

CAMBRIDGE HALLS PBSA APPENDIX C

Sustainability Services
Approved Document O Overheating Assessment
Stage 2

BSD15299-WAT-XX-XX-RP-V-59016

April 2025

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Client Name:

Unite Students

Document Reference:

BSD15299-WAT-XX-XX-RP-V-59016

Project No / File:

U:\Projects\BSD15299\15 Documents\01 Reports\ Energy\Reports

Quality Assurance – Approval Status

This document has been prepared and checked in accordance with
Waterman Group's IMS (BS EN ISO 9001: 2015, BS EN ISO 14001: 2015 and BS EN ISO 45001:2018)

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	P02 – Issue for Planning			

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Contents

EXECUTIVE SUMMARY 1

INTRODUCTION 2

1.1 Development Description 2

1.2 Report Objectives.....2

2. PLANNING POLICY AND PROJECT REQUIREMENTS 3

2.1 Building Regulations: Approved Document Part O 3

2.1.1 Simplified Method.....3

2.1.2 Dynamic Thermal Modelling 3

2.2 Manchester Core Strategy (2012) and Places for Everyone (2023).....3

3. OVERHEATING AND COOLING HIERARCHY 4

3.1 CIBSE's TM59 Modelling 4

3.2 CIBSE's TM59 Criteria 4

3.2.1 Compliance Criteria for Predominately Naturally Ventilated.....4

3.2.2 Compliance Criteria for Predominately Mechanically Ventilated 4

3.3 Part O – Limits on CIBSE's TM59 Modelling 4

3.4 Key Constraints.....4

4. OVERHEATING ANALYSIS 6

4.1 Overview 6

4.2 Energy Efficient Design / Cooling Strategy 6

4.3 Modelling Parameters 6

5. Results 7

5.1 Proposed Strategy 7

5.1.1 Assumptions.....7

5.1.2 Results 7

5.2 Proposed Strategy – Extreme Weather scenario 7

5.2.1 Assumptions.....7

5.2.2 Results 7

6. CONCLUSIONS 8

Figures

Figure 1: Development floor plan 6

Figure 2: IES Model of overheating samples (red – sample rooms, yellow – adjacent rooms).....7

Tables

Table 1: TM59 Results Summary 1

Table 2: Student Accommodation Provisions 2

Table 3: Overheating Settings..... 6

Table 4: Day Only Natural Ventilation + Nighttime Boost extract 7

Table 5 – 2050 Weather File 7

EXECUTIVE SUMMARY

Unite Students has commissioned Waterman Building Services to conduct an Overheating Assessment in support of a planning application for the proposed development located at Cambridge Halls, Manchester.

The development involves the demolition of the existing Cambridge Halls student accommodation, and the erection of a new development at 22-28 storeys in height excluding ground floor. The development features 2302 bedrooms as a mix of clusters and studios and has a mix of amenity spaces both internal and external. The assessment undertaken follows guidelines from the Chartered Institution of Building Services Engineers (CIBSE) Technical Memorandum (TM) 59, considering the restrictions imposed by Part O 2021.

This assessment aims to demonstrate compliance with Approved Document O and Manchester City Council which has been demonstrated in this report to show best practice considerations.

The analysis considers various factors such as building orientation, glazing, insulation, and ventilation strategies to mitigate overheating risk. Results show compliance with TM59 criteria for both mechanically and naturally ventilated spaces in line with relevant requirements.

The overheating mitigation strategy integrates passive measures such as optimised glazing, external shading, and exposed thermal mass, alongside a combination of natural and mechanical ventilation. A wet heating system provided by Air Source Heat Pumps is proposed for space heating with natural ventilation and boosted nighttime ventilation to omit the need for active cooling. Cooling has been provided to the ‘super kitchen’ in Phase 2 due to the nature of the activity within the space.

The design meets overheating requirements through passive measures. It accounts for site-specific constraints such as noise and air quality, necessitating a mechanically ventilated approach. However, passive measures are prioritized to future-proof the design, allowing for potential natural cooling in the future. The proposed strategy aligns with local planning policies and emphasizes energy efficiency and climate resilience.

In conclusion, the proposed development demonstrates a comprehensive approach to addressing overheating risks, ensuring occupant comfort, and meeting regulatory requirements.

Table 1: TM59 Results Summary

Room Type	Natural Ventilation + Nighttime boost Ventilation
Bedrooms/Studios	Pass
Student Kitchens	Pass

INTRODUCTION

Unite Students has instructed Waterman Building Services to prepare an Overheating Assessment to support the planning application for the Proposed Development located at Cambridge Halls, Manchester. Using CIBSE TM59 guidelines, a dynamic overheating modelling was undertaken for the energy strategy submission, taking into consideration the restrictions imposed by Part O 2021 when conducting the TM59 assessment.

1.1 Development Description

The development is situated in the city centre of Manchester, with close proximity to the university as well as Manchester Oxford station, and Manchester Picadilly Station which provide direct services to London, Birmingham and other major UK cities. The development has 22-28 storeys split over two buildings with a total of 2302 bedrooms split into 1101 in Phase 1 and 1201 in phase 2 with 209 studios and 170 Post grad clusters across the phases. There are Class E/F1/F2 spaces on the ground and first floor, described as:

“Demolition of existing halls of residence and erection of two buildings of 30 and 24 storeys above ground, plus basement and rooftop plant levels, comprising purpose-built student accommodation with internal and external rooftop communal amenity space (Sui Generis). Ground floor commercial and community uses (Flexible Use Classes E, F1 or F2). Hard and soft landscaping and associated highway works.”

Proposed Development

The Proposed Development comprises of the following student accommodation provisions:

Table 2: Student Accommodation Provisions

Type of Unit	Phase 1	Phase 2
Unite Standard (s)	1067	443
Affordable (s)		413
Post Graduate (s)		170
Unite Studio(s)	34	175
Total	1101	1201

1.2 Report Objectives

In line with Approved Document O, a residential building including institutional must adhere to the Chartered Institution of Building Service Engineers (CIBSE) Technical Memorandum (TM) 59

The model should demonstrate:

- The building should be designed to limit risk of overheating, in accordance with CIBSE TM59, these criteria are mentioned in section 3.2.
- Reasonable provision must be made in respect of a dwelling, institution or any other building containing one or more rooms for residential purposes, other than a room in a hotel (“residences”) to
 - (a) limit unwanted solar gains in summer,
 - (b) provide an adequate means to remove heat from the indoor environment.

To limit solar gains, Approved Document Part O¹ states the maximum glazing area of the building or part of the building. It is also recommended to explore for any glazing areas that can be reduced to limit solar gain and/or include external shading.

¹ [Approved Document O: Overheating \(publishing.service.gov.uk\)](#)

This report will also evaluate climate resilience as per Manchester Places for Everyone by using future weather files to ensure that the development can mitigate overheating during the lifetime of the building.

2. PLANNING POLICY AND PROJECT REQUIREMENTS

2.1 Building Regulations: Approved Document Part O

In December 2021 the government published a new Approved Document (AD) for overheating in residential building called 'Part O'. The primary aim of the requirement of Part O is to protect health and welfare of occupants of the building by reducing the occurrence of high indoor temperatures.

The requirement of Part O is met by designing and constructing the building to achieve one of the following:

- The simplified method for limiting solar gains and providing a means of removing excess heat as set out below.
- The dynamic thermal modelling method.

The overheating AD provides two routes for compliance, a simplified approach which is based on a ratio between window and dwelling areas and dynamic simulation closely following the CIBSE TM59 methodology.

The window ratios stated for the simplified approach provide a reasonably good starting point, which will also improve the building energy efficiency by avoiding excessive glazed areas.

Single aspect apartments should be avoided, particularly on the South and West elevations. In addition to this, the following design features should be avoided where possible:

- Rooms with large glazing areas.
- Have rooms with large sun-facing windows.
- Have limited opening windows.
- Approved Documentation Part O's limits on the use of CIBSE TM59 methodology as set out below.
- Adopting acceptable strategies for reducing overheating risk as set out below.

2.1.1 Simplified Method

To limit those solar gains the following standards should be followed.

- The maximum glazing area of the building or part of the building as shown in Table 1 or 2. This should be determined using the orientation of the façade that has the largest area of glazing.
- The maximum glazing area of the most glazed room given in Table 1 or 2. This should be determined using the orientation of the façade that has the largest area of glazing.

2.1.2 Dynamic Thermal Modelling

This section details a dynamic thermal modelling method for demonstrating compliance with requirement O1. It provides a standardised approach to predicting overheating risk for residential buildings using dynamic thermal modelling as an alternative to the simplified method.

The methodology is suitable for all residential buildings and offers additional flexibility over the solutions outlined in the simplified approach in the following situations:

- Residential buildings with very high levels of insulations and airtightness
- Residential buildings with specific site conditions that means the building is not well represented within the high or medium risk areas.

To demonstrate compliance using the dynamic thermal modelling method the following guidance needs to be followed: CIBSE's TM59 methodology for predicting overheating risk.

2.2 Manchester Core Strategy (2012) and Places for Everyone (2023)

The Manchester Core Strategy (2012) and the Places for Everyone (2023) framework both emphasise the need to mitigate overheating in urban developments. The Core Strategy outlines key policies such as EN4, which promotes passive design strategies like natural ventilation and shading to reduce overheating, and EN6, which requires developments to integrate green infrastructure, including trees and green roofs, to counteract urban heat island effects. Additionally, EN14 supports the use of sustainable drainage systems (SuDS) to manage heat-related risks from extreme weather.

Building on this, the Places for Everyone plan strengthens overheating mitigation through policies such as JP-S2, which mandates climate resilience measures in new developments, and JP-G6, which encourages urban greening and blue infrastructure, such as parks and water features, to provide cooling benefits. Furthermore, JP-P1 requires developers to demonstrate how their buildings avoid overheating by incorporating passive design principles and efficient cooling systems. Overall, both strategies prioritise sustainable urban planning to ensure buildings and public spaces remain comfortable and resilient in a warming climate.

Mitigation of overheating is demonstrated in this report to align with the current policies, particularly for future weather scenarios.

3. OVERHEATING AND COOLING HIERARCHY

3.1 CIBSE's TM59 Modelling

CIBSE's TM59 methodology for the assessment of overheating risk in homes is a standardised approach to predicting overheating risk for residential building designs (new-build or major refurbishment) using dynamic thermal analysis. The methodology provides a baseline for all domestic overheating risk assessments. Studies for student accommodations, care homes, prisons or unusual accommodation uses, and heatwave strategy analysis can employ this methodology as a starting point, as long as variations are clearly identified, and justifications provided. It should be noted that the weather file will have the largest impact on the overheating results. The variance of weather or human behaviour cannot be predicted within their dwellings. According to TM59 chapter 3.6, the modelled air speed should be set to 0.1 m/s. To meet this requirement, an appropriate air velocity schedule can be set at building level on the Activity tab to define air speed in all zones.

3.2 CIBSE's TM59 Criteria

3.2.1 Compliance Criteria for Predominately Naturally Ventilated

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

- For living rooms, kitchens and bathrooms: the number of hours during which ΔT is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3% 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 °C will be recorded as a failure).

3.2.2 Compliance Criteria for Predominately Mechanically Ventilated

For dwellings 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 (CIBSE Guide A (2015a)).

The assessment should be carried out using a dynamic thermal analysis software which must comply with CIBSE AM11: Building performance modelling (2015b).

The assessment is carried out on all the dwellings that are at a risk of overheating. These are likely to be those with:

- South and west facing dwellings
- Dwellings that are single aspect
- Dwellings with large glazing to floor ratios.

Where communal pipework is present the corridors should be included in the overheating assessment.

According to TM59 chapter 5.1: "A maximum sensible heat 75 W/person and a maximum latent heat gain of 55 W/person are assumed in living spaces".

3.3 Part O – Limits on CIBSE's TM59 Modelling

Approved Document Part O sets out a number of limitations on CIBSE's TM59 method. This includes the following:

When a room is occupied during the day (8am to 11pm), openings should be modelled to do all of the following:

- Start to open when the internal temperature exceeds 22°C
- Be fully open when the internal temperature exceeds 26°C
- Starts to close when the internal temperature falls below 26°C
- Be fully closed when the internal temperature falls below 22°C

At nighttime (11pm to 8am), it should be modelled as fully open if both of the following apply:

- The opening is on the first floor or above and not easily accessible
- The internal temperature exceeds 23°C at 11pm

When a ground floor or easily accessible room is unoccupied, the following applies:

- In the day windows, patio doors and balcony doors should be modelled as open, if this can be done securely i.e., using fixed or lockable shutters, window grilles or railings.
- At night, windows patio doors and balcony doors should be modelled as closed.
- An entrance door should be included, which should be shut all the time.

Although internal blinds and curtains do provide some mitigation of solar gains, they cannot be considered as part of the overheating assessment for Part O compliance.

3.4 Key Constraints

The building should be constructed to meet Part O, using passive means as far as reasonably practicable. Building control requires the development to demonstrate that all practicable passive means of limiting unwanted solar gains and removing excess heat have been utilised first before adopting mechanical cooling. Any mechanical cooling (air-conditioning) is expected to be used only where Part O cannot be met using openable windows.

Limitations on openable windows

In instances where security, air quality or noise concerns pose limitations to the opening of windows, it is required to demonstrate that all passive design measures have been thoroughly investigated.

Noise at night

There are concerns regarding the noise which would pose limitations to the opening of windows for the purposes of mitigating overheating risk. The site faces out to main roads and is located in a central area of the city and has particularly high noise levels at certain elevations which has been considered at

The Association of Noise Consultants' Acoustics, Ventilation and Overheating: Residential Design Guide (2020) states that the windows are likely to be closed if the noise within the bedrooms exceeds the following limits:

- 40 dB LAeq1 averaged over 8 hours (between 11pm and 7 am)
- 55 dB LAFmax more than 10 times a night (between 11pm and 7 am)

Due to the above, windows are not expected to be able to open during nighttime, and preliminary modelling indicates that mechanical ventilation would be required to mitigate overheating between 11pm-7am.

Pollution

Buildings located near to significant local pollution sources should be designed to minimise the intake of external air pollutants as stated in Section 2 of Approved Document F.

Security

When determining the free area available for ventilation during sleeping hours, only the proportion of openings that can be opened securely should be considered to provide useful ventilation. This particularly applies in the following location, where openings may be vulnerable to intrusion.

- Ground floor bedrooms
- Easily accessible bedrooms

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

- Fixed or lockable louvered shutters.
- Fixed or lockable window grilles or railings.

As such, the development has been assumed to have windows shut at nighttime and these openable windows to sit behind an external perforated panel.

Protection from entrapment

Louvered shutters, window railings and ventilation grilles should not allow body parts to become trapped. They should comply with the following:

- Not allow the passage of a 100mm diameter sphere.
- Any hole which allows the passage of an 8mm diameter rod should also allow the passage of a 25mm, such holes should not taper in a way that allows finger entrapment.
- Any looped cords must be fitted with child safety devices.

4. OVERHEATING ANALYSIS

4.1 Overview

Whilst the whole building was modelled to correctly account for building mass and internal heat transfer, to streamline the process the top floor, 13th and 7th floor were evaluated in detail for the assessment as a representative sample of rooms and orientations, in line with standard practice for TM59 assessments; the floor plans can be seen in Figure 2 below. This floorplate is representative of the majority of floorplates within the taller, southern, higher-risk tower. It is safe to conclude that this higher floor sample represents a reasonable worst case sample, and that the results are a valid representation of overheating risk within the scheme.

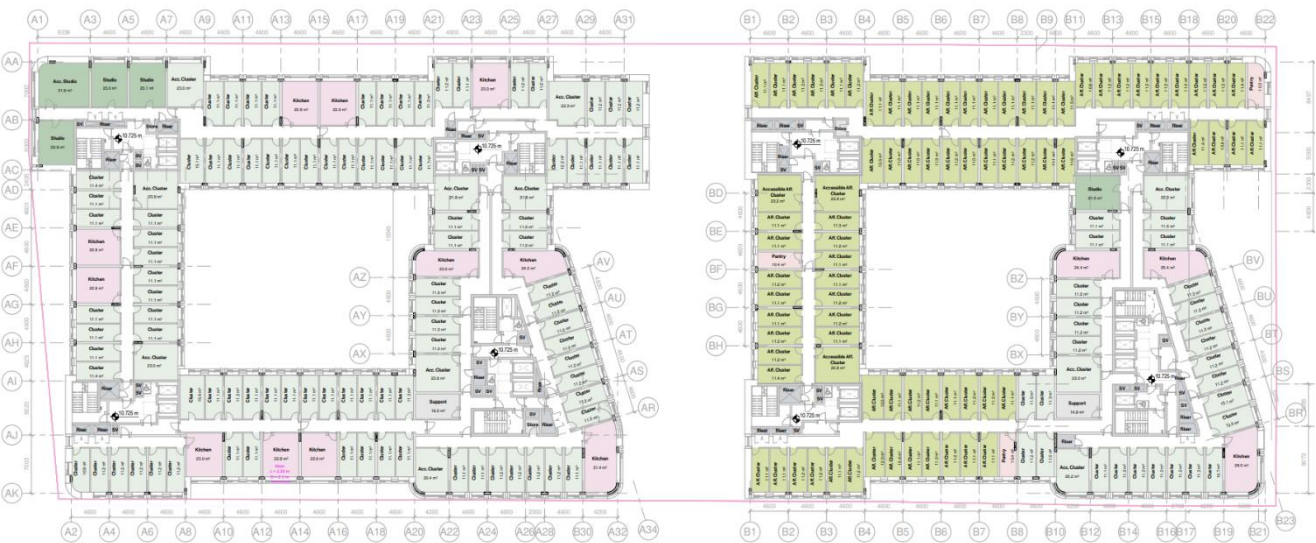


Figure 1: Development floor plan

4.2 Energy Efficient Design / Cooling Strategy

The proposed development has been thoughtfully planned to minimise the amount of heat that enters the structure. In order to decrease the amount of glazing and, consequently, the solar gains, the glazing is integrated with louvred panels providing external shading and limiting solar gain.

Solar analysis was undertaken to determine optimal glazing g-values and the placement of the ventilation louvres, which vary per façade due to the off-true orientation of the building. As a result, glazing solar transmittance varies from 0.4 to 0.5 depending on orientation and usage, with southern amenity spaces provided a lower value due to their increased occupancy and solar gains, and north-east living spaces a higher value, as the spaces are less at risk from overheating but could benefit from early morning solar gain to minimise winter heating demand.

The building is built in with a square tower geometry with good form factor the heat distribution system will have minimal pipe lengths and lateral pipework in corridors shall be negligible.

Passive ventilation is provided via the openable windows with the fixed louvred shutters providing security as well as reducing solar gain. These openings however are only allowed to be used for during the daytime due to air and noise quality concerns at the site, and to ensure acceptable indoor air quality a mechanical system is proposed for general ventilation and overheating mitigation. The openings have however been sized to allow compliance with the Part O overheating risk assessment, to demonstrate passive measures have suitably reduced risk and to provide a future potential option, should air quality issues at the site improve.

4.3 Modelling Parameters

The following parameters were provided for the overheating analysis:

Table 3: Overheating Settings

Element	Design Parameters	
U-Values w/m2K	External Walls	0.15
	Roof	0.12
	Ground Floor/Soffits	0.12
	Glazing	0.8
	Glazing G-value	0.4
	External Doors	1.6
Ventilation (l/s)	Bedrooms	8
	Kitchens	13
	Studios	21
Overheating	All rooms are boosted to 40l/s when temperature exceeds 22c.	
	TM59 – Studio	
Thermal Templates	TM59 – Single Bedroom	
	TM59 – 3 bed Kitchen/living	
Window Opening	Window behind opaque panel openable 90 degrees during daytime.	

5. Results

5.1 Proposed Strategy

The heating and cooling design for the Proposed Development uses wet radiators with natural ventilation and boosted mechanical ventilation at nighttime.

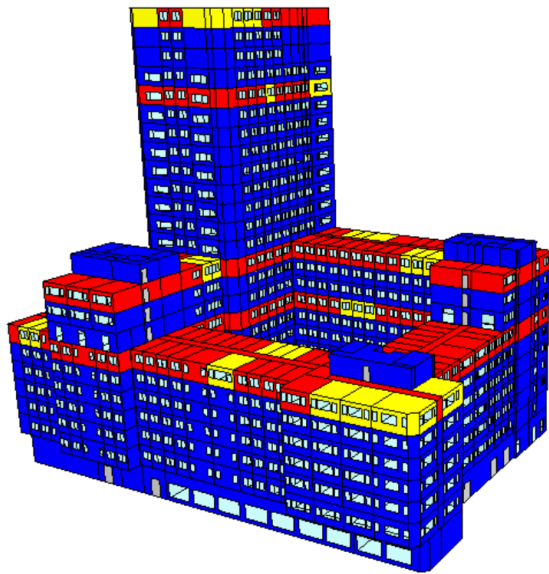


Figure 2: IES Model of overheating samples (red – sample rooms, yellow – adjacent rooms).

5.1.1 Assumptions

Background ventilation rate modelled in accordance with Approved Document Part F with a flow of 8l/s to bedrooms and 13 l/s to kitchens. An increased purge rate up to 40l/s is applied during the hours of 11pm-7am if the room exceeds 22°C.

5.1.2 Results

The assessed units comprise of single bedrooms, a studio and three student kitchens. All occupied rooms were included within the assessment excluding ensembles and circulation areas.

As stated in section 3.2, the following criteria are required to be met:

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

- **Criteria 1:** For living rooms, kitchens and bathrooms: the number of hours during which ΔT is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3% of occupied hours.
- **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.

The results for the natural ventilation assessment are as follows: 2465

Table 4: Day Only Natural Ventilation + Nighttime Boost extract

Criteria	Bedrooms	Student Kitchens
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Criteria 1	100% of rooms Pass	100% of rooms Pass
Criteria 2	100% of rooms Pass	N/A

5.2 Proposed Strategy – Extreme Weather scenario

In line with the Manchester Places for Everyone, mitigation of climate change scenarios which includes overheating as the global temperature increases should be incorporated into the design of new development.

5.2.1 Assumptions

Assumptions are in line with the primary strategy assumptions. However, internal blinds are also included as an additional mitigation measure (excluded from the primary results per the requirements of Part O). These results demonstrate the likely overheating risk in the future weather scenarios, including blinds modelling in line with CIBSE TM59.

5.2.2 Results

Only one criterion applies for bedrooms with mechanical ventilation.

- For dwellings 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 (CIBSE Guide A, restated within CIBSE TM59).

Table 5 – 2050 Weather File

Criteria	Bedrooms	Student Kitchens
Criteria 1	100% of rooms Pass	100% of rooms Pass
Criteria 2	100% of rooms Pass	N/A

6. CONCLUSIONS

The relevant overheating requirements for the site are Approved Document O (ADO) of the building regulations and to show best practice, adhering to Manchester City Council relevant planning policies. The overheating approach must be consistent with the building's acoustic and air-quality policies. The site's location therefore prohibits the usage of opening windows overnight for background ventilation or overheating mitigation.

A nighttime boosted ventilation approach has been proposed to ensure acceptable comfort levels within the bedrooms and shared kitchens due to predicted levels of acoustic and air-quality. This shall be provided with natural ventilation to mitigate overheating during the daytime with the windows assumed closed during the nighttime and the mechanical ventilation providing up to 40l/s of purge when the room exceeds 22c. The proposed strategy is compliant with Approved Document O.

The following scenarios were undertaken to demonstrate that the building has been designed to meet requirements to both the current Part O regulatory requirements, and also the requirements of Manchester City Council with regard to mitigating risk over the building's design life.

- 1- Proposed Strategy – 2020 Weather file
- 2- Proposed Strategy – 2050 Weather file

The findings of the overheating assessment revealed that all areas met the relevant requirements when assessed under each scenario. Furthermore, additional testing of extreme weather years revealed that all spaces would meet the requirements under the 2050 climate change scenario. The extreme weather year of 2080 was also tested, and demonstrated very good relative performance top typical schemes, although the test was not met in all spaces, indicating that fans or other mitigation measures could be required by occupants in the distant future or during extreme weather events.

The proposed design includes low energy and passive design techniques to control the risk of the building overheating, which is essential to responding to future climatic changes.

The following passive measures are proposed:

- Glazing g-values have been optimised to reduce solar gains to exposed façades.
- The building's orientation allows for summer shade through protrusions on the façade.
- External shading for each room is used to reduce solar gain and allow for a windows to open further to mitigate heating and for purge ventilation.

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