



TM52 Overheating assessment

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Prepared for:

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1.0 Analysis Methodology: -

The project is required to formally assess the potential for future overheating. Dynamic modelling has been undertaken with CIBSE Guidance AM11 compliant modelling software, to check the project and the natural ventilation strategy to ensure that thermal comfort levels and the elimination of overheating risks were compliant with CIBSE Technical Memorandum 59 (TM59) – The standard of assessing overheating within residential properties.

The CIBSE Overheating Task Force decided that a new approach to the definition of overheating is necessary, particularly for buildings without mechanical cooling. This will follow the methodology and recommendations of BS EN 15251 (BSI, 2007) to determine whether an existing occupied building can be classed as overheating or a proposed building is in danger of becoming overheated.

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

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

(2) The second criterion deals with the severity of overheating within any one day, which can be as important as its frequency, the level of which is a function of both temperatures rise and its duration. This criterion sets a daily limit for acceptability.

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

Occupancy patterns, estimated heat loads and the adaptive behaviour of the building occupants are derived from guidance within CIBSE Guide A.

For a building to meet the Adaptive Thermal Comfort criteria, the following conditions must be met:

$$T_{\text{comf}} = 0.33T_{\text{rm}} + 18.8 \text{ and } T_{\text{max}} = T_{\text{comf}} + A_r$$

Hence:

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

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

$$\Delta T = T_{op} - T_{max} (^{\circ}\text{C})$$

ΔT is rounded to the nearest degree (i.e. for ΔT between 0.5 and 1.5 the value used is 1°C , for 1.5 to 2.5 the value used is 2°C and so on). The building is deemed to be at risk of overheating if two or more of the following three criteria are exceeded:

- **Criteria 1 – Hours of Exceedance (H_e):**
 - The number of hours (H_e) that ΔT is greater than or equal to 1°C during the five summer months (May to September) shall not be more than 3%.
- **Criteria 2 – Daily Weighted Exceedance (W_e):**
 - To allow for the severity of overheating the weighted exceedance (W_e) shall be less than or equal to 6 in any one day where:
 - $W_e = \sum H_e \times W_f = (H_{e1} \times 1) + (H_{e2} \times 2) + (H_{e3} \times 3)$ and
 - $W_f = 0$ if $\Delta T \leq 0$, otherwise $W_f = \Delta T$, and $H_{ey} =$ time in hours when $W_f = y$.
- **Criteria 3 – Upper Limit Temperature (T_{upp}):**
 - ΔT is not to exceed 4°C .

Following on from the TM52 methodology, CIBSE have now published updated guidance on assessing the overheating risk in dwellings. Accordingly, the methodology behind the overheating analysis has been followed in accordance with the latest CIBSE Technical Memorandum 59 - Design methodology for the assessment of overheating risk in homes, which uses as its foundation TM52 modelling techniques and outputs.

TM59 sets the requirements and parameters for occupancy levels and internal gains.

TM59 clarifies the compliance criteria for homes predominantly naturally ventilated:

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

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

(b) For bedrooms only: to guarantee comfort during the sleeping hours the operative temperature in the bedroom from 10 pm to 7 am shall not exceed 26 °C for more than 1% of annual hours. (Note: 1% of the annual hours between 22:00 and 07:00 for bedrooms is 32 hours, so 33 or more hours above 26 °C will be recorded as a fail).

Criteria 2 and 3 of CIBSE TM52 may fail to be met, but both (a) and (b) above must be passed for all relevant rooms.

Design parameters:

- All windows are openable to 25 degrees, side hung
- All glazed doors are fully openable
- Glazing g value is currently in at 0.3
- All occupancy patterns strictly as per TM59 guidance

2.0 Current Design Assessment: -

Based upon the aforementioned design criteria a dynamic simulation was run to assess whether the building as designed has an overheating potential when assessed against London weather data files DSY1, DSY2 and DSY3.

As naturally ventilated dwellings, criterion 1 is the only relevant TM52 standard in this case, along with the bedroom test assessing the number of hours in exceedance of 26°C between the hours of 2200-0700.

3.0 Results: -

The TM52 results are shown in the table below. The design team are happy that the project in its entirety is at minimal risk of overheating. In view of the complete compliance with Criterion 1 of TM52 and therefore Criterion (a) of TM59, naturally ventilated dwellings against London 2020 DSY1 and general overall compliance when considered against extreme weather data files DSY2 and DSY3. It can be seen that when assessed against future weather data, particularly 2080, there is a high risk of potential overheating. Despite this being twice the general lifespan of commercial plant, we have detailed in section 4 the future mitigation measure that can be implemented to overcome this issue.

In order to display compliance with Criterion (b) of TM59 for naturally ventilated dwellings, the bedroom range test was also carried out and has been produced along with the TM52 results below: -

Current Weather Data: -

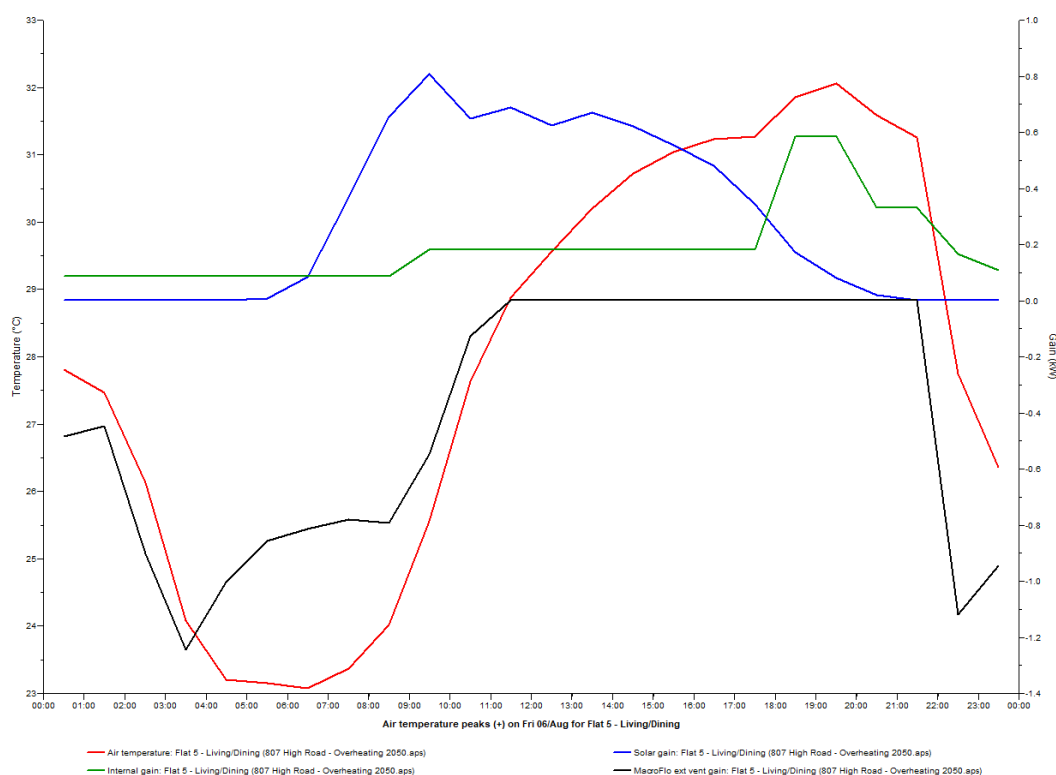
	DSY 1		DSY 2		DSY 3	
	Criteria 1 (% of occupied hours that bedrooms, living rooms, and kitchens are greater than or equal to one degree (K) warmer) Target <3%	Criteria 2 (Number of sleeping hours the operative bedroom temperature exceeds 26 °C (10 pm - 7am)) Target <33	Criteria 1 (% of occupied hours that bedrooms, living rooms, and kitchens are greater than or equal to one degree (K) warmer) Target <3%	Criteria 2 (Number of sleeping hours the operative bedroom temperature exceeds 26 °C (10 pm - 7am)) Target <33	Criteria 1 (% of occupied hours that bedrooms, living rooms, and kitchens are greater than or equal to one degree (K) warmer) Target <3%	Criteria 2 (Number of sleeping hours the operative bedroom temperature exceeds 26 °C (10 pm - 7am)) Target <33
Flat 1 - Living/Dining	1.3		2.4		3.7	
Flat 1 - Double Bedroom	0.7	18	1.5	20	2.2	35
Flat 1 - Single Bedroom	1.3	16	2.0	20	2.9	29
Flat 6 - Double Bedroom	0.6	17	1.1	19	1.6	31
Flat 1 - Double Bedroom	1.3	13	1.8	20	2.8	34
Flat 5 - Living/Dining	0.6		2.1		2.3	
Flat 3 - Double Bedroom	0.1	15	0.5	24	0.9	40
Flat 5 - Double Bedroom	0	15	0.5	21	0.8	26
Flat 4 - Living/Dining	1.1		2.6		4.0	
Flat 3 - Living/Dining	1.4		2.5		3.9	
Flat 4 - Double Bedroom	0.5	19	1.1	32	1.7	50
Flat 8 - Living/Dining	1.8		3.6		4.6	
Flat 7 - Double Bedroom	0	13	0.2	18	0.6	27
Flat 8 - Double Bedroom	0.5	12	1.3	20	1.5	29
Flat 8 - Single Bedroom	1	13	1.7	18	2.5	25
Flat 7 - Living/Dining	0.8		2.0		2.7	
Flat 6 - Living/Dining	1		1.9		3.0	
Flat 6 - Double Bedroom	0.8	13	1.1	20	1.7	35
Criteria 1 scores	Criteria 2 scores		Highlight colour of the box			
<2%	Less than 24 hours (<0.75%)		Green			
2% - 3%	24-32 hours (0.75-1%)		Amber			
>3%	33 hours or more (>1%)		Red			

Future Weather Data: -

	2050s		2080s	
	Criteria 1 (% of occupied hours that bedrooms, living rooms, and kitchens are greater than or equal to one degree (K) warmer) Target <3%	Criteria 2 (Number of sleeping hours the operative bedroom temperature exceeds 26 °C (10 pm - 7am)) Target <33	Criteria 1 (% of occupied hours that bedrooms, living rooms, and kitchens are greater than or equal to one degree (K) warmer) Target <3%	Criteria 2 (Number of sleeping hours the operative bedroom temperature exceeds 26 °C (10 pm - 7am)) Target <33
Flat 1 - Living/Dining	3.2		24.7	
Flat 1 - Double Bedroom	1.8	30	16.9	342
Flat 1 - Single Bedroom	2.5	27	18.4	317
Flat 6 - Double Bedroom	1.4	28	15.5	329
Flat 1 - Double Bedroom	2.4	22	16.5	296
Flat 5 - Living/Dining	2.6		23.3	
Flat 3 - Double Bedroom	0.9	32	13.5	408
Flat 5 - Double Bedroom	0.4	31	11.8	364
Flat 4 - Living/Dining	3.1		28.8	
Flat 3 - Living/Dining	3.6		27.1	
Flat 4 - Double Bedroom	1.5	42	18	437
Flat 8 - Living/Dining	4.1		28.8	
Flat 7 - Double Bedroom	0.3	23	11.9	333
Flat 8 - Double Bedroom	1.4	28	15.6	319
Flat 8 - Single Bedroom	2.1	21	17.2	276
Flat 7 - Living/Dining	3.1		25.6	
Flat 6 - Living/Dining	2.7		23.3	
Flat 6 - Double Bedroom	1.5	25	13.8	305
Criteria 1 scores	Criteria 2 scores		Highlight colour of the box	
<2%	Less than 24 hours (<0.75%)		Green	
2% - 3%	24-32 hours (0.75-1%)		Amber	
>3%	33 hours or more (>1%)		Red	

4.0 Future Mitigation: -

Temperature-Gain Correlation Graph



The above graph indicates the internal air temperature rises in correlation with solar and internal gains. The internal gains are fixed in accordance with TM59 criteria and therefore in order to mitigate the overheating risk, the proposal is to limit the solar gain via the use of a solar reflective film.

A typical option could be 3M™ Sun Control Window Film Prestige 70 Exterior, which can reflect a further 50% of potential solar gain from the applied windows, with a film that is virtually clear – thus have no impact on the external aesthetics.

Additionally, upon occupation, residents will be provided with a user guide that explains to occupants the key features of the scheme; this should be a short and visual document in simple language. It should cover measures they can take to prevent overheating in their home and include the following information as a minimum:

Blinds can be installed that will provide a resistance to the solar gain. Blinds that are white or light in colour, offer an increased reflectivity than darker colours. Vertical fin blinds work more effectively to as the offer least restriction to the airflow, which provides an element of free cooling.

During days of peak summer temperatures, occupants will be advised to keep the windows closed when the building is left unoccupied when the external air temperature exceeds that of the internal air temperature – i.e. feels uncomfortably warm, if done in conjunction with closing the blinds the internal air temperature will be kept to a minimum.

Finally, advice will be given on evening purge ventilation; once the external air temperature has decreased, this will subsequently reduce the likeliness of night-time overheating between the hours of 2200 – 0700.