thermal simulation software which is fully compliant with CIBSE Applications Manual AM11. The software can compute operative temperatures using CIBSE weather data sets, building fabric specification, window areas and opening, all aspects of solar and internal gains as well as natural ventilation flows within buildings. Compliance of the design with the CIBSE TM59 criteria has been sought and recommendations are formulated to future-proof the design for further interventions in the future.

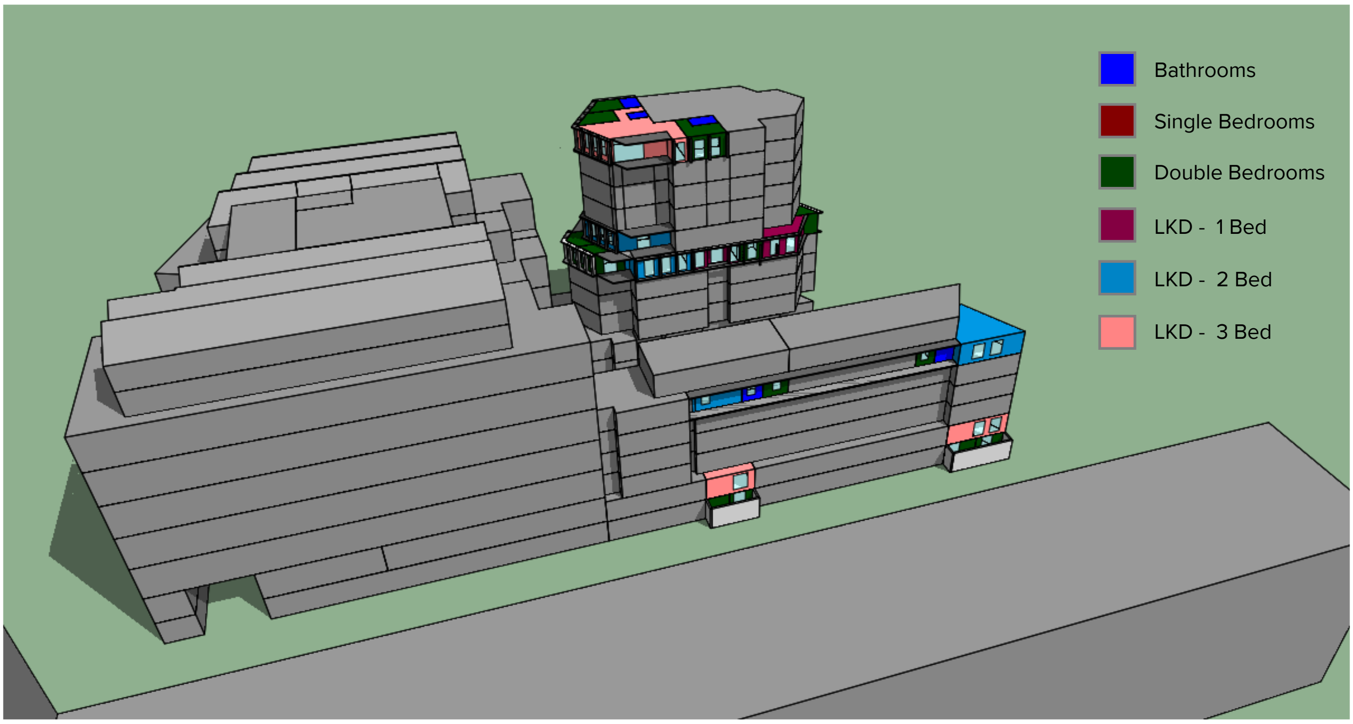


Figure 1: 3D view of thermal model

ASSESSMENT CRITERIA

The performance standards set out within CIBSE TM59 have been used to assess the overheating risk within the proposed development.

Considering acoustic constraints across the development, the dwellings cannot rely solely on natural ventilation with openable windows for overheating mitigation throughout the summer. Therefore, the proposed scheme will use mechanical ventilation as the primary mechanism to mitigate overheating risk, the following criterion must be met:

- **For living rooms, kitchens and bedrooms:**
  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))

Please refer to the Environmental Noise and Acoustic Design Statement Report by Hann Tucker Associates for further details on the acoustic constraints.

MODELLING ASSUMPTIONS

FABRIC PERFORMANCE

The specification of the fabric is aligned with the proposals at planning stage as these are outlined in the Energy Statement for the scheme and summarised in Table 1:

Table 1: Building fabric assumptions.

Element	Specification	
	U-value [W/m².K]	
External Walls	0.15	
Ground Floor	0.10	
Roof	0.10	
	U-value [W/m².K]	**g-value**
Glazing (South facing)	1.30	0.5
Glazing (North, East, West facing)		0.7
	Air permeability (@50Pa)	
Residential	3 $m^3/m^2.h$	

OCCUPANCY

The TM59 methodology specifies the hours during which spaces are anticipated to be occupied and these have been used within the overheating assessment calculations. Table 2 sets out the predicted occupancy patterns for the assessed rooms within the dwellings in line with the TM59 requirements; these are programmed into the dynamic software model to calculate the relative occupancy gains for the designated spaces.

Table 2: Occupancy assumptions for the room types assessed.

Area	TM59 Predicted occupation pattern
Bedroom	24 hours a day
Living room/Kitchen/Dining room	09:00 – 22:00

TM52 does not specify the exact hours that the spaces are occupied, and as a result the BRE estimates that are inherited for the National Calculation Methodology (NCM) are often used as a basis for the prediction of the occupied hours of different areas of occupation in overheating assessment calculations.

INTERNAL GAINS

Similar to the predicted occupancy hours, the internal gains (lighting, equipment, people) for occupied areas are incorporated within the model in line with the guidance set out in TM59.

Table 3 sets out the various internal gains for the assessed rooms within the dwellings. Non-occupied spaces such as circulation, bathrooms and storage were modelled based on the typical internal gains specified within the TM59 methodology.

Table 3: Internal Gains modelled for each room type assessed.

Area	Predicted Internal Gains		
	Lighting [W/m²]	People [peak W]	Equipment [peak W]
Double Bedroom	2.0 W/m²	150 W sensible, 110 W latent	80 W
Single Bedroom	2.0 W/m²	75 W sensible, 55 W latent	80 W
1Bed Living/kitchen/dining area	2.0 W/m²	75 W sensible, 55 W latent	450 W
2Bed Living/kitchen/dining area	2.0 W/m²	150 W sensible, 110 W latent	450 W
3Bed Living/kitchen/dining area	2.0 W/m²	225 W sensible, 165 W latent	450 W

VENTILATION

Without relying on operable windows or the provision of operable ventilation louvres, the addition of active air tempering on MVHR level is required in order to meet the targets set out in TM59 for all occupied spaces. Mechanical cooling is introduced using the MVHR units with air tempering of up to 1.5kW cooling capacity.

The estimated ventilation flow rates have been included in the model in line with Part F requirements for ventilation to provide a conservative baseline for assessment (see Table 4). Trickle vents and louvres have not been incorporated in the building envelope. Openable windows incorporated throughout the development are only relied upon for purge ventilation conditions as defined by Building Regulations Approved Document F which only occur occasionally (e.g. to remove odour from painting and decorating or from burnt food). The boosted MVHR ventilation rates were not considered in line with CIBSE TM59 guidance, thereby providing a conservative assessment.

Table 4: Ventilation rates modelled for each room type assessed.

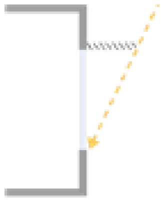
Area	Ventilation Rate [L/s]
Bedrooms	6 L/s
Living rooms	12 L/s
Kitchen and LKDs	12 L/s

COOLING HIERARCHY

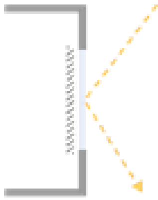
In accordance with Policy CC2 of the Camden Local Plan, the development has applied the cooling hierarchy to reduce the impact of overheating. The cooling hierarchy is according to Policy SI 4 of the Intend to Publish London Plan:

1. reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure
2. minimise internal heat generation through energy efficient design
3. manage the heat within the building through exposed internal thermal mass and high ceilings
4. provide passive ventilation
5. provide mechanical ventilation
6. provide active cooling systems.

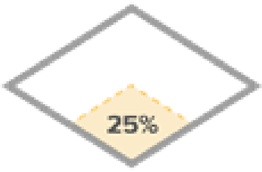
Coordination with the design team at early design stage has been carried out in order to introduce measures that address the steps of the cooling hierarchy. The following measures have been incorporated into the scheme following after collaboration with the design team:



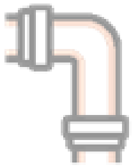
Introduction of external shading where possible.



Incorporation of low g-value and internal shading options where external shading is not feasible.



Reduction of glazing ratio as far as possible, with the aim of limiting this to 25% of room area.



Specification of insulation to LTHW pipework throughout the development.

Specification of LED lighting throughout the residential development.

RESULTS

This section presents the results summary for each of the tests carried out for the proposed development:

In total, 2 communal corridors and 28 habitable spaces were included in the assessment consisting of:

- 19 bedrooms – 17 double bedrooms & 2 single bedrooms
- 9 living/kitchen/dining rooms

Non-habitable spaces such as bathrooms, storage rooms and dwelling circulation areas have also been included in the assessment; and their internal gains have been accounted for in the model.

The results for the communal corridors are presented for the DSY1 weather file only.

The dwelling results outline the case where MVHR with air tempering is relied upon for mitigating overheating within the dwellings. In order to pass, the temperature in all occupied rooms should not exceed an operative temperature of 26°C for more than 3% of the annual occupied hours. All windows are modelled as closed in each iteration presented.

A summary of the estimated cooling loads for each sample apartment is provided for the DSY1 weather file. Improvements to fabric and solar control strategies have been incorporated to reduce these cooling loads as far as is feasible for the scheme. The results for DSY2 and DSY3 are also provided for reference only, as compliance with these weather files is not required.

Results for the development with only passive measures are also presented for information only.

COMMUNAL CORRIDOR RESULTS

The following results are presented for the sample communal corridors included in the dynamic thermal model. The results are for the DSY1 weather file.

Although there is no mandatory target for communal corridors, TM59 guidance requires these to be tested and flagged as a significant risk if the operative temperature is above 28°C for more than 3% of the annual hours. As shown in the following results table, the communal corridors will not be at risk if the windows are operable.

Table 5: Overheating assessment results for London Weather Centre DSY1 for the 2020s, high emissions, 50% percentile scenario

Communal Corridor	Operative temperature should not exceed 28°C for more than 3% of total annual hrs (% hrs exceedance)	
	Iteration 1: Closed windows, g-value of 0.7, no internal blinds	**Iteration 2:** Operable windows, 10% free opening area
Level 10 Communal Corridor	10.4%	1.5%
Level 05 Communal Corridor	6.6%	0.9%

DWELLING RESULTS

DSY1 2020

Table 6: Overheating assessment results for London Weather Centre DSY1 for the 2020s, high emissions, 50% percentile scenario

Apartment Room	Operative temperature should not exceed 26°C for more than 3% of total annual occupied hrs (% hrs exceedance)		
	Iteration 1: g-value of 0.7, no internal blinds	Iteration 2: g-value of 0.7, internal blinds	Iteration 3: g-value of 0.5 to south facing windows, internal blinds
Single Bedrooms	0.0%	0.0%	0.0%
Double Bedrooms	4.8%	4.0%	1.7%
LKDs	11.5%	5.8%	0.0%

DSY2 2020

Table 7: Overheating assessment results for London Weather Centre DSY1 for the 2020s, high emissions, 50% percentile scenario

Apartment Room	Operative temperature should not exceed 26°C for more than 3% of total annual occupied hrs (% hrs exceedance)		
	Iteration 1: g-value of 0.7, no internal blinds	Iteration 2: g-value of 0.7, internal blinds	Iteration 3: g-value of 0.5 to south facing windows, internal blinds
Single Bedrooms	0.0%	0.0%	0.0%
Double Bedrooms	4.8%	4.0%	3.7%
LKDs	11.7%	6.2%	3.9%

DSY3 2020

Table 8: Overheating assessment results for London Weather Centre DSY1 for the 2020s, high emissions, 50% percentile scenario

Apartment Room	Operative temperature should not exceed 26°C for more than 3% of total annual occupied hrs (% hrs exceedance)		
	Iteration 1: g-value of 0.7, no internal blinds	Iteration 2: g-value of 0.7, internal blinds	Iteration 3: g-value of 0.5 to south facing windows, internal blinds
Single Bedrooms	10.1%	8.8%	8.2%
Double Bedrooms	16.4%	14.5%	13.7%
LKDs	25.7%	23.9%	22.8%

DWELLING COOLING LOADS

Table 9: Cooling Loads using London Weather Centre DSY1 for the 2020s, high emissions, 50% percentile scenario

Sample Apartment	Cooling Load (kWh/yr/m²)		
	Iteration 1: g-value of 0.7, no internal blinds	Iteration 2: g-value of 0.7, internal blinds	Iteration 3: g-value of 0.5 to south facing windows
BlockA_LGF_Dulpex03	23.2	17.7	15.6
BlockA_LGF_Dulpex06	29.2	20.5	16.2
BlockA_L04_Flat02	27.7	21.9	20.2
BlockA_L04_Flat04	41.5	28.0	24.3
BlockB_L05_Flat01	33.9	23.1	18.9
BlockB_L05_Flat02	45.4	29.7	21.8
BlockB_L05_Flat03	43.5	27.8	24.0
BlockB_L06_Flat01	26.3	19.7	18.6
BlockB_L10_Flat02	35.5	24.0	19.7

DWELLING RESULTS

Table 10 shows the results for the development relying only on the passive measures incorporated in the design – reduced g-value, internal blinds, and natural passive ventilation – and without taking into consideration the air tempering of the MVHR and site constraints. Results are for DSY1 weather file. These results are for information only as enhanced mechanical ventilation is required for compliance with CIBSE TM59 overheating risk criteria sue to site constraints.

Table 10: Overheating assessment results for London Weather Centre DSY1

ID	Design change	Bedrooms	LKDs	Bedrooms TM59 night-time 26°C criterion	Bedrooms TM52 Criterion 1	LKD TM52 Criterion 1
		Window opening area and profile		No. of rooms not meeting criteria		
1	Passive measures only (reduced g-value, internal blinds and natural passive ventilation)	15-90% 24/7	15-90% day 0% night	0/19	0/19	0/9

CONCLUSIONS AND RECOMMENDATIONS

The results show that all habitable spaces assessed achieve compliance with CIBSE TM59 overheating risk criteria for London Weather Centre (LWC) DSY1 future weather data, provided that adequate design measures are incorporated. These have been developed through an extensive iterative process including a combination of mechanical ventilation, façade design, and solar control strategies.

The assessment was done in close collaboration with the design team with a robust coordination of strategies to ensure the development demonstrates optimal thermal comfort for future occupants.

Based on the thermal simulations, the following have been found:

- Due to window opening restrictions for acoustic reasons, all dwellings require comfort cooling to mitigate overheating risk for limited periods of time in the year.
- Habitable rooms in dwellings are predicted to satisfy the overheating risk criteria for the TM49 probabilistic Design Summer Year DSY1 (2020s, high emissions, 50% percentile scenario) weather data for London Weather Centre through natural ventilation strategies and the inclusion of internal blinds.
- Enhanced solar glazing specification is recommended to the south facing façade of both residential blocks, where rooms have a high solar radiation due to its orientation. Solar transmittance (g-value) is decrease to 0.5 for this case and 0.7 elsewhere. Further reductions in g-value have not been considered feasible to ensure balance between overheating mitigation and energy savings.
- For communal corridors, it is recommended that the external windows are openable to allow for purge ventilation to extract built-up heat.

Table 11 summarises the design recommendations that contribute to reducing overheating risk.

Table 11: Summary of recommendations for the proposed development.

Measure	Implementation
Minimise internal heat generation through energy efficient design	
High efficiency lighting installations (LED)	All spaces
LTHW pipework design and installations (location, configuration and insulation) to minimise heat losses.	LTHW pipework running in corridors and circulation areas to be highly insulated across the whole length; including jackets for valves and junctions. Primary distribution within the residential blocks will be vertical rather than horizontal to reduce pipe lengths.
Reduce the amount of heat entering the building	

Measure	Implementation
Glazing areas	Glazing percentages on each façade and space type were coordinated with the design team to ensure thermal comfort and adequate daylight.
External shading	Slight recesses included within windows across site and balconies where present. Projected and recessed balconies and recessed windows in the design provide an element of external shading.
Internal shading via opaque blinds and opaque lower window pane for bedrooms	Internal blinds integrated in design for all lounges and bedrooms in residential spaces. Opaque lower panes incorporated in bedrooms to reduce solar gain into habitable spaces.
Solar control glazing	Integrated in design. For south facing façades a g-value of 0.50 and 0.7 g-value for all other orientations.
Mechanical ventilation	
MVHR with air tempering	Bedrooms and LKDs in all apartments will require MVHR units utilising air tempering to provide approximately 1.5kW of cooling to the space to mitigate overheating.