10 Grand Union Walk, Camden

Overheating Analysis

May 2020

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Document Control

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Executive Summary

This report has been produced to support the planning application for the refurbishment of recently listed Grade 2 building designed by Grimshaw architects in the 1980s. The existing building is a single-family dwelling and this report demonstrates the need for active cooling to maintain reasonable internal temperatures. Alterations to the existing fabric is prohibited due to the listed status.

This report has been requested by the planning department of London Borough of Camden to support the proposed installation of comfort cooling system in bedroom 2 located on the second floor of the building.

U-values of existing building fabric have been calculated using scanned copies of original drawings produced by Grimshaw architects.

The existing building has some constraints which are highlighted in this report that have an impact on the potential measures to the building envelope that can be put in place to prevent overheating. This report identifies all potential alterations that can be made to prevent overheating as per the Cooling hierarchy in London Plan. After reviewing a number of suitable alternatives to active cooling and their suitability for this development, it is proposed that bedroom 2 located on the second floor of the building should be provided with active cooling system consisting of an outdoor air source heat pump unit and an indoor unit with high efficiency fans to maintain reasonable thermal comfort levels during summer.

Dynamic simulation carried out using hevacomp thermal modelling software has identified bedroom 2 as being at a high risk of overheating under deign summer conditions, this is likely to become worse in the future due to climate change.

Passive deign measures of improving ventilation and insulating existing fabric cannot be applied due to the listed status of the building. Active cooling system is being proposed for bedroom 2 to maintain thermal comfort levels

Dynamic simulation has been undertaken in accordance with CIBSE TM52 *"The limits of thermal comfort: avoiding overheating in European buildings"* and CIBSE TM59 *"Design methodology for the assessment of overheating risk in homes"*. Table 1 below shows the results of dynamic simulation using weather data for the three weather years.

Bedroom 2	**Hours of exceedance *(He)* *Target 3%***	**Annual hours above 26°C Target 32**
DSY1 – moderately warm year	82%	3898
	Fail	Fail
DSY2 – single intense warm spell	80%	4058
	Fail	Fail
DSY3 - prolonged period of sustained warmth	77%	3815
	Fail	Fail

Table 1 Results Summary

Factors contributing to Overheating

1. Site location
2. Building fabric
3. Cross flow ventilation not possible
4. Glazing

2 Introduction

Peter Deer & Associates have been instructed by Hugh Cullum Architects to carry out overheating analysis for an existing Grade 2 listed building located in the Regents Canal Conservation area in London Borough of Camden. The building forms part of a row of terraced properties and is a 3-storey residential dwelling constructed in the late 1980's. Given the Grade 2 listed nature of the building there are limitations on the alterations that can be carried out that have a significant effect on the aesthetics of the building.

The current London Plan identifies the likelihood of rising external temperatures due to climate change which is likely to intensify the urban heat island effect in the near future. This will have a big impact on highly congested urban areas such as Camden which will experience higher ambient temperatures even after sunset when compared to rural areas. This will mean that building structures will absorb heat from the sun during the day and will not be able to disperse all of the heat back into the atmosphere even after sunset retaining part of the heat in the structure resulting in an overheating risk.

As part of the refurbishment, it is proposed to install an active cooling system comprising of an outdoor air source heat pump unit located on roof terrace behind parapet wall and an indoor unit serving bedroom 2 located on the second floor of the building. The current owners have experienced overheating in this particular room and a thermal model of the building has been produced using Bentley Hevacomp software and overheating analysis carried out using the Energy Plus engine to demonstrate this.

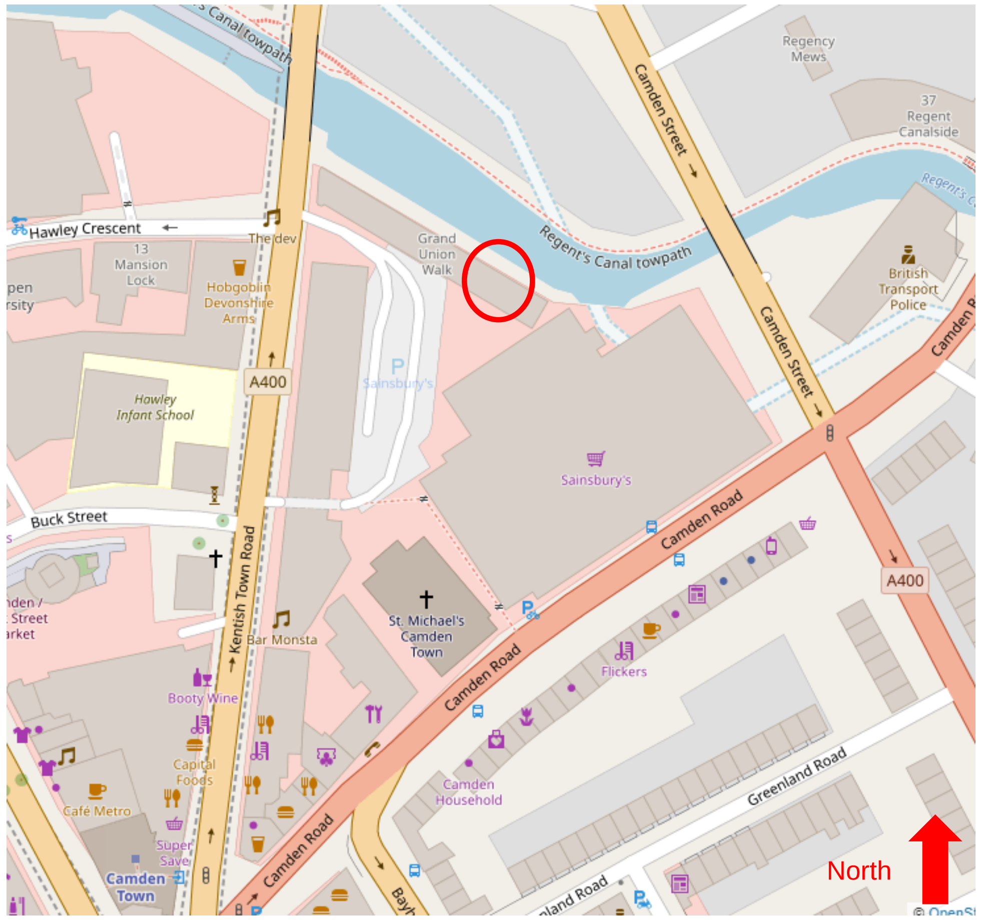
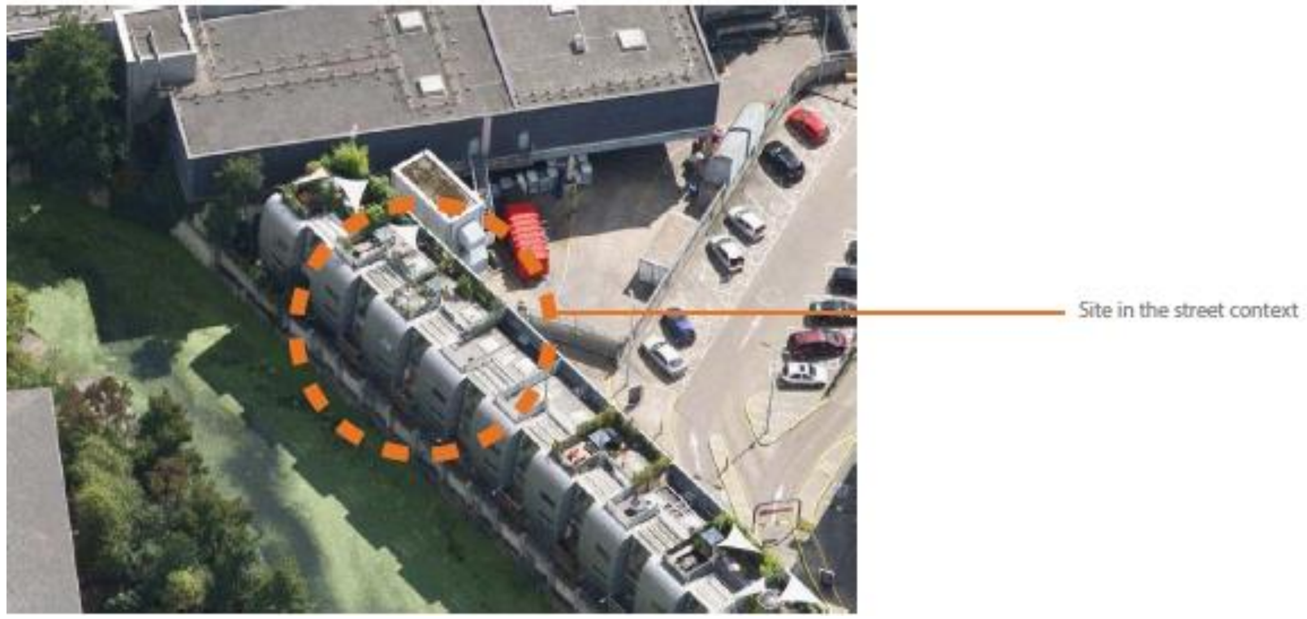


Figure 2- Site location



3 Planning Policies

London Borough of Camden - Sustainability and Climate Change Policies

3.1 It is expected that refurbishment of existing developments will be carried out to the highest standards of sustainable design and construction as proposed by the GLA London Plan (2016) and London Borough of Camden, Local Plan (2017).

3.2 Greater London Policies March 2015 identified as being relevant to this report:

- Policy 5.9 Overheating and Cooling

3.3 The overheating analysis must fully comply with Policy 5.9 of the London Plan and, recognising the integrated nature of London Plan policies, take account of relevant design, spatial, air quality, transport and climate change adaptation policies in the Plan.

Policy 5.9 Overheating and Cooling

Strategic

a. *The Mayor seeks to reduce the impact of the urban heat island effect in London and encourages the design of places and spaces to avoid overheating and excessive heat generation, and to reduce overheating due to the impacts of climate change and the urban heat island effect*

Planning decisions

b. *Major development proposals should reduce potential overheating and reliance on air conditioning systems and demonstrate this in accordance with the following cooling hierarchy:*
   1. *minimise internal heat generation through energy efficient design*
   2. *reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls*
   3. *manage the heat within the building through exposed internal thermal mass and high ceilings*
   4. *passive ventilation*
   5. *mechanical ventilation*
   6. *active cooling systems (ensuring they are the lowest carbon options).*

c. *Major development proposals should demonstrate how the design, materials, construction and operation of the development would minimise overheating and also meet its cooling needs. New development in London should also be designed to avoid the need for energy intensive air conditioning systems as much as possible. Further details and guidance regarding overheating and cooling are outlined in the London Climate Change Adaptation Strategy.*

LDF preparation

d. *Within LDFs boroughs should develop more detailed policies and proposals to support the avoidance of overheating and to support the cooling hierarchy.*

London Borough of Camden - Sustainability and Climate Change Policies

- Policy CC1 Climate Change Mitigation – Energy efficiency and carbon emission reduction, Carbon neutral developments and connection to district heat networks.
- Policy CC2 Adapting to climate change – Summertime over heating Risk

3.4 The council aims to tackle the causes of climate change in the Borough by ensuring existing buildings are adapted where possible to be more energy efficient, serviced using renewable technologies, minimise the use of resources and be able to deal effectively with changes to our climate such as wetter winters and hotter summers.

Policy CC1 Climate Change Mitigation

The Council will require all development to minimise the effects of climate change and encourage all developments to meet the highest feasible environmental standards that are financially viable during construction and occupation.

We will:

a. *promote zero carbon development and require all development to reduce carbon dioxide emissions through following the steps in the energy hierarchy;*
b. *require all major development to demonstrate how London Plan targets for carbon dioxide emissions have been met;*
c. *ensure that the location of development and mix of land uses minimise the need to travel by car and help to support decentralised energy networks;*
d. *support and encourage sensitive energy efficiency improvements to existing buildings;*
e. *require all proposals that involve substantial demolition to demonstrate that it is not possible to retain and improve the existing building; and*
f. *expect all developments to optimise resource efficiency.*

For decentralised energy networks, we will promote decentralised energy by:

g. *working with local organisations and developers to implement decentralised energy networks in the parts of Camden most likely to support them;*
h. *protecting existing decentralised energy networks (e.g. at Gower Street, Bloomsbury, King's Cross, Gospel Oak and Somers Town) and safeguarding potential network routes; and*
i. *requiring all major developments to assess the feasibility of connecting to an existing decentralised energy network, or where this is not possible establishing a new network.*

To ensure that the Council can monitor the effectiveness of renewable and low carbon technologies, major developments will be required to install appropriate monitoring equipment.

Policy CC2 Adapting to climate change

The Council will require developments to be resilient to climate change.

All developments should adopt appropriate climate change adaptation measures such as:

a. *the protection of existing green spaces and promoting new appropriate green infrastructure;*
b. *not increasing, and wherever possible reducing, surface water runoff through increasing permeable surfaces and use of Sustainable Drainage Systems*
c. *Incorporating bio-diverse roofs, combination green and blue roofs and green walls where appropriate; and measures to reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy.*
d. *Any development involving 5 or more residential units or 500 sqm or more of any additional floorspace is required to demonstrate the above in a Sustainability Statement.*

Sustainable design and construction measures

The Council will promote and measure sustainable design and construction by:

a. *ensuring development schemes demonstrate how adaptation measures and sustainable development principles have been incorporated into the design and proposed implementation;*
b. *encourage new build residential development to use the Home Quality Mark and Passivhaus design standards*
c. *encouraging conversions and extensions of 500 sqm of residential floorspace or above or five or more dwellings to achieve "excellent" in BREEAM domestic refurbishment; and*
d. *expecting non-domestic developments of 500 sqm of floorspace or above to achieve "excellent" in BREEAM assessments and encouraging zero carbon in new development from 2019*

Climate change adaptation measures

To minimise the risks connected with climate change we will expect the design of developments to consider anticipated changes to the climate.

4 Cooling and Overheating

4.1 Current London Plan highlights the importance of identifying potential overheating risk in residential accommodation and then incorporating suitable passive measures within the building envelope and services design to mitigate overheating and reduce cooling demand in line with London Plan.

Cooling Hierarchy

4.2 Although the cooling hierarchy in the London Plan is a requirement for all major developments, the principles should also be applied to minor developments. This will ensure all potential measures have been explored to reduce the demand for cooling as detailed below: -

1. *Reduce the amount of heat entering the building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure. It is also expected that external shading will form part of major proposals.*

- **The building is an existing Grade 2 listed building and it is not feasible or permissible to alter the building orientation or add external shading.**

2. *Minimise internal heat generation through energy efficient design: For example, heat distribution infrastructure within buildings should be designed to minimise pipe lengths, particularly lateral pipework in corridors of apartment blocks, and adopting pipe configurations which minimise heat loss e.g. twin pipes.*

- **This clause is aimed more at high density apartment blocks with central plant and piped services running throughout the building via communal areas. The proposed works to the do not include any significant alterations to the existing services and any changes to existing services will not have a big impact on internal heat generation.**

3. *Manage the heat within the building through exposed internal thermal mass and high ceilings: Increasing the amount of exposed thermal mass can help to absorb excess heat within the building. Efficient thermal mass should be coupled with night time purge ventilation.*

- **Although the building has a combination of exposed concrete support structure and high ceilings in some areas, building's single aspect ventilation, light weight construction (low thermal mass) and urban location does not allow the building structure to disperse heat effectively with night time purge ventilation. Any alterations to building fabric prohibited due to listed status of the building. Dynamic simulation demonstrates that the building suffers from a high risk of overheating due to heat gains through lightly insulated metal clad walls.**

4. *Provide passive ventilation: For example, through the use of openable windows, shallow floorplates, dual aspect units or designing in the 'stack effect' where possible.*

- **The floorplate cannot be altered as this is an existing building, the building is ventilated naturally via ac combination of openable windows and rooflights to aid natural ventilation through 'stack effect' but reasonable indoor air temperatures cannot be maintained with natural ventilation alone. Once the internal temperatures rise within the building maintaining thermal comfort is not possible using natural ventilation as cross flow ventilation cannot be achieved due to openable windows on only north elevation of the building.**

5. *Provide mechanical ventilation: Mechanical ventilation can be used to make use of 'free cooling' where the outside air temperature is below that in the building during summer months. This will require a by-pass on the heat recovery system for summer mode operation.*

- **Mechanical ventilation systems for controlling indoor air temperatures operate by way of transferring very large volumes of air to enable high air change rates. This requires a network of large ventilation ducts to be installed throughout the building. The existing building does not have large voids to accommodate the ducts required for mechanical ventilation systems.**

6. *Provide active cooling systems: The increased use of air conditioning systems is generally not supported, as these have significant energy requirements and, under conventional operation, expel hot air, thereby adding to the urban heat island effect. However, once passive measures have been prioritised if there is still a need for active cooling systems, such as air conditioning systems, these should be designed in a very efficient way and should aim to reuse the waste heat they produce.*

- **The dynamic modelling demonstrates that the building overheats due to its light weight construction coupled with heat gains through metal clad building fabric and single aspect windows failing to provide effective purge ventilation. Therefore, active cooling is proposed to maintain acceptable thermal comfort levels within bedroom 2. Various active cooling systems that make use of the waste heat have been considered for this development but discounted due to the large internal and external plant that is required for those systems. It is recommended to provide bedroom 2 with an adequately sized split system comprising of an outdoor air source heat pump unit and a high efficiency indoor fan unit to maintain acceptable levels of thermal comfort within the space.**

Calculation Method

4.3 A thermal model for the whole dwelling was created using Hevacomp and overheating analysis carried out using Energy Plus engine. Bedroom 2 was set up as a double bedroom with a maximum occupancy of 2, occupied hours and internal gains as per CIBSE TM59.

4.4 Summer simulation for a single day in the summer (4th July) and frequency simulation for the whole year to assess compliance with CIBSE TM52 has been carried out using the weather data from all three DSYs.

4.5 Although any additional openings in existing building envelope may not be permissible due to the Grade 2 listing, a further simulation was carried out with an additional rooflight with an openable area of 0.79m² in bedroom 2 to aid higher natural ventilation rates by creating a 'stack effect' but the bedroom failed to comply with the requirements of CIBSE TM59 even with the additional window. Results for all simulations have been included in Appendix B.

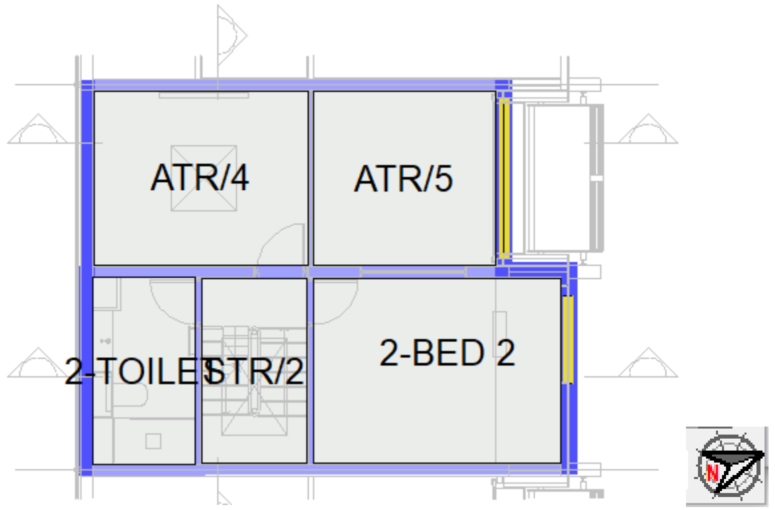


Figure 2- Thermal Model

Building envelope

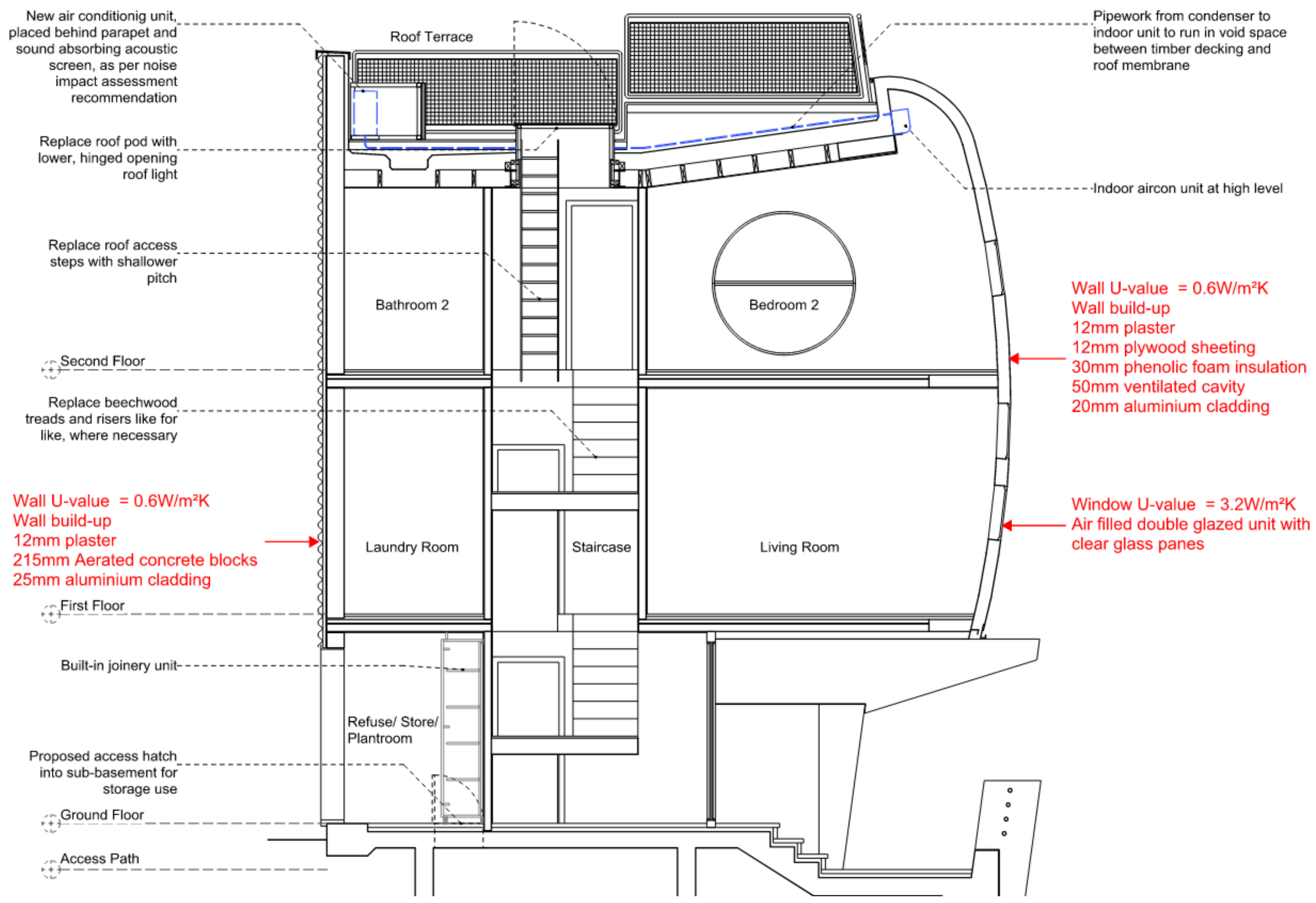


Figure 3- Building section showing wall build up

Factors contributing to Overheating

1. Site location – The development is located in a dense urban area which is classed as urban heat island in the London Plan which means the area is likely to experience higher ambient temperatures throughout the year.
2. Building fabric – External walls and roof of the building are not insulated to modern standards which allows high heat transfer through the fabric resulting in higher heat gains in the summer and higher heat losses in the winter. External insulation to existing walls and roof cannot be considered due to Grade 2 listing and insulating the building internally is not economically viable.
3. Cross flow ventilation not possible – Cross flow ventilation is not possible due to openable windows on only north facing elevation.
4. Glazing – The building has large amounts of glazed areas and only a small proportion of glazing is openable. Large glazed areas result in high solar gains and single aspect small openable windows do not ventilate the space effectively to maintain acceptable thermal comfort levels.

GLA - Dynamic Simulation Method. (CIBSE: TM59) for Overheating

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

4.7 “TM59: Design Methodology for Assessment of Overheating in Homes CIBSE 2017”. This document is based on the “TM52: The Limits of Thermal Comfort: Avoiding Overheating in European Buildings”.

4.8 Homes that are predominantly naturally ventilated, including homes that have mechanical ventilation with heat recovery (MVHR), with good opportunities for natural ventilation in the summer should assess overheating using the adaptive method based on CIBSE TM52 (2013)

4.9 In order to allow the occupants to ‘adapt’, each habitable room needs openable windows with a minimum free area that satisfies the purge ventilation criteria set in Approved Document Part F of the Building Regulations for England (2010). Control of overheating may require accessible, secure, quiet ventilation with a significant openable area.

4.10 For homes which are predominantly mechanically ventilated 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 1% of the annual occupied annual hours (CIBSE Guide A (2015a)).

TM52 Adaptive Method Criterion for Non-Domestic Naturally Ventilated Occupied Areas

Criterion 1: Hours of Exceedance - The first criterion sets a limit for the number of hours that the operative temperature can exceed the threshold comfort temperature (upper limit of the range of comfort temperature) by 1K or more during the occupied hours of a typical non-heating season (1 May to 30 September). Hours of exceedance is 3%.

Criterion 2: Daily Weighted Exceedance - The second criterion deals with the severity of overheating within any one day, which can be as important as its frequency, the level of which is a function of both temperature rise and its duration. This criterion sets a daily limit for acceptability. Weighted exceedance ≤ 6hrs.

Criterion 3: Upper Limit Temperature - The third criterion sets an absolute maximum daily temperature for a room, beyond which the level of overheating is unacceptable. It requires that the internal operative temperature is not to exceed the external running mean temperature by more than 4 degrees. $\Delta T \leq 4K$

Criteria for homes predominantly naturally ventilated

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

For living rooms, kitchens and bedrooms: the number of hours during which the temperature difference is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3 per cent 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 for bedrooms is 32 hours, so 33 or more hours above 26 °C will be recorded as a fail).

4.11 Criteria 2 and 3 of CIBSE TM52 may fail to be met, but both the above criteria must be passed for all relevant rooms.

Design Weather Files

4.12 In 2014 the CIBSE, working in conjunction with the GLA, published: Design Summer Years for London (TM49: 2014)21. This guide aims to provide a risk-based approach to help developers and their advisers simultaneously address the challenges of developing in an urban heat island and managing an uncertain future climate. It provides guidance to help ensure that new developments are better designed for the climate they will experience over their operating life.

4.13 Overheating modelling for both domestic and non-domestic developments is required to estimate the overheating risk with the following climatic weather data:

- DSY1 – 1989: a year with moderately warm summer,
- DSY2 – 2003: a year with a very intense single warm spell,
- DSY3 – 1976: a year with a prolonged period of sustained warmth,

Design Summer Year (DSY) for the 2020s is of particular interest as this relates to the period 2011–2040, which is the current period. For the 50% percentile changes, which may be viewed as the ‘best guess’ level of change, the estimated return periods for 1976, 1989 and 2003 drop to 11 years, 3 years and 7 years, respectively.

4.14 Dynamic thermal analysis to assess the overheating of bedroom 2 has been carried out in strict accordance with the CIBSE TM49 & TM59.

Results

4.15 The results of the overheating analysis show that bedroom 2 located on the second floor has a very high risk of overheating in the summer months. The metal cladded external walls and light weight construction allows heat gains into the building but thermal comfort levels by natural ventilation alone cannot be maintained due to lack of cross flow ventilation.

4.16 Summer simulation shows that on an average summer day with the window fully open, internal air temperatures in bedroom 2 can get up to 31.8°C at 18:00hrs which gives an indication of peak internal temperatures in a single day.

4.17 Frequency simulation shows that the number of hours during which the temperature difference is greater than or equal to one degree (K) during the summer period (CIBSE TM52 Criterion 1: Hours of exceedance) is 82% (DSY1) of the occupied hours which identifies a high risk of overheating, the results also show that the number of hours annually where internal air temperatures are expected to peak above 26°C are 4058 which is recorded as failing to prevent overheating as per CIBSE TM59.

Summary of Calculations & Results

Appendix B1 – Summer Simulation (Single Summer Day)

Peak internal temperatures of 31.8°C

Appendix B2 – Frequency Simulation (DSY1 – Moderately warm summer)

Internal temperatures predicted to be above 26°C for 3898 hours annually and operative temperature exceeds comfort temperatures for 82% of the occupied hours (Hours of exceedance *He).*

Appendix B3 – Frequency Simulation (DSY2 – Single intense warm spell)

Internal temperatures predicted to be above 26°C for 4058 hours annually and operative temperature exceeds comfort temperatures for 80% of the occupied hours (Hours of exceedance *He).*

Appendix B4 – Frequency Simulation (DSY3 – Prolonged period of sustained warmth)

Internal temperatures predicted to be above 26°C for 3815 hours annually and operative temperature exceeds comfort temperatures for 77% of the occupied hours (Hours of exceedance *He).*

Appendix B5 – Summer Simulation (Single Summer Day) Additional openable roof light in bedroom 2

Peak internal temperatures of 28.6°C

Appendix B6 – Frequency Simulation (DSY1 – Moderately warm summer) Additional openable roof light in bedroom 2

Internal temperatures predicted to be above 26°C for 3388 hours annually and operative temperature exceeds comfort temperatures for 59% of the occupied hours (Hours of exceedance *He).*

Appendix B7 – Frequency Simulation (DSY1 – Moderately warm summer) Additional openable roof light in bedroom 2 and south facing wall insulated to improve U-value to 0.2W/m²K

Internal temperatures predicted to be above 26°C for 3391 hours annually and operative temperature exceeds comfort temperatures for 58% of the occupied hours (Hours of exceedance *He).*

5 Appendices

Appendix A Glossary

Domestic building - is a dwelling

Non-Domestic Building

This is for any building design for occupation that is not domestic building.

Building Regulations Exempt of Part L - Buildings which are exempt Part L for the Building Regulations are:

Dwelling - A dwelling is a building designed for use as residential accommodation occupied (whether or not as a sole or main residence):

by an individual or by individuals living together as a family; or

by not more than six individuals living together as a single household (including a household where care is provided for residents)

Energy Assessment – an energy assessment is a document which explains how the London Plan targets for CO2 reduction will be met for a particular development within the context of the energy hierarchy.

Low Energy Building - Low energy building is defined as buildings, that are general not heated or cooled other than the by process heat. Building or parts of a building that only require heating or cooling for short periods in the production cycle.

Megawatt (MW) – One million watts. A watt is a measure of power.

Other Low Carbon Heat Technology – in the context of this document, this is intended to be any waste heat source that could be used to serve a heat network, potentially with the use of heat pumps to increase the output. For example, waste heat recovered from the waste incineration process, or from transformers.

Part L of the Building Regulations – Approved documents L1A and L2A of the Building. Regulations relate to the conservation of fuel and power in all new buildings.

Notional Dwelling - This dwelling, that is the same size and shape the proposed building but design to comply with the 2010 building regulation using the specifications set out in table of the Approved Document Part L1B (2013).

Standard Assessment Procedure (SAP) – This is a methodology for assessing and comparing the energy and environmental performance of dwellings. Its purpose is to provide accurate and reliable assessments of dwelling energy performances that are needed to underpin Building Regulations and other policy initiatives.

Zero Carbon Homes - homes forming part of major development applications (i.e. those with 10 or more units) where the residential element of the application achieves at least a 35 per cent reduction in regulated carbon dioxide emissions (beyond Part L 2013) onsite. The remaining regulated carbon dioxide emissions, to 100 per cent, are to be offset through cash in lieu contribution to the relevant borough to be ring fenced to secure delivery of carbon dioxide savings elsewhere.

Appendix B Dynamic Simulation Results

Appendix B1 - Summer Simulation (Single Summer Day)

Date 29th May 2020

Project 200526-DDB *Project no.* 4486
Engineer *Checked by* *Date checked*
File G:\Projects\4486 - 10 Grand Union Walk\Calcs\200526-DDB\

Results file: Summer Sim Test 1 - CIBSE LHR DSY1 2020 High 50
Room: 2-BED 2
Calculation type: Summertime temperatures
Design day: 4th Jly

Room temperatures °C

Hour	Index	Air	MRT	% Sat	Furniture	Outside
1	28.9	27.8	29.9	35	29.7	17.1
2	28.3	27.2	29.4	35	29.1	15.8
3	27.8	26.6	28.9	35	28.6	14.7
4	27.3	26.1	28.5	36	28.2	14.0
5	26.9	25.7	28.1	37	27.8	13.7
6	26.8	25.6	28.0	37	27.7	13.8
7	27.0	25.8	28.1	36	27.7	14.5
8	27.7	27.0	28.5	41	28.2	15.6
9	28.2	27.6	28.9	45	28.8	17.2
10	28.7	28.2	29.2	46	29.1	19.0
11	29.1	28.8	29.4	47	29.4	21.0
12	29.6	29.5	29.8	48	29.8	22.9
13	30.2	30.2	30.2	49	30.2	24.6
14	30.7	30.8	30.5	50	30.6	26.1
15	31.1	31.3	30.9	50	31.0	27.1
16	31.4	31.7	31.2	51	31.3	27.6
17	31.7	31.9	31.5	50	31.6	27.6
18	31.8	31.9	31.7	50	31.8	27.2
19	31.7	31.8	31.7	49	31.9	26.3
20	31.6	31.5	31.7	48	31.9	25.1
21	31.4	31.1	31.7	48	31.8	23.7
22	31.0	30.6	31.5	47	31.5	22.1
23	30.1	29.3	31.0	42	30.9	20.4
24	29.4	28.5	30.4	36	30.3	18.7

Appendix B2 - Frequency Simulation (DSY1 - Moderately Warm Summer)

Date 29th May 2020

Project	200526-DDB			*Project no.*	4486
Engineer		*Checked by*		*Date checked*	
File	G:\Projects\4486 - 10 Grand Union Walk\Calcs\200526-DDB\				

Results file: Frequency Test 1 - CIBSE LHR DSY1 2020 High 50

Room: 2-BED 2

Calculation type: Frequency

Room temperature (°C) frequency distribution

Room temperature	% of year above	Hours above
39	0.0	0
38	0.2	15
37	1.0	85
36	2.2	192
35	4.2	369
34	8.6	750
33	13.4	1175
32	18.8	1644
31	23.5	2055
30	29.0	2540
29	34.3	3004
28	38.1	3338
27	40.9	3582
26	44.5	3898
25	50.3	4402
24	56.7	4969
23	65.0	5695
22	81.3	7125
21	89.4	7835
20	96.3	8432
19	99.5	8712
18	99.9	8751
17	100.0	8760

CIBSE TM59 - Design methodology for the assessment of overheating risk in homes
For homes which are predominantly mechanically ventilated 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 1% of the annual occupied annual hours (CIBSE Guide A (2015a)).

Date 29th May 2020

Project	200526-DDB			*Project no.*	4486
Engineer		*Checked by*		*Date checked*	
File	G:\Projects\4486 - 10 Grand Union Walk\Calcs\200526-DDB\				

Results file: Frequency Test 1 - CIBSE LHR DSY1 2020 High 50

Room: 2-BED 2

Calculation type: Frequency

CIBSE TM52 Overheating Criterion 1, 2 and 3

Month	He	Occ. Hours	We	Tupp
Jan				
Feb				
Mar				
Apr				
May	591	744	29	221
Jun	640	720	30	338
Jly	740	744	31	519
Aug	693	744	31	323
Sep	352	720	30	11
Oct				
Nov				
Dec				
Totals	**3016**	**3672**	**151**	**1412**

CIBSE TM52 - The limits of thermal comfort: avoiding overheating in European buildings
Criterion 1: Hours of Exceedance - The first criterion sets a limit for the number of hours that the operative temperature can exceed the threshold comfort temperature (upper limit of the range of comfort temperature) by 1K or more during the occupied hours of a typical non-heating season (1 May to 30 September). Hours of exceedance is 3%.

Date 29th May 2020

Project	200526-DDB	*Project no.*	4486
Engineer	*Checked by*	*Date checked*	
File	G:\Projects\4486 - 10 Grand Union Walk\Calcs\200526-DDB\		

Results file: Frequency Test 1 - CIBSE LHR DSY2 2020 High 50

Room: 2-BED 2

Calculation type: Frequency

Room temperature (°C) frequency distribution

Room temperature	% of year above	Hours above
40	0.0	0
39	0.4	34
38	1.0	91
37	1.9	163
36	3.3	288
35	5.1	446
34	8.2	714
33	13.7	1201
32	19.0	1666
31	23.0	2013
30	28.2	2474
29	32.2	2825
28	35.8	3137
27	41.3	3617
26	46.3	4058
25	51.3	4491
24	56.1	4913
23	65.8	5768
22	77.4	6781
21	85.0	7450
20	91.2	7991
19	97.2	8512
18	98.6	8633
17	99.9	8751
16	100.0	8760

CIBSE TM59 - Design methodology for the assessment of overheating risk in homes
For homes which are predominantly mechanically ventilated 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 1% of the annual occupied annual hours (CIBSE Guide A (2015a)).

Date 29th May 2020

Project	200526-DDB			*Project no.*	4486
Engineer		*Checked by*		*Date checked*	
File	G:\Projects\4486 - 10 Grand Union Walk\Calcs\200526-DDB\				

Results file: Frequency Test 1 - CIBSE LHR DSY2 2020 High 50

Room: 2-BED 2

Calculation type: Frequency

CIBSE TM52 Overheating Criterion 1, 2 and 3

Month	He	Occ. Hours	We	Tupp
Jan				
Feb				
Mar				
Apr				
May	422	744	30	59
Jun	710	720	30	432
Jly	712	744	31	417
Aug	680	744	31	380
Sep	426	720	30	43
Oct				
Nov				
Dec				
Totals	**2950**	**3672**	**152**	**1331**

CIBSE TM52 - The limits of thermal comfort: avoiding overheating in European buildings
Criterion 1: Hours of Exceedance - The first criterion sets a limit for the number of hours that the operative temperature can exceed the threshold comfort temperature (upper limit of the range of comfort temperature) by 1K or more during the occupied hours of a typical non-heating season (1 May to 30 September). Hours of exceedance is 3%.

Date 29th May 2020

Project 200526-DDB *Project no.* 4486
Engineer *Checked by* *Date checked*
File G:\Projects\4486 - 10 Grand Union Walk\Calcs\200526-DDB\

Results file: Frequency Test 1 - CIBSE LHR DSY3 2020 High 50
Room: 2-BED 2
Calculation type: Frequency

Room temperature (°C) frequency distribution

Room temperature	% of year above	Hours above
42	0.0	0
41	0.1	12
40	0.7	60
39	1.9	169
38	3.2	278
37	4.3	373
36	5.3	461
35	6.4	565
34	9.4	821
33	14.1	1235
32	18.2	1593
31	22.9	2007
30	27.3	2394
29	31.1	2723
28	35.3	3091
27	39.2	3431
26	43.6	3815
25	47.4	4152
24	53.5	4685
23	61.1	5356
22	74.2	6498
21	82.4	7215
20	85.6	7497
19	91.9	8053
18	96.6	8466
17	98.8	8657
16	100.0	8760

CIBSE TM59 - Design methodology for the assessment of overheating risk in homes
For homes which are predominantly mechanically ventilated 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 1% of the annual occupied annual hours (CIBSE Guide A (2015a)).

Date 29th May 2020

Project	200526-DDB			*Project no.*	4486
Engineer		*Checked by*		*Date checked*	
File	G:\Projects\4486 - 10 Grand Union Walk\Calcs\200526-DDB\				

Results file: Frequency Test 1 - CIBSE LHR DSY3 2020 High 50

Room: 2-BED 2

Calculation type: Frequency

CIBSE TM52 Overheating Criterion 1, 2 and 3

Month	He	Occ. Hours	We	Tupp
Jan				
Feb				
Mar				
Apr				
May	489	744	31	170
Jun	640	720	30	332
Jly	744	744	31	591
Aug	713	744	31	284
Sep	243	720	23	6
Oct				
Nov				
Dec				
Totals	**2829**	**3672**	**146**	**1383**

CIBSE TM52 - The limits of thermal comfort: avoiding overheating in European buildings
Criterion 1: Hours of Exceedance - The first criterion sets a limit for the number of hours that the operative temperature can exceed the threshold comfort temperature (upper limit of the range of comfort temperature) by 1K or more during the occupied hours of a typical non-heating season (1 May to 30 September). Hours of exceedance is 3%.

Date 29th May 2020

Project 200526-DDB *Project no.* 4486

Engineer *Checked by* *Date checked*

File G:\Projects\4486 - 10 Grand Union Walk\Calcs\200526-DDB - Copy\

Results file: Summer Sim Test 2 - CIBSE LHR DSY1 2020 High 50

Room: 2-BED 2

Calculation type: Summertime temperatures

Design day: 4th Jly

Room temperatures °C

Hour	Index	Air	MRT	% Sat	Furniture	Outside
1	23.2	21.2	25.3	51	24.7	17.1
2	22.3	20.2	24.5	53	23.7	15.8
3	22.0	20.2	23.8	52	23.1	14.7
4	21.8	20.0	23.5	52	22.8	14.0
5	21.4	19.7	23.1	52	22.4	13.7
6	21.4	19.7	23.0	52	22.4	13.8
7	21.5	19.9	23.2	52	22.5	14.5
8	21.9	20.3	23.6	54	23.1	15.6
9	22.4	20.9	23.9	54	23.5	17.2
10	23.2	22.0	24.4	52	24.1	19.0
11	24.1	23.2	25.0	50	24.8	21.0
12	25.2	24.6	25.7	49	25.7	22.9
13	26.2	25.9	26.5	47	26.6	24.6
14	27.2	27.1	27.3	46	27.4	26.1
15	27.9	28.0	27.9	45	28.2	27.1
16	28.5	28.5	28.5	44	28.7	27.6
17	28.7	28.6	28.8	44	29.1	27.6
18	28.7	28.4	29.0	44	29.2	27.2
19	28.5	27.9	29.0	44	29.1	26.3
20	28.0	27.2	28.8	45	28.8	25.1
21	27.4	26.3	28.4	45	28.4	23.7
22	26.6	25.3	27.9	46	27.8	22.1
23	25.4	23.7	27.1	47	26.8	20.4
24	24.3	22.4	26.2	49	25.7	18.7

Date 29th May 2020

Project 200526-DDB *Project no.* 4486
Engineer *Checked by* *Date checked*
File G:\Projects\4486 - 10 Grand Union Walk\Calcs\200526-DDB - Copy\

Results file: Frequency Test 2 - CIBSE LHR DSY1 2020 High 50
Room: 2-BED 2
Calculation type: Frequency

Room temperature (°C) frequency distribution

Room temperature	% of year above	Hours above
41	0.0	0
40	0.1	5
39	0.2	14
38	0.4	37
37	0.9	83
36	1.9	164
35	3.1	274
34	4.9	430
33	8.7	759
32	12.3	1074
31	16.6	1453
30	21.1	1847
29	25.7	2253
28	29.6	2592
27	34.6	3032
26	38.7	3388
25	45.1	3949
24	51.9	4550
23	59.2	5190
22	72.0	6308
21	83.1	7283
20	89.9	7871
19	96.1	8416
18	99.3	8702
17	100.0	8757
16	100.0	8760

CIBSE TM59 - Design methodology for the assessment of overheating risk in homes
For homes which are predominantly mechanically ventilated 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 1% of the annual occupied annual hours (CIBSE Guide A (2015a)).

Date 29th May 2020

Project	200526-DDB			*Project no.*	4486
Engineer		*Checked by*		*Date checked*	
File	G:\Projects\4486 - 10 Grand Union Walk\Calcs\200526-DDB - Copy\				

Results file: Frequency Test 2 - CIBSE LHR DSY1 2020 High 50

Room: 2-BED 2

Calculation type: Frequency

CIBSE TM52 Overheating Criterion 1, 2 and 3

Month	He	Occ. Hours	We	Tupp
Jan				
Feb				
Mar				
Apr				
May	464	744	29	198
Jun	480	720	30	215
Jly	558	744	31	351
Aug	478	744	30	165
Sep	189	720	20	4
Oct				
Nov				
Dec				
Totals	**2169**	**3672**	**140**	**933**

CIBSE TM52 - The limits of thermal comfort: avoiding overheating in European buildings
Criterion 1: Hours of Exceedance - The first criterion sets a limit for the number of hours that the operative temperature can exceed the threshold comfort temperature (upper limit of the range of comfort temperature) by 1K or more during the occupied hours of a typical non-heating season (1 May to 30 September). Hours of exceedance is 3%.

Results file: Frequency Test 3 - CIBSE LHR DSY1 2020 High 50

Room: 2-BED 2

Calculation type: Frequency

Room temperature (°C) frequency distribution

Room temperature	% of year above	Hours above
41	0.0	0
40	0.0	3
39	0.1	12
38	0.3	30
37	0.8	72
36	1.7	152
35	2.9	257
34	4.7	410
33	8.2	716
32	11.9	1040
31	16.2	1418
30	20.7	1810
29	25.5	2234
28	29.4	2573
27	34.5	3025
26	38.7	3391
25	45.1	3955
24	52.3	4584
23	59.8	5236
22	73.7	6452
21	84.3	7382
20	91.3	7997
19	96.9	8488
18	99.7	8732
17	100.0	8760

CIBSE TM59 - Design methodology for the assessment of overheating risk in homes
For homes which are predominantly mechanically ventilated 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 1% of the annual occupied annual hours (CIBSE Guide A (2015a)).

Date 1st Jun 2020

Project	200526-DDB			*Project no.*	4486
Engineer		*Checked by*		*Date checked*	
File	G:\Projects\4486 - 10 Grand Union Walk\Calcs\200526-DDB - Copy\				

Results file: Frequency Test 3 - CIBSE LHR DSY1 2020 High 50

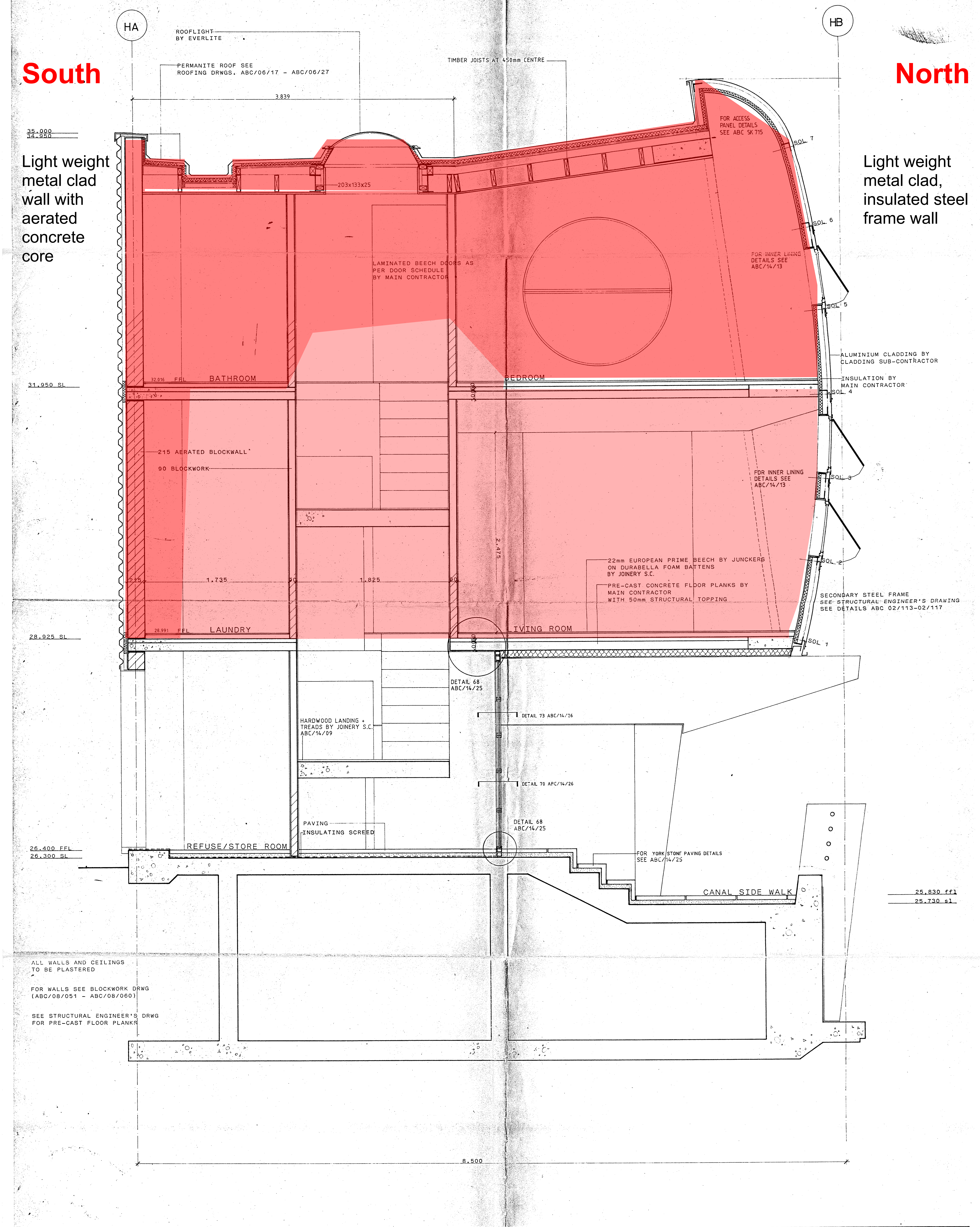
Room: 2-BED 2

Calculation type: Frequency

CIBSE TM52 Overheating Criterion 1, 2 and 3

Month	He	Occ. Hours	We	Tupp
Jan				
Feb				
Mar				
Apr				
May	462	744	29	189
Jun	474	720	30	202
Jly	554	744	31	336
Aug	476	744	30	153
Sep	185	720	20	4
Oct				
Nov				
Dec				
Totals	**2151**	**3672**	**140**	**884**

CIBSE TM52 - The limits of thermal comfort: avoiding overheating in European buildings
Criterion 1: Hours of Exceedance - The first criterion sets a limit for the number of hours that the operative temperature can exceed the threshold comfort temperature (upper limit of the range of comfort temperature) by 1K or more during the occupied hours of a typical non-heating season (1 May to 30 September). Hours of exceedance is 3%.



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NO	REV	DATE
A	REDRAWN	1 JAN 1988
B	ENTRANCE SCREEN REVISED	8.6.88
C	FINISHES + JOINERY DETAIL CROSS REFERENCES ADDED, BENCHES	17.06.88
D	BENCHES REMOVED, DETAIL REFS ADDED	28-09-88