Integration

Date
07.02.2024

City House
Overheating Analysis

integrationuk.com

Integration
+44 (0)20 7183 8610

52—54 Rosebery Avenue
London EC1R 4RP

Integration Consultancy Limited
Registered in England
No. 07573777

Document status

Project no	**Project**	**Client**	**In conjunction with:**
762	City House Sutton Park Road Sutton SM1 2AE United Kingdom	Macar Living (City House) Ltd Sutton Park Road Sutton SM1 2AE United Kingdom	Wimshurst Pelleriti The Mews 6 Putney Common London SW15 1H

Revision	**Date**	**Status**	**Prepared by**	**Checked by**
—	20.12.23	Draft issue for comment	Oscar Akam	Alan Harries
1	30.01.24	Issue for planning	Oscar Akam	Alan Harries
2	07.02.24	Issue for planning	Oscar Akam	Alan Harries

Contents

1 Executive Summary

This overheating analysis has been prepared by Integration Consultancy Limited in support of the full planning application for the proposed new-build development at City House, Sutton, London. The development comprises the demolition of existing building and erection of a part 13-storey and part 5-storey building, for 70 'build to rent' residential apartments (Class C3), 191m^2 (NIA) office space (Class E(g)(i)) and associated landscape and public realm improvements.

The analysis follows the CIBSE TM59 standard which requires the creation of a 3D dynamic thermal model of the development.

RESIDENTIAL OVERHEATING (TM59)

An acoustic survey has been carried out to determine the impact of external noise to residents during the night-time. The acoustician has advised that the local background noise level at night exceeds the Part O noise criteria and, to mitigate the level of noise entering bedrooms at night, windows should remain closed.

The scheme does not include any ground floor or easily accessible units.

The overheating strategy for the development comprises primarily of solar control glazing (g value 0.4) and large openable window areas. The scheme introduces external shading in the form of overhangs over balcony areas, window reveals and balcony walls to reduce direct solar gains during the hottest hours of the day.

Residential overheating is considered to occur if an occupied room fails any of the following two criteria:

- Criteria 1 – Annual Overheating Hours (living rooms, kitchen and bedrooms).

  3% of occupied hours the operative temperature exceeds the threshold comfort temperature (upper limit of the range of comfort temperature) by 1°C from 1st May to 30th September.

- Criteria 2 – Overheating Temperature limit (Bedrooms only)

  During sleeping hours the operative temperature in the bedroom from 10pm to 7 am shall not exceed 26°C for more than 1% of annual hours.

The results show that the scheme passes CIBSE TM59 when window opening is unrestricted. When acoustic restrictions are applied to the model, the units require mechanical ventilation with supplementary cooling to temper the environment in order to pass the overheating criteria. This is not full air conditioning but will allow for enough cooling to meet the standard.

Therefore, the study shows that all sampled accommodation passes the CIBSE TM59 overheating standard.

The room specific results are presented overleaf. The results are based on the assumptions contained within the report associated with heat gains, building operation, construction thermal properties and windows openings.

COMMERCIAL OVERHEATING (TM52)

The commercial area has solar control glazing (g value 0.4) to reduce the solar gains. Openable area and mechanical ventilation enable fresh air to circulate through the space, which is dual aspect, enabling effective removal of warm air.

Commercial overheating is considered to occur if an occupied room fails two or more criteria:

- Criteria 1 – Annual Overheating Hours.

  3% of occupied hours the operative temperature exceeds the threshold comfort temperature (upper limit of the range of comfort temperature) by 1°C from 1st May to 30th September.

- Criteria 2 – Daily Temperature Exceedance

  To allow for the severity of overheating, the weighted exceedance shall be less than or equal to 6 in any one day. For example, the operative temperature exceeds the threshold comfort temperature by 2°C over 4 hours in one day then that area would fail (as 2 x 4 = 8).

- Criteria 3 – Overheating Temperature maximum limit

  An absolute maximum value for the indoor operative temperature which shall not exceed the threshold comfort temperature by more than 4°C.

The commercial space passes the CIBSE TM52 overheating standard.

There will be periods in the year where the commercial areas will have higher internal gains than the typical use case examined in this study. Therefore, active cooling will be provided in communal areas to allow for flexibility of use.

Blinds have not been used in the dynamic model in order to achieve the pass ratings given overleaf. Therefore, there are additional measures that can be put in place to decrease the risk should overheating become an issue in the future in certain areas. A building user guide will be created to help building users manage overheating.

Flat & Room Name	Criteria 1 – Overheating Hours		Criteria 2 – Overheating Temperatures Limit (bedrooms only)	
	(3% or less)	Pass/Fail	(1% or less annual hours over 26°C, 10pm-7am)	Pass/Fail
Unit 1 Bedroom 1	0	Pass	0.30	Pass
Unit 1 Bedroom 2	0	Pass	0.43	Pass
Unit 1 Kitchen/Living	1.3	Pass	-	-
Unit 2 Bedroom 1	0	Pass	0.27	Pass
Unit 2 Bedroom 2	0	Pass	0.33	Pass
Unit 2 Bedroom 3	0.9	Pass	0.46	Pass
Unit 2 Kitchen/Living	0	Pass	-	-
Unit 3 Bedroom 1	0.2	Pass	0.40	Pass
Unit 3 Kitchen/Living	0	Pass	-	-
Unit 4 Bedroom 1	0.1	Pass	0.43	Pass
Unit 4 Bedroom 2	0	Pass	0.30	Pass
Unit 4 Kitchen/Living	2.4	Pass	-	-
Unit 5 Bedroom 1	0	Pass	0.37	Pass
Unit 5 Bedroom 2	0	Pass	0.21	Pass
Unit 5 Kitchen/Living	1.2	Pass	-	-
Unit 6 Bedroom 1	0	Pass	0.30	Pass
Unit 6 Kitchen/Living	0	Pass	-	-
Unit 7 Bedroom 1	0	Pass	0.33	Pass
Unit 7 Bedroom 2	0	Pass	0.21	Pass
Unit 7 Kitchen/Living	1.2	Pass	-	-
Unit 8 Bedroom 1	0	Pass	0.21	Pass
Unit 8 Bedroom 2	0	Pass	0.27	Pass
Unit 8 Kitchen/Living	1.4	Pass	-	-
Unit 9 Bedroom 1	0	Pass	0.27	Pass
Unit 9 Bedroom 1	0	Pass	0.27	Pass
Unit 9 Kitchen/Living	1.5	Pass	-	-

Table 1: Residential overheating analysis results (case 3)

Room Name	Criteria 1 – Annual Overheating Hours	Criteria 2 – Daily Temp Exceedance	Criteria 3 – Overheating Max Limit	Pass/Fail
	(target: 3% or less)	(target 6°C.Hrs or less)	(target 4°C or less)	Pass 2 out of 3
Commercial Space	2.0	21	3	Pass

Table 2: Commercial space overheating analysis results

2 Introduction

This overheating analysis has been prepared by Integration Consultancy Limited in support of the full planning application for the proposed new-build development at City House, Sutton.

The health and wellbeing impacts of overheating can be significant for residents and this type of study becomes increasingly important in the context of climate change. Overheating can result in stress, anxiety, sleep deprivation and even early deaths in heat waves especially for vulnerable occupants. The Committee on Climate Change has estimated that mortality rates in the UK arising from overheating could rise from 2000 per year in 2015 to 7000 per year by 2050.

2.1 THE DEVELOPMENT SITE

The site is located at City House, Sutton Park Road, Sutton.

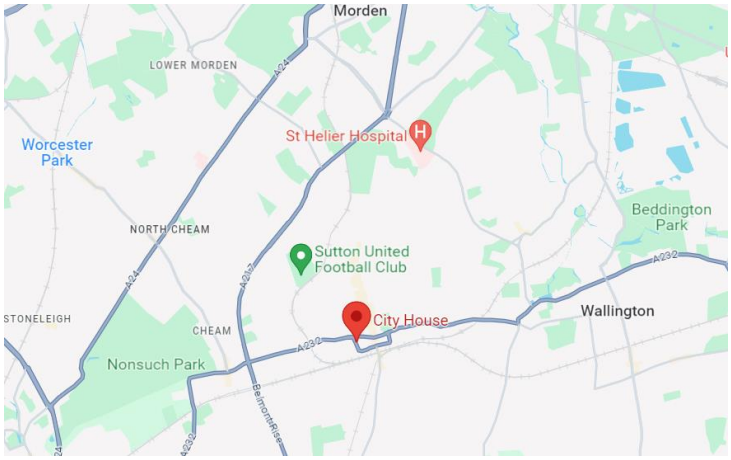


Figure 1: Site Location

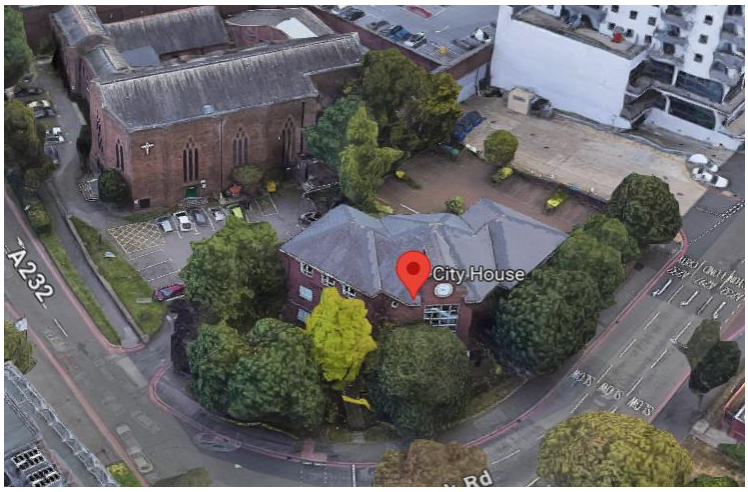


Figure 2: Aerial view of site.

2.2 PROPOSED DEVELOPMENT OVERVIEW

The development comprises the demolition of existing building and erection of a part 13-storey and part 5-storey building, for 70 'build to rent' residential apartments (Class C3), 191m^2 (NIA) office space (Class E(g)(i)) and associated landscape and public realm improvements.

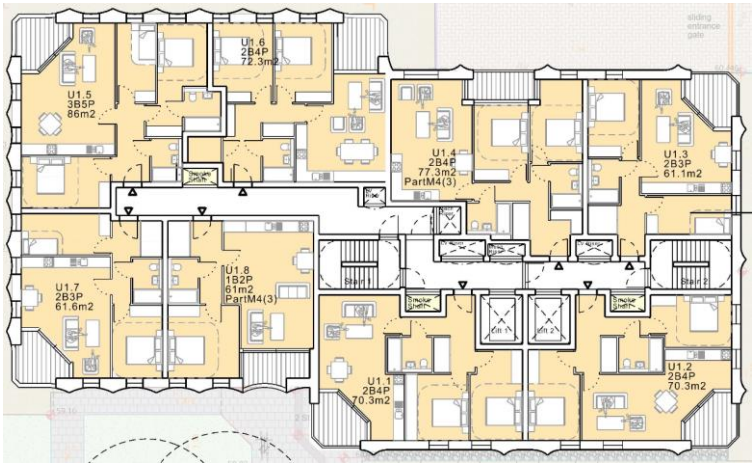


Figure 3: Proposed development scheme, typical 'low' floor

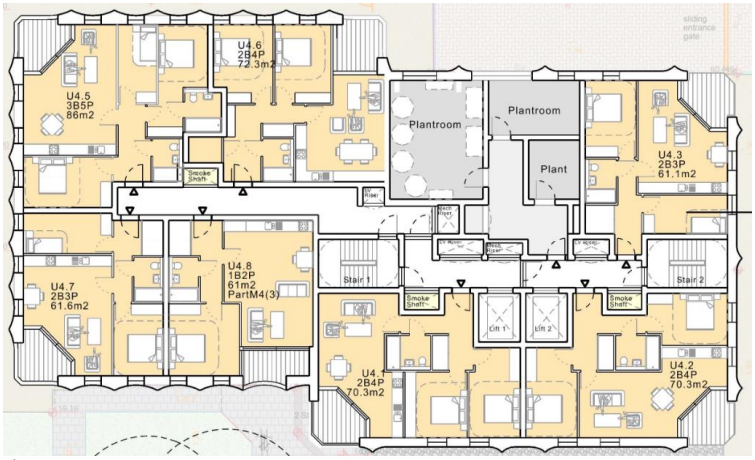


Figure 4: Proposed development scheme, 4th floor

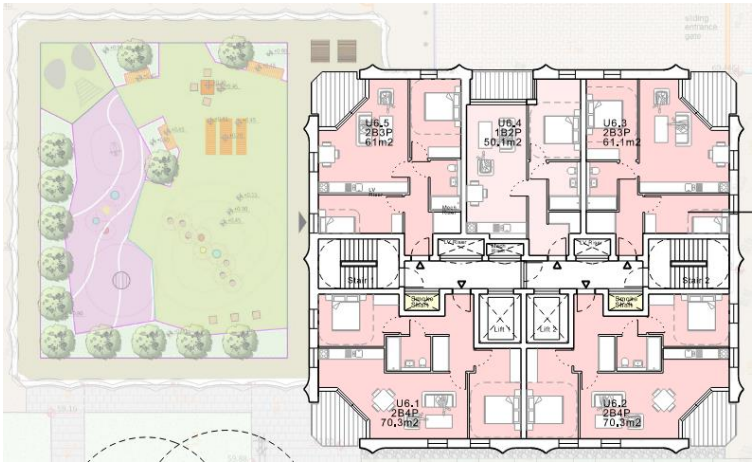


Figure 5: Proposed development scheme, typical 'high' floor

Figure 6: Proposed development scheme: North Elevation (left), South Elevation (right)

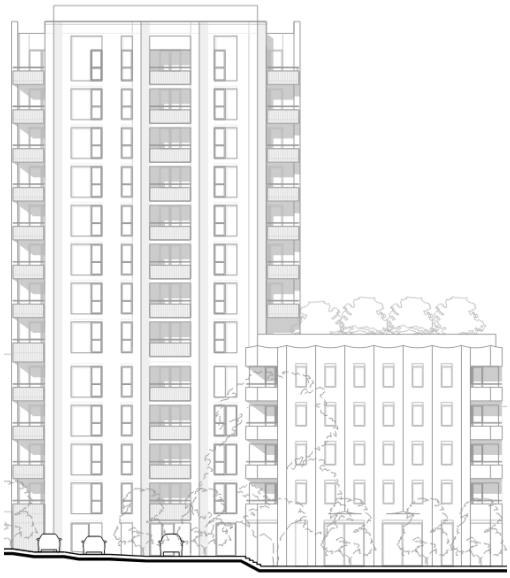


Figure 7: Proposed development scheme, East Elevation

2.3 CIBSE TM59 RESIDENTIAL OVERHEATING REQUIREMENT

The analysis follows the CIBSE Technical Memorandum TM59 (2017) methodology. This is a standardised approach predicting overheating risk for residential building design using dynamic thermal analysis.

The methodology builds on the CIBSE TM52 (2012) method and has been through several rounds of testing on a variety of real and prototype projects. The results of the testing indicate that the methodology is reliable.

Overheating is considered to occur if an occupied room fail any of the following criteria:

- Criteria 1 – Overheating Hours.

  3% of occupied hours the operative temperature exceeds the threshold comfort temperature (upper limit of the range of comfort temperature) by 1°C from 1st May to 30th September. This is Criteria 1 of CIBSE TM52.

- Criteria 2 – Overheating Temperature limit (Bedrooms only)

  During sleeping hours, the operative temperature in the bedroom from 10pm to 7 am shall not exceed 26°C for more than 1% of annual hours (note: 1% of annual hours between 10pm and 7am is 32 hours. Therefore 33 or more hours a year above 26°C will be recorded as a fail).

The assessment examines the performance of the residential accommodation. Typically, areas at most risk are occupied areas that:

- Have large unshaded glazing area (especially south facing).
- Are on the highest floor levels with the least shading from surrounding buildings and trees.
- Have limited openable windows.
- Have single aspects windows (which may limit the efficacy of natural ventilation).

A representative sample of the worst-case units have been sampled as part of this exercise, including the top floors of both building segments.

2.4 NOISE

Noise has been identified at the planning stage as a key consideration and has been surveyed for this development. An acoustic assessment conducted by Aval Consulting Group has shown that the Part O noise criteria, summarised below, have been exceeded for all elevations. Therefore, in term of TM59 overheating modelling it must be assumed, to provide adequate noise attenuation, all bedroom windows must be closed at night.

> *In locations where external noise may be an issue (for example, where the local planning authority considered external noise to be an issue at the planning stage), the overheating mitigation strategy should take account of the likelihood that windows will be closed during sleeping hours (11pm to 7am).*
>
> *Windows are likely to be closed during sleeping hours if noise within bedrooms exceeds the following limits.*
>
> > *a. 40dB $L_{Aeq,T}$, averaged over 8 hours (between 11pm and 7am).*
> >
> > *b. 55dB L_{AFmax}, more than 10 times a night (between 11pm and 7am).*
>
> *Where in-situ noise measurements are used as evidence that these limits are not exceeded, measurements should be taken in accordance with the Association of Noise Consultants' Measurement of Sound Levels in Buildings with the overheating mitigation strategy in use.*

2.5 SECURITY

There are no bedrooms on the ground floor or those which are easily accessible.

3 Thermal Model – Residential

3.1 MODEL SETUP

The CIBSE Technical Memorandum TM59 and 52 methodologies require the creation of a 3D dynamic thermal model of the proposed development. The set-up is described below.

Software: IES VE PRO Engineer (2023)

Weather Data: CIBSE DSY 1 (Design Summer Year) for London Heathrow 2020 high emissions 50th percentile.

Sampling: The study considers a representative sample of the worst-case units, including the top floors of both building segments.

Model Assumptions: Input values are presented in the tables below.

In line with Part O of the UK Building Regulations, openable windows start to open when internal temperature exceeds 22°C and reach fully open when internal temperature reaches 26°C, between the hours 8:00-23:00. From 23:00-08:00, openable windows are opened if the internal temperature exceeds 23°C.

Geometry Data: Geometry is depicted below and is based on drawing as indicated the table below.

All areas modelled have been zoned into separate rooms including living areas, bedrooms, bathrooms and halls etc. Building construction are modelled as proposed and reflect thermal properties such as thermal mass, insulation and airtightness.

Internal doors are considered to be closed at night.

Drawing No (version)	Name	Source
WP-0816-A-0172-P-Low	Typical Low Floor Proposed Schematic Plan	Wimshurst Pelleriti
WP-0816-A-1055-P-High	Typical High Floor Proposed Schematic Plan	Wimshurst Pelleriti
WP-0816-A-0203-E-S	South Elevation Proposed	Wimshurst Pelleriti
WP-0816-A-0203-E-N	North Elevation Proposed	Wimshurst Pelleriti
WP-0816-A-0204-E-E	East Elevation Proposed	Wimshurst Pelleriti

Table 3: Drawings used to create the dynamic thermal model

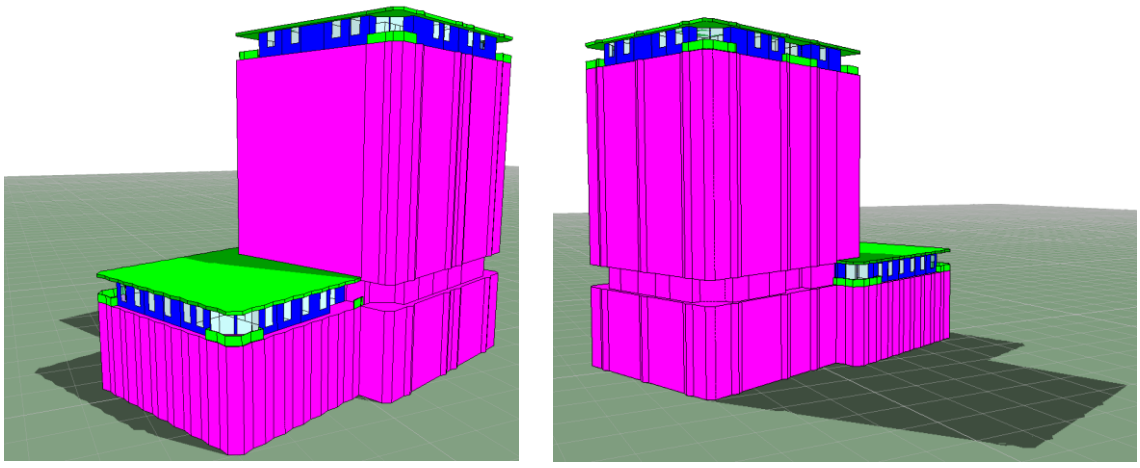


Figure 8: Model geometry: development viewed from the north-west (left), south-east (right)

The building construction and operation is summarised as follows:

Element	Inputs
External Walls	0.15 W/m^{2}K
Floor	0.12 W/m^{2}K
Roof	0.10 W/m^{2}K
Windows	1.2 W/m^{2}K (g value 0.4)
Air Tightness	3.0 m^3/m^2/h @50Pa

Table 4: Building envelope

The overheating strategy for the development includes solar control glazing (g value 0.4) and large openable window areas. The scheme introduces external shading in the form of overhangs over balcony areas, deep reveals and balcony walls to reduce direct solar gains during the hottest hours of the day.

3.2 WINDOW OPENINGS

Natural ventilation is essential to remove excess heat during the summer months and enable the provision of high air quality. When used in combination with exposed thermal mass, natural ventilation will reduce internal daily temperature fluctuations and minimise the overheating risk. The window openings are summarised below.

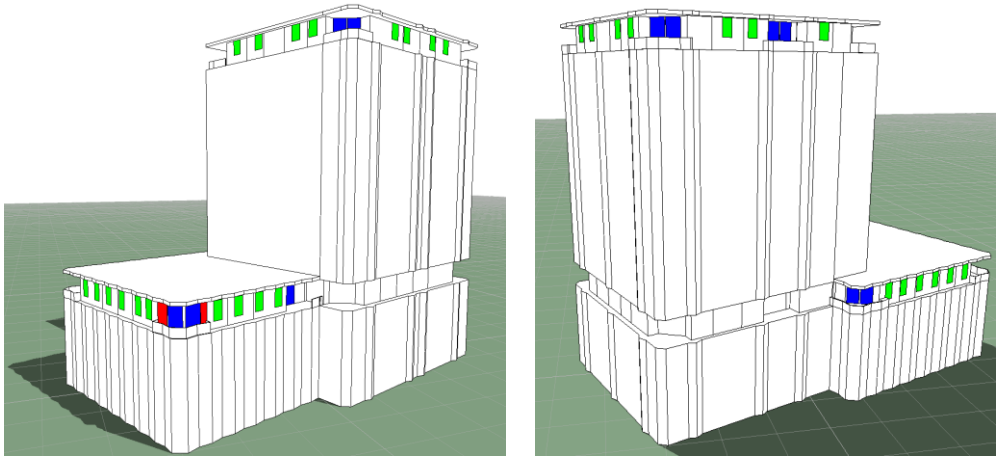


Figure 9: Window Types – refer to table below. North-west (left), south-east (right

Window Type	Description	Total openable area (as a proportion of the glazing area)
Type 1 (RED)	Fixed glazing	0% openable
Type 2 (GREEN)	Top Hung windows 30 degrees	100% openable
Type 3 (BLUE)	Side Hung Doors 90 degrees	100% openable

Table 5: Window types

As described in Section 2.4, acoustic restrictions apply, and bedroom windows must remain closed at night.

3.3 LIGHTING, EQUIPMENT AND OCCUPANCY GAINS

The TM59 occupancy residential gains used in the modelling process are given below.

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. 200 W from 8 pm to 10 pm. 110 W from 9 am to 6 pm and from 10 pm to 12 pm. Base load of 85 W for the rest of the day
2-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. 200 W from 8 pm to 10 pm. 110 W from 9 am to 6 pm and from 10 pm to 12 pm. Base load of 85 W for the rest of the day
3-bedroom apartment: living room/kitchen	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. 200W from 8 pm to 10 pm. 110 W from 9 am to 6 pm and from 10 pm to 12 pm. Base load of 85 W for the rest of the day.
Double bedroom	3 people at 25% gains from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 300 W from 6 pm to 8 pm. Base load of 50 W for the rest of the day.

Table 6: Residential occupancy and equipment gains

3.4 MODEL RESULTS

3.4.1 Case 1 – Initial Results – Without Window Restrictions

The room specific results from the study are given below.

The initial study shows that the spaces pass the CIBSE TM59 overheating standard when there are no window restrictions. This shows that the scheme is well designed in terms of overheating.

Flat & Room Name	Criteria 1 – Overheating Hours		Criteria 2 – Overheating Temperatures Limit (bedrooms only)	
	(3% or less)	Pass/Fail	(1% or less annual hours over 26°C, 10pm-7am)	Pass/Fail
Unit 1 Bedroom 1	0	Pass	0.61	Pass
Unit 1 Bedroom 2	0	Pass	0.73	Pass
Unit 1 Kitchen/Living	2.1	Pass	-	-
Unit 2 Bedroom 1	0	Pass	0.37	Pass
Unit 2 Bedroom 2	0	Pass	0.70	Pass
Unit 2 Bedroom 3	0.9	Pass	0.46	Pass
Unit 2 Kitchen/Living	0	Pass	-	-
Unit 3 Bedroom 1	0.3	Pass	0.52	Pass
Unit 3 Kitchen/Living	0	Pass	-	-
Unit 4 Bedroom 1	0.3	Pass	0.79	Pass
Unit 4 Bedroom 2	0	Pass	0.67	Pass
Unit 4 Kitchen/Living	2.8	Pass	-	-
Unit 5 Bedroom 1	0	Pass	0.64	Pass
Unit 5 Bedroom 2	0	Pass	0.58	Pass
Unit 5 Kitchen/Living	1.4	Pass	-	-
Unit 6 Bedroom 1	0	Pass	0.70	Pass
Unit 6 Kitchen/Living	0.7	Pass	-	-
Unit 7 Bedroom 1	0	Pass	0.70	Pass
Unit 7 Bedroom 2	0	Pass	0.64	Pass
Unit 7 Kitchen/Living	1.4	Pass	-	-
Unit 8 Bedroom 1	0	Pass	0.67	Pass
Unit 8 Bedroom 2	0	Pass	0.67	Pass
Unit 8 Kitchen/Living	1.5	Pass	-	-
Unit 9 Bedroom 1	0	Pass	0.70	Pass
Unit 9 Bedroom 1	0	Pass	0.70	Pass
Unit 9 Kitchen/Living	1.7	Pass	-	-

Table 7: Case 1 initial overheating analysis results

3.4.2 Case 2 – With Window Opening Restrictions

Case 2 applies the window restrictions discussed in Section 2.4. The room specific results from the study are given below.

The initial study shows that the sampled bedroom spaces all fail the CIBSE TM59 overheating standard due to the restriction in openable area.

Flat & Room Name	Criteria 1 – Overheating Hours		Criteria 2 – Overheating Temperatures Limit (bedrooms only)	
	(3% or less)	Pass/Fail	(1% or less annual hours over 26°C, 10pm-7am)	Pass/Fail
Unit 1 Bedroom 1	0.4	Pass	6.03	Fail
Unit 1 Bedroom 2	1.8	Pass	7.61	Fail
Unit 1 Kitchen/Living	2.3	Pass	-	-
Unit 2 Bedroom 1	0.2	Pass	7.52	Fail
Unit 2 Bedroom 2	2.2	Pass	11.75	Fail
Unit 2 Bedroom 3	1.7	Pass	4.44	Fail
Unit 2 Kitchen/Living	0.3	Pass	-	-
Unit 3 Bedroom 1	1.7	Pass	5.30	Fail
Unit 3 Kitchen/Living	0	Pass	-	-
Unit 4 Bedroom 1	1.9	Pass	6.18	Fail
Unit 4 Bedroom 2	1	Pass	4.72	Fail
Unit 4 Kitchen/Living	3.2	Fail	-	-
Unit 5 Bedroom 1	0.3	Pass	3.20	Fail
Unit 5 Bedroom 2	0.2	Pass	4.08	Fail
Unit 5 Kitchen/Living	1.8	Pass	-	-
Unit 6 Bedroom 1	0.9	Pass	8.10	Fail
Unit 6 Kitchen/Living	1.2	Pass	-	-
Unit 7 Bedroom 1	0.7	Pass	6.36	Fail
Unit 7 Bedroom 2	0.7	Pass	5.27	Fail
Unit 7 Kitchen/Living	1.9	Pass	-	-
Unit 8 Bedroom 1	0.2	Pass	6.03	Fail
Unit 8 Bedroom 2	1.1	Pass	6.58	Fail
Unit 8 Kitchen/Living	1.8	Pass	-	-
Unit 9 Bedroom 1	1.1	Pass	6.58	Fail
Unit 9 Bedroom 1	0.2	Pass	6.58	Fail
Unit 9 Kitchen/Living	2	Pass	-	-

Table 8: Case 2 overheating analysis results with bedroom window restriction at night.

3.4.3 Case 3 – Final Proposal

A mechanical purge solution to bedroom nighttime overheating was explored, in order to compensate for the opening area restrictions. Mechanical ventilation of 45l/s was added to each bedroom, to purge hot air building up overnight. This option was not able to meet the TM59 standard.

The mechanical ventilation with heat recovery system in each apartment is proposed to be supplemented with cooling which follows the cooling hierarchy. This scenario models 15l/s provided to bedrooms and living areas, using a NUAIRE MRXBOX Hybrid Cooling System, details of which are presented in Appendix A.

As demonstrated by the previous cases, the addition of supplementary cooling through the existing ventilation system is required to comply with the overheating criteria. This is due to the acoustic restrictions, which limit the ability of the units to purge hot air at night when temperatures are cooler.

These results shows that each sampled unit meets the CIBSE TM59 overheating standard.

The room specific results from the study are given below.

Flat & Room Name	Criteria 1 – Overheating Hours		Criteria 2 – Overheating Temperatures Limit (bedrooms only)	
	(3% or less)	Pass/Fail	(1% or less annual hours over 26°C, 10pm-7am)	Pass/Fail
Unit 1 Bedroom 1	0	Pass	0.30	Pass
Unit 1 Bedroom 2	0	Pass	0.43	Pass
Unit 1 Kitchen/Living	1.3	Pass	-	-
Unit 2 Bedroom 1	0	Pass	0.27	Pass
Unit 2 Bedroom 2	0	Pass	0.33	Pass
Unit 2 Bedroom 3	0.9	Pass	0.46	Pass
Unit 2 Kitchen/Living	0	Pass	-	-
Unit 3 Bedroom 1	0.2	Pass	0.40	Pass
Unit 3 Kitchen/Living	0	Pass	-	-
Unit 4 Bedroom 1	0.1	Pass	0.43	Pass
Unit 4 Bedroom 2	0	Pass	0.30	Pass
Unit 4 Kitchen/Living	2.4	Fail	-	-
Unit 5 Bedroom 1	0	Pass	0.37	Pass
Unit 5 Bedroom 2	0	Pass	0.21	Pass
Unit 5 Kitchen/Living	1.2	Pass	-	-
Unit 6 Bedroom 1	0	Pass	0.30	Pass
Unit 6 Kitchen/Living	0	Pass	-	-
Unit 7 Bedroom 1	0	Pass	0.33	Pass
Unit 7 Bedroom 2	0	Pass	0.21	Pass
Unit 7 Kitchen/Living	1.2	Pass	-	-
Unit 8 Bedroom 1	0	Pass	0.21	Pass
Unit 8 Bedroom 2	0	Pass	0.27	Pass
Unit 8 Kitchen/Living	1.4	Pass	-	-
Unit 9 Bedroom 1	0	Pass	0.27	Pass
Unit 9 Bedroom 1	0	Pass	0.27	Pass
Unit 9 Kitchen/Living	1.5	Pass	-	-

Table 9: Final overheating analysis results

4 Thermal Model – Commercial

4.1 CIBSE TM52 COMMERCIAL OVERHEATING REQUIREMENT

Non domestic overheating, is considered to occur if an occupied room fails two or more criteria:

- Criteria 1 – Annual Overheating Hours.

  3% of occupied hours the operative temperature exceeds the threshold comfort temperature (upper limit of the range of comfort temperature) by 1°C from 1st May to 30th September.

- Criteria 2 – Daily Temperature Exceedance

  To allow for the severity of overheating, the weighted exceedance shall be less than or equal to 6 in any one day. For example, the operative temperature exceeds the threshold comfort temperature by 2°C over 4 hours in one day then that area would fail (as 2 x 4 = 8).

- Criteria 3 – Overheating Temperature maximum limit

  An absolute maximum value for the indoor operative temperature which shall not exceed the threshold comfort temperature by more than 4°C.

4.2 MODEL SETUP

The CIBSE Technical Memorandum TM 52 methodology require the creation of a 3D dynamic thermal model of the proposed development. The set-up is described below.

Software: IES VE PRO Engineer (2023)

Weather Data: CIBSE DSY 1 (Design Summer Year) for London Heathrow 2020 high emissions 50th percentile.

Sampling: The study considers the ground floor commercial space.

Model Assumptions: Input values are presented in the tables below. Openable windows open when the internal temperature exceeds 20˚C.

Geometry Data: Geometry is depicted below and is based on drawing as indicated the table below.

All areas modelled have been zoned into separate rooms including living areas, bedrooms, bathrooms and halls etc. Building construction are modelled as proposed and reflect thermal properties such as thermal mass, insulation and airtightness.

Internal doors are considered to be closed at night.

Drawing No (version)	Name	Source
WP-0816-A-0151-P-GF	Ground Floor Proposed Schematic Plan	Wimshurst Pelleriti

Table 10: Drawings used to create the dynamic thermal model

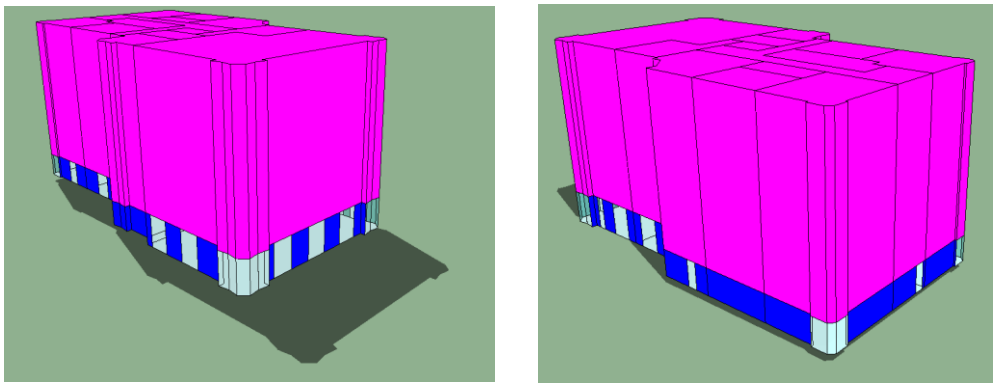


Figure 10: Model geometry: development viewed from the north-east (left), south-west (right)

The building construction and operation is summarised as follows:

Element	Inputs
External Walls	0.15 W/m^{2}K
Floor	0.12 W/m^{2}K
Windows	1.2 W/m^{2}K (g value 0.4)
Air Tightness	3.0 m^3/m^2/h @50Pa

Table 11: Building envelope

The overheating strategy for the commercial areas includes solar control glazing (g value 0.4) and openable window areas. The space is dual aspect which allows for cross ventilation to effectively purge hot air from the space.

4.3 WINDOW OPENINGS

Natural ventilation is essential to remove excess heat during the summer months and enable the provision of high air quality. When used in combination with exposed thermal mass, natural ventilation will reduce internal daily temperature fluctuations and minimise the overheating risk. The window openings are summarised below.

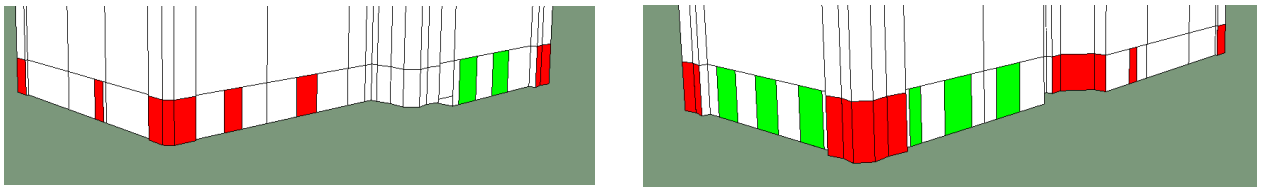


Figure 11: Window Types – refer to table below. North-west (left), south-east (right)

Window Type	Description	Total openable area (as a proportion of the glazing area)
Type 1 (RED)	Fixed glazing/doors	0% openable
Type 2 (GREEN)	Openable windows	20% openable

Table 12: Window types

4.4 EQUIPMENT AND OCCUPANCY GAINS

The commercial space is assumed to have 10m^2/person occupancy, 5W/m^2 equipment and 5W/m^2 lighting during the hours of 7am-10pm. Mechanical ventilation is is also supplied at 10l/s/p.

4.5 MODEL RESULTS

The room specific results from the study are given below. The study shows that the sampled spaces pass the CIBSE TM52 overheating standard.

Room Name	Criteria 1 – Annual Overheating Hours	Criteria 2 – Daily Temp Exceedance	Criteria 3 – Overheating Max Limit	Pass/Fail
	(target: 3% or less)	(target 6°C.Hrs or less)	(target 4°C or less)	Pass 2 out of 3
Commercial Space	2.0	21	3	Pass

Table 13: Commercial space overheating analysis results

There will be periods in the year where the commercial areas will host activities that have higher internal gains than the general use case examined in this study. Therefore, active cooling will be provided in this area to allow for flexibility of use.

5 Conclusions

5.1 RESIDENTIAL OVERHEATING (TM59)

An acoustic survey has been carried out to determine the impact of external noise to residents during the night-time. The acoustician has advised that the local background noise level at night exceeds the Part O noise criteria and, to mitigate the level of noise entering bedrooms at night, windows should remain closed.

The overheating strategy for the development comprises primarily of solar control glazing (g value 0.4) and large openable window areas. The scheme introduces external shading in the form of overhangs over balcony areas, deep reveals and balcony walls to reduce direct solar gains during the hottest hours of the day.

The results show that high openable window area and solar control significantly are not sufficient to meet the TM59 standard when acoustic restrictions are applied. Therefore, to account for the restrictions to window openings at night, the mechanical ventilation with heat recovery units in each residential unit will have supplementary cooling to temper the environment. This is not full air conditioning but will allow for enough cooling to meet the TM59 standard.

Residential overheating is considered to occur if an occupied room fails any of the following two criteria:

- Criteria 1 – Annual Overheating Hours (living rooms, kitchen and bedrooms).

  3% of occupied hours the operative temperature exceeds the threshold comfort temperature (upper limit of the range of comfort temperature) by 1°C from 1st May to 30th September.

- Criteria 2 – Overheating Temperature limit (Bedrooms only)

  During sleeping hours the operative temperature in the bedroom from 10pm to 7 am shall not exceed 26°C for more than 1% of annual hours.

The study shows that the sampled residential units pass the CIBSE TM59 overheating standard.

Blinds have not been used in the dynamic model in order to achieve the pass ratings given below. Therefore, there are additional measures that can be put in place to decrease the risk should overheating become an issue in the future in certain areas. A building user guide will be created to help building users manage overheating.

5.2 COMMERCIAL OVERHEATING (TM52)

The commercial area has solar control glazing (g value 0.4) to reduce the solar gains. Openable area and mechanical ventilation enable fresh air to circulate through the space, which is dual aspect, enabling effective removal of warm air.

Commercial overheating is considered to occur if an occupied room fails two or more criteria:

- Criteria 1 – Annual Overheating Hours.

  3% of occupied hours the operative temperature exceeds the threshold comfort temperature (upper limit of the range of comfort temperature) by 1°C from 1st May to 30th September.

- Criteria 2 – Daily Temperature Exceedance

  To allow for the severity of overheating, the weighted exceedance shall be less than or equal to 6 in any one day. For example, the operative temperature exceeds the threshold comfort temperature by 2°C over 4 hours in one day then that area would fail (as 2 x 4 = 8).

- Criteria 3 – Overheating Temperature maximum limit

  An absolute maximum value for the indoor operative temperature which shall not exceed the threshold comfort temperature by more than 4°C.

The study shows the sampled communal areas and light industrial building pass the CIBSE TM52 overheating standard.

Appendix A – Aval Consulting Group Acoustic Advice

The following advice was received from an email from Nuvin Boyjonauth from Aval Consulting Group on 26-06-23, which is reproduced below.

From: Nuvin Boyjonauth <nuvin.boyjonauth@aval-group.co.uk>
Sent: Monday, June 26, 2023 5:15 PM
To: Joaquin Vizcaino <Joaquin@wp.uk.com>; Megan Tudor <megan.tudor@aval-group.co.uk>
Cc: Aval Consulting Group <contact@aval-group.co.uk>; Pratheek Ramesh <pratheek.ramesh@aval-group.co.uk>; Alan Harries <alan.harries@integrationuk.com>; Will Wimshurst <will@wp.uk.com>
Subject: RE: [WP: 00816] [INTEG: 0762] City House Sutton - Acoustic and air quality reports

Hi Joaquin,

Unfortunately, the windows would need to be fully closed to achieve the desired noise reduction as flanking would still occur even if the windows are open just a little bit and substantial levels of noise would still break in regardless of the internal floor area.

In regard to the Lmax, if the exceedances were below 10 we could use this as an argument, however, since the exceedances are more like 20+, this is significantly adverse and the mitigation required would be 77 – 55 = 22dB, which can only be achieved by closed windows.

We therefore conclude that one of the options we have would be to have acoustically attenuated openings which would permit the windows to be open, otherwise, as a second option, a purge ventilation unit would be adequate.

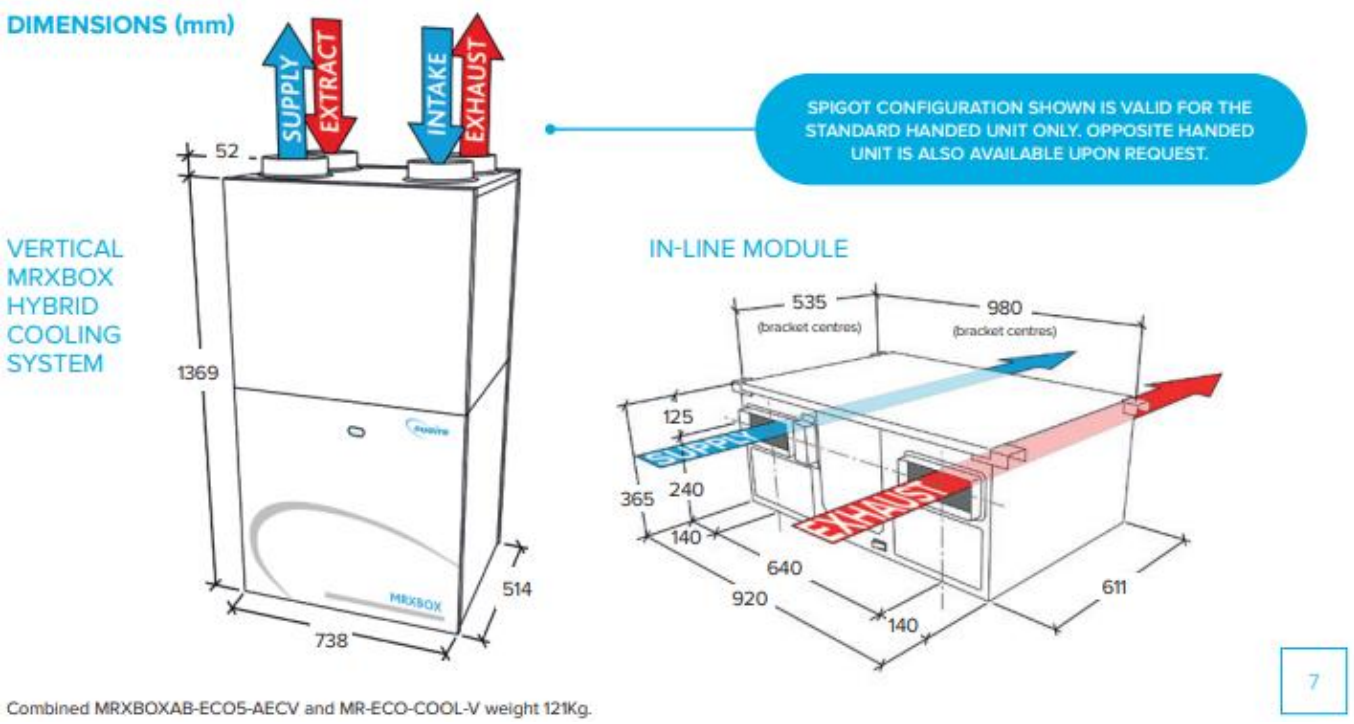
I hope this meets you well.

Best Regards,
Nuvin Boyjonauth
Senior Environmental Consultant

Aval Consulting Group.

Appendix B – NUAIRE MRXBOX Hybrid Cooling System

The NUAIRE MRXBOX Hybrid Cooling System attaches to the proposed mechanical ventilation with heat recovery system to temper the air.



The system has a range of cooling outputs, depending on the internal and external temperature. A conservative temperature offset of -12.0˚C has been used for the overheating modelling, taken from the manufacturers IES integration sheet below.

29°C DB External Vs Temp offset (reduction) from external

Conditions	Cooling/Airflow	70	80	90
23°C Internal	Supply air °C	15.2	15.7	16.2
	Temp. Offset	13.8	13.3	12.8
24° C Internal	Supply air °C	15.9	16.3	16.8
	Temp. Offset	13.1	12.7	12.2
25° C Internal	Supply air °C	16.4	16.9	17.4
	Temp. Offset	12.6	12.1	11.6
26° C Internal	Supply air °C	17.0	17.5	18.1
	Temp. Offset	12.0	11.5	10.9

Appendix C – DSY 2 and DSY 3 reference results

The overheating modelling in this report has been conducted using the DSY1 (Design Summer Year) for the 2020s, high emissions, 50% percentile scenario. The CIBSE compliance criteria has been met for the DSY1 weather scenario.

However, additional reference testing has been undertaken using the 2020 versions of the following more extreme design weather years:

- DSY2 – 2003: a year with a very intense single warm spell.
- DSY3 – 1976: a year with a prolonged period of sustained warmth.

The results for DSY2 and DSY 3, for reference, are given below.

Flat & Room Name	**Criteria 1 – Overheating Hours**		**Criteria 2 – Overheating Temperature Limit (bedrooms only)**	
	(3% or less)	**Pass/Fail**	**(1% or less annual hours over 26°C, 10pm-7am)**	**Pass/Fail**
Unit 1 Bedroom 1	0	Pass	0.82	Pass
Unit 1 Bedroom 2	0.2	Pass	0.79	Pass
Unit 1 Kitchen/Living	1.3	Pass	-	-
Unit 2 Bedroom 1	0	Pass	0.97	Pass
Unit 2 Bedroom 2	0	Pass	0.73	Pass
Unit 2 Bedroom 3	1.6	Pass	1.25	Fail
Unit 2 Kitchen/Living	0.8	Pass	-	-
Unit 3 Bedroom 1	0.6	Pass	1.07	Fail
Unit 3 Kitchen/Living	0	Pass	-	-
Unit 4 Bedroom 1	0.7	Pass	1.00	Pass
Unit 4 Bedroom 2	0	Pass	0.61	Pass
Unit 4 Kitchen/Living	2.9	Pass	-	-
Unit 5 Bedroom 1	0	Pass	0.79	Pass
Unit 5 Bedroom 2	0	Pass	0.52	Pass
Unit 5 Kitchen/Living	2	Pass	-	-
Unit 6 Bedroom 1	0	Pass	0.73	Pass
Unit 6 Kitchen/Living	0	Pass	-	-
Unit 7 Bedroom 1	0	Pass	0.79	Pass
Unit 7 Bedroom 2	0	Pass	0.61	Pass

Unit 7 Kitchen/Living	3.2	Fail	-	-
Unit 8 Bedroom 1	0	Pass	0.64	Pass
Unit 8 Bedroom 2	0	Pass	0.88	Pass
Unit 8 Kitchen/Living	2.5	Pass	-	-
Unit 9 Bedroom 1	0	Pass	0.79	Pass
Unit 9 Bedroom 1	0	Pass	0.79	Pass
Unit 9 Kitchen/Living	1.5	Pass	-	-

Table 14: Overheating analysis results for each residential unit (DSY 2)

Flat & Room Name	**Criteria 1 – Overheating Hours**		**Criteria 2 – Overheating Temperature Limit (bedrooms only)**	
	(3% or less)	**Pass/Fail**	**(1% or less annual hours over 26°C, 10pm-7am)**	**Pass/Fail**
Unit 1 Bedroom 1	0.1	Pass	1.64	Fail
Unit 1 Bedroom 2	0.8	Pass	1.49	Fail
Unit 1 Kitchen/Living	3.3	Fail	-	-
Unit 2 Bedroom 1	0	Pass	2.34	Fail
Unit 2 Bedroom 2	0.4	Pass	1.34	Fail
Unit 2 Bedroom 3	2.7	Pass	2.01	Fail
Unit 2 Kitchen/Living	1	Pass	-	-
Unit 3 Bedroom 1	1.2	Pass	1.92	Fail
Unit 3 Kitchen/Living	0	Pass	-	-
Unit 4 Bedroom 1	1.4	Pass	1.74	Fail
Unit 4 Bedroom 2	0.4	Pass	1.22	Fail
Unit 4 Kitchen/Living	5.9	Fail	-	-
Unit 5 Bedroom 1	0.1	Pass	1.55	Fail
Unit 5 Bedroom 2	0	Pass	0.91	Pass
Unit 5 Kitchen/Living	3.8	Fail	-	-
Unit 6 Bedroom 1	0	Pass	1.46	Fail
Unit 6 Kitchen/Living	1	Pass	-	-
Unit 7 Bedroom 1	0	Pass	1.43	Fail
Unit 7 Bedroom 2	0	Pass	0.94	Pass
Unit 7 Kitchen/Living	4.6	Fail	-	-

Unit 8 Bedroom 1	0	Pass	0.94	Pass
Unit 8 Bedroom 2	0	Pass	1.52	Fail
Unit 8 Kitchen/Living	4.2	Fail	-	-
Unit 9 Bedroom 1	0	Pass	1.52	Fail
Unit 9 Bedroom 1	0	Pass	1.52	Fail
Unit 9 Kitchen/Living	4.2	Fail	-	-

Table 15: Overheating analysis results for each residential unit (DSY 3)

The commercial TM52 results for DSY2 and DSY 3 scenarios are given below.

Flat & Room Name	**Criteria 1 – Annual Overheating Hours**	**Criteria 2 – Daily Temp Exceedance**	**Criteria 3 – Overheating Max Limit**	**Pass/Fail**
	(target 3% or less)	**(target 6 or less)**	**(target 4°C or less)**	**Pass 2 out of 3**
Commercial Space	3.2	37	5	Fail

Table 16: Commercial overheating analysis results for commercial unit (DSY 2)

Room Name	**Criteria 1 – Annual Overheating Hours**	**Criteria 2 – Daily Temp Exceedance**	**Criteria 3 – Overheating Max Limit**	**Pass/Fail**
	(target 3% or less)	**(target 6 or less)**	**(target 4°C or less)**	**Pass 2 out of 3**
Commercial Space	5	35	4	Fail

Table 17: Commercial overheating analysis results for commercial unit (DSY 3)

The GLA acknowledges that meeting the CIBSE compliance criteria is challenging for the DSY 2 & 3 weather files and where the CIBSE compliance criteria is not met for DSY 2 and DSY 3 it should be demonstrated that the risk of overheating has been reduced as far as practical.

In terms of practical overheating reduction, the scheme uses:

- Large openable window areas.
- Exposed thermal mass
- Night cooling strategy.
- High performance glazing with 0.4 g-value.

In addition, as a strategy for residents to cope in extreme weather events, the scheme commits to providing overheating guidance document to occupants to help them manage overheating:

- Explaining cross-flow ventilation and night ventilation.
- Promoting the use of fans to create air movement to cool the skin as well as low energy evaporative cooling fans to cool the air.
- Providing examples of highly reflective screens/binds that can reduce solar gains.
- Showing how to use the MVHR with summer bypass for additional background ventilation.
- Encouraging the use of low energy / heat generating equipment.

As discussed within the main body of the report, the acoustic restrictions described in Appendix A limit the ability of the units to effectively address overheating risk, as such, supplementary cooling has been specified. This has the added benefit of future proofing the spaces against increased temperatures. For the commercial units, higher occupancy and heat gains during the day from equipment will limit the potential of passive cooling and in these cases active cooling will be available from high efficiency equipment.