RS MEP
DESIGN LTD

Dynamic Thermal Comfort Model

34a Netherhall Gardens, London, NW3 5TP

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Issue and Revision Record

Rev	Date	Rev Comments	Produced by	Checked by
0	04/10/24		L Pasifull	

Contents

1. Executive Summary

RSMEP have been appointed to build a dynamic thermal model and undertake a thermal comfort analysis of the new development 34A Netherhall Gardens, to establish if the habitable zones provide comfort levels in line with CIBSE TM59 and Approved Document Part O.

To achieve compliance, dwellings must pass both below criteria:

- For living rooms, kitchens, and bedrooms: the number of hours during which DT is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3 percent of occupied hours. (CIBSE TM52 Criterion 1: Hours of exceedance).
- For bedrooms only: to guarantee comfort during the sleeping hours the operative temperature in the bedroom from 10 pm to 7 am shall not exceed twenty-six °C for more than 1% of annual hours. (Note: 1% of the annual hours between 22:00 and 07:00 for bedrooms is 32 hours, so 33 or more hours above 26 °C will be recorded as a failure).

The initial results of the study identified a compliance failure to the living areas when looking to achieve compliance with the TM59 criteria.

When consulting with the design team, further calculations were conducted and in order to achieve the required internal comfort conditions, the following measures have been proposed:

- 0.63 g-value
- Air conditioning/cooling cassette to all habitable rooms

Accounting for the above proposals, all assessed zones achieve the required internal thermal comfort conditions to show compliance with both Approved Document O (2021) & CIBSE TM59. The above ventilation rates should be checked with the MEP consultant to ensure that this is possible. Failing this, mechanical cooling will be required.

2. Introduction

The overheating assessment for the residential part of the development has been conducted in accordance with the guidance set out in CIBSE TM59: Design Methodology for the Assessment of Overheating in Homes.

The weather data for Gatwick (representative of lower density urban and suburban areas outside the Central Activity Zone) has been used for all scenarios assessed.

The latest DSY weather files have been used to conduct overheating risk assessments using TM59. It is required to pass the overheating criteria using the DSY1 file most appropriate to the site location, for the 2020s, high emissions, 50% percentile scenario. Other files including the more extreme DSY2 and DSY3 files can be used to further test designs but a pass against these other weather files is not mandatory for TM59.

With the view to mitigate any risk of overheating and reduce any reliance on any mechanical cooling, all new developments should be designed in line with the acceptable strategies for reducing overheating risk in mind, these outlined in the Approved Document O (2021) as detailed below:

2.1 Limiting solar gains

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

- Fixed shading devices, comprising any of the following.
- Shutters
- External blinds
- Overhangs
- Awnings

2.1.2 Glazing design, involving any of the following:

- Size
- Orientation
- g-value
- Depth of the window reveal

2.1.3 Building design – for example, the placement of balconies.

2.1.4 Shading provided by adjacent permanent buildings, structures, or landscaping.

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

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

2.2 Removing Excess Heat

The building should be constructed to meet requirement O1 using passive means as far as reasonably practicable. It should be demonstrated to the building control body that all practicable passive means of limiting unwanted solar gains and removing excess heat have been used first before adopting mechanical cooling. Any mechanical cooling (air-conditioning) is expected to be used only where requirement O1 cannot be met using openings.

3. Site Overview

The proposed development sees the Demolition of existing buildings and construction of 4 new dwellings alongside the retention of an existing dwelling. The proposals also include associated access, vehicular parking, private amenity space and landscaping.

3.1 Building Fabric

The following design fabric measures have been used within the simulation model. The measures were obtained from the SAP report.

Element	U Value	
Ground Floors	0.10	W/m^{2}k
External Wall	0.16	W/m^{2}k
Flat Roof	0.10	W/m^{2}k
Pitched Roof	0.10	W/m^{2}k
Windows	1.20	W/m^{2}k
Gg Value	0.63	-
Window Opening Angle	External Doors & Sash windows - 90° All other Windows, Rooflights - 60° Top Roof windows (Second floor) - 60° Bottom Roof windows (Second floor) - 0°	
Front Door	1.00	W/m^{2}k
Design Air Pressure	5	m^3/hm^2 @ 50 Pa.

3.2 Natural Ventilation

Openable windows have been incorporated into the design, to provide natural ventilation throughout. In line with Part O, openable windows are modelled as per the following, provided guidance:

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

- Start to open when the internal temperature exceeds twenty-two.
- Be fully open when the internal temperature exceeds twenty-six.

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

At night (11pm to 8am), openings 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 twenty-three at 11pm.

The free aperture of the windows has been modelled in line with the window schedule available.

The discharge coefficient calculator (Part O – Appendix D) has been used to calculate the equivalent area. Window opening angles have been calculated to comply with Section 3.9 of Approved Document O ‘.

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

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

3.3 Mechanical Ventilation

A mechanical ventilation system has been incorporated into the compliant model, but not in the original model. In this case, the system installed provides appropriate levels of background ventilation. The ventilation system is assumed to achieve minimum Part F ventilation rates to each of the applicable rooms.

3.4 Internal Doors

Internal doors have been modelled and are scheduled to be left open during the daytime (07:00-22:00) but are assumed closed outside of these hours, as per CIBSE TM59.

3.5 Occupancy

The internal occupancy of the dwellings has been modelled in line with CIBSE TM59 – Figure 1, which provides residential occupancy schedules, as detailed in Appendix A of this document.

4. Assessment Methodology

CIBSE TM59:2017 - Design Methodology for Assessment of Overheating Risk in Homes, sets a standardised approach to predicting overheating risk for residential building designs (new-build or major refurbishment) using dynamic thermal analysis.

This document provides a set of profiles that represent reasonable usage patterns for a home suitable for evaluating overheating risk. Where possible the magnitude of gains is taken from CIBSE guidance.

Profiles are developed to evaluate the building design, not to cover all usage modes. Where assumptions for heat and solar gains are taken from established CIBSE guidance. Profiles are developed to evaluate the building design, not to cover all or unusual usage modes, albeit different profiles exist for distinct groups of occupants.

4.1 Methodology Inclusions

- Allows unique designs to be compared with a common approach, based on set assumptions for occupancy and internal gains.
- Supports design decisions that improve comfort without cooling.
- Provides consistency across the industry as all consultants will be using the same methodology for overheating risk prediction.

4.2 Methodology Exclusions

- Guarantee that people will always be comfortable in compliant spaces, however they act.
- Consider unusual or excessive use.

4.3 Modelling Software

Designbuilder, a fully Dynamic Simulation Modelling (DSM) software has been used to produce overheating assessment. Designbuilder is a recommended design tool in accordance with CIBSE AM11: Building Energy and Environmental Modelling.

The process for using DSM tools for predicting overheating risk is that a model of the building is created, using a significant amount of data including building geometry, internal layout, location and orientation of the building, construction details, internal gains, ventilation details and weather data.

The house has been assessed as a **Category II** type dwelling, with normal expectations for occupants in residential buildings, in accordance with CIBSE recommendations, as detailed in the following table:

Category	Notation	Suggested Acceptable Range (K)
I	High level of expectation only used for spaces occupied by very sensitive and fragile persons	± 2
II	Normal expectation (for new buildings and renovations)	± 3
III	A moderate expectation	± 4
IV	Values outside the criteria for the above categories (only acceptable for a limited period)	> 4

4.4 Assessment Criteria for Residential Buildings

CIBSE TM59 sets different overheating compliance criteria for homes that are naturally ventilated and for homes that are mechanically ventilated.

For homes that are naturally ventilated, the method with two criteria should be used to assess overheating. The first overheating criteria, which applies to both living rooms/kitchens and bedrooms, is an adaptive criterion.

The second overheating criterion is a fixed temperature criteria which applies only to bedrooms. Both criteria must be met for all spaces within a home to demonstrate compliance.

For mechanically ventilated homes, the fixed temperature method with a single criterion should be used to assess overheating. This single criterion must be met for all spaces (living rooms/kitchens and bedrooms) within a mechanically ventilated home to demonstrate compliance. The TM59 criteria for naturally and mechanically ventilated homes are summarised:

Assessment Criterion	Applicable Rooms	Occupied Hours	Naturally, Ventilated Homes (Openable Windows)	Mechanically Ventilated Homes (Close Windows)
Criterion one	Living rooms, kitchens and bedrooms	Living /Kitchen / Dining rooms – 9am to 10pm (13 hours/day) Bedrooms – 24-hour occupancy	The number of hours during which external and internal temperature difference 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.	Not Applicable
Criterion two	Bedrooms Only	Bedrooms 24-hour occupancy	The operative temperature in the bedroom from 10 pm to 7 am shall not exceed twenty-six °C for more than 1% of annual hours. **33 or more hours above 26˚C will be a failure**	Not Applicable
Criterion three	Living rooms, kitchens and bedrooms	Living / Kitchen / Dining rooms – 9am to 10pm (13 hours/day) Bedrooms – 24-hour occupancy	Not applicable	The operative temperature in occupied all occupied rooms should not exceed twenty-six for more than 3% of the annual occupied annual hours. **143 or more hours above 26˚C for living rooms and kitchens will be a failure.** **263 or more hours above 26 ˚C for bedrooms will be a failure**

All criteria must be met for all spaces within a home to demonstrate full compliance.

4.5 Weather Data

The overheating risk assessments are conducted using dynamic thermal simulation models, running under the CIBSE Design Summer Year (DSY) weather data. The DSY is a historical year, selected as the year with the third warmest April–September period from a set of 20 years of historical weather data. The current DSY for London is 2020 and the weather data used is from Gatwick.

4.6 External Shading

There is currently no external shading proposed for the dwelling.

4.7 Internal Shading

Although internal blinds and curtains provide some reduction in solar gains and will be installed, they should not and have not been considered when modelling the dwelling.

4.8 Internal Gains

Occupancy and equipment gain of the modelled residential units have been modelled in accordance with CIBSE TM59: 2017 and are summarised in the table below.

Unit Room Type	Occupancy	Equipment Gain
Studio	Two people at all times Sensible gain 150 W/person, latent gain 110 W/person all day	Peak load of 450 W from 6 pm to 8 pm. 200W from 8 pm to 10 pm 110W from 9 am to 6 pm and 10 pm to 12 pm Base load of 85 W for the rest of the day
1-bedroom apartment: living room/kitchen	One person from 9 am to 10 pm; room is unoccupied for the rest of the day Sensible gain 75 W/, latent gain 55 W from 10 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 110W 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	Two people from 9 am to 10 pm; room is unoccupied for the rest of the day Sensible gain 150 W, latent gain 110 W from 10 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 110W 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	Three people from 9 am to 10 pm; room is unoccupied for the rest of the day Sensible gain 225 W, latent gain 165 W from 10 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 110W 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	Two people at 105 W sensible gains, 77 W latent gains from 11 pm to 8 am and 150 W sensible gains, 110 W latent gains from 8 am to 9 am and from ten pm to 11 pm one person at 75 W sensible gains, 55 W latent gains in the bedroom from 9 am to 10 pm	Peak load of 80W from 8 am to 11 pm Base load of 10 W during the sleeping hours
Single bedroom	One person at 52.5 W sensible gains, 38.5 W latent gains from 11 pm to 8 am and 75 W sensible gains, 55 W latent gains from 8 am to 11 pm	Peak load of 80W from 8 am to 11 pm Base load of 10W during sleeping hours
Communal corridors	Assumed to be zero	Sensible gain of 6 W/m2 all day and night
HIU Cupboards	Assumed to be zero	Sensible gain of 50 W all day and night

Lighting gains have been modelled in accordance with CIBSE TM59: 2017 as follows:

- Maximum sensible gain of 2W/m2 from 6 pm to 11 pm is used for energy efficiency lighting.

5. Layout and 3D Model Images

Floor Plans

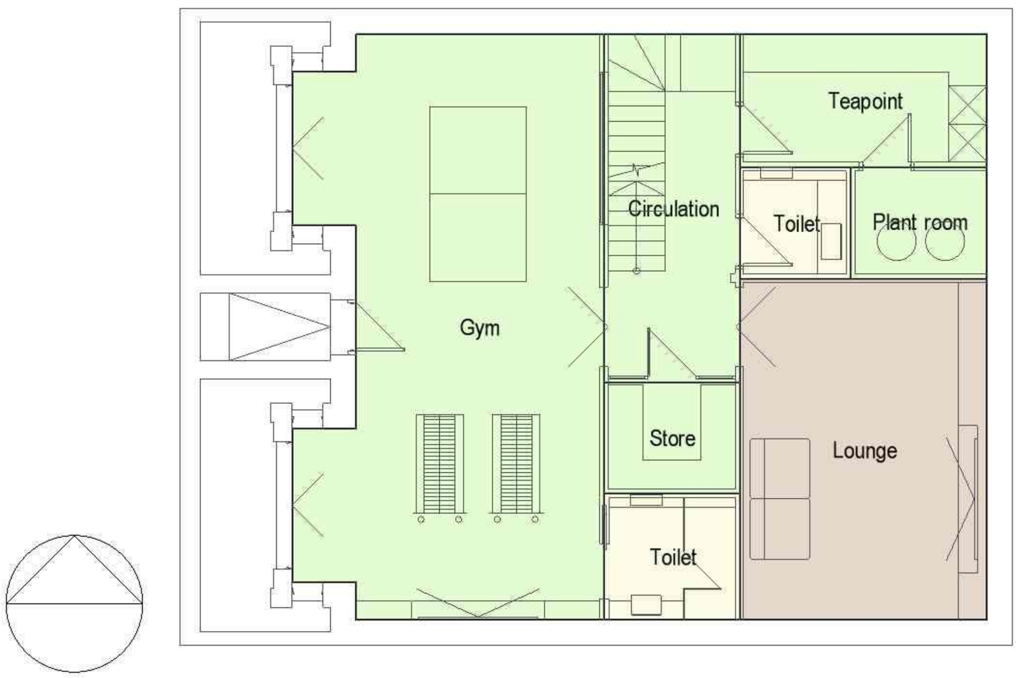

Figure 1. Basement Floor

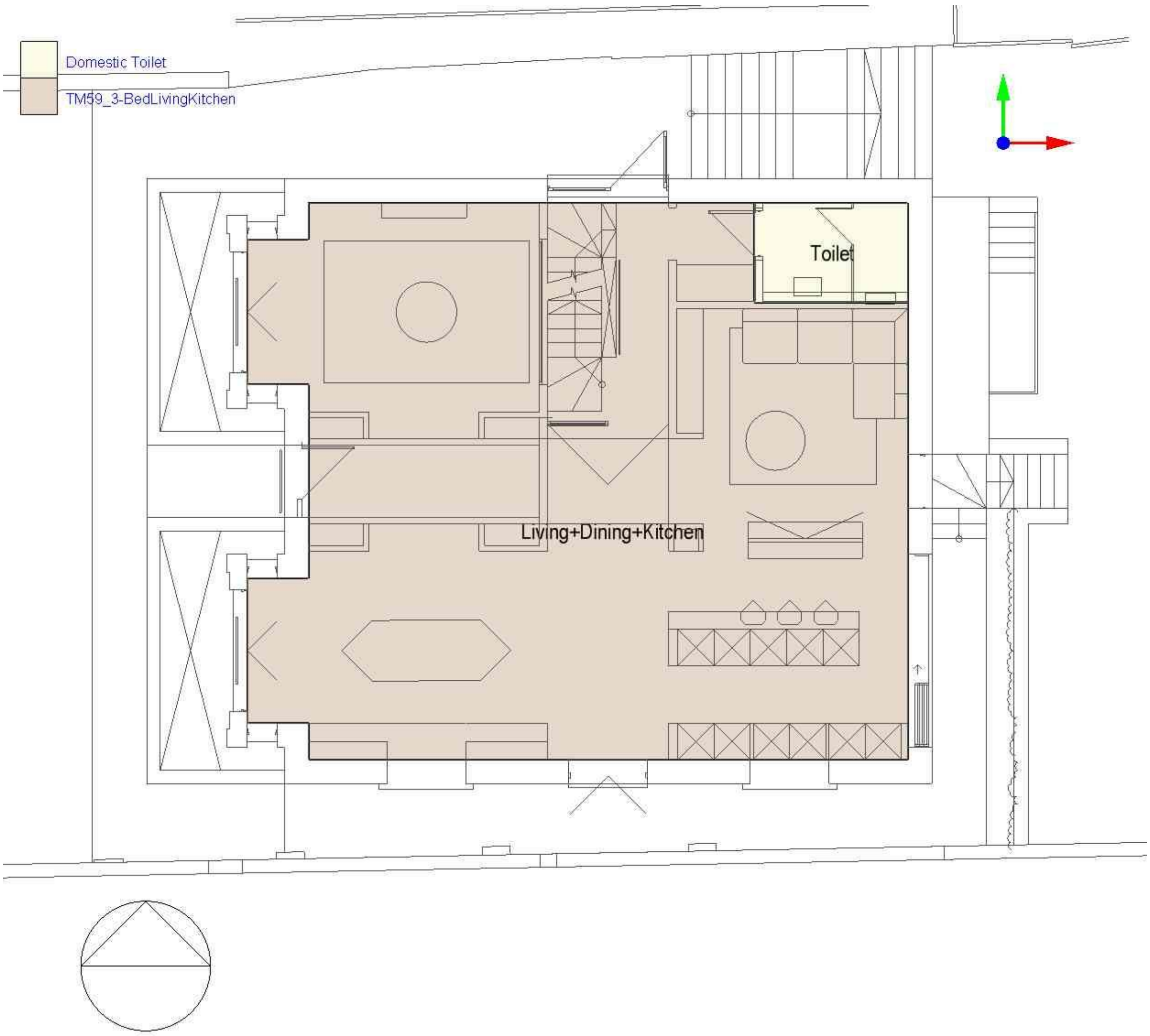

Figure 2. Ground floor

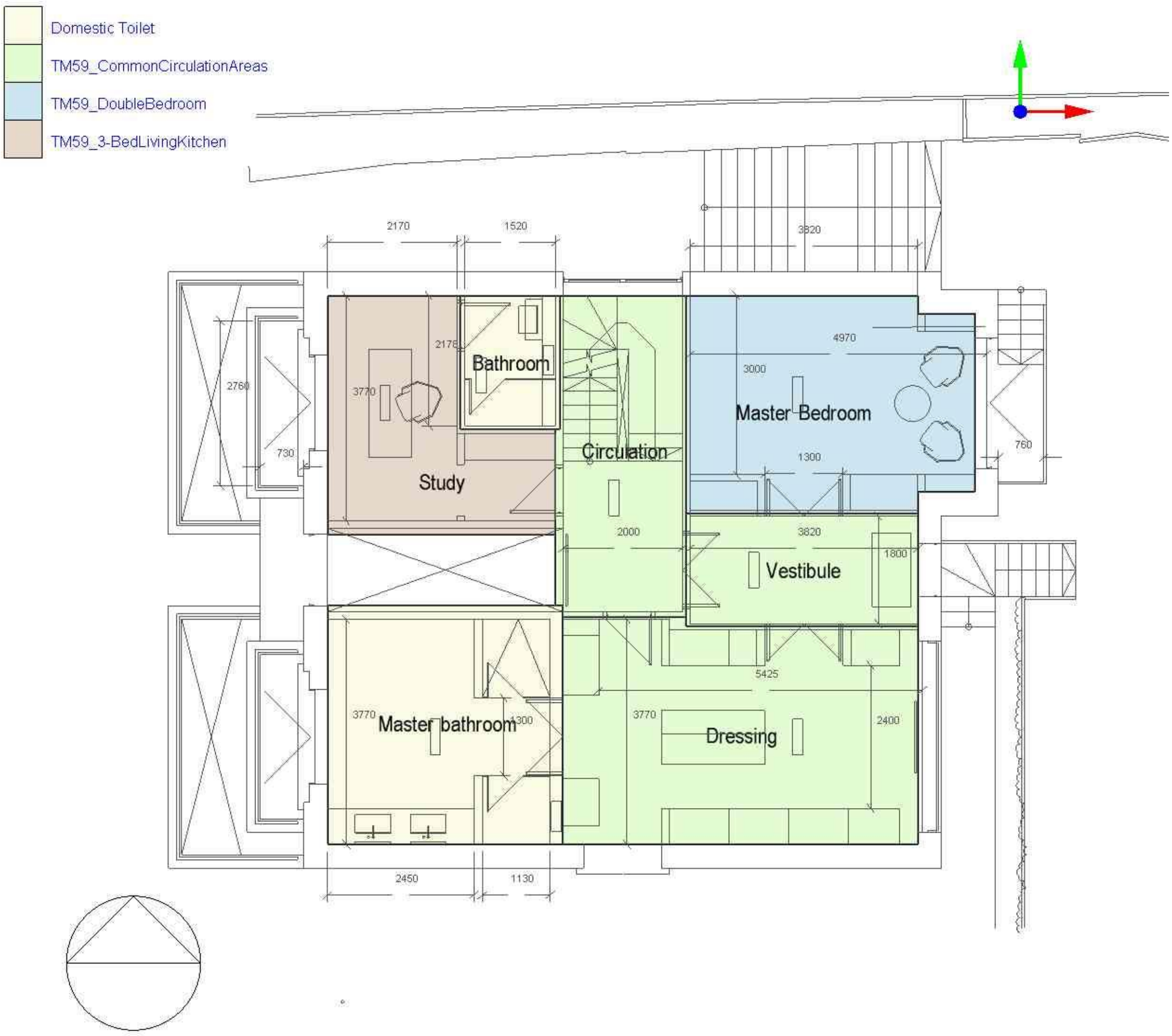

Figure 3. First floor

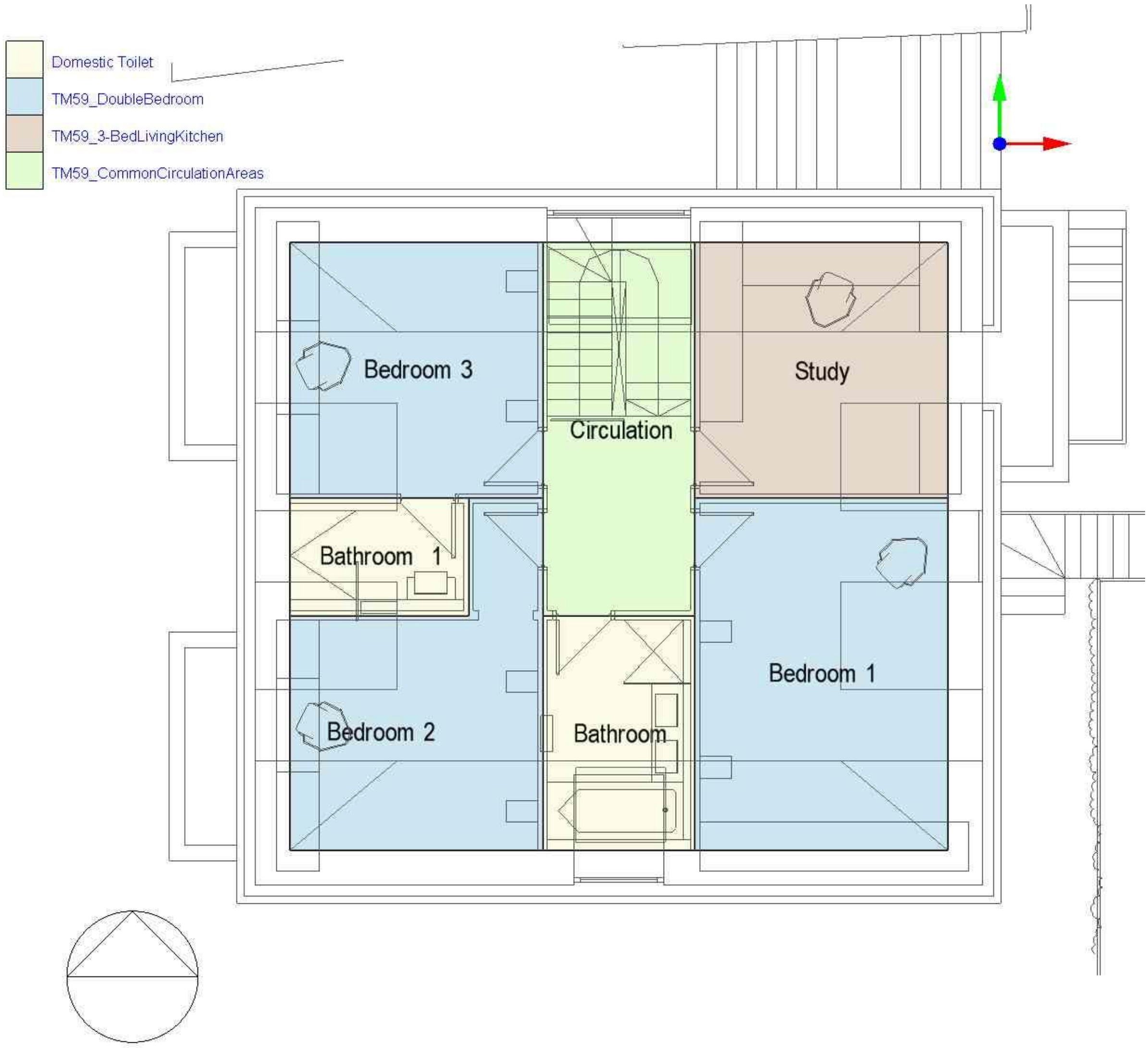

Figure 4. Second floor

Dynamic Thermal Model Images

6. Results and Recommendation

The following results summarise all assessed habitable rooms against the criteria of CIBSE TM59. Initial results assuming a notional specification and using the methodology detailed throughout report, showed a compliance failing with a typical, standard 0.63 g-value, and natural ventilation which can be seen from the following result. This is due to the massive glazing throughout and specifically on West façade in comparision to the floor areas for each individual zones.

Criteria for predominantly naturally ventilated homes

Block	Room	Criterion A (%)	Criterion B (hr)	Pass/Fail
Basement	Lounge/ Home Theatre	3.47	N/A	Fail
Ground floor	Living+Dinning+Kitchen	1.04	113.83	Fail
First floor	Study	11.57	N/A	Fail
First floor	Master Bedroom	1.98	272.17	Fail
Second floor	Bedroom 1	3.62	259.67	Fail
Second floor	Bedroom 2	2.78	227.83	Fail
Second floor	Bedroom 3	42.7	N/A	Fail
Second floor	Study	85.8	N/A	Fail

Ground floor Living+Dinning+Kitchen passed with the adaption of 0.40 g-value. Basement Lounge/ Home theatre and Master Bedroom on First floor passed with 20l/s and 10l/s mech ventilation flow rate, respectively. Simulations were conducted with extremely high ventilation flow rates (50l/s) in other areas including First floor Study (Oriented on West façade with massive glazing), Second floor Bedrooms (which failed to pass overheating criteria 2) and Study which, failed to compliance TM59. Therefore, the cooling was adopted to make it compliant.

6.1 Remedial works

When consulting with the design team, further calculations were conducted and in order to achieve the required internal comfort conditions within the current design constraints, the following measures have been proposed:

- Mechanical ventilation and Air conditioning cassette as follows:

6.2 Updated Results

The following result was achieved with 0.40 g-value and cooling

Floors	Room	Criterion A (%)	Criterion B (hr)	Pass/Fail
Basement	Lounge/ Home Theatre	0.90	N/A	Pass
Ground floor	Living+Dinning+Kitchen	0.25	8.33	Pass
First floor	Study	0.78	N/A	Pass
First floor	Master Bedroom	0.35	18.83	Pass
Second floor	Bedroom 1	0.43	18.17	Pass
Second floor	Bedroom 2	0.31	17.67	Pass
Second floor	Bedroom 3	1.35	N/A	Pass
Second floor	Study	0.91	N/A	Pass

The following result was achieved with 0.63 g-value and cooling:

Floors	Room	Criterion A (%)	Criterion B (hr)	Pass/Fail
Basement	Lounge/ Home Theatre	2.05	N/A	Pass
Ground floor	Living+Dinning+Kitchen	0.42	8.50	Pass
First floor	Study	1.07	N/A	Pass
First floor	Master Bedroom	0.46	21.33	Pass
Second floor	Bedroom 1	0.64	22.00	Pass
Second floor	Bedroom 2	0.40	22.00	Pass
Second floor	Bedroom 3	2.18	N/A	Pass
Second floor	Study	1.66	N/A	Pass

7. Conclusion

The results of the initial modelling indicated that during peak summertime conditions, the living areas failed to maintain acceptable levels of thermal comfort, with many zones failing to meet more than one of the CIBSE TM59 criteria.

To address this, the following measures are recommended:

- 0.63 g-value
- Air conditioning/cooling cassette to all habitable rooms

With the suggested mitigation measures, all zones show compliance with the CIBSE TM59 criterion and align with Approved Document Part O (2021).

8. Appendix A – CIBSE TM59 Occupancy Patterns

Figure 1 Heat gain profile

Number of people	Description	Peak load (W)		Period																							
		Sensible	Latent	00–01	01–02	02–03	03–04	04–05	05–06	06–07	07–08	08–09	09–10	10–11	11–12	12–13	13–14	14–15	15–16	16–17	17–18	18–19	19–20	20–21	21–22	22–23	23–24
				Hour ending																							
				1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	24.00
1	Single bedroom occupancy	75	55	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.7
2	Double bedroom cccupancy	150	110	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	0.7
2	Studio occupancy	150	110	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.7
1	1-bedroom living/kitchen occupancy	75	55	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
1	1-bedroom living occupancy	75	55	0	0	0	0	0	0	0	0	0	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0	0
1	1-bedroom kitchen occupancy	75	55	0	0	0	0	0	0	0	0	0	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0	0
2	2-bedroom living/kitchen occupancy	150	110	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
2	2-bedroom living occupancy	150	110	0	0	0	0	0	0	0	0	0	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0	0
2	2-bedroom kitchen occupancy	150	110	0	0	0	0	0	0	0	0	0	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0	0
3	3-bedroom living/kitchen occupancy	225	165	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
3	3-bedroom living occupancy	225	165	0	0	0	0	0	0	0	0	0	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0	0
3	3-bedroom kitchen occupancy	225	165	0	0	0	0	0	0	0	0	0	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0	0
	Single bedroom equipment	80		0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.13
	Double bedroom equipment	80		0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.13
	Studio equipment	450		0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	1	1	0.44	0.44	0.24	0.24
	Living/litchen equipment	450		0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	1	1	0.44	0.44	0.24	0.24
	Living equipment	150		0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	1	1	1	1	0.4	0.4
	Kitchen equipment	300		0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	1	1	0.17	0.17	0.17	0.17
	Lighting profile	2 (W/m2)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0