HODKINSON

**Dynamic Overheating Report**

Richmond Housing Partnership

# Sheldon House

Final


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January 2023

# DOCUMENT CONTROL RECORD

REPORT STATUS: FINAL

| Version | Date | Reason for issue | Author | Checked by | Approved for Issue by Project Manager |
|---|---|---|---|---|---|
| v.1 | 24/01/2023 | Draft | H Fry | K Paxton | Z Lowther |
| v.2 | 31/01/2023 | Final | H Fry | K Paxton | Z Lowther |
| | | | | | |

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Our team of technical specialists offer advanced levels of expertise and experience to our clients. We have a wide experience of the construction and development industry and tailor teams to suit each individual project.

We are able to advise at all stages of projects from planning applications to handover.

Our emphasis is to provide innovative and cost-effective solutions that respond to increasing demands for quality and construction efficiency.

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# Executive Summary

The purpose of this report is to provide an overheating mitigation strategy for the proposed development at Sheldon House by Airey Miller in The London Borough of Richmond upon Thames, in support of the planning application and demonstrating compliance with local, regional and national policy standards.

The performance of dwellings has been assessed against the Charted Institution of Building Services Engineers (CIBSE) guidance TM59 *Design methodology for the assessment of overheating risk in homes* (2017) and Approved Document O *Overheating* (2021).

A sample of dwellings has been selected for the dynamic overheating assessment based on design characteristics that establish them as representative of the overall proposed scheme. This selection of dwellings includes consideration of varying floors levels, orientations and occupancy types.

For the purpose of this report, improved solar control glazing, external shading and peak-lopping MVHR have been explored to demonstrate the use of passive measures as far as practicable and to avoid the need for active cooling.

All dwellings tested demonstrate compliance with the CIBSE TM59 and AD(O) overheating assessment criteria under the mandatory weather file (DSY1 for the 2020s, high emissions, 50% percentile scenario) for a 'no noise risk' scenario. The results are based on key design features and passive mitigation measures following the London Plan cooling hierarchy, as outlined within Table i. Further mechanical measures are proposed for a noise risk scenario whilst avoiding the requirement for active cooling as per the London Plan cooling hierarchy.

**Table i: Design features incorporated in accordance with the London Plan cooling hierarchy**

| Cooling hierarchy | Design feature | Discussion |
|---|---|---|
| **1. Reduce amount of heat entering the building** | Efficient building fabric and air tightness standards | In line with energy strategy |
| | Solar control glazing with G-value of 0.40 (frame factor 0.8) | A low G-value reduces solar gain, but has implications on $CO_2$ emissions, fabric energy efficiency and internal daylight levels and has therefore been optimised to balance all aspects as far as possible |

| Cooling hierarchy | Design feature | Discussion |
|---|---|---|
| | External shading provided by balcony overhangs, briese soleil and vertical shading fins, where required. | Balcony overhangs in line with design proposals.<br><br>Additional external shading added for overheating mitigation. |
| **2. Minimise internal heat generation** | Energy efficient design of building services | In line with energy strategy |
| **3. Manage the heat** | Concrete floor slab between dwellings in apartment blocks | The thermal mass of this will help reduce the risk of overheating by absorbing heat during the daytime |
| **4. Passive ventilation** | Openable windows used as the primary means of ventilation for overheating | Windows are simulated to start to open when the internal temperature exceeds 22°C and the external temperature is lower than the internal temperature, and be fully open when internal temperatures reach 26°C.<br><br>If bedroom temperatures exceed 23°C at 23:00, windows are simulated open through the night. Otherwise, bedroom windows are simulated to be closed during sleeping hours. |
| **5. Mechanical ventilation** | Peak-lopping MVHR ventilation with background rate at minimum Part F rates | MVHR unit modelled based on Nuaire MR-ECO-COOL operating at 110 L/s.<br><br>Minimum Part F ventilation rates range from 0.92 - 0.62 ach for the assessed dwellings. |
| **6. Active cooling** | N/A | No requirement for active cooling |

# CONTENTS

# 1. INTRODUCTION

**1.1** This document has been prepared by Hodkinson Consultancy, a specialist energy and environmental consultancy for planning and development, to present the overheating mitigation strategy for the proposed development at Sheldon House by Airey Miller.

## Site Location

**1.2** The site at Sheldon House lies on the southwest corner of the junction with Cromwell Road and Fairfax Road, within Teddington. The site location is shown in Figure 1 below.


**Figure 1: Site Location – Map data © 2022 Google**

**1.3** The site currently comprises a block of flats with 24 residential units, 14 parking spaces and 7 garages used for storage.

## Development Description

**1.4** The proposed development comprises a 5-storey building providing 27 residential units, to be 100% affordable. Associated landscaping, car parking and cycle parking will also be provided.

**1.5** Figure 2 below indicates the proposed site plan.


**Figure 2: Proposed Site Layout – Clive Chapman Architects (2022)**

## Overheating and Thermal Comfort

**1.6** Maintaining comfortable thermal comfort conditions in the face of climate change and increasing temperatures is one of the greatest challenges to be addressed by designers. The main objective is to achieve thermal comfort and minimise summertime overheating without the use of conventional air conditioning systems, which typically have associated greenhouse gas emissions and impact on the urban heat island effect.

**1.7** Dynamic thermal simulations have been carried out for representative dwellings, to determine whether there is a risk of overheating. Appropriate mitigation measures have been recommended to mitigate the overheating risk and ensure that comfortable thermal conditions are achieved as far as practicable.

# 2. PLANNING POLICY

**2.1** The following planning policies and requirements have informed the sustainable design of the proposed development.

## National Planning Policy: NPPF

**2.2** The revised National Planning Policy Framework (NPPF) was published on the 20th July 2021 and sets out the Government's planning policies for England. It describes a proactive approach that plans should take to mitigating and adapting to climate change, considering the risk of overheating from rising temperatures.

**2.3** New developments should be planned for in ways that avoid increased vulnerability to the range of impacts arising from climate change.

## Regional Planning Policy: The London Plan (2021)

**2.4** The following key policy of the London Plan is considered relevant to the proposed development and this Overheating Assessment:

**2.5** **Policy SI4 Managing Heat Risk** states that development proposals should minimise adverse impacts on urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure and that major development proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the following cooling hierarchy (Figure 3):

**2.6** Low-energy measures should be used to mitigate overheating risk. These include solar shading, building orientation and solar-controlled glazing. Occupant behaviour will also have an impact on overheating risk.

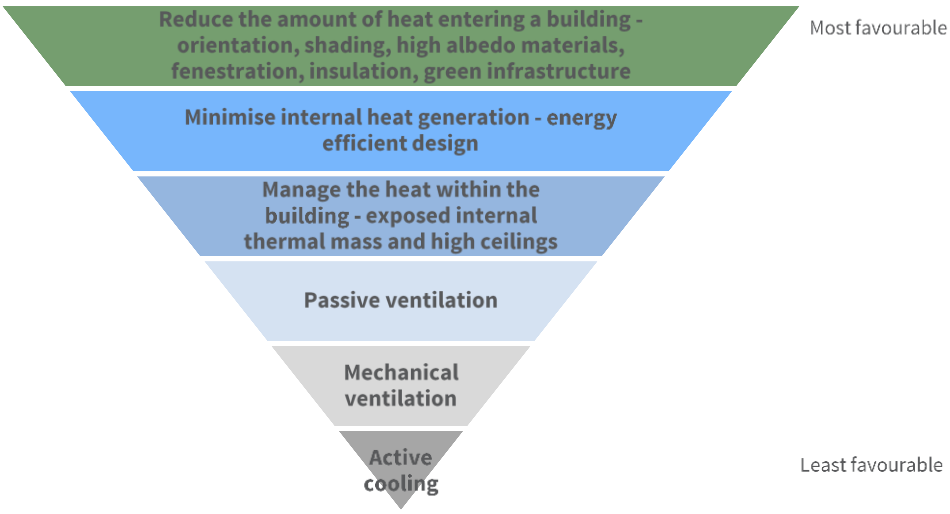


**Figure 3: Cooling Hierarchy (London Plan 2021)**

**2.7** Passive ventilation should be prioritised, (accounting for external noise issues and local air quality). The increased use of air conditioning systems is not desirable. If active cooling systems, such as air conditioning systems, are unavoidable, these should be designed to reuse the waste heat they produce.

## GLA Energy Assessment Guidance (2022)

**2.8** The GLA Energy Assessment Guidance (2022) requires all developments to undertake a detailed analysis of the risk of overheating.

**2.9** For dwellings, final proposals must demonstrate compliance with Building Regulations Part O (2021) and CIBSE TM59 (2017).

## Local Planning Policy: London Borough of Richmond upon Thames Local Plan (2018)

**2.10** The Local Plan for the London Borough of Richmond upon Thames was adopted in July 2018. The following policies are considered relevant to this report in respect of the development at Sheldon House:

**2.11** **Policy LP 20**: **Climate Change Adaptation** – A) The Council will promote and encourage development to be fully resilient t the future impacts of climate change in order to minimise vulnerability of people and property. B) New development, in their layout, design, construction, materials, landscaping and operation, should minimise the effects of overheating as well as minimise energy consumption in accordance with the following cooling hierarchy:

> Minimise internal heat generation through energy efficient design;

> Reduce the amount of heat entering a building in summer through shading, reducing solar reflectance, fenestration, insulation and green roofs and walls;

> Manage the heat within the building through exposed internal thermal mass and high ceilings;

> Passive ventilation;

> Mechanical ventilation;

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

C) Opportunities to adapt existing buildings, places and spaces to the likely effects of climate change should be maximised and will be supported.

## Local Planning Policy: London Borough of Richmond upon Thames Draft Local Plan

**2.12** A Draft Local Plan is currently under consultation by the Richmond upon Thames Borough Council. The third public consultation is expected to begin in March of 2023, with the new Local Plan projected to be adopted in Winter 2024. Though not yet in effect, the following Draft Local Plan policies are considered relevant to this assessment:

**2.13** **Policy 3: Tackling the Climate Emergency** - Development must not exacerbate climate change. Development should increase local resilience to current and future impacts of climate changes, especially for the most vulnerable people and property. This will be achieved by requiring all development to:

> Adapt to the changing climate by minimising the effects of overheating, mitigating the urban heat island effect, managing flooding, and minimising energy consumption in accordance with the London Plan’s Cooling Hierarchy.

**2.14** **Policy 4: Minimising Greenhouse gas emissions and promoting energy efficiency** – New-build residential development of 1 or more dwellings, and major residential development of 10 or more dwellings (including changes of use, conversions and major refurbishments), and non-residential development of 500 sqm or more:

> Reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the London Plan's Cooling Hierarchy (Policy SI 4 Managing Heat Risk).

# 3. OVERHEATING CRITERIA

**3.1** The following building regulations and guidance provide a standardised approach to predicting overheating risk in residential dwellings within the UK. They set out the criteria by which the risk of overheating can be assessed or identified.

## Approved Document O (2021)

**3.2** The proposed development will be subject to Part O of the Building Regulations, for which requirements are set out within Approved Document O (AD(O)) for Overheating (2021). Compliance is based on meeting the following requirements:

- Reasonable provision to limit unwanted solar gains in summer and to provide adequate means to remove excess heat;
- Taking account of safety, noise, pollution, protection of falling and entrapment when developing the strategy. Mechanical cooling should only be considered when feasible passive means are insufficient.

**3.3** There are two methods for demonstrating compliance under AD(O):

- **Simplified**: The simplified method requires dwellings to accommodate design limitations on maximum glazed areas, minimum openable areas for natural ventilation and external shading.
- **Dynamic**: The dynamic method requires dwellings to demonstrate compliance with CIBSE TM59 criteria (with a few specific limitations on use of the TM59 methodology) via dynamic thermal modelling.

## CIBSE TM59 (2017) Assessment Criteria

**3.4** The criteria for the assessment of overheating risk have been specified by the Chartered Institute of Building Services Engineers (CIBSE) in TM59 *Design methodology for the assessment of overheating risk in homes* (2017). CIBSE TM59 provides a standardised approach to predicting overheating risk for both naturally and mechanically ventilated residential buildings.

**3.5** The following criteria must be met in order to demonstrate compliance:

- **Criterion A**: The indoor operative temperature should not exceed the threshold comfort temperature by 1°C or more for more than 3% of occupied hours in living rooms, kitchens and bedrooms.
- **Criterion B**: To guarantee comfort during the sleeping hours the operative temperature in the bedroom from 10 pm to 7 am should not exceed 26°C for more than 1% of annual hours.

3.6 Whilst there is no mandatory target to meet for communal corridors, TM59 suggests a threshold temperature of 28ºC to be exceeded for no more than 3% of the total annual hours.

# 4. MODELLING APPROACH

4.1 Dynamic thermal modelling has been undertaken using DesignBuilder Software (v.7). The performance of the units has been assessed following CIBSE TM59 and the adaptive thermal comfort method for a primarily natural ventilated scenario. Additional modelling limitations set by AD(O) have also been applied.

4.2 Thermal comfort category II has been used as default for this development.

## Unit Selection

4.3 Representative dwelling units with different layouts, sizes, orientation and external shading have been assessed. The selection of the units for overheating risk assessment was based on the following design characteristics:

> Orientations;

> Occupancy types (no. occupants); and

> Floor levels.

4.4 The location and the internal layouts of the homes selected for assessment are presented in Appendix A. Design modelling inputs for the assessed dwellings can be found in Appendix B.

4.5 Communal corridors have not been modelled as part of the analysis, since temperatures in distribution piping will be ambient and no heat loss occurs – hence no overheating risk is present.

## Site External Weather Conditions

4.6 External temperatures and incident solar gains are greatest during summer months, coinciding with periods of lower wind speeds. Solar altitude is also highest during summer months, increasing the effects of façade shading from balcony overhangs and window reveals. Such considerations should be accounted for when designing for overheating risk.

4.7 The effects of external conditions are vital in an overheating assessment as they influence:

> Solar heat gains (a function of incident direct and diffuse solar radiation and solar altitude); and

> Calculated natural ventilation rates (a function of external temperature, wind directions and speeds).

4.8 CIBSE design summer year (DSY) weather data for London Heathrow (representative of lower density urban and suburban areas) has been used for the 2020s, high emissions, 50 % percentile scenario as required by CIBSE TM59.

4.9 The assessment of overheating risk has been undertaken using the DSY1 weather file, in accordance with the requirements of TM59 and the London Plan/AD(O).

## Model Geometry and Local Shading

4.10 Overshadowing from the building blocks has been taken into account during the simulation, based on the model geometry and the site orientation.

4.11 Solar control forms an integral part of overheating mitigation strategies. External shading in the form of balconies is applied across many of the façades as part of the design proposals. These were incorporated in the simulation model as shown in Figure 4.

4.12 Horizontal shading devices such as balconies and overhangs are more efficient when applied in south oriented façades and during midday when the solar angle is high. Their role in reducing solar gains in the summer period is considered to be paramount.

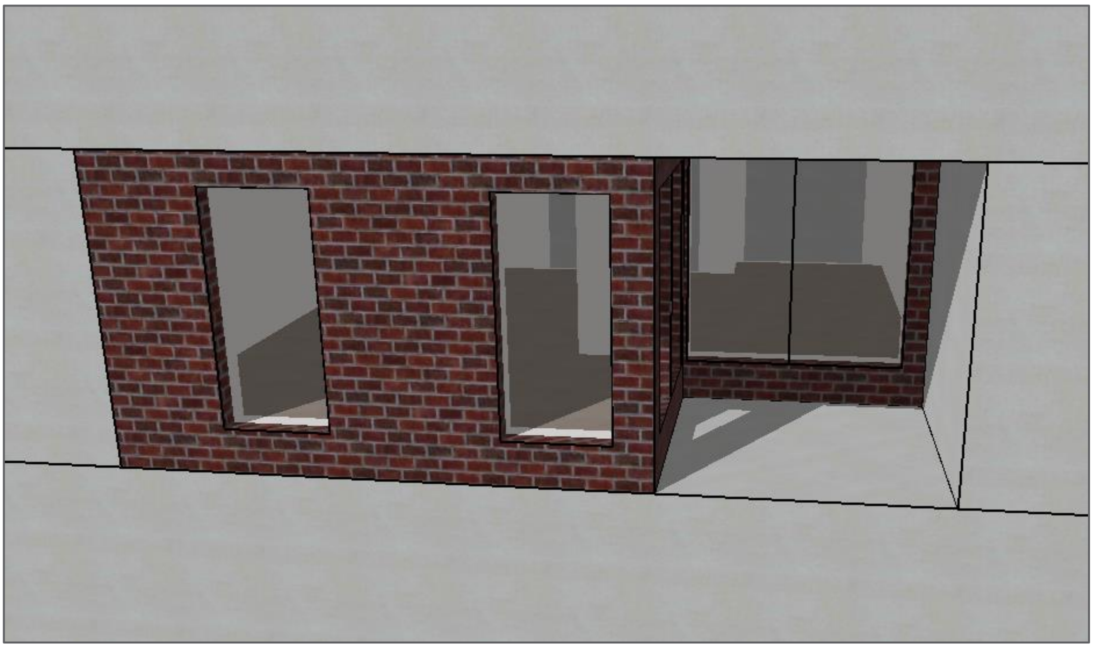

**Figure 4: Simulation model from DesignBuilder – balcony shading**

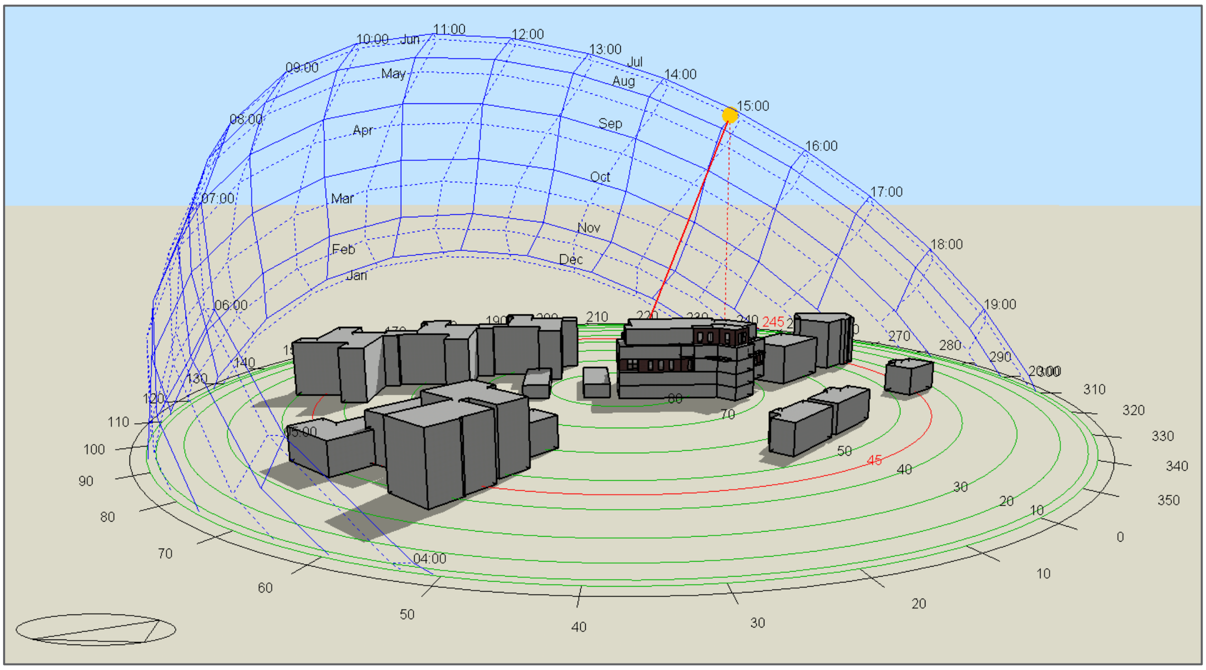


**Figure 5: Simulation model from DesignBuilder.**

# 5. EXTERNAL NOISE AND AIR QUALITY CONSTRAINTS

**5.1** A Noise Impact Assessment (KP Acoustics, January 2023) has been completed for the development site. The assessment details maximum openable areas of windows to achieve AD-O target internal noise levels, shown in Table 1 below. Results suggest significant noise risk at the site, and hence no openability of windows during night-time hours across all façades.

**Table 1: Window openable areas (KP Acoustics, January 2023)**

| Elevation | Sound Reduction Required to Achieve ADO Target Internal $L_{Aeq}$ Noise Levels | Sound Reduction Required to Achieve ADO Target Internal $L_{Amax}$ Noise Levels | Maximum Open Area of the Window as a Percentage of the Floor Area to Achieve ADO Target Internal Noise Levels |
|---|---|---|---|
| North | 16 dB | 26 dB | 0 % |
| South | 13 dB | 21 dB | 0 % |

5.2 Table 2 outlines the window opening schedule, based on the outlined risk from noise and air quality impacts.

**Table 2: Proposed natural ventilation strategy for dwellings**

| Façade | Room | Occupancy schedule (TM59) | Window opening schedule |
|---|---|---|---|
| All façades | Kitchen / Living areas | 09:00-22:00 | 09:00 – 22:00 |
| | Bedrooms | 24/7 (allowing for use as home office or daytime resting in addition to night-time use) | 07:00 – 23:00 (closed during sleeping hours) |

5.3 In accordance with TM59 and additional limits set by AD(O), windows are simulated to gradually open when the internal temperature exceeds 22°C and the external temperature is lower than the internal temperature, to be fully open when internal temperatures reach 26°C.

5.4 For the modelling of apartments without external noise constraints, bedroom windows will be simulated to remain open through the night if the internal temperature exceeds 23°C at 23:00. If the bedroom temperature is below 23°C at 23:00, windows will be simulated to remain closed until 07:00. Under the 'noise risk' scenario, all bedroom windows are closed throughout the night.

# 6. OVERHEATING MITIGATION STRATEGY

## Strategy Development

**6.1** The overheating strategy has been developed to prioritise passive measures and demonstrate compliance as far as is reasonably practicable whilst avoiding the use of comfort cooling.

**6.2** Noise risk has been found to be significant at this site. For the purposes of demonstrating prioritisation of passive measures, results are initially presented for a ‘no noise risk’ scenario; this shows that noise risk is the sole constraint causing overheating risk (i.e., poor fabric performance and/or lack of passive measures are not the cause of overheating risk).

**6.3** Non-passive measures are then proposed to reduce overheating risk as far as possible without the use of comfort cooling.

## Proposed Passive Measures

**6.4** The following passive design measures have been incorporated in order to reduce the risk of overheating to an acceptable level, as determined by CIBSE TM59:

> Highly efficient fabric envelope and high efficiency building services heating system, lighting and appliances are proposed in all dwellings to reduce internal gains;

> A concrete floor slab within the apartment blocks provides some thermal capacity to absorb excessive heat within the building;

> High performance solar control glazing with a g-value of 0.40. This has been balanced to mitigate overheating risk whilst achieving fabric energy efficiency targets and natural daylight provision;

> External shading is provided in the form of recessed balconies, briese soleil to south-facing façades and vertical shading to the north-eastern façade;

**6.5** Results for the ‘no noise risk’ scenario are shown in Table 3 overleaf.

Table 3: TM59 overheating results for dwellings under DSY1 2020s, 'no noise risk' scenario

| Unit | Room | TM59 Criterion A: Hours of exceedance (pass ≤ 3 %) | TM59 Criterion B: Bedroom temperature hours > 26 °C (pass ≤ 32) | Overall compliance with TM59 |
|---|---|---|---|---|
| | | % Hours of overheating | Hours of overheating | |
| GF, 1B2P | Bed1 | 0.0 | 18 | Pass |
| | LKD | 1.2 | N/A | Pass |
| 2F, 1B2P | Bed1 | 0.1 | 31 | Pass |
| | LKD | 1.1 | N/A | Pass |
| 2F, 2B4P | Bed1 | 0.1 | 30 | Pass |
| | Bed2 | 0.3 | N/A | Pass |
| | LKD | 0.0 | 23 | Pass |
| 2F, 3B5P | Bed1 | 0.1 | 31 | Pass |
| | Bed2 | 2.4 | N/A | Pass |
| | Bed3 | 0.0 | 25 | Pass |
| | LKD | 0.0 | 27 | Pass |
| 4F, 1B2P | Bed1 | 1.0 | N/A | Pass |
| | LKD | 0.1 | 25 | Pass |

**6.6** Proposed passive measures are sufficient for demonstrating compliance with CIBSE TM59 criteria for a 'no noise risk' scenario. This is in line with the Approved Document O: *Overheating* Frequently Asked Questions No. 13, which advises that designing the building to pass using no mechanical cooling in use and assuming no usability issues (e.g., noise risk) is a way to demonstrate 'using passive means as far as reasonably practicable'.

**6.7** Results for the actual noise risk scenario are presented in Table 4 overleaf.

**Table 4: TM59 overheating results for dwellings under DSY1 2020s, 'noise risk' scenario**

| Unit | Room | TM59 Criterion A: Hours of exceedance (pass ≤ 3 %) | TM59 Criterion B: Bedroom temperature hours > 26 °C (pass ≤ 32) | Overall compliance with TM59 |
|---|---|---|---|---|
| | | % Hours of overheating | Hours of overheating | |
| GF, 1B2P | Bed1 | 0.1 | 223 | Fail |
| | LKD | 1.6 | N/A | Pass |
| 2F, 1B2P | Bed1 | 0.5 | 444 | Fail |
| | LKD | 1.4 | N/A | Pass |
| 2F, 2B4P | Bed1 | 0.2 | 44 | Fail |
| | Bed2 | 1.0 | N/A | Pass |
| | LKD | 0.2 | 426 | Fail |
| 2F, 3B5P | Bed1 | 1.2 | 549 | Fail |
| | Bed2 | 2.0 | N/A | Pass |
| | Bed3 | 0.3 | 452 | Fail |
| | LKD | 0.6 | 501 | Fail |
| 4F, 1B2P | Bed1 | 1.7 | N/A | Pass |
| | LKD | 0.5 | 405 | Fail |

**6.8** Proposed passive measures are not sufficient for demonstrating compliance with the CIBSE TM59 criteria when considering noise risk – i.e., noise risk causes overheating risk and non-compliance. As a result, additional non-passive measures will be required.

## Additional Mechanical Measures

**6.9** To alleviate overheating risk at the Sheldon House development, in addition to already proposed passive measures, peak-lopping MVHR units are proposed.

**6.10** Peak-lopping MVHR works by using a cooling coil in addition to cooling from the heat recovery system for the mechanical ventilation system. This is active during temperature 'peaks', providing additional cooling capacity to the system. Whilst this is a non-passive measure, it is not classified as active cooling in the cooling hierarchy and is typically less energy intensive than full active cooling.

## Final Results

**6.11** The following results presented in Table 5 indicate that, based on the design modelling inputs in Appendix B, window opening schedules presented in Table 1 and overheating mitigation measures outlined above, the majority of assessed rooms meet the CIBSE TM59 criteria.

**Table 5: TM59 overheating results for dwellings under DSY1 2020s**

| Unit | Room | TM59 Criterion A: Hours of exceedance (pass ≤ 3 %) | TM59 Criterion B: Bedroom temperature hours > 26 °C (pass ≤ 32) | Overall compliance with TM59 |
|---|---|---|---|---|
| | | % Hours of overheating | Hours of overheating | |
| GF, 1B2P | Bed1 | 0.1 | 29 | Pass |
| | LKD | 1.6 | N/A | Pass |
| 2F, 1B2P | Bed1 | 0.5 | 7 | Pass |
| | LKD | 1.4 | N/A | Pass |
| 2F, 2B4P | Bed1 | 0.2 | 29 | Pass |
| | Bed2 | 1.0 | N/A | Pass |
| | LKD | 0.2 | 23 | Pass |
| 2F, 3B5P | Bed1 | 1.2 | 35 | Fail |
| | Bed2 | 2.0 | N/A | Pass |
| | Bed3 | 0.3 | 48 | Fail |
| | LKD | 0.6 | 49 | Fail |
| 4F, 1B2P | Bed1 | 1.7 | N/A | Pass |
| | LKD | 0.5 | 43 | Fail |

**6.12** Additional results are shown for alternative maximum temperatures of 26.5 °C and 27 °C in Table 6. These demonstrate that hours above 26 °C are often within 1 °C, representing marginal non-compliance with the CIBSE TM59 criteria. Due to limitations and the potential for minor inaccuracies when modelling in software, it is generally accepted that such a deviation may be caused due to these inaccuracies and thus the overheating risk is acceptable.

**6.13** With consideration of noise risk limitations, prioritisation of passive measures as far as practicable and use of peak-lopping MVHR as an option in opposition to active cooling, it is thought that the overheating strategy presented is the most appropriate strategy for the Sheldon House development.

Table 6: Additional temperatures overheating results for dwellings under DSY1 2020s

| Unit | GF, 1B2P Bed1 | 2F, 1B2P Bed1 | 2F, 2B4P Bed1 | 2F, 2B4P Bed2 | 2F, 3B5P Bed1 | 2F, 3B5P Bed2 | 2F, 3B5P Bed3 | 4F, 1B2P Bed1 |
|---|---|---|---|---|---|---|---|---|
| **Bedroom temperature hours > 26 °C (pass ≤ 32)** | 29 | 7 | 29 | 23 | 35 | 48 | 49 | 43 |
| **Bedroom temperature hours > 26.5 °C** | 18 | 2 | 16 | 13 | 22 | 38 | 35 | 30 |
| **Bedroom temperature hours > 27 °C** | 10 | 2 | 7 | 7 | 13 | 25 | 26 | 23 |

# 7. CONCLUSION

**7.1** The purpose of this report is to provide an overheating mitigation strategy for the proposed development at Sheldon House by Airey Miller in The London Borough of Richmond upon Thames, in support of the planning application and demonstrating compliance with local, regional and national policy standards.

**7.2** The performance of dwellings has been assessed against the Charted Institution of Building Services Engineers (CIBSE) guidance TM59 *Design methodology for the assessment of overheating risk in homes* (2017) and Approved Document O *Overheating* (2021).

**7.3** A sample of dwellings has been selected for the dynamic overheating assessment based on design characteristics that establish them as representative of the overall proposed scheme. This selection of dwellings includes consideration of varying floors levels, orientations and occupancy types.

**7.4** For the purpose of this report, improved solar control glazing, external shading and peak-lopping MVHR have been explored to demonstrate the use of passive measures as far as practicable and to avoid the need for active cooling.

**7.5** All dwellings tested demonstrate compliance with the CIBSE TM59 and AD(O) overheating assessment criteria under the mandatory weather file (DSY1 for the 2020s, high emissions, 50% percentile scenario) for a 'no noise risk' scenario. The results are based on key design features and passive mitigation measures following the London Plan cooling hierarchy, as outlined within Table i. Further non-passive measures are proposed for a noise risk scenario whilst avoiding the requirement for active cooling as per the London Plan cooling hierarchy.

# APPENDICES

## Appendix A
Assessed Dwellings

## Appendix B
Design Modelling Inputs

# Appendix A
## Assessed Dwellings

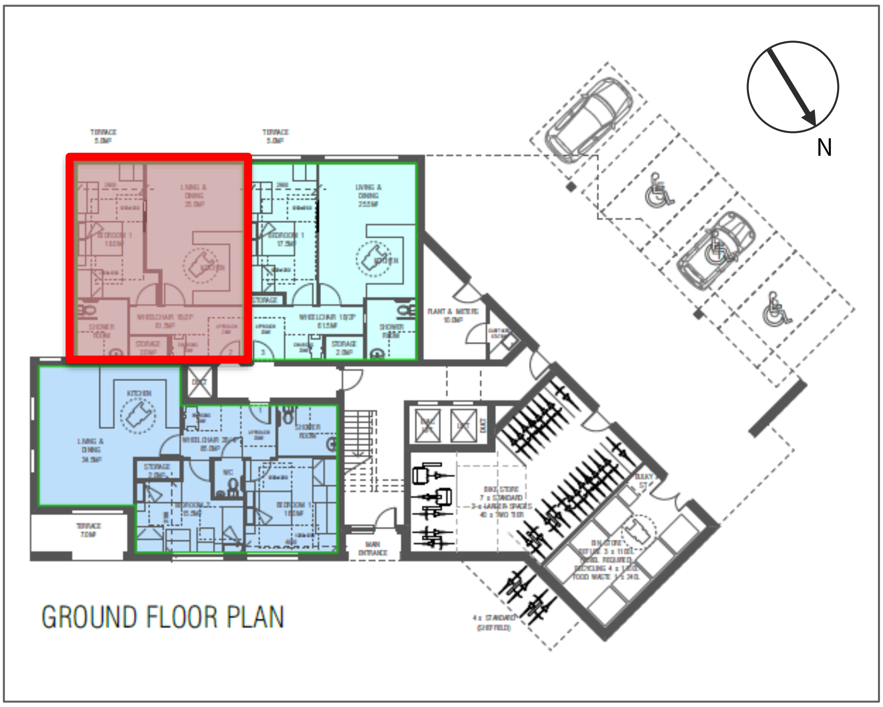


**Figure A.1:GF 1B2P. Dual aspect north/west facing**

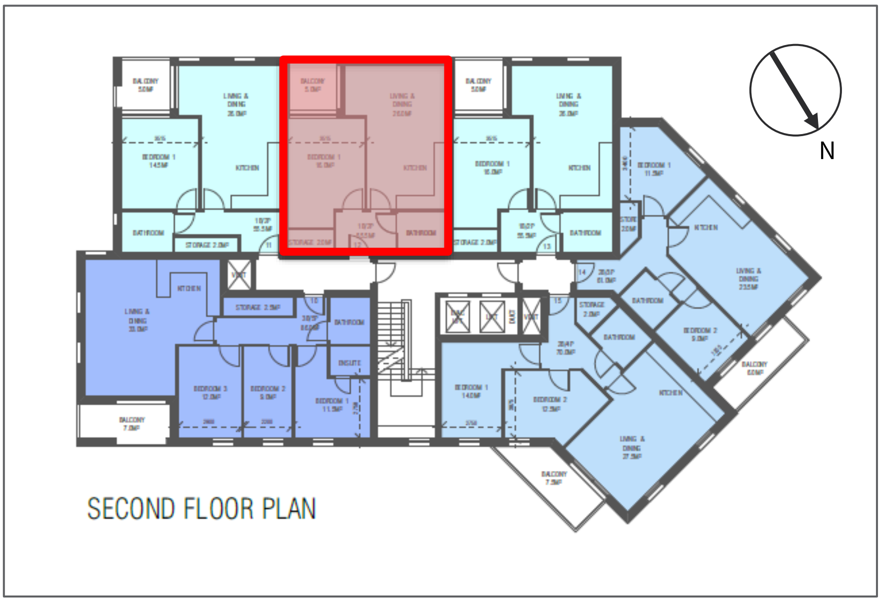


**Figure A.2:2F 1B2P. Single aspect south-west facing**

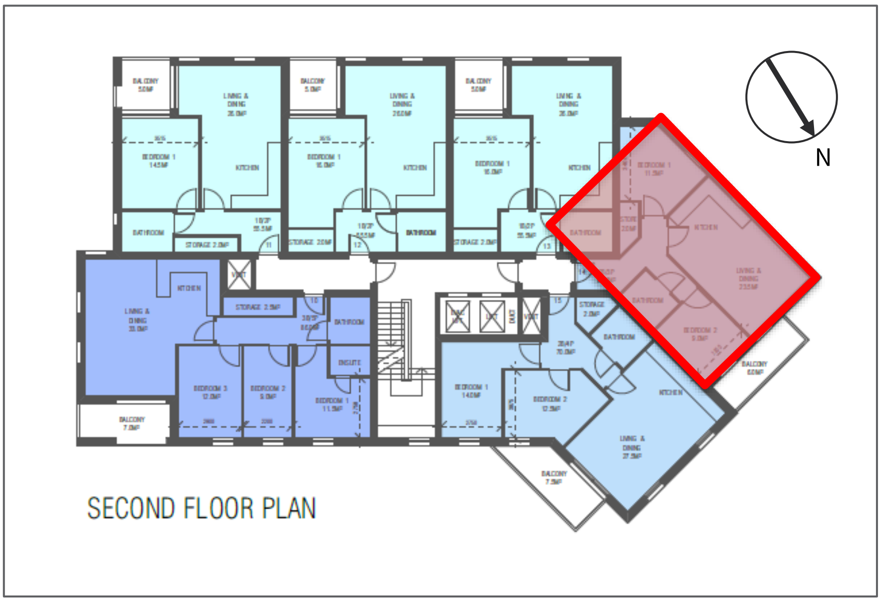


**Figure A.3: 2F 2B4P. Dual aspect north/west facing**

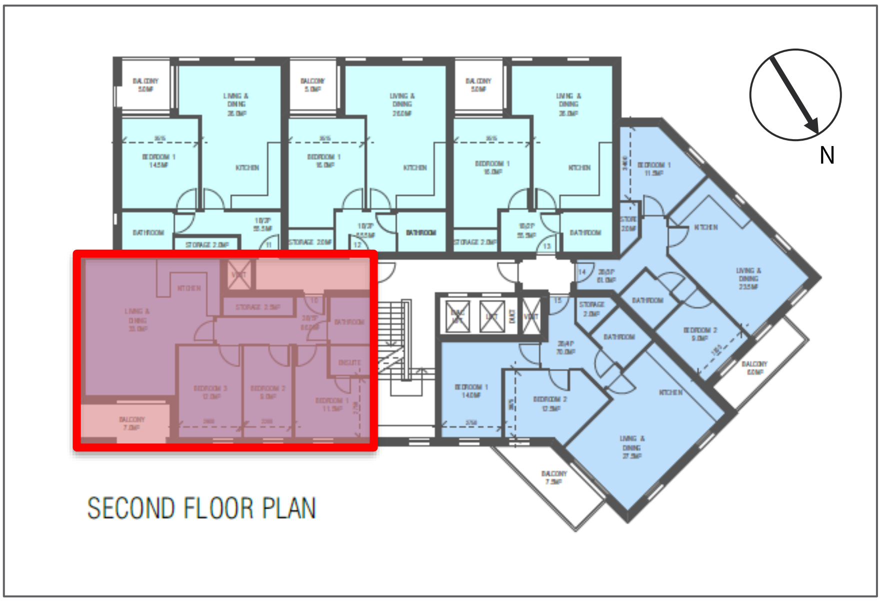


**Figure A.4: 2F 3B5P. Dual aspect north/east facing**


Figure A.5: 4F 1B2P. Single aspect east facing

# Appendix B
## Design Modelling Inputs

The following modelling inputs have been included in the baseline dynamic thermal simulation.

**Table B.1: Baseline dynamic thermal modelling design assumptions**

| Data Input | | | Discussion |
|---|---|---|---|
| **Weather data** | **Location** | CIBSE London Heathrow Design Summer Years (DSYs) for 2020s, high emissions, 50% percentile scenario | *Geographically closest and most representative industry-standard CIBSE weather data file* |
| **Building Fabric Construction details** | **External walls** | 0.18 W/m$^2$K<br><br>Brickwork on SFS with insulation. | *As per the Energy & Sustainability Report (Clive Chapman Architects, November 2022)* |
| | **Roofs** | 0.11 W/m$^2$K<br><br>Reinforced concrete with glass wool and cavity | *As per the Energy & Sustainability Report (Clive Chapman Architects, November 2022)* |
| | **Ground floor** | 0.13 W/m$^2$K<br><br>Reinforced concrete with glass fibre board insulation, screed and wooden flooring | *As per the Energy & Sustainability Report (Clive Chapman Architects, November 2022)* |
| | **Ceilings/floors** | Assumed to be adiabatic between adjacent floors | *Concrete slabs will add to the thermal capacity of the building*<br>*When dwelling units above / below heat loss is assumed to be zero* |
| | **Party walls between units and houses** | Assumed to be adiabatic between adjacent dwellings | *Walls adjacent to other units are assumed to be lightweight partitions*<br>*Adjacent units have been included in the dynamic simulation calculations* |
| | **Partitions within units** | Fully insulated plasterboard partitions | *Assumed thicknesses as per drawings* |
| | **Internal doors** | 0.90 m width | *As per drawings (Clive Chapman Architects, February 2022)* |
| **Windows** | **Windows and Glazed Doors** | U value 1.20 W/m$^2$K | *As per the Energy & Sustainability Report (Clive Chapman Architects, November 2022)* |
| | **Reveal depth** | External reveal: 183 mm | *As per drawings (Clive Chapman Architects, February 2022)* |

| Data Input | | | Discussion |
|---|---|---|---|
| | **Discharge Coefficient** | Discharge coefficients ranging from: 0.52 – 0.58 | *Calculated from window dimensions as per drawings (Clive Chapman Architects, February 2022)* |
| **Infiltration** | **Air Tightness** | 5.0 m3/hr-m2 @ 50 pascals | *As per the Energy & Sustainability Report (Clive Chapman Architects, November 2022)* |

The following occupancy schedules and internal gains assumptions have been used, in accordance with CIBSE TM59 guidance.

**Table B.2: Occupancy and equipment gains for dwellings (CIBSE TM59)**

| Unit/room type | Occupancy | Equipment Load |
|---|---|---|
| **1-bedroom apartment: living room/kitchen** | 1 person from 9 am to 10 pm; room is unoccupied for the rest of the day | Peak load of 450 W from 6 pm to 8 pm<br>200 W from 8 pm to 10 pm<br>110 W from 9 am to 6 pm and from 10 pm to 12 pm<br>Base load of 85 W for the rest of the day |
| **2-bedroom apartment: living room/kitchen** | 2 people from 9 am to 10 pm; room is unoccupied for the rest of the day | Peak load of 450 W from 6 pm to 8 pm<br>200 W from 8 pm to 10 pm<br>110 W from 9 am to 6 pm and from 10 pm to 12 pm<br>Base load of 85 W for the rest of the day |
| **3-bedroom apartment: living room/kitchen** | 3 people from 9 am to 10 pm; room is unoccupied for the rest of the day | Peak load of 450 W from 6 pm to 8 pm<br>200W from 8 pm to 10 pm<br>110 W from 9 am to 6 pm and from 10 pm to 12 pm<br>Base load of 85 W for the rest of the day |
| **Double bedroom** | 2 people at 70% gains from 11 pm to 8 am, 2 people at full gains from 8 am to 9 am and from 10 pm to 11 pm, 1 person at full gain in the bedroom from 9 am to 10 pm | Peak load of 80 W from 8 am to 11 pm<br>Base load of 10 W during the sleeping hours |
| **Single bedroom** | 1 person at 70% gains from 11 pm to 8 am, 1 person at full gains from 8 am to 11 pm | Peak load of 80 W from 8 am to 11 pm<br>Base load of 10 W during sleeping hours |
| **Utility cupboard** | N/A | 10 W on 24/7 |

The proposed peak lopping MVHR should be capable of achieving mechanical ventilation rates of 110 L/s, as well as background rates meeting minimum Part F requirements.

**Table B.3: Mechanical ventilation rates for dwellings (minimum Part F)**

| **Dwelling** | GF, 1B2P | 2F, 1B2P | 2F, 2B4P | 2F, 3B5P | 4F, 1B2P |
|---|---|---|---|---|---|
| **Floor area / m²** | 61.88 | 55.57 | 61.2 | 86.05 | 45.6 |
| **Storey height / m** | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| **Volume / m³** | 154.7 | 138.925 | 153 | 215.125 | 114 |
| **Kitchen** | 1 | 1 | 1 | 1 | 1 |
| **Utility cupboard** | 1 | 1 | 1 | 1 | 1 |
| **Bathroom** | 1 | 1 | 1 | 2 | 1 |
| **Ensuite** | 0 | 0 | 0 | 0 | 0 |
| **Boost rate / l/s** | 29 | 29 | 29 | 37 | 29 |
| **Whole dwelling ventilation rate / cu.m/hr** | 104.4 | 104.4 | 104.4 | 133.2 | 104.4 |
| **Air change rate / ach** | **0.67** | **0.75** | **0.68** | **0.62** | **0.92** |