



CIBSE TM59 Overheating Assessment

**Former Gravesend & North Kent, Hospital (M
Block),
Bath Street, Gravesend, DA11 0DG**

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1. Executive Summary

Waterstone Design has been appointed to perform a thermal comfort analysis of the proposed development at Former Gravesend & North Kent, Hospital (M Block), Bath Street, Gravesend, DA11 0DG to identify whether any dwellings are at a significant risk of overheating as well demonstrating compliance with Approved Document O (2021 edition).

This report summaries the process undertaken and outlines the results of the thermal comfort analysis whilst describing any passive measures which may be required to ensure all spaces maintain acceptable levels of thermal comfort. The assessment uses profiles and schedules which are in line with CIBSE guidance TM52:2013 & TM59:2017.

In order to achieve compliance, dwellings must pass both of the below criteria:

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

Initial results have identified that using a specification of 0.63 g-value and natural ventilation, many of the habitable rooms did not comply with the TM59 criteria. Subsequently, in order to achieve compliance, the following measures have been proposed:

- All residential glazing to benefit from a g-value of 0.45
- All flats to benefit from openable windows to provide natural ventilations
- System 4 (MVHR) ventilation to habitable areas within dwellings to Part F regulations

With the above passive measures accounted for, all applicable areas achieve an acceptable level of thermal comfort showing compliance in all CIBSE TM59 assessment criteria. In addition to this, all dwellings modelled and calculated demonstrate compliance with Approved Document O (2021 edition) using currently up to date software (v7.1.0.110) which may be subject to change once further software is released.



2. Introduction

In order to reduce the risk of overheating and reliance on cooling measures such as air conditioning, the development has been designed in accordance with new guidance released as part of Approved Document O (Overheating) 2021 edition to ensure the strategy for reducing overheating risk is acceptable. This is outlined below:

Limiting solar gains

Solar gains in summer should be limited by any of the following means.

- a. Fixed shading devices, comprising any of the following.
 - i. Shutters
 - ii. External blinds
 - iii. Overhangs
 - iv. Awnings
- b. Glazing design, involving any of the
 - i. Size
 - ii. Orientation
 - iii. g-value
 - iv. Depth of the window reveal.
- c. Building design – for example, the placement of balconies.
- d. Shading provided by adjacent permanent buildings, structures, or landscaping.

Although internal blinds and curtains provide some reduction in solar gains, they should not be taken into account when considering whether requirement O1 has been met.

Foliage, such as tree cover, can provide some reduction in solar gains. However, it should not be taken into account when considering whether requirement O1 has been met.

Removing excess heat

Excess heat should be removed from the residential building by any of the following means.

- a. Opening windows (the effectiveness of this method is improved by cross-ventilation).
- b. Ventilation louvres in external walls.
- c. A mechanical ventilation system.
- d. A mechanical cooling system

The building should be constructed to meet requirement O1 using passive means as far as reasonably practicable.

It should be demonstrated to the building control body that all practicable passive means of limiting unwanted solar gains and removing excess heat have been used first before adopting mechanical cooling.

Any mechanical cooling (air-conditioning) is expected to be used only where requirement O1 cannot be met using openings.

3. CIBSE TM52 Overheating Criteria – Adaptive Thermal Comfort

Historically, overheating in buildings has been quantified by the number of hours per year that the indoor temperature exceeds a particular temperature regardless of what the external temperature may be. However, studies have demonstrated that comfortable room temperatures vary subject to the external air temperature. Occupants are more likely to be 'comfortable' at higher room temperatures during periods of prolonged warmer weather. This is known as Adaptive Thermal Comfort.

In response to this CIBSE produced Technical Memorandum 52 (TM52) "The limits of thermal comfort: avoiding overheating in European buildings" which provides a methodology for assessment of Adaptive Thermal Comfort.

The TM52 assessment is based on the comparison of predicted room temperature with a maximum acceptable room temperature derived from the running mean of the outdoor temperature. The running mean used, places greater weight on the temperature for days closer to the present as these have more influence on a person's perceived comfort levels.

TM52 assesses thermal comfort based upon three criteria, with a 'pass' being dependent upon at least two of the three criteria being met. The three criteria are described below:

1. Hours of Exceedance

This criterion assesses the number of hours (He) during which the temperature difference (between actual operative temperature and maximum allowed temperature) is greater than or equal to one degree during the period of May to September inclusive shall not be more than 3% of occupied hours.

Threshold temperature exceeded by one degree $\leq$ 3% of occupied hours

2. Daily Weighted Exceedance

This criterion assesses the severity of overheating, the weighted exceedance (We) shall be less than or equal to 6 degree-hours in any one day.

Daily weighted exceedance (degree-hours) $\leq$ 6

3. Upper Limit Temperature

Criterion 3 sets an absolute maximum threshold for the indoor operative temperature for which the temperature difference between indoor operative temperature and maximum allowed temperature shall not exceed four degrees

Temperature $\leq$ upper limit



4. CIBSE TM59 Overheating Criteria - Adaptive Thermal Comfort

Homes that are predominantly naturally ventilated, including homes that have mechanical ventilation with heat recovery (MVHR), with good opportunities for natural ventilation in the summer should assess overheating using the adaptive method based on CIBSE TM52 (2013), as described in section 1 below.

In order to allow the occupants to 'adapt', each habitable room needs operable windows with a minimum free area that satisfies the purge ventilation criteria set in Part F of the Building Regulations, i.e. the window opening area should be at least 1/20th of the floor area of the room (different conditions exist for windows with restricted openings, and the same requirement applies for external doors). Control of overheating may require accessible, secure, quiet ventilation with a significant openable area.

Homes that are predominantly mechanically ventilated because they have either no opportunity or extremely limited opportunities for opening windows (e.g. due to noise levels or air quality) should be assessed for overheating using the fixed temperature method based on CIBSE Guide A (2015a), as described in section 2 below.

1. 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 DT is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3 percent 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.

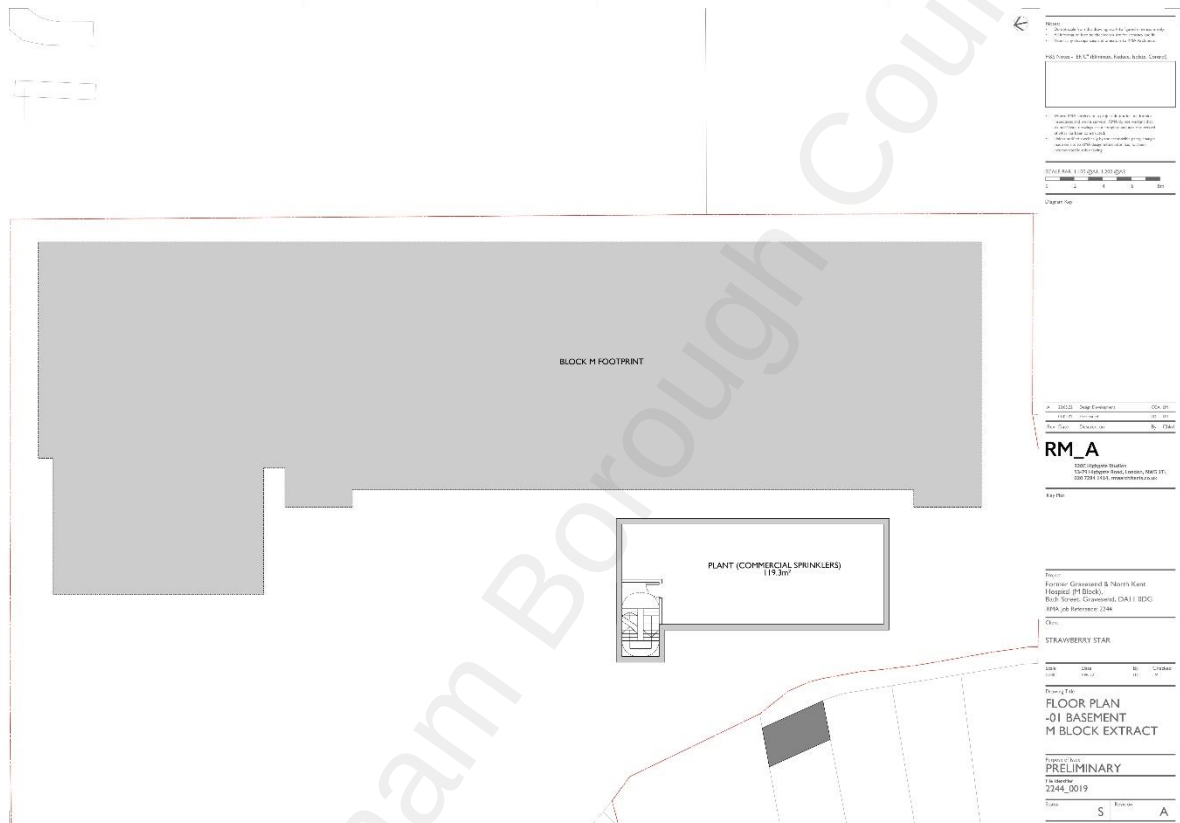
2. Criteria for homes predominantly mechanically ventilated

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

5. Detailed Site Analysis

The building known as M Block has not been in use since 2006 and the principle of redeveloping the site for residential purposes has been established.

Block M will be an apartment block which will be a conversion of existing hospital building with an 11-storey side extension and a single storey roof extension, the construction of a new residential building ranging from 3-6 storeys to provide 115 residential units consisting of 47 one bed units, 59 two bed units and 9 three bed units





7. Development Features

7.1 Building Fabric

The following building elements have been modelled as per the drawings from RMA Architects which detail the build ups for construction. The U-Values, thermal mass and g-values have been assumed as follows.

Element	U-Value (W/m ² K)	Kappa (kJ/m ² K)
Exposed Floor	0.13	135.0777
External Wall	0.18	123.86
Roofs	0.11	37.6544
Windows	1.2 (0.45 g-value)	N/A

7.2 Natural Ventilation

Natural ventilation is to be provided by means of openable windows where applicable which is an effective way to mitigate overheating as this delivers fresh air to the occupants. It should be noted that ventilation air change rates have been calculated by EnergyPlus utilising the detailed calculation, and wind speed/orientation data from the weather data files which allows calculation of air change rates for the given site location.

It has been scheduled that the occupants will be able to open any applicable windows during hot weather when internal temperatures are in line with Section 2 of Approved Document O:

- 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.

The free aperture of the windows has been calculated in accordance with the current elevational drawings. In order to calculate equivalent area, the discharge coefficient calculator as per Appendix D of Approved Document O has been utilised with further modelling undertaken to determine precise aperture alongside window opening angles which can be seen below.

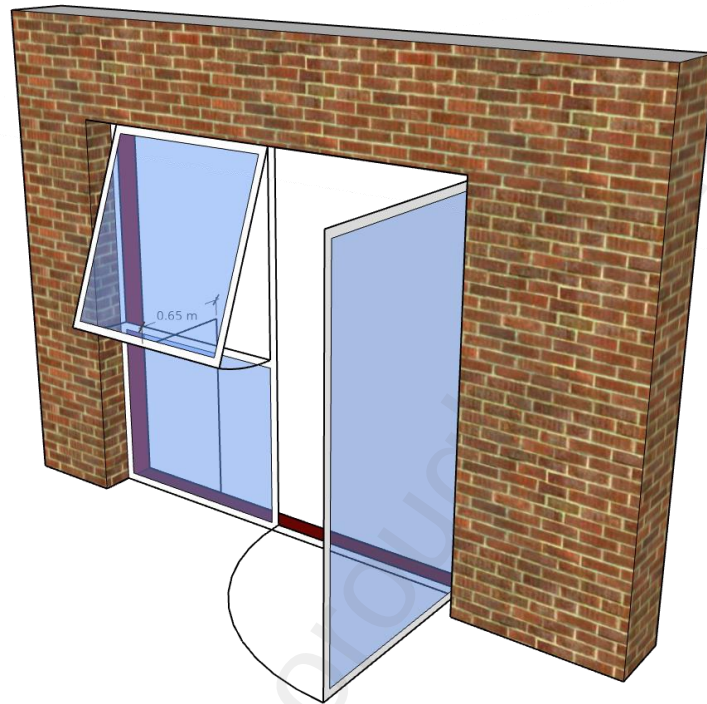
It should be noted that the equivalent area calculations have been modelled to ensure the overheating mitigation strategy is usable to coincide with Section 3 of Approved Document O.

3.9 Openings that can be opened wider than 100mm may form part of the overheating mitigation strategy where they meet the follow condition:

- a. Windows handles on windows the open outwards are not more than 650mm from the inside face of the wall when the window is at its maximum openable angle.

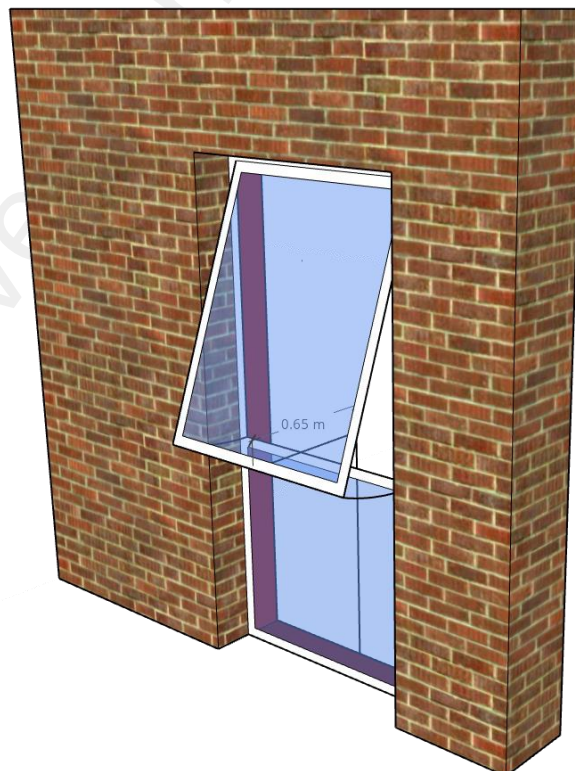
KITCHEN, DINING, LOUNGE

- Top Hung Window – 21.1° opening angle
- Side Hung Doors - 90° opening angle



BEDROOM

- Top Hung Window – 20.3° opening angle





7.3 Mechanical Ventilation

Mechanical ventilation systems are to be installed in line with Part F regulations to all dwellings providing ventilation. A System 4 (MVHR) ventilation unit with a rate of 8 l/s (litre per second) has been modelled into any bathroom areas, 22 l/s (litre per second) within Kitchen/Living/Dining areas and 11 l/s (litre per second) within Bedrooms. It should be noted that occupants are still able to open windows as per the natural ventilation above.

7.4 Internal Doors

Internal doors have been included and left open in the model in the daytime (07:00-22:00), but are assumed to be closed when the occupants are sleeping.

7.5 Assumed Occupancy

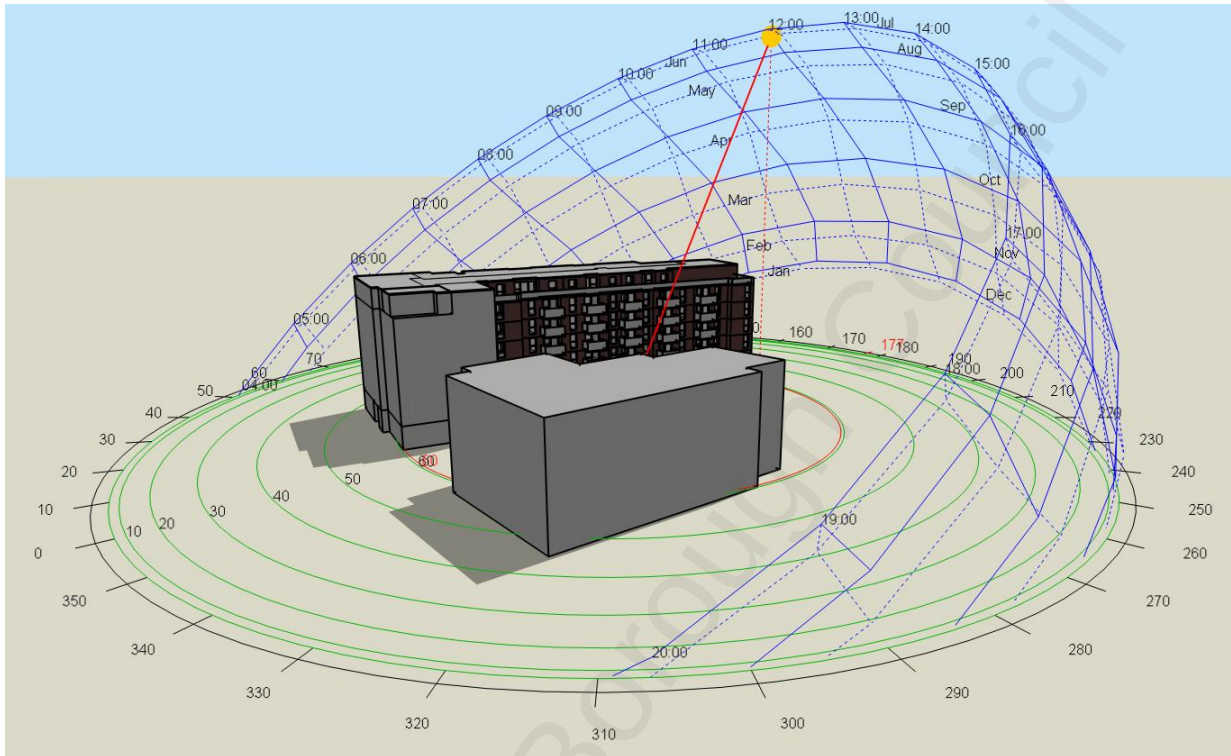
Occupancy levels have been defined by schedules within the software, which have been written in line with the values set out in Figure 1 within CIBSE TM59. This table is attached as Appendix A at the end of this document.

7.6 Corridors

All corridors have been modelled throughout the building in order to allow us to assess what temperatures they reach throughout the year.

In line with CIBSE TM59, there are no pass or fail criteria, but it is to be noted within the report if the temperature exceeds 28°C for more than 3% of the total annual hours. The results are shown in Appendix B of this document.

8. 3D Visualisation





9. Results & Recommendations

The following results demonstrates a summary of for all assessed habitable rooms against the criteria of CIBSE TM59.

Based on a notional specification, methodology and assumptions outlined within this report, the initial results demonstrated that many of the habitable living spaces were exceeding the stipulated level of thermal comfort as defined by TM59.

In order to address this, measures to reduce the level of overheating have been recommended as follows:

- Natural ventilation has been provided through openable windows but only operational once the internal air temperature exceeds 22°C or 23°C accordingly
- All residential glazing to benefit from a 0.45 g-value
- Achieve a mechanical ventilation rate in line with Part F in for relevant areas - 8 l/s (litre per second) for bathrooms, 11l/s (litre per second) for bedrooms and 13 l/s for Kitchen/Living/Dining

Block	Zone	Criterion A (%)	Criterion B (hr)	Pass/Fail
011B2P2	DOUBLEBEDROOM	0	20.83	Pass
011B2P2	KITCHENLIVING	0.07	N/A	Pass
011B2P3	DOUBLEBEDROOM	0	20.67	Pass
011B2P3	KITCHENLIVING	0.12	N/A	Pass
011B2P4	DOUBLEBEDROOM	0	18.83	Pass
011B2P4	KITCHENLIVING	0.11	N/A	Pass
012B4P1	DOUBLEBEDROOM	0.07	25.17	Pass
012B4P1	KITCHENLIVING	0	N/A	Pass
012B4P1	MASTERBEDROOM	0	23.5	Pass
012B4P5	DOUBLEBEDROOM	0.05	19.33	Pass
012B4P5	KITCHENLIVING	0.07	N/A	Pass
012B4P5	MASTERBEDROOM	0	19	Pass
021B2P2	DOUBLEBEDROOM	0	21.5	Pass
021B2P2	KITCHENLIVING	0.09	N/A	Pass
021B2P3	DOUBLEBEDROOM	0.02	20.83	Pass
021B2P3	KITCHENLIVING	0.13	N/A	Pass
021B2P4	DOUBLEBEDROOM	0	19.17	Pass
021B2P4	KITCHENLIVING	0.09	N/A	Pass
022B4P1	DOUBLEBEDROOM	0.08	24.5	Pass
022B4P1	KITCHENLIVING	0	N/A	Pass
022B4P1	MASTERBEDROOM	0	23.17	Pass
022B4P5	DOUBLEBEDROOM	0.05	20.33	Pass
022B4P5	KITCHENLIVING	0.01	N/A	Pass
022B4P5	MASTERBEDROOM	0	19.5	Pass
031B2P2	DOUBLEBEDROOM	0.08	25	Pass
031B2P2	KITCHENLIVING	0.13	N/A	Pass



031B2P3	DOUBLEBEDROOM	0.05	23.17	Pass
031B2P3	KITCHENLIVING	0.15	N/A	Pass
031B2P4	DOUBLEBEDROOM	0.01	21.67	Pass
031B2P4	KITCHENLIVING	0.12	N/A	Pass
032B4P1	DOUBLEBEDROOM	0.09	26.17	Pass
032B4P1	KITCHENLIVING	0.11	N/A	Pass
032B4P1	MASTERBEDROOM	0	24.83	Pass
032B4P5	DOUBLEBEDROOM	0.07	22.67	Pass
032B4P5	KITCHENLIVING	0.09	N/A	Pass
032B4P5	MASTERBEDROOM	0	21.67	Pass
041B2P2	DOUBLEBEDROOM	0.09	27.33	Pass
041B2P2	KITCHENLIVING	0.15	N/A	Pass
041B2P3	DOUBLEBEDROOM	0.06	26.17	Pass
041B2P3	KITCHENLIVING	0.17	N/A	Pass
041B2P4	DOUBLEBEDROOM	0.05	24.17	Pass
041B2P4	KITCHENLIVING	0.13	N/A	Pass
042B4P1	DOUBLEBEDROOM	0.1	27.83	Pass
042B4P1	KITCHENLIVING	0.13	N/A	Pass
042B4P1	MASTERBEDROOM	0	26.83	Pass
042B4P5	DOUBLEBEDROOM	0.08	26	Pass
042B4P5	KITCHENLIVING	0.11	N/A	Pass
042B4P5	MASTERBEDROOM	0	23.67	Pass
051B2P2	DOUBLEBEDROOM	0.08	27.33	Pass
051B2P2	KITCHENLIVING	0.21	N/A	Pass
051B2P3	DOUBLEBEDROOM	0.09	30.67	Pass
051B2P3	KITCHENLIVING	0.33	N/A	Pass
051B2P4	DOUBLEBEDROOM	0.07	27.83	Pass
051B2P4	KITCHENLIVING	0.21	N/A	Pass
052B4P1	DOUBLEBEDROOM	0.19	27.33	Pass
052B4P1	KITCHENLIVING	0.15	N/A	Pass
052B4P1	MASTERBEDROOM	0.07	25.83	Pass
052B4P5	DOUBLEBEDROOM	0.15	30	Pass
052B4P5	KITCHENLIVING	0.18	N/A	Pass
052B4P5	MASTERBEDROOM	0	27	Pass
061B2P1	KITCHENLIVING	0.97	N/A	Pass
061B2P1	MASTERBEDROOM	0.21	29	Pass
061B2P2	KITCHENLIVING	0.8	N/A	Pass
061B2P2	MASTERBEDROOM	0.22	28.17	Pass
062B3P3	DOUBLEBEDROOM	0.19	27.83	Pass
062B3P3	KITCHENLIVING	1.27	N/A	Pass
062B3P3	SINGLEBEDROOM	0.35	24.67	Pass

10. Conclusion

- The results have represented a large number of 'at risk' dwelling types which provides a thorough analysis of overheating and the measures implemented to alleviate this issue.
- This assessment has been undertaken in accordance with CIBSE TM59 methodology which aligns with room profiles, equipment, lighting, and occupancy gains.
- The modelling has been conducted using weather data for London Gatwick (LGW) – Design Summer Year 1 (LGW DSY1 – 2020, high emission, 50% percentile scenario).
- The results of the initial modelling indicated that during peak summertime conditions some dwellings failed to maintain acceptable levels of thermal comfort, with many zones failing to meet more than one of the CIBSE TM59 criteria.
- To address this, the following measures are recommended:
 - Natural ventilation has been provided through openable windows but only operational once the internal air temperature exceeds 22°C or 23°C accordingly
 - Windows handles on windows the open outwards are not more than 650mm from the inside face of the wall when the window is at its maximum openable angle
 - All residential glazing to benefit from a 0.45 g-value
 - Achieve a mechanical ventilation rate in line with Part F in for relevant areas - 8 l/s (litre per second) for bathrooms, 11 l/s (litre per second) for bathrooms & 13 l/s for Kitchen/Living/Dining
- Following these improvement measures, all dwellings have demonstrated compliance with both Criterion as defined by CIBSE TM59 methodology and maintain acceptable levels of thermal comfort.
 - a. *For living rooms, kitchens and bedrooms: the number of hours during which DT is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3 percent 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).*

[illegible]



Appendix B – Corridor Results (TM59)

Block	Zone	% Hours Exceeded	Pass/Fail
CORRIDOR1	CORRIDOR	0.02	Pass
CORRIDOR2	CORRIDOR	0.32	Pass
CORRIDOR3	CORRIDOR	0.47	Pass
CORRIDOR4	CORRIDOR	0.17	Pass
CORRIDOR6	CORRIDOR	0.76	Pass
CORRIDOR	CORRIDOR	0	Pass