TM59 Overheating Report

21-0136 – Holly Lodge
1st November 2022

Sophie Williams

0844 500 3383
swilliams@mesh-energy.com
www.mesh-energy.com

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the smart renewable energy consultancy

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Revision Log

Section	Revision	Issue	Date
	For review and comment	Issue 1	01/11/2022

1 Introduction

1.1 Overview

Eileen and Hans have been working closely with Paul Archer Design on 15 Holly Lodge Gardens, where they are planning to extend the original property and refurbish the internal aspects.

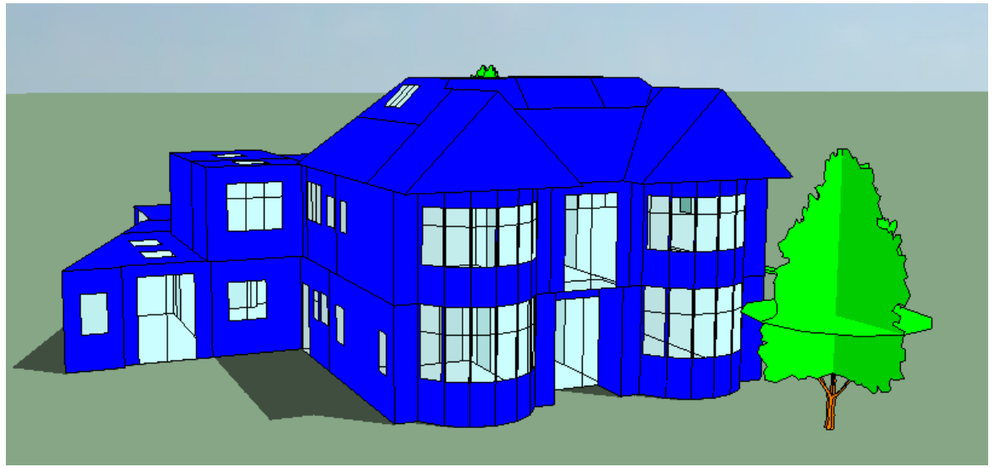

Figure 1: IES-VE model of the property

Mesh Energy have been commissioned to carry out CIBSE TM59 thermal modelling to demonstrate that occupant thermal comfort cannot be maintained year-round through natural ventilation.

The purpose of the report is to demonstrate that various rooms throughout the property do not maintain sufficient occupant thermal comfort levels to comply with TM59.

2 Executive Summary

The findings of the report conclude that the Lounge, Master bedroom, Bedroom F3, Office and Study fail to meet the criteria required to demonstrate that they do not suffer from overheating under current climatic conditions (DSY1) representing a moderately warm summer. All other rooms failed to maintain an adequate level of thermal comfort and do not suffer overheating under current climatic conditions (DSY1) representing a moderately warm summer.

With climatic conditions changing, it is important to see into the future to understand how rising temperatures will affect the performance of the house.

Overheating analysis carried for the expected conditions between 2041 and 2070 (DSY2) representing an intense single warm spell, and radical conditions between 2041 and 2070 (DSY3) with a prolonged period of sustained warmth, show that as the climate changes, all the bedrooms are likely to overheat.

3 Fabric First

3.1 The fabric-first approach

A ‘fabric first’ approach to building design involves maximising the performance of the components and materials that make up the building fabric itself, before considering the use of mechanical or electrical building services systems. This can help reduce capital and operational costs, improve energy efficiency, and reduce CO_2 emissions through methods such as:

- Maximising airtightness.
- Using super-high insulation.
- Optimising solar gain through the provision of openings and shading.
- Optimising natural ventilation.
- Using the thermal mass of the building fabric.
- Using energy from occupants, electronic devices, cookers and so on.

3.2 Fabric specification

The proposed U-values (W/m^{2}K) for the project based on information provided by Paul Archer Design:

Construction Element	**U-Value** (W/m^{2}K)
Ground floor – existing	0.40
Ground floor – new	0.13
Ground floor – pool house	0.13
External walls - existing	2.1
External walls – existing with EWI	0.30
External walls – new, W1	0.26
Walls – pool house	0.18
New flat roofs	0.13
New pitched roof	0.15
Pool house roof	0.13
Windows	1.40
Front elevation windows - existing	4.80
2 door sliding windows	1.10
4 door sliding windows	1.30
Windows – fixed panel	1.30
Rear elevation windows	1.36
Pool house windows	1.40
Rooflights	1.10
Pivot door	1.80
Infiltration Rate – main house	25m^3/h.m^2@50Pa
Infiltration Rate – pool house	5m^3/h.m^2@50Pa

4 Occupant Thermal Comfort

Overheating and the inability for occupants to adapt for their own comfort is generally taken to occur above 28ºC. The occurrence of overheating is determined by the interplay of the following factors:

- The shape of the property.
- The degree of insulation and thermal mass.
- Internal and external overhangs, louvres and blinds.
- The size of windows and the direction they face.
- Heat from people, lights and equipment.
- The degree of ventilation provided.
- The ability to allow air to flow through the property through open windows and internal doors.

4.1 RIBA 2030 target

The CIBSE TM59 'Design methodology for the assessment of overheating risk in homes' has been followed to assess the effectiveness of the ventilation of the building. The assessment criteria for overheating for natural ventilation between May and September are:

1. Criteria 'a', sets a 3% limit on the number of occupied hours that the room temperature can exceed the threshold comfort temperature of 28ºC. This is applied to living and sleeping spaces.
2. Criteria 'b', for bedrooms sets a limit of >26ºC between 10pm and 7am for no more than 32 hrs/yr, or 1% of the annual occupied hours. This is to ensure a good nights sleep.
3. All other ancillary spaces are assessed to see if a 'significant risk' of overheating is posed.
4. Criteria 'a' and 'b' must be met to achieve a pass.

4.2 Weather files

Overheating is assessed for the periods', namely the 2020s (2011-2040) and 2050s (2041-2070). Weather data files are provided by CIBSE.

2011-2040 is assessed against a moderately warm summer, while 2041-2070 is assessed against a year with a very intense single warm spell, and the problematic year with a prolonged period of sustained warmth.

4.3 Window opening

The dynamic thermal model allows window opening behaviour to be emulated for each season, depending on whether the window is for a room on the ground or upper floor, or an internal or external door. Windows and doors are assigned the following 'behaviour'.

Opening type by season*	In use	20ºC	22ºC	26ºC	28ºC
Winter internal door	07-22hrs		Closed	30% open	
Spring internal door	07-22hrs		Closed	60% open	
Summer internal door	07-22hrs		Closed		100% open**
Autumn internal door	07-22hrs		Closed	60% open	
External door	24hrs	Closed			
Winter window ground floor	07-22hrs		Closed	30% open	
Winter window upper floor	24hrs		Closed	30% open	
Spring window ground floor	07-22hrs		Closed	60% open	
Spring window upper floor	24hrs		Closed	60% open	
Summer window ground floor	07-22hrs		Closed		100% open**
	22-07hrs	Closed			
Summer window upper floor	07-22hrs		Closed		100% open**
	22-07hrs	Closed	100% open		
Autumn window ground floor	07-22hrs		Closed	60% open	
Autumn window upper floor	24hr		Closed	60% open	

** Winter (1st Dec-28th Feb), Spring (1st Mar-31st May), Summer (1st Jun-31st Aug), Autumn (1st Sep-30th Nov)*

*** If the internal temperature is greater than the external temperature*

Table 1 Window opening behaviour

As natural ventilation will be employed, windows are opened in response to indoor CO_2, which equates to the sensation of stuffiness. Windows are considered likely to opened at any time through-out the year between 700ppm and 1000ppm CO_2, regardless of the outdoor temperature. The degree of opening ranges from 30% to 100% according to the season as set out in the table above.

5 Overheating Outcome

5.1 A moderately warm summer 2011-2040

A pass is required for both criteria – where applicable – to demonstrate compliance.
The overheating criteria for occupied spaces were met for the Lounge, Master bedroom, Bedroom F3, Office and Study. All other rooms failed to maintain an adequate level of thermal comfort. Additionally, 2 ancillary areas were found to have significant risk of overheating.

Space	Criteria a	Status	Criteria b	Status
GF: Snug	8	Fail	NA	NA
GF: Guest Bedroom	0.2	Pass	39	Fail
GF: Lounge	1.1	Pass	NA	NA
FF: Master Bedroom	0.1	Pass	12	Pass
FF: Bedroom F3	0.8	Pass	31	Pass
GF: Dining / Living	4.4	Fail	NA	NA
FF: Office	0.8	Pass	NA	NA
FF: Bedroom F2	1.6	Pass	59	Fail
SF: Study	1.5	Pass	NA	NA

Weather settings on IES - London Weather Centre DSY1 2020 High Emissions in the 50th percentile for a moderately warm summer 2011-2040

5.2 An intense single warm spell 2041-2070

All the rooms failed to maintain adequate levels of thermal comfort, with some rooms starting to experience significant overheating. Criteria ‘a’ was met for both the Guest bedroom and Master bedroom, but both failed criteria ‘b’ by a significant margin. Additionally, 4 ancillary areas were found to have significant risk of overheating.

Space	Criteria a	Status	Criteria b	Status
GF: Snug	11.2	Fail	NA	NA
GF: Guest Bedroom	1.3	Pass	145	Fail
GF: Lounge	4.6	Fail	NA	NA
FF: Master Bedroom	1.4	Pass	61	Fail
FF: Bedroom F3	3.2	Fail	121	Fail
GF: Dining / Living	7.5	Fail	NA	NA
FF: Office	4.3	Fail	NA	NA
FF: Bedroom F2	4.4	Fail	167	Fail
SF: Study	6.1	Fail	NA	NA

Weather settings on IES - London Weather Centre DSY2 2050 Medium Emissions in the 50th percentile for a moderately warm summer 2041-2070

5.3 A period of sustained warmth 2041-2070

All the rooms failed to maintain adequate levels of thermal comfort, with some rooms starting to experience significant overheating. Criteria ‘a’ was met for both the Guest bedroom and Master bedroom, but both failed criteria ‘b’ by a significant margin. Additionally, 6 ancillary areas were found to have significant risk of overheating.

Space	Criteria a	Status	Criteria b	Status
GF: Snug	15.1	Fail	NA	NA
GF: Guest Bedroom	1.4	Pass	169	Fail
GF: Lounge	5.5	Fail	NA	NA
FF: Master Bedroom	1.7	Pass	65	Fail
FF: Bedroom F3	3.6	Fail	117	Fail
GF: Dining / Living	10.2	Fail	NA	NA
FF: Office	4.7	Fail	NA	NA
FF: Bedroom F2	4.9	Fail	187	Fail
SF: Study	7.2	Fail	NA	NA

Weather settings on IES - London Weather Centre DSY3 2050 Medium Emissions in the 50th percentile for a moderately warm summer 2041-2070

6 Appendix A – Openable Windows

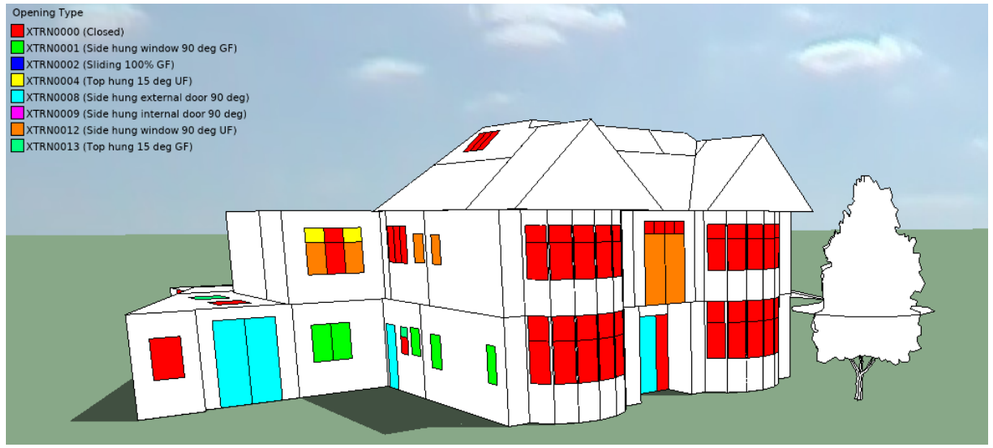

Figure 2 Front and side elevation

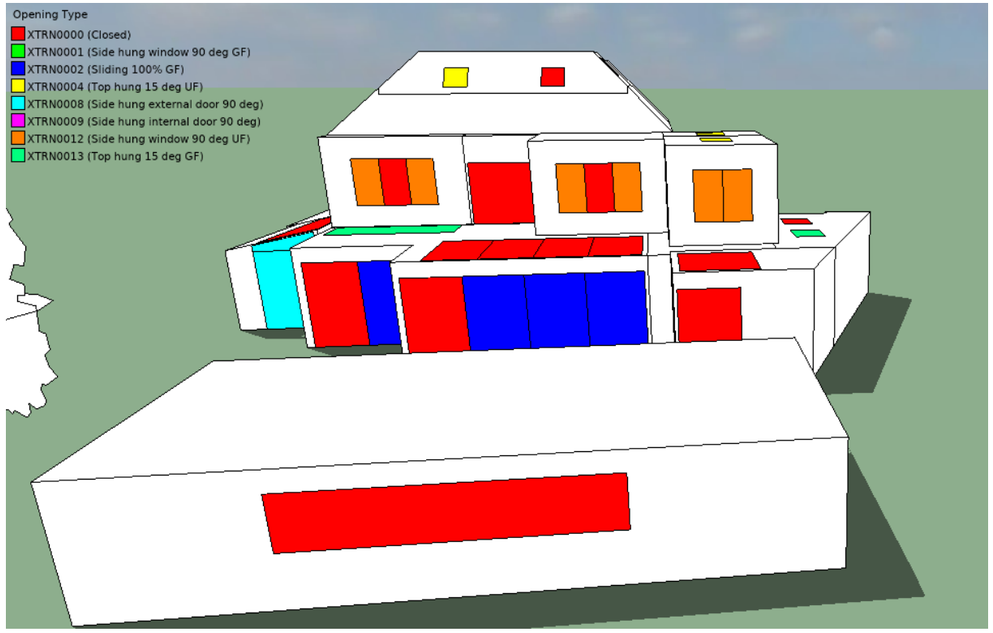

Figure 3 Back elevation

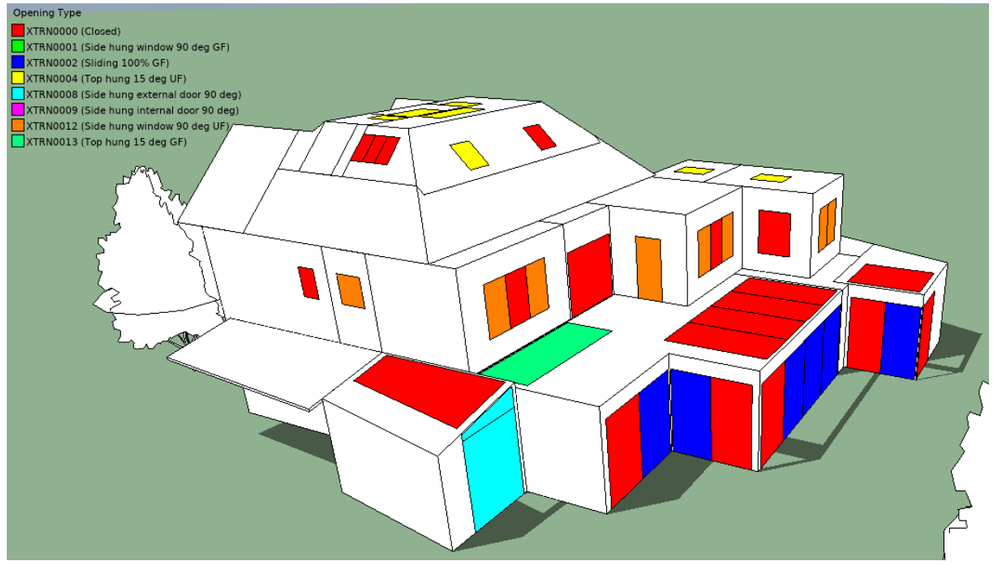

Figure 4 Back and side elevation

mesh.
the smart renewable energy consultancy

Contact us

08445 003383
Mesh-energy.com
info@mesh-energy.com

Cambridge House
8 East Street
Farnham
GU9 7RX

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