
Hydrock

# Sutton High Street

## Overheating Analysis

*For Reid Capital (Sutton) Ltd*

*Date:* *1 February 2021*

*Doc ref:* *16336-HYD-XX-XX-RP-ME-0002*

# DOCUMENT CONTROL SHEET

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| Checked by | | Michael Howarth |
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# Executive Summary

This report has used in depth analysis to assess the risk of overheating in the Sutton High Street development.

A representative sample of dwellings were selected and analysed in different orientations and across various levels. The analysis tests seven flats on the north and south-facing façade on the first storey, and four flats on the north-facing façade on the seventh and eighth storeys.

The main conclusions from the analysis are as follows:

• The building as designed fails the CIBSE fixed temperature test which is identified in TM59 as the appropriate test for predominantly mechanically ventilated dwellings. It additionally fails the adaptive comfort criteria of TM52.

• Most occupied spaces have failed the comfort analysis and have exceeded the threshold comfort temperature by 1°K or more during the occupied hours of a typical non-heating season (1st May to 30th September). This is identified as Criteria 1.

• All bedrooms are at risk of overheating, meaning the temperature in the bedroom from 10 pm to 7 am exceeded 26°C for more than 1% of annual hours (for 33 or more hours). This is identified as Criteria 2.

These criteria have failed because we have assumed the windows are unopenable, though they can be opened for purge ventilation. This approach is dictated by the acoustic assessment that has been carried out for the sire, which has identified reliance on openable windows as incompatible with providing a good acoustic environment.

A number of alternative approaches were investigated, such as including enhanced ventilation rates and summer cooling via ventilation to reduce the overheating risk. These were tested in line with Criteria 3, since the dwellings have restricted window openings, a fixed temperature test must be followed: all occupied rooms should not exceed an operative temperature of 26°C for more than 3% of annual hours. This increased the performance of the spaces; all passed Criteria 3 after summer cooling was added to the dwellings, via enhanced ventilation rates.

Table 1 below, identifies the steps of each solution, and the relative success of each approach.

*Table 1: Results summary table*

| | Result for the building as designed | | | Active measures to reduce overheating (tests using Criteria 3) | | | |
|---|---|---|---|---|---|---|---|
| Room Name | Criteria 1 | Criteria 2 | Criteria 3 | Enhanced ventilation | Enhanced ventilation with reduced g-value of 0.4 | Summer cooling via ventilation at 110 l/s | Summer cooling via ventilation at 125 l/s |
| 2B4P Flat 1 Bedroom South-West | Fail | Fail | Fail | Fail | Fail | Fail* | Pass |
| 2B4P Flat 1 Bedroom North-East | Fail | Fail | Fail | Fail | Fail | Pass | n/a |
| 2B3P Flat 2 Bedroom North-West | Fail | Fail | Fail | Fail | Fail | Pass | n/a |
| 2B3P Flat 2 Bedroom South-East | Pass | Fail | Fail | Fail | Fail | Pass | n/a |
| 1B2P Flat 3 Bedroom | Fail | Fail | Fail | Fail | Fail | Pass | n/a |
| 2B3P Flat 4 Bedroom Double | Pass | Fail | Fail | Fail | Fail | Pass | n/a |
| 2B3P Flat 4 Bedroom Single | Fail | Fail | Fail | Fail | Fail | Pass | n/a |
| 1B1P Flat 5 Bedroom | Pass | Fail | Fail | Fail | Fail | Pass | n/a |
| 3B4P Flat 6 Bedroom South-West | Fail | Fail | Fail | Fail | Fail | Pass | n/a |
| 3B4P Flat 6 Bedroom North-West | Pass | Fail | Fail | Fail | Fail | Pass | n/a |
| 3B4P Flat 6 Bedroom North-East | Fail | Fail | Fail | Fail | Fail | Pass | n/a |
| 1B2P Flat 7 Bedroom | Pass | Fail | Fail | Fail | Fail | Pass | n/a |
| 2B4P Flat 8 Bedroom North | Fail | Fail | Fail | Pass | Pass | Pass | n/a |
| 2B4P Flat 8 Bedroom South | Pass | Fail | Fail | Fail | Fail | Pass | n/a |
| 2B4P Flat 9 Bedroom North | Fail | Fail | Fail | Pass | Pass | Pass | n/a |
| 2B4P Flat 9 Bedroom South | Pass | Fail | Fail | Fail | Fail | Fail* | Pass |
| 2B4P Flat 10 Bedroom North | Fail | Fail | Fail | Fail | Fail | Pass | n/a |
| 2B4P Flat 10 Bedroom South | Pass | Fail | Fail | Fail | Fail | Pass | n/a |
| 2B4P Flat 11 Bedroom North | Fail | Fail | Fail | Pass | Pass | Pass | n/a |
| 2B4P Flat 11 Bedroom South | Fail | Fail | Fail | Fail | Fail | Pass | n/a |
| 2B4P Flat 1 Kitchen/living | Pass | n/a | Fail | Fail | Fail | Pass | n/a |
| 2B3P Flat 2 Kitchen/living | Pass | n/a | Fail | Fail | Fail | Pass | n/a |
| 1B2P Flat 3 Kitchen/living | Pass | n/a | Fail | Fail | Fail | Pass | n/a |
| 2B3P Flat 4 Kitchen/living | Fail | n/a | Fail | Fail | Fail | Pass | n/a |
| 1B1P Flat 5 Kitchen/living | Pass | n/a | Fail | Fail | Fail | Pass | Pass |
| 3B4P Flat 6 Kitchen/living | Pass | n/a | Fail | Fail | Fail | Pass | n/a |
| 1B2P Flat 7 Kitchen/living | Fail | n/a | Fail | Fail | Fail | Pass | n/a |
| 2B4P Flat 8 Kitchen/living | Fail | n/a | Fail | Fail | Fail | Pass | n/a |
| 2B4P Flat 9 Kitchen/living | Fail | n/a | Fail | Fail | Fail | Pass | n/a |
| 2B4P Flat 10 Kitchen/living | Fail | n/a | Fail | Fail | Fail | Pass | n/a |
| 2B4P Flat 11 Kitchen/living | Fail | n/a | Fail | Fail | Fail | Pass | n/a |

# 1. INTRODUCTION

This report has been produced to inform the design team how the Sutton High Street development design performs in terms of overheating. Sutton High Street is a mixed development scheme consisting of several floors of residential apartments with commercial spaces on the ground floor. Only the residential areas have been included in the assessment as comfort cooling is assumed to be provided in the commercial areas.

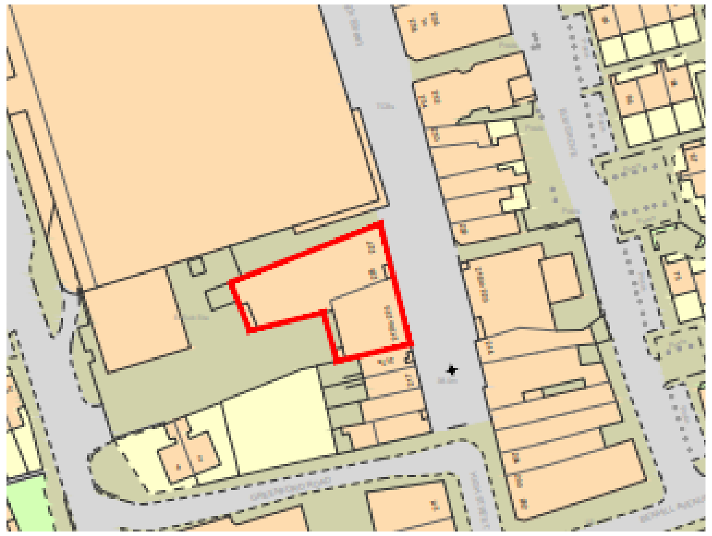

*Figure 1: Site boundary*

The dwellings have been tested in line with CIBSE TM59 - Design methodology for the assessment of overheating risk in homes. This methodology is a recognised industry standard and outlines two criteria in the dwellings which should be achieved:

Criteria 1 - For living rooms, kitchens and bedrooms: 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 (1st May to 30th September). This criterion dictates 3% of occupied hours as a threshold.

Criteria 2 - 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).

However, as the acoustic assessment has identified the scheme cannot rely on openable windows, the appropriate overheating test is therefore the fixed temperature test, referenced here as criteria 3.

Criteria 3 – For homes with restricted window openings, the 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.

# 2. PLANNING POLICIES

## 2.1 The London Plan - Policy 5.9 Overheating and Cooling

Major development proposals should reduce potential overheating and reliance on air conditioning systems and demonstrate this in accordance with the following cooling hierarchy:

1. Minimise internal heat generation through energy efficient design

2. Reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls

3. Manage the heat within the building through exposed internal thermal mass and high ceilings

4. Passive ventilation

5. Mechanical ventilation

6. Active cooling systems (ensuring they are the lowest carbon options).

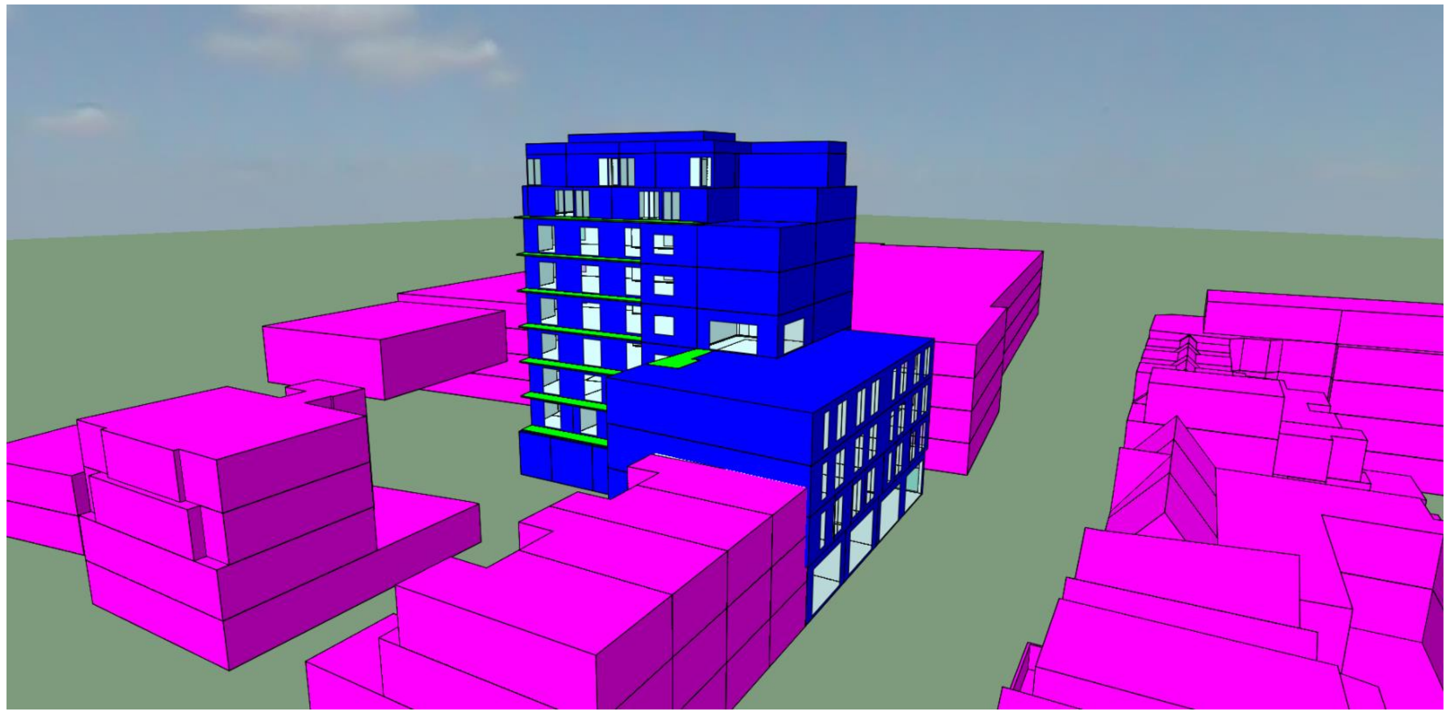

*Figure 2: Model south-east elevation*

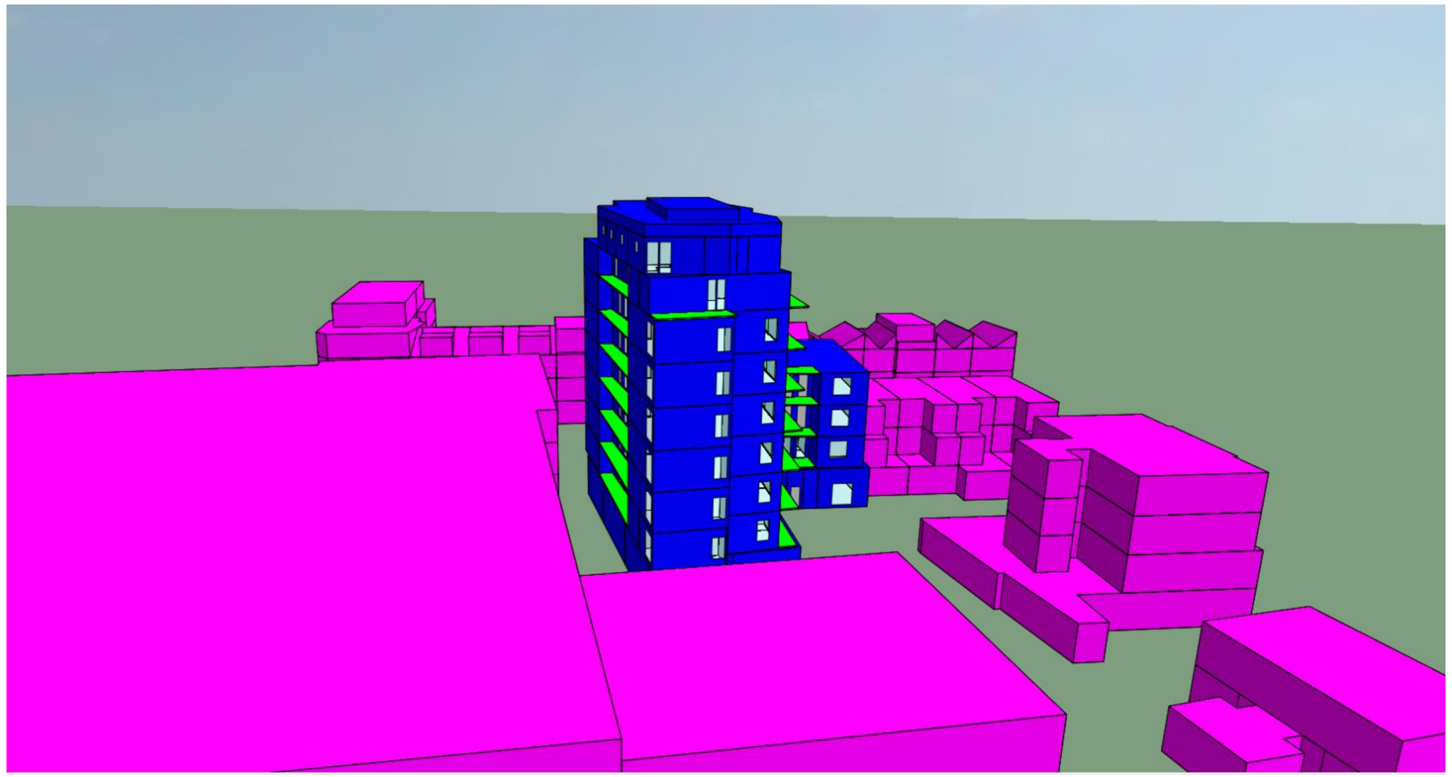

*Figure 3: Model north-west elevation*

# 3. METHODOLOGY

There are various factors which impact the resilience a building has to overheating. These include the thermal fabric, air permeability, ventilation strategy, window size, solar gains and shading. In this section the inputs relating to these factors and the modelling assumptions are outlined. The geometry has been built based on the architectural design package received on the 07/12/20 including floor plans and elevations.

11 apartments were chosen with varying orientations across different levels to provide a wide representation of the different apartment types. The chosen apartments are shown in Figure 4 and have been given the following references, based on their level and location:

- 2B4P Flat 1
- 2B3P Flat 2
- 1B2P Flat 3
- 2B3P Flat 4
- 1B1P Flat 5
- 3B4P Flat 6
- 1B2P Flat 7
- 2B4P Flat 8
- 2B4P Flat 9
- 2B4P Flat 10
- 2B4P Flat 11

## 3.1 Weather Files

London Weather Centre (LWC) DSY1 (Design Summer Year) 2020, high emissions, 50th percentile scenario - weather data was used for the simulations. This approved weather data is the closest available for the site geographical location.

## 3.2 Ventilation

Increased air flow through the apartment helps to prevent overheating by providing cooler air from outside. The apartments will benefit from mechanical ventilation heat recover (MVHR) units. The ventilation rates in Table 2 have been applied to rooms which require fresh air supply based broadly in line with approved document F of the Building Regulations. This is a base level of ventilation and higher flow rates can be applied for extra cooling in cases where over heating is prevalent.

*Table 2: Apartment Ventilation Rates*

| Room | Ventilation Rate (l/s) |
|---|---|
| Kitchen | 13 |
| Bedrooms | 8 |

## 3.3 Building Fabric

The building fabric is a key factor in overheating as it represents how much heat transfer can occur between the inside and outside. Glazing has a significant contribution to overheating due to the solar radiation it allows into a building. The window g-value, also known solar transmittance factor, is a measure of how much of the sun's radiation can pass through glazing. The below values have been assumed in the model, in line with the recommendations of the energy strategy.

*Table 3: Proposed building fabric*

| Building Element | U Values ($W/m^2k$) |
|---|---|
| Roof | 0.12 |
| Wall | 0.18 |
| Glazing | 1.2 (g-value of 0.6) |
| Floor | 0.12 |
| Air Permeability | 3 $m^3/m^2/hr$ @ 50 Pa |

## 3.4 Occupancy and Profiles

The TM59 templates contain standardised information regarding occupancy, operational profiles, internal gains etc which can be found in Appendix B[1]. These profiles also dictate when the windows are open or closed.

The heating system strategy is a communal ambient loop system, and so this will not contribute to the internal heats gains in the corridors as the distribution pipework is at ambient space temperature. Low grade heat is circulated to every dwelling. Additionally, the majority of the circulation is external and so not at risk.

## 3.5 Window Openings

The windows in this overheating analysis are assumed to be not openable due to the noise pollution when they are left open. However, the windows will be openable for purge ventilation.


*Figure 4: Apartments analysed*

# 4. RESULTS

## 4.1 Proposed Design

In the first step of the analysis the proposed design is simulated to assess the current risk of overheating. All inputs discussed in the previous section are used in the analysis.

The results from these calculations are summarised in Table 4 which shows the number of rooms passing or failing. A dwelling will not achieve a pass if one or more rooms fail these criteria.

Individual room results for the proposed design and further analysis are listed in Table 9 in the Appendix A.

*Table 4: Results summary from proposed design simulations*

| Criteria 3 | |
|---|---|
| Rooms Passing | Rooms Failing |
| 0 | 31 |

All rooms have failed Criteria 3, meaning occupied rooms exceed an operative temperature of 26°C for more than 3% of annual hours.

Further analysis has been conducted to prevent the risk of overheating in these rooms.

### *4.1.1 Further Analysis*

To increase the performance of the dwellings a number of options are available which can decrease the risk of overheating. These include but are not limited to:

- Higher ventilation rates
- Improved fabric performance
- Summer cooling via ventilation

These active measures have been applied to the proposed design to find a solution which satisfies all dwellings. Since the building has restricted window openings, these measures will be tested in line with Criteria 3 (as explained earlier) rather than Criteria 1 and Criteria 2.

## 4.2 Active and Passive Measures

This looks at passive measures such as enhanced fabric performance and active measures such as increasing ventilation rates and adding cooling to the dwellings

### *4.2.1 Boost Ventilation*

Summer time boost ventilation increases the MVHR ventilation rates when the temperature in the dwelling gets above a certain temperature. Boosted ventilation rates may result in higher noise levels if additional acoustic attenuation is not accounted for.

Criteria 3 was tested using an air flow rate of 100 l/s per apartment split across the occupied rooms. However, after adding enhanced ventilation, all but three rooms fail Criteria 3. This means that enhanced ventilation does not prevent overheating and most occupied rooms exceed an operative temperature of 26°C for more than 3% of annual hours.

*Table 5: Result with enhanced ventilation.*

| Criteria 3 | |
|---|---|
| Rooms Passing | Rooms Failing |
| 3 | 28 |

### *4.2.2 Boost Ventilation with reduced g-values (0.4)*

Solar gains can be one of the main contributing factors to overheating in buildings. The g-value is a measure of the amount of solar energy a glazing element permits to pass through it, a lower g-value window admits less energy into the space.

The flow rate of 100 l/s per apartment has remained the same and the glazing g-value has been lowered from 0.6 to 0.4. After lowering the g-value, the results have improved (shown in Table 9 in the Appendix A) but 28 rooms still fail Criteria 3. A g-value of 0.4 is low and to reduce it anymore would see a large increase in the glazing cost.

*Table 6: Result with enhanced ventilation and lower g-value of 0.4.*

| Criteria 3 | |
|---|---|
| Rooms Passing | Rooms Failing |
| 3 | 28 |

### *4.2.3 Summer cooling via ventilation*

Cooling could be applied directly to the occupied spaces via in line ducted cooling. The option of providing peak lopping cooling has been simulated. Peak lopping means that cooling will be provided when the temperature reaches a certain point to prevent overheating. In this instance, cooling will be provided when the room temperature reaches 26°C. This type of cooling is not used to provide space comfort cooling as the system capacity will not be large enough.

Peak lopping of supply air temperatures could be achieved in a number of ways. The most straightforward being a cooling coil in the supply air stream, with cooling provided from the micro-water source heat pumps already within the apartments to provide heating and hot water. An enhanced ventilation rate of 110 l/s per apartment was split across the occupied rooms. The supply air temperature is set to 14°C.

As seen in Table 7, there is a significant improvement with all but two rooms passing the overheating criteria. However, by increasing the enhanced ventilation rate to 125 l/s in the two failing rooms, all rooms are able to pass Criteria 3. This can be seen in Table 9 in the Appendix A. This means occupied rooms do not exceed an operative temperature of 26°C for more than 3% of annual hours.

*Table 7: Result with summer cooling recovery ventilation of 110 l/s*

| Criteria 3 | |
|---|---|
| Rooms Passing | Rooms Failing |
| 29 | 2 |

## 5. CONCLUSION

A representative sample of dwellings has been analysed in the different orientations and across various levels. The results from this analysis are summarised in Table 8

The proposed design was analysed first to confirm if there was a risk of overheating. This initial study found that most rooms tested failed to meet Criteria 1 and all bedrooms analysed failed to meet Criteria 2, due to restricted window openings. Therefore, further active measures were taken to ensure that the overheating risk of all of the rooms would be reduced.

Active measures including enhanced ventilation and summer cooling via ventilation air have been investigated to reduce overheating, tested in line with Criteria 3 as window openings are restricted. All but two rooms passed this criterion with a summer cooling ventilation rate of 110 l/s. The remaining two rooms will be supplied with a slightly higher ventilation rate within the spaces that failed. A further test was done on these apartments, with the ventilation rate boosted slightly further to 125l/s , which was successful in avoiding overheating. This therefore demonstrates that all the spaces are able to pass Criteria 3.

In order to provide enhanced flow rate, an MVHR will need to be selected capable of these enhanced ventilation rates. A unit such as the Vent-Axia Sentinel Kinetic high flow would be appropriate. The cooling could be provided via an in-line cooling coil, other than the top floor units which would require a dedicated FCU, with chilled water produced by the WSHPs specified to provide heating and hot water to the units.

*Table 8: Results summary table*

| | Result for the building as designed | | | Active measures to reduce overheating (tests using Criteria 3) | | | |
|---|---|---|---|---|---|---|---|
| Room Name | Criteria 1 | Criteria 2 | Criteria 3 | Enhanced ventilation | Enhanced ventilation with reduced g-value of 0.4 | Summer cooling via ventilation at 110 l/s | Summer cooling via ventilation at 125 l/s |
| 2B4P Flat 1 Bedroom South-West | Fail | Fail | Fail | Fail | Fail | Fail* | Pass |
| 2B4P Flat 1 Bedroom North-East | Fail | Fail | Fail | Fail | Fail | Pass | n/a |
| 2B3P Flat 2 Bedroom North-West | Fail | Fail | Fail | Fail | Fail | Pass | n/a |
| 2B3P Flat 2 Bedroom South-East | Pass | Fail | Fail | Fail | Fail | Pass | n/a |
| 1B2P Flat 3 Bedroom | Fail | Fail | Fail | Fail | Fail | Pass | n/a |
| 2B3P Flat 4 Bedroom Double | Pass | Fail | Fail | Fail | Fail | Pass | n/a |
| 2B3P Flat 4 Bedroom Single | Fail | Fail | Fail | Fail | Fail | Pass | n/a |
| 1B1P Flat 5 Bedroom | Pass | Fail | Fail | Fail | Fail | Pass | n/a |
| 3B4P Flat 6 Bedroom South-West | Fail | Fail | Fail | Fail | Fail | Pass | n/a |
| 3B4P Flat 6 Bedroom North-West | Pass | Fail | Fail | Fail | Fail | Pass | n/a |
| 3B4P Flat 6 Bedroom North-East | Fail | Fail | Fail | Fail | Fail | Pass | n/a |
| 1B2P Flat 7 Bedroom | Pass | Fail | Fail | Fail | Fail | Pass | n/a |
| 2B4P Flat 8 Bedroom North | Fail | Fail | Fail | Pass | Pass | Pass | n/a |
| 2B4P Flat 8 Bedroom South | Pass | Fail | Fail | Fail | Fail | Pass | n/a |
| 2B4P Flat 9 Bedroom North | Fail | Fail | Fail | Pass | Pass | Pass | n/a |
| 2B4P Flat 9 Bedroom South | Pass | Fail | Fail | Fail | Fail | Fail* | Pass |
| 2B4P Flat 10 Bedroom North | Fail | Fail | Fail | Fail | Fail | Pass | n/a |
| 2B4P Flat 10 Bedroom South | Pass | Fail | Fail | Fail | Fail | Pass | n/a |
| 2B4P Flat 11 Bedroom North | Fail | Fail | Fail | Pass | Pass | Pass | n/a |
| 2B4P Flat 11 Bedroom South | Fail | Fail | Fail | Fail | Fail | Pass | n/a |
| 2B4P Flat 1 Kitchen/living | Pass | n/a | Fail | Fail | Fail | Pass | n/a |
| 2B3P Flat 2 Kitchen/living | Pass | n/a | Fail | Fail | Fail | Pass | n/a |
| 1B2P Flat 3 Kitchen/living | Pass | n/a | Fail | Fail | Fail | Pass | n/a |
| 2B3P Flat 4 Kitchen/living | Fail | n/a | Fail | Fail | Fail | Pass | n/a |
| 1B1P Flat 5 Kitchen/living | Pass | n/a | Fail | Fail | Fail | Pass | Pass |
| 3B4P Flat 6 Kitchen/living | Pass | n/a | Fail | Fail | Fail | Pass | n/a |
| 1B2P Flat 7 Kitchen/living | Fail | n/a | Fail | Fail | Fail | Pass | n/a |
| 2B4P Flat 8 Kitchen/living | Fail | n/a | Fail | Fail | Fail | Pass | n/a |
| 2B4P Flat 9 Kitchen/living | Fail | n/a | Fail | Fail | Fail | Pass | n/a |
| 2B4P Flat 10 Kitchen/living | Fail | n/a | Fail | Fail | Fail | Pass | n/a |
| 2B4P Flat 11 Kitchen/living | Fail | n/a | Fail | Fail | Fail | Pass | n/a |

# Appendix A

It is important to note that with any modelling exercise there are assumptions and approximations that have to be made. As far as possible, details of all assumptions made, and approximations used are supplied as part of the report. These should be read carefully. All results are based on the output from computer modelling software and should be taken as an indication of the likely final situation, but these conditions cannot be guaranteed.

Table 9 shows the detailed results obtained for the proposed design and the results after the application of the ventilation and cooling solutions. The results table shows a summary of Criteria 3 for each solution.

*Table 9: Results summary for Criteria 3 with active measures*

| | Results for the proposed building | | Active measures to reduce overheating | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | As designed | | Enhanced ventilation | | Enhanced ventilation with reduced g-value (0.4) | | Summer cooling via ventilation at 110 l/s | | Summer cooling via ventilation at 125 l/s | |
| Room Name | Criteria 3: Operative temperature with % hours in range (> 26 °C) | Criteria 3 Pass/Fail | Criteria 3: Operative temperature with % hours in range (> 26 °C) | Criteria 3 Pass/Fail | Criteria 3: Operative temperature with % hours in range (> 26 °C) | Criteria 3 Pass/Fail | Criteria 3: Operative temperature with % hours in range (> 26 °C) | Criteria 3 Pass/Fail | Criteria 3: Operative temperature with % hours in range (> 26 °C) | Criteria 3 Pass/Fail |
| 2B4P Flat 1 Bedroom South-West | 20.6 | Fail | 15.3 | Fail | 13.3 | Fail | 3.9 | Fail | 2.3 | Pass |
| 2B4P Flat 1 Bedroom North-East | 25.2 | Fail | 16.1 | Fail | 14 | Fail | 2.4 | Pass | n/a | n/a |
| 2B4P Flat 1 Kitchen/living | 10.7 | Fail | 13.9 | Fail | 12.5 | Fail | 0.8 | Pass | n/a | n/a |
| 2B3P Flat 2 Bedroom North-West | 26.6 | Fail | 13.7 | Fail | 12.2 | Fail | 0.4 | Pass | n/a | n/a |
| 2B3P Flat 2 Bedroom South-East | 7.9 | Fail | 16.2 | Fail | 13.7 | Fail | 2.9 | Pass | n/a | n/a |
| 2B3P Flat 2 Kitchen/living | 16.1 | Fail | 12.7 | Fail | 10.8 | Fail | 0 | Pass | n/a | n/a |
| 1B2P Flat 3 Bedroom | 29.2 | Fail | 12.6 | Fail | 10.2 | Fail | 0 | Pass | n/a | n/a |
| 1B2P Flat 3 Kitchen/living | 14.6 | Fail | 10.1 | Fail | 8.7 | Fail | 0 | Pass | n/a | n/a |
| 2B3P Flat 4 Bedroom Double | 25.2 | Fail | 12.7 | Fail | 11.1 | Fail | 0 | Pass | n/a | n/a |
| 2B3P Flat 4 Bedroom Single | 25.8 | Fail | 12.6 | Fail | 10.8 | Fail | 0 | Pass | n/a | n/a |
| 2B3P Flat 4 Kitchen/living | 12.1 | Fail | 13.2 | Fail | 10.5 | Fail | 1.7 | Pass | n/a | n/a |
| 1B1P Flat 5 Kitchen/living | 5.2 | Fail | 6.7 | Fail | 5.4 | Fail | 0 | Pass | n/a | n/a |
| 1B2P Flat 5 Bedroom | 5.2 | Fail | 5.1 | Fail | 4.8 | Fail | 0 | Pass | n/a | n/a |
| 3B4P Flat 6 Bedroom South-West | 6.6 | Fail | 11.4 | Fail | 8.3 | Fail | 0.7 | Pass | n/a | n/a |
| 3B4P Flat 6 Bedroom North-West | 11.7 | Fail | 8.4 | Fail | 6.8 | Fail | 0 | Pass | n/a | n/a |
| 3B4P Flat 6 Bedroom North-East | 21.4 | Fail | 9.2 | Fail | 8.0 | Fail | 0 | Pass | n/a | n/a |
| 3B4P Flat 6 Kitchen/living | 24.1 | Fail | 8.2 | Fail | 6.6 | Fail | 0 | Pass | n/a | n/a |
| 1B2P Flat 7 Kitchen/living | 13.2 | Fail | 7.1 | Fail | 4.9 | Fail | 0 | Pass | n/a | n/a |
| 1B2P Flat 7 Bedroom | 11.1 | Fail | 7.1 | Fail | 5.3 | Fail | 0 | Pass | n/a | n/a |
| 2B4P Flat 8 Kitchen/living | 30.3 | Fail | 8.3 | Fail | 6.3 | Fail | 0 | Pass | n/a | n/a |
| 2B4P Flat 8 Bedroom North | 15.5 | Fail | 2.2 | Pass | 1.4 | Pass | 0 | Pass | n/a | n/a |
| 2B4P Flat 8 Bedroom South | 51.4 | Fail | 10.9 | Fail | 6.8 | Fail | 1.4 | Pass | n/a | n/a |
| 2B4P Flat 9 Kitchen/living | 35.3 | Fail | 8.8 | Fail | 6.7 | Fail | 0 | Pass | n/a | n/a |
| 2B4P Flat 9 Bedroom North | 16.8 | Fail | 1.6 | Pass | 1.1 | Pass | 0 | Pass | n/a | n/a |
| 2B4P Flat 9 Bedroom South | 52.9 | Fail | 12.1 | Fail | 7.7 | Fail | 3.3 | Fail | 1.9 | Pass |
| 2B4P Flat 10 Kitchen/living | 36.3 | Fail | 8.3 | Fail | 6.3 | Fail | 0 | Pass | n/a | n/a |
| 2B4P Flat 10 Bedroom North | 10.9 | Fail | 2.1 | Pass | 1.1 | Pass | 0 | Pass | n/a | n/a |
| 2B4P Flat 10 Bedroom South | 52.9 | Fail | 12.2 | Fail | 7.6 | Fail | 2.7 | Pass | n/a | n/a |
| 2B4P Flat 11 Kitchen/living | 37.8 | Fail | 9.6 | Fail | 6.8 | Fail | 0 | Pass | n/a | n/a |
| 2B4P Flat 11 Bedroom North | 25.5 | Fail | 8.3 | Fail | 5.3 | Fail | 0.8 | Pass | n/a | n/a |
| 2B4P Flat 11 Bedroom South | 52.4 | Fail | 11.6 | Fail | 7.3 | Fail | 1.9 | Pass | n/a | n/a |

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# Appendix B

TM59 Descriptions

*Table 10: TM59 Occupancy and equipment gain descriptions*

| Room | Occupancy | Lighting Gains | Equipment Gains | Profiles |
|---|---|---|---|---|
| **Single bedroom (too small to accommodate double bed)** | 1 person at 70% gains from 11 pm to 8 am<br>1 person at full gains from 8 am to 11 pm | 2 W/m2 from 6pm to 11pm | As Per TM59 Template:<br>Peak load of 80 W from 8 am to 11 pm<br>Base load of 10 W during sleeping hours | As Per TM59 Template |
| **Double Bedroom** | 2 people at 70% gains from 11pm to 8am<br>2 people at full gains from 8am to 9am and from 10pm to 11pm<br>1 person at full gain from 9am to 10pm | 2 W/m2 from 6pm to 11pm | As per Double bedroom TM59:<br>Peak load of 80 W from 8 am to 11 pm<br>Base Load of 10 W during sleeping hours | As Per TM59 Template |
| **1 bed Living Room Kitchen** | 1 person from 9am to 10pm;<br>room is unoccupied for the rest of the day | 2 W/m2 from 6pm to 11pm | As per 1-bedroom apartment living room/ kitchen TM59:<br>Peak load of 450 W from 6pm to 8pm, 200W from 8pm to 10pm, Base load of 85 W for the rest of the day | As Per TM59 Template |
| **2 bed Living Room Kitchen** | 2 people at 75% gains from 9am to 10pm;<br>room is unoccupied for the rest of the day | 2 W/m2 from 6pm to 11pm | As per 1-bedroom apartment living room/ kitchen TM59:<br>Peak load of 450 W from 6pm to 8pm, 200W from 8pm to 10pm, 110W from 9am to 6pm and from 10pm to 12pm<br>Base load of 85 W for the rest of the day | As Per TM59 Template |