Overheating Risk Assessment

Dorrington Gardens Car Park

For Mercury Land Holdings

October 2024

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Contents

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1 Executive Summary

Overheating analysis was carried out for the proposed development at the Dorrington Gardens Car Park in Hornchurch, within the London Borough of Havering. This report outlines the results of the analysis for the planning application.

The methodology adopted is in line with Approved Document Part O of the Building Regulations (2021) and CIBSE Technical Memorandum 59 (2017). To carry out the assessment, a 3D computer model of the proposed development was generated in line with the guidelines.

The approach followed includes modelling the baseline design received from the architects and testing overheating performance improvement techniques following the GLA's cooling hierarchy. Aspects of the cooling hierarchy not suitable for this development are discussed in more detail in the accompanying Energy and Sustainability statement for the planning application. After identifying the most appropriate solutions following discussions with the design team, the architects have updated the drawings and incorporated the required measures into the scheme to enable compliance with Part O.

The analysis shows that the proposed development submitted for the planning application can comply with Part O, provided the incorporated measures are retained.

In summary, the proposed development includes the following design measures:

- High specification building fabric to prevent unintended heat ingress through conduction or infiltration.
- Generous openable areas as shown in the submitted elevations for when the noise environment is suitable. All openable panes are proposed to be opening to 90 degrees. Rooflights will be openable to at least 30-degrees.
- Solar control glazing with g-value of 0.4 across the scheme.
- MVHR for all dwellings to provide 24-hour ventilation. Boost mode and summer bypass will be available although these features are not accounted for in the assessment in line with Part O and CIBSE TM59 methodology.

The above measures enable all dwellings to comply with Part O using passive measures alone.

Following feedback from noise consultants Sandy Brown, windows cannot be relied upon for natural ventilation during night-time. Therefore, the following additional measures are proposed for the scheme which can be used as back-up by future residents to mitigate overheating risks:

- Increased MVHR flow rates for bedrooms, achieving 60l/s per bedroom and, if possible, 90l/s per bedroom during night-time.
- Where increased flow rates are not achievable by the specified system post-planning, a cooling coil can be integrated to the MVHR system.
- Final solution per dwelling will be determined post-planning and is subject to detailed design with input from a M&E consultant. Both options will be explored with the aim of maximising energy efficiency.

Figure 1. Design strategies to reduce overheating risks for Dorrington Gardens Car Park. Top: north facade of Blocks A and B; bottom: south façade of Block A.

2 Introduction

2.1 Site

Dorrington Gardens Car Park is located in Hornchurch, to the south and west of the commercial heart of Hornchurch Town Centre. The site is bounded to the north by the road of Dorrington Gardens; to the east by commercial/mixed use and residential buildings fronting Station Lane; to the south by rear gardens of residential properties fronting The Avenue; and to the west by flank walls of houses accessible from Bruce Avenue and Dorrington Gardens.

The site is currently a car park with mainly hardstanding areas and no notable existing above ground structures present.

The scheme comprises of a mix of apartments and family houses. The apartments are distributed across two separate blocks.

The approximate site location is presented in Figure 2.

2.2 Application of guidance

The analysis is based on the latest industry standards including the Building Regulations Part O (2021) and CIBSE Technical Memorandum 59 (2017).

Approved Document Part O (hereafter referred to as ADO or Part O), sets out rigorous performance standards in relation to overheating risks for residential developments and applies additional considerations to CIBSE TM59 guidance.

The overheating risk is evaluated for habitable spaces during occupied hours. These are determined from CIBSE TM59 guidance. Kitchen/ living/ dining (KLD) spaces are occupied during daytime, while bedrooms are assumed occupied on a 24-hour basis. The criteria applicable to both bedrooms and KLDs relate to the frequency of overheating during occupied hours and between May to September, when overheating is most likely to cause discomfort. This evaluation test is referred as "occupied hours criterion" in the report.

There is an additional criterion for bedrooms where the frequency of overheating is assessed during night-time only, on an annual basis. This assessment metric is referred to as "night-time criterion" in the report.

Whilst there are no criteria for the potential severity of overheating on any given day within Part O and TM59, the standards are challenging to meet and require robust mitigation strategies incorporated into the design from the earliest stages of the projects.

The specific numerical and technical standards set out within CIBSE TM59 and Part O are presented in more detail in Appendix C of this report.

A range of technical analyses has been conducted for a representative sample of dwellings within the development.

The London Plan includes the cooling hierarchy that has been considered for the proposed scheme:

- Reduce the amount of heat entering the building.
- Minimise internal heat generation through energy efficient design.
- Manage the heat within the building through exposed internal thermal mass and high ceilings.
- Provide passive ventilation.
- Provide mechanical ventilation.
- Provide active cooling systems.

The accompanying Energy and Sustainability Statement discusses how the cooling hierarchy has informed the design of the proposed development at Dorrington Gardens Car Park.

This report provides the analysis carried out using dynamic thermal modelling in line with GLA's Energy Assessment guidance (June 2022) and quantifies performance improvements that are achieved for the proposed development by implementing specific measures from the cooling hierarchy that are deemed appropriate and feasible for the scheme.

Figure 2. Approximate site location of Dorrington Gardens Car Park development.

3 Technical model

3.1 Sources of information

Architectural drawings have been used to create a 3D computer model of the proposed development. The full list of sources of information used in this assessment is as follows:

- 1394-GSA-ZZ-00-DR-A-2100 _Proposed Ground Floor Plan_P10
- 1394-GSA-ZZ-00-DR-A-2120 _Proposed Ground Floor Plan House Type 1_P05
- 1394-GSA-ZZ-00-DR-A-2122 _Proposed Ground Floor Plan Block A&B_P03
- 1394-GSA-ZZ-00-DR-A-2125 _Proposed Ground Floor Plan House Type 2_P03
- 1394-GSA-ZZ-01-DR-A-2101 _Proposed 1st Floor Plan_P07
- 1394-GSA-ZZ-01-DR-A-2121 _Proposed First Floor Plan House Type 1_P05
- 1394-GSA-ZZ-01-DR-A-2123 _Proposed First Floor Plan Block A&B_P03
- 1394-GSA-ZZ-01-DR-A-2126 _Proposed First Floor Plan Block House Type 2_P03
- 1394-GSA-ZZ-02-DR-A-2102 _Proposed 2nd Floor Plan_P07
- 1394-GSA-ZZ-02-DR-A-2124 _Proposed Second Floor Plan Block A&B_P03
- 1394-GSA-ZZ-02-DR-A-2127 _Proposed Second Floor Plan Block House Type 2_P03
- 1394-GSA-ZZ-RF-DR-A-2103 _Proposed Roof Plan_P07
- 1394-GSA-ZZ-ZZ-DR-A-3101 _Proposed Site Elevations_P05
- 1394-GSA-ZZ-ZZ-DR-A-3119 _Proposed Elevations House Type 1 Semi-Detached (3B-5P)_P05
- 1394-GSA-ZZ-ZZ-DR-A-3120 _Proposed Elevations House Type 2 Semi-Detached Houses (4B-7P) _P03
- 1394-GSA-ZZ-ZZ-DR-A-3121 _Proposed Elevations Apartment Block (A&B)_P03
- 1394-GSA-ZZ-ZZ-DR-A-4101 _Proposed Section A-A & B-B_P06
- 1394-GSA-ZZ-ZZ-DR-A-4102 _Proposed Section C-C & D-D_P03

3.2 Scope of assessment

Figure 3 shows the technical 3D model developed for the analysis. Both house types were included in the analysis that is representative of all houses designed for the scheme. All apartments in Block A were modelled in detail and are considered representative of dwellings within Block B.

The baseline thermal model includes the following key inputs summarised below.

- Building fabric as shown in Appendix B. These inputs are coordinated across the accompanying energy/sustainability and daylight/sunlight reports for the planning application. The assessment first considered the use of clear double-glazing with g-value of 0.63.
- Surrounding buildings have been omitted as they are unlikely to provide significant shading to the windows of the dwellings modelled which are most exposed to solar radiation.
- The degree of window opening was determined from the architects' drawings which indicate which panes are openable. An example is shown in Figure 4.
- Ground floor bedroom windows were not modelled as openable during night-time due to security considerations as per Part O.
- Kitchen/ Living/ Dining rooms were modelled with openable windows during daytime as per Part O. Upper floor bedrooms were assessed with windows being open during both day and night-time.

For full details of the model's technical inputs, please refer to Appendix B.

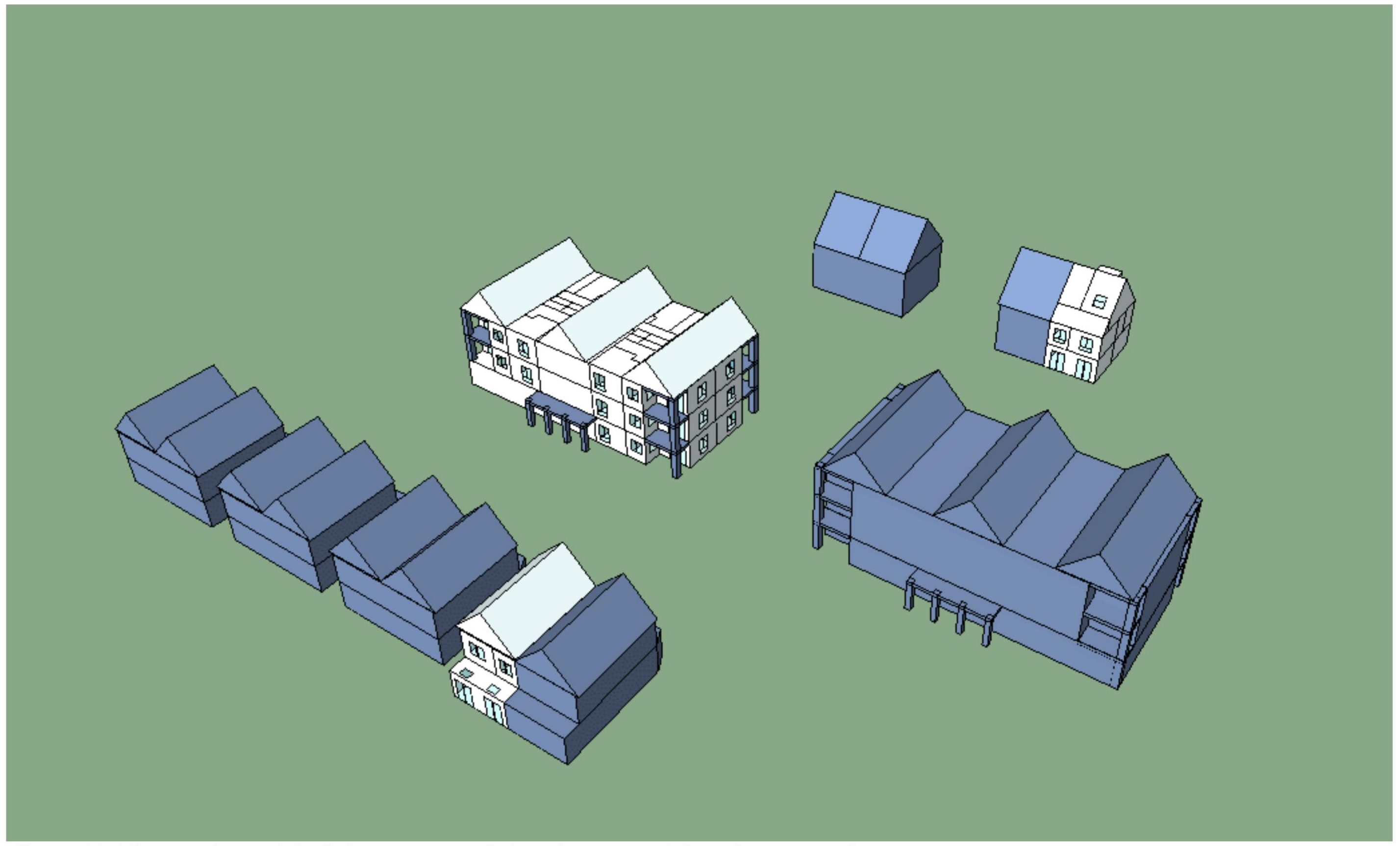


Figure 3. Thermal model of the proposed development. View from southeast.

Figure 4. Initial design of the south elevation of Blocks A and B. Openable windows are side hung and 90-degree inward opening.

4 Assessment results

4.1 Baseline design

The initial design developed by the architects already includes features that help reduce overheating risks. Full height glazing or significant areas of fixed panes have generally been avoided. Any openable windows have been designed to achieve a full 90-degree openable angle which enables good natural ventilation potential.

However, when considering a g-value of 0.63 for clear double glazing, the analysis indicated that certain habitable rooms within the baseline design will experience potential risks of overheating. These spaces included:

- Ground floor and first floor bedrooms in Blocks A (and by inference Block B). Figure 5 shows the specific rooms within Block A.
- First floor bedroom 3 of House Type 2.
- Ground floor living room of House Type 1.

The detailed numerical results are presented in Appendix A.

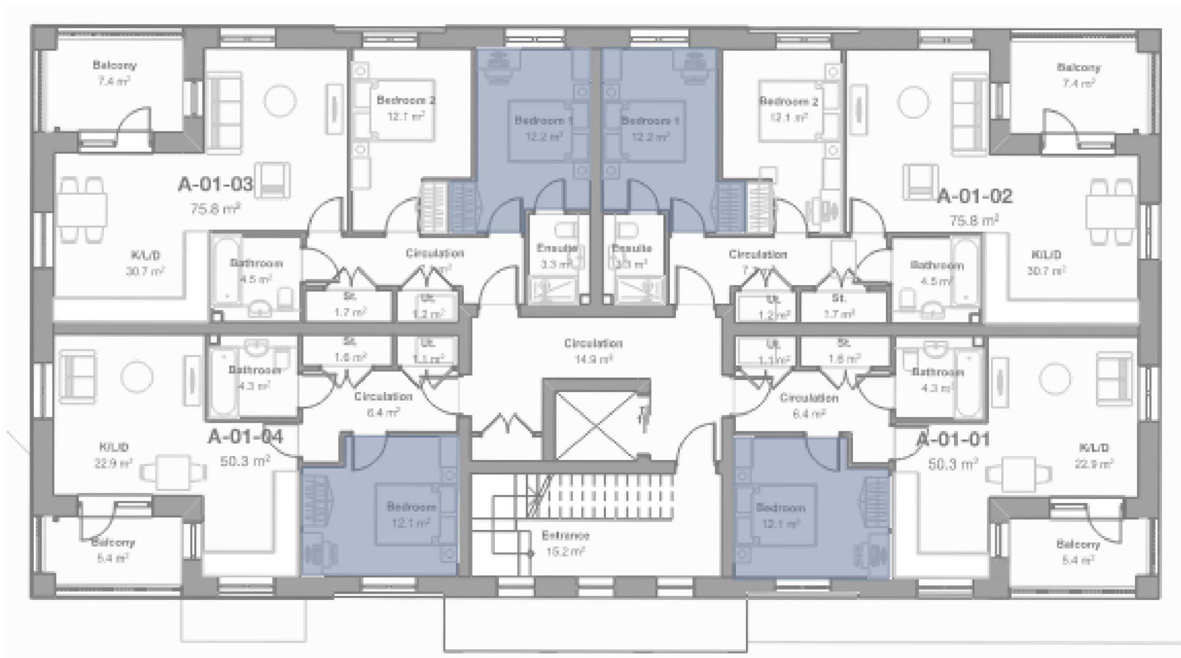
Ground floor bedrooms in the apartment blocks were generally found to not comply with the night-time overheating risk criteria. This is not necessarily due to design, but because windows cannot be opened to their full ventilating capacity securely during night-time to reduce temperatures in line with the Part O methodology.

A few first-floor bedrooms (mainly within Block A but also one bedroom in House Type 2), were not found to comply with the night-time overheating risk criteria. This indicated that the ventilating capacity of the windows should be increased.

In terms of Kitchen/ Living / Dining (KLD) spaces, the assessment identified potential risks for the south-facing living room of House Type 1. As the design already includes generous openable areas, a g-value below 0.63 should be applied for these rooms.

In principle, key overheating remediation techniques include reducing solar gains and increasing the ventilating capacity of windows. These were explored via dynamic thermal modelling and are discussed in more detail in the next section of the report.

Block A - Ground floor



Block A - First floor

Figure 5. Bedrooms with night-time overheating risk in the baseline design highlighted in blue.

4.2 Modelling iterations

Following the evaluation of the baseline design, modelling iterations were carried out to identify the route to compliance with Part O.

Initially, a change to the glazing specification to include solar control glazing with a g-value of 0.5 for windows and 0.4 for rooflights was introduced (Iteration 1, Table 1). This brought about improvements to the findings. All KLD spaces were found to comply with Part O and some improvements were achieved for the number of bedrooms meeting Part O (as shown in Table 2).

Subsequently and following discussions with the design team, the architects increased the width of the window assemblies to bedrooms by 100mm. This increased the ventilating capacity of windows during nighttime. As a result, all bedrooms (except for ground floor bedrooms which are constrained by security) were found to meet Part O with passive measures alone.

Further to this, following noise and acoustics guidance received from Sandy Brown, it was determined that based upon the expected external noise levels, open windows in bedrooms at night can likely not be relied upon as a method to remove excess heat. Therefore, modelling was carried out with all bedroom windows closed during night-time (Iterations 3 and 4).

Firstly, the use of the MVHR system's boost mode was explored (iteration 3). This enabled a small proportion of bedrooms to meet Part O. During detailed design post-planning, the possibility of using boost mode should be explored in more detail with M&E consultant's input.

Subsequently, an iteration was carried out to identify the least energy intensive method of reducing overheating risks. The use of air tempering coils integrated within the proposed MVHR system was explored in detail (Iteration 4, Table 1). This system is not a full active cooling system but can provide an element of air tempering and a back-up option for future residents. The analysis indicated that Part O overheating criteria can be met with this system while the windows remain closed during night-time.

Detailed results for all iterations are presented in Appendix A.

Table 1. Iterations carried out to identify how Part O compliance can be achieved for the sample dwellings modelled.

Iteration	Windows	Glazing g-value	Rooflight g-value
Baseline	Degree of window openings as per architect's design, clear-double glazing (g-value 0.63). GF bedroom windows closed during nighttime.	0.63	0.63
1	Baseline + glazing with solar control (g-value of 0.5)	0.5	0.4
2	Iteration 1 + increased window sizes for bedrooms as per design freeze drawings	0.5	0.4
3	Iteration 2 + MVHR boost (60l/s per bedroom, 10l/s per KLD). All bedroom windows closed during nighttime.	0.5	0.4
4	Iteration 3 + MVHR 30l/s per bedroom, 10l/s per KLD, air tempering attached to MVHR system. All bedroom windows closed during nighttime.	0.5	0.4

Table 2. Part O modelling results summary.

Iteration	Room type	Applicable number of sample rooms	Sample rooms meeting criteria	% of rooms complying
Baseline	KLD + Bedrooms	39	38	97%
	Bedrooms	24	14	58%
Iteration 1	KLD + Bedrooms	39	39	100%
	Bedrooms	24	17	71%
Iteration 2	KLD + Bedrooms	39	39	100%
	Bedrooms	24	19*	79%
Iteration 3	KLD + Bedrooms	39	39	100%
	Bedrooms	24	3	13%
Iteration 4	KLD + Bedrooms	39	39	100%
	Bedrooms	24	24	100%

**only bedrooms which are on the ground floor without open windows at night do not comply.*

4.3 Proposed design

The diagram to the right shows the proposed design for planning submission, illustrating the increased window sizes adopted when compared against the elevation in Figure 4.

The overheating risk mitigation strategy includes a number of measures and follows the cooling hierarchy set out in the London Plan. Certain aspects of the cooling hierarchy which were not found to be applicable for the proposed development are discussed in the accompanying Energy and Sustainability Statement.

In summary, the proposed scheme includes the following measures to reduce overheating risks:

- High specification building fabric to prevent unintended heat ingress through conduction or infiltration.
- Generous openable areas as shown in the elevations for when the noise environment is suitable. All openable panes are proposed to be opening to 90-degrees as shown in Figure 6. Rooflights are proposed to be openable to at least 30-degrees.
- Solar control glazing with g-value of 0.5 for windows and 0.4 for rooflights across the scheme.
- MVHR for all dwellings to provide 24-hour ventilation. The system will have boost mode and summer bypass facilities. The use of boost mode can be explored in more detail with M&E consultant input post-planning.
- Where boost mode alone is not sufficient, air tempering coil integrated with the MVHR system will be included as a back-up option for future residents. This system could be used during night-time while windows remain closed to enable compliance with Part O overheating and noise performance criteria. It is proposed to apply this system to ground floor dwellings or any homes that do not meet Part O noise criteria.

The preliminary analysis at planning stage indicates with all these measures in place, the proposed development is predicted to comply with Part O of the Building Regulations.


Figure 6. Proposed design - South façade of Block A with wider bedroom windows.

5 Conclusions

The overheating risk mitigation strategy includes a number of measures and follows the cooling hierarchy of the London Plan. The proposed development has been designed to enable thermal comfort for future residents. Therefore, the scheme complies with GLA and Havering's overheating related policies.

Appendix A – Detailed results

The table below presented the detailed results, with the following key tests:

- **Test A**: % of occupied hours ∆T>1K (<3%)
- **Test B**: Night hours Top>26C (<33)

Table 3. Detailed Part O results. Cells highlighted in orange indicate non-compliance with Part O.

	Baseline		Iteration 1		Iteration 2		Iteration 3		Iteration 4	
Room Name	**Test A**	**Test B**	**Test A**	**Test B**	**Test A**	**Test B**	**Test A**	**Test B**	**Test A**	**Test B**
0L A-00-01 Bedroom 1	1.2	329	1	270	1.1	278	0.8	46	0.4	12
0L A-00-01 KLD 1B	1.8	N/A	1.6	N/A	1.6	N/A	1.5	N/A	1.4	N/A
0L A-00-02 Bedroom 1	1.2	256	1	231	1	222	0.7	38	0.3	10
0L A-00-02 Bedroom 2	1.3	237	1	217	1.1	213	0.7	38	0.3	10
0L A-00-02 KLD 2B	1.6	N/A	1.5	N/A	1.5	N/A	1.4	N/A	1.4	N/A
0L A-00-03 Bedroom 1	1.2	256	1	232	1	225	0.7	38	0.3	10
0L A-00-03 Bedroom 2	1.3	241	1	216	1.1	214	0.7	38	0.3	10
0L A-00-03 KLD 2B	1.7	N/A	1.6	N/A	1.6	N/A	1.5	N/A	1.4	N/A
0L H Kitchen/Dining 3B	1.6	N/A	1.5	N/A	1.5	N/A	1.5	N/A	1.4	N/A
0L H Living 3B	3.2	N/A	2.5	N/A	2.5	N/A	2.5	N/A	1.9	N/A
0L H2 Kitchen 4B	1.7	N/A	1.3	N/A	1.3	N/A	1.3	N/A	0.9	N/A
0L H2 LD 4B	2.9	N/A	2.3	N/A	2.3	N/A	2.3	N/A	1.6	N/A
1L A-01-01 Bedroom 1	1.1	38	0.8	34	0.9	32	0.9	45	0.4	13
1L A-01-01 KLD 1B	1.6	N/A	1.5	N/A	1.5	N/A	1.5	N/A	1.4	N/A
1L A-01-02 Bedroom 1	0.7	33	0.7	31	0.7	28	0.7	38	0.3	10
1L A-01-02 Bedroom 2	0.8	31	0.7	28	0.8	24	0.7	36	0.4	10
1L A-01-02 KLD 2B	1.4	N/A	1.4	N/A	1.4	N/A	1.4	N/A	1.3	N/A
1L A-01-03 Bedroom 1	0.8	33	0.7	31	0.7	27	0.7	38	0.3	10
1L A-01-03 Bedroom 2	0.8	30	0.7	29	0.8	25	0.8	36	0.4	10
1L A-01-03 KLD 2B	1.5	N/A	1.5	N/A	1.5	N/A	1.5	N/A	1.4	N/A
1L A-01-04 Bedroom	1	33	0.8	32	0.9	30	0.9	43	0.4	12
1L A-01-04 KLD 1B	1.7	N/A	1.5	N/A	1.6	N/A	1.6	N/A	1.4	N/A
1L H Bedroom 1	0.7	20	0.6	20	0.6	20	0.6	36	0.3	10
1L H Bedroom 2	0.8	30	0.7	27	0.7	27	0.8	38	0.3	10
1L H Bedroom 3 Single	1.3	26	1	23	1	23	1	29	0.4	6
1L H2 Bedroom 2	0.7	21	0.7	21	0.7	21	0.7	39	0.4	11

	Baseline		Iteration 1		Iteration 2		Iteration 3		Iteration 4	
Room Name	**Test A**	**Test B**	**Test A**	**Test B**	**Test A**	**Test B**	**Test A**	**Test B**	**Test A**	**Test B**
1L H2 Bedroom 3	1	36	0.7	34	0.9	26	1	41	0.4	12
1L H2 Bedroom 4 single	1.4	24	1	22	1.3	20	1.1	31	0.4	7
2L A-02-01 Bedroom 1	0.8	32	0.7	30	0.8	28	0.8	42	0.4	12
2L A-02-01 KLD 1B	1.5	N/A	1.4	N/A	1.4	N/A	1.4	N/A	1.3	N/A
2L A-02-02 Bedroom 1	0.7	28	0.6	26	0.7	22	0.7	37	0.3	10
2L A-02-02 Bedroom 2	0.7	27	0.7	25	0.7	22	0.7	35	0.3	10
2L A-02-02 KLD 2B	1.4	N/A	1.4	N/A	1.4	N/A	1.4	N/A	1.2	N/A
2L A-02-03 Bedroom 1	0.7	28	0.6	26	0.7	22	0.7	37	0.3	10
2L A-02-03 Bedroom 2	0.7	27	0.7	24	0.7	22	0.7	35	0.3	10
2L A-02-03 KLD 2B	1.5	N/A	1.4	N/A	1.4	N/A	1.4	N/A	1.3	N/A
2L A-02-04 Bedroom	0.8	32	0.7	30	0.7	28	0.8	42	0.4	12
2L A-02-04 KLD 1B	1.6	N/A	1.5	N/A	1.5	N/A	1.5	N/A	1.4	N/A
2L H2 Bedroom 1	0.6	13	0.5	11	0.5	11	0.6	22	0.4	12

Appendix B – Model inputs

The buildings have been modelled using dynamic thermal simulation software which is fully compliant with CIBSE Applications Manual AM11.

The tables on this page summarise the thermal model inputs for the calculations carried out.

The weather file used for the analysis is CIBSE TM49 London_LWC_DSY1_2020High50.epw.

Window opening profiles were based on paragraph 2.6 of Approved Document Part O (2021). Ground floor windows were not modelled as openable during night-time due to security reasons in line with Part O.

Table 4: Baseline thermal model building fabric.

Element	Specification
External wall U-value	0.15 W / m².K
External wall thermal mass (software default)	76 kJ / m².K (very lightweight)
Ground floor U-value	0.10 W / m².K
Ground floor thermal mass (software default)	66 kJ / m².K (very lightweight)
Roof U-value	0.10 W / m².K
Roof thermal mass (software default)	8 kJ / m².K (very lightweight)
Glazing U-value	1.2 W / m².K`
Glazing g-value	0.63 (baseline) 0.5/ 0.4 (amended design)
Air permeability	3m³ / m².h at 50 Pa (baseline)

Table 5: Occupancy gains and profiles

Space	Occupancy
1-bed KLD	1 person from 9am to 10pm; unoccupied for the rest of the day
2-bed KLD	2 people from 9am to 10pm; room is unoccupied for the rest of the day
2-bed kitchen	2 people at 25% gains from 9 am to 10 pm; room is unoccupied for the rest of the day
2-bed living room	2 people at 75% gains from 9 am to 10 pm; room is unoccupied for the rest of the day
3-bed KLD	3 people from 9am to 10pm; room is unoccupied for the rest of the day
3-bed kitchen	3 people at 25% gains from 9 am to 10 pm; room is unoccupied for the rest of the day
3-bed living room	3 people at 5% gains from 9 am to 10 pm; room is unoccupied for the rest of the day
Double Bedroom	2 people at 70% gains from 11pm to 8am 2 people at full gains from 8am to 9am and from 10pm to 11pm 1 person at full gain in the bedroom from 9am to 10pm
Single bedroom	1 person at 70% gains from 11pm to 8am 1 person at full gain in the bedroom from 8am to 11pm

Table 6: Internal gains and profiles

Space	Equipment and lighting
1-bed KLD	Peak load of 450 W from 6 pm to 8 pm 200 W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day
2-bed KLD	Peak load of 450 W from 6 pm to 8 pm 200 W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day
2-bed kitchen	Peak load of 300 W from 6 pm to 8 pm Base load of 50 W for the rest of the day
2-bed living room	Peak load of 150 W from 6 pm to 10 pm 60 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 35 W for the rest of the day
3-bed KLD	Peak load of 450 W from 6pm to 8pm 200W from 8pm to 10pm 110 W from 9am to 6pm and from 10pm to 12pm Base load of 85 W for the rest of the day
3-bed kitchen	Peak load of 300 W from 6 pm to 8 pm base load of 50 W for the rest of the day
3-bed living room	Peak load of 150 W from 6 pm to 10 pm 60 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 35 W for the rest of the day
Double Bedroom	Peak load of 80 W from 8am to 11pm Base load of 10 W during the sleeping hours
Single bedroom	Peak load of 80 W from 8 am to 11 pm Base load of 10 W during sleeping hours
All rooms	Lighting 2 W / m² from 6pm to 11pm daily

Appendix C – CIBSE TM59 & Part O

CIBSE TM59 (2017)

CIBSE TM59 is a rigorous overheating risk performance standard for dwellings in the UK. It sets out the methodology that needs to be followed, outlining details that go into the thermal models such as occupancy patterns, internal gains, weather files, window opening profiles etc. It enables an element of consistency in the approach in the industry and allows modellers to mainly modify solar control and ventilation strategies to show that overheating risks are within acceptable limits.

Assessment criteria

When natural ventilation is the primary mechanism to mitigate overheating risk, the following two criteria must be met:

<u>For living rooms, kitchens and bedrooms:</u>

The number of hours during which the difference between operative and threshold comfort temperatures (ΔT) is greater than or equal to one degree (K), during the period of May to September inclusive, shall not be more than 3 per cent of occupied hours. (CIBSE TM52 Criterion 1: Hours of exceedance). We refer to the above as "Occupied hours criterion" in our report.

<u>For bedrooms only:</u>

To evaluate 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). We refer to the above as "Night-time criterion" in our report.

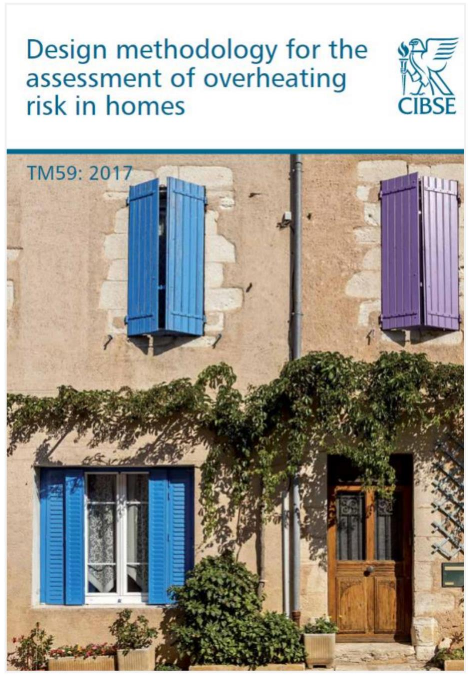
Technical definitions

The first criterion is evaluated in terms of the ΔT, which is the difference between the operative temperature T_{op} and the limiting maximum temperature T_{max}, $\Delta T = T_{op} - T_{max}$.

Operative temperature models the combined effect of convective and radiant heat transfer. It accounts for the combined of the temperature of the air, the temperature of the surfaces and air speed. To estimate T_{op}, dynamic thermal modelling is carried out to compute the predicted temperature distribution in the different thermal zones of the building.

T_{max} is the maximum acceptable temperature and is dependent on the outdoor running mean temperature and the building category with each associated acceptability range. The table details the suggested acceptability in terms of the temperature range of naturally ventilated buildings. For the assessment, we have used Category II limits.

Category	Explanation	Acceptable range (C)
II	New build	±3



Building Regulations Part O (2021)

Part O builds on the guidance set out within CIBSE T59 and implements additional considerations. On window openings, ADO states:

"All of the following limits on CIBSE's TM59, section 3.3, apply:

a. *When a room is occupied during the day (8am to 11pm), openings should be modelled to do all of 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.*
b. *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.*
c. *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, following the guidance in paragraph 3.7 below.*
   ii. *At night, windows, patio doors and balcony doors should be modelled as closed."*

Paragraph 3.7 explains:

"Open windows or doors can be made secure by using any of the following.

a. *Fixed or lockable louvred shutters.*
b. *Fixed or lockable window grilles or railings."*

Part O does not support the use of internal blinds as part of the overheating mitigation strategy.

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