15-17 Leeke Street

Internal Environmental Analysis

Insignis Consulting Engineers Ltd.
48 Dover Street | London | W1S 4FF
t: +44 (0) 203 869 8444
e: admin@insignisconsulting.co.uk
www.insignisconsulting.co.uk

Document Reference

0343-INSIG-RP-MEP-01

Issue Status

Issue	Date	Description	By	Checker
01	3 July 2023	Draft Issue for Comment	RM	JH
02	10 July 2023	Final Issue	RM	JH

Contents

Executive Summary

General

The purpose of this report is to assess compliance with the Camden Local Plan Cooling hierarchy for the proposed office refurbishment at 15-17 Leeke Street, Camden, London.

CIBSE TM52 'The limits of thermal comfort: avoiding overheating in European buildings' has also been assessed.

Internal Environmental Analysis

Dynamic thermal simulation has been used to carry out the overheating analysis which is a sophisticated form of predictive building performance modelling.

To accurately model the dynamic nature of the proposed developments' thermal response, hourly recorded weather data was used in the form of the future CIBSE London Design Summer Year (DSY) for the 2020s, high emissions, 50% percentile weather file to carry out the initial CIBSE TM52 (2013) assessment.

Results

A number of scenarios were assessed for the proposed development in order to demonstrate compliance with the Camden Local Plan cooling hierarchy and TM52 overheating criteria.

These results confirm that after the inclusion of passive design measures to reduce overheating risk and cooling demand, the assessed building still overheats and requires the inclusion of air conditioning to mitigate overheating.

Figure 1 – Ariel view of 15-17 Leeke Street, Camden, London

Figure 2 – Street view of 15-17 Leeke Street, Camden, London

1 Introduction

1.1 General

This report has been prepared in response to the below comment received from Camden Council on the 22 May 2023 with regards to planning application submitted for the refurbishment of the office located at 15-17 Leeke St, Camden in London.

"*Secondly, we also cannot support the installation of active cooling without evidence that there is a risk of overheating, and that other more passive measures have been incorporated first, in line with the cooling hierarchy (as per policy CC1 of the Local Plan, para. 8.41*)."

This report addresses Policy CC1 of the Local Plan. Paragraph 8.43 of this policy defines the cooling hierarchy process that should be followed.

The cooling hierarchy includes the following:

- Minimise internal heat generation through energy efficient design.
- Reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls.
- Manage the heat within the building through exposed internal thermal mass and high ceilings.
- Passive ventilation.
- Mechanical ventilation.
- Active cooling.

The report details simulations completed to assess criteria detailed above.

CIBSE TM52 'The limits of thermal comfort: avoiding overheating in European buildings' has also been assessed to ensure building occupant comfort levels are also achieved.

1.2 Project Description

The Leeke St development is located within the London Borough of Camden.

The site included in the analysis consists of an open plan office, plant room and 2 cellular meeting rooms.

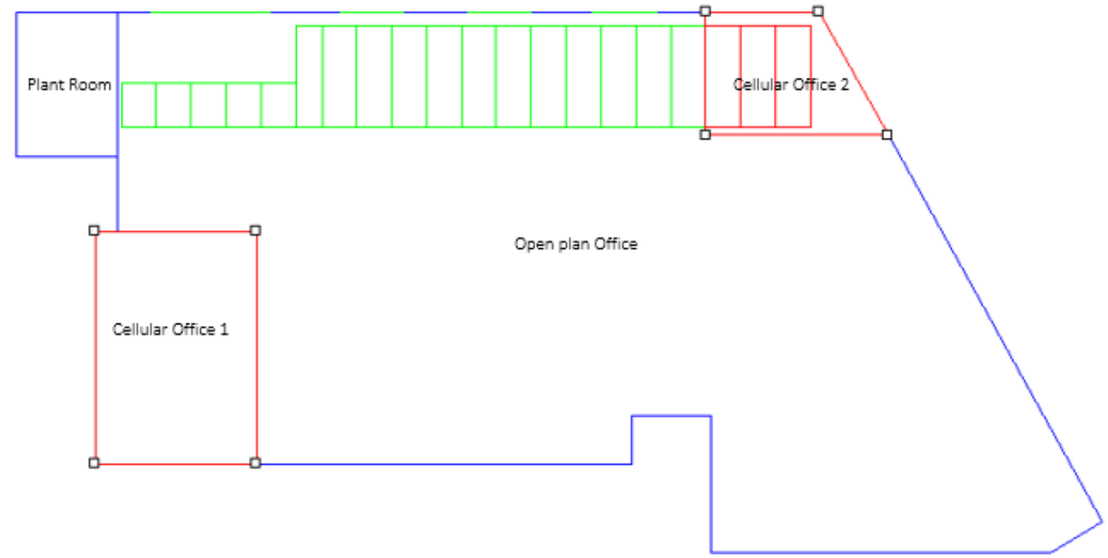

Figure 3 – Plan of development

1.3 Objective

The objective of this document is to summarise the approach to mitigating overheating risk, in response to the overheating criteria planning requirements.

1.4 Methodology

The overheating calculations have been carried out using Dynamic Simulation Modelling (DSM) software; IES Virtual Environment software suite, Version 2022. This detailed form of modelling is approved National Calculation Method (NCM) simulation software.

The above image shows a screenshot of the thermal model built within the IES software.

This allows realistic variations in fabric thermal storage (thermal mass effects), occupancy, weather conditions, solar and other internal gains to be taken into account and their impact upon building/plant operation to be modelled effectively.

The dynamic thermal simulation uses zone specific operational profiles (occupancy, lighting, ventilation and DHW demand) and HVAC plant performance data to effectively model and predict the energy performance of a building. This comprehensive calculation tool is considered best practice for assessing building energy consumption and has been carried out in accordance with CIBSE AM11 Building Energy and Environmental Modelling.

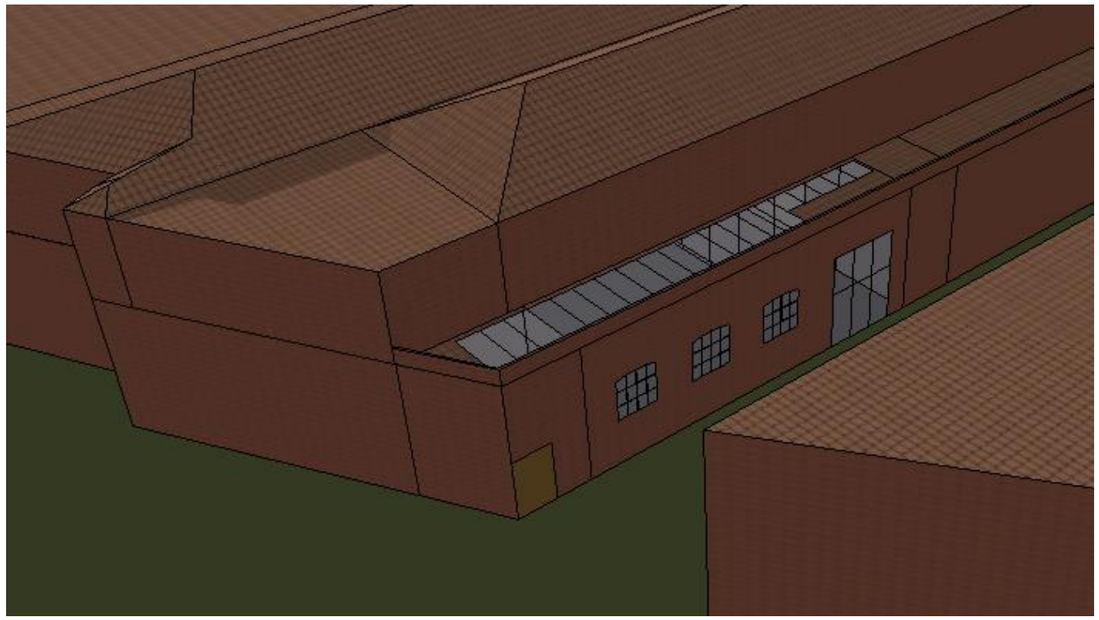

Figure 4 – IES Model of 15-17 Leeke Street, Camden, London

2 Overheating Criteria

This Section describes the Overheating Guidance Targets applicable to the proposed development.

2.1 Camden Local Plan Cooling Hierarchy

An initial overheating analysis has been conducted on the proposed development based on the Camden Local Plan cooling hierarchy Policy CC2 Adapting to Climate Change. Paragraph 8.43 defines the cooling hierarchy process that should be followed.

The cooling hierarchy includes the following:

- Minimise internal heat generation through energy efficient design
- Reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls
- Manage the heat within the building through exposed internal thermal mass and high ceilings
- Passive ventilation
- Mechanical ventilation
- Active cooling

The following sections detail the CIBSE TM52 methodology used in assessing the overheating potential of the Leeks St development.

2.2 CIBSE TM52 (2013)

CIBSE Guide TM52, entitled 'The Limits of Thermal Comfort: Avoiding Overheating in European Buildings' sets three criterion which all consider the difference between the actual operative temperature of an occupied room at any time and the maximum acceptable temperature. The three criteria are described below:

- Hours of Exceedance – The number of hours during which the difference between the actual operative temperature and the maximum acceptable temperature, during the period May to September shall not be more than 3% of occupied hours.
- Daily Weighted Exceedance - This criterion assesses the severity of overheating which includes large short-term exceedance and short-term exceedance. The weighted exceedance is required to be less than or equal to 6 degree-hours in any one day.
- Upper Limit Temperature – This criterion sets an absolute maximum value for the indoor operative temperature. This maximum temperature is required to not exceed a temperature difference between the actual operative temperature and the maximum acceptable temperature by 4°C.

To demonstrate compliance with TM52 at least two out of three of the criteria must be met in all habitable rooms. The GLA Energy Assessment Guidance recommends the DSY1 (Design Summer Year) for the 2020s, high emissions, 50% percentile scenario weather files are used in this assessment.

2.3 PMV and PPD

The Predicted Mean Vote (PMV) is adopted as part of an *ISO standard (ISO 7730) for Thermal Comfort*. It is an interpretation of a humans' sensation of thermal comfort. PMV predicts the average vote of a large group of people on a seven-point thermal sensation scale.

Predicted Percentage Dissatisfied (PPD) is: an index that establishes a quantitative prediction of the percentage of thermally dissatisfied people who feel too cool or too warm. For the purposes of *ISO 7730,* thermally dissatisfied people are those who will feel hot, warm, cool or cold. The industry has standard threshold guidance on both PMV and PPD results:

- PMV: Should fall within the tolerance of -0.5 (cool) to 0.5 (warm).
- PPD: Should result in a room acceptance value of below 10% - a greater figure means the occupants are either too hot or too cold.

3 Modelling Methodology

This section describes the thermal modelling analysis carried out to assess the overheating risk of the proposed office development against the London Plan cooling hierarchy and the TM52 criteria.

3.1 Dynamic Thermal Simulation Modules

To complete the dynamic thermal simulations required to assess the overheating risk, the "Virtual Environment" software suite from Integrated Environmental Solutions Ltd (version 2022) was used. This software uses an integrated suite of application modules based around a 3D geometrical model.

The modules used for the proposed Leeke St development include;

- ModelIT – This generates the 3D geometry as a single integrated data model which is shared by all the application models.
- SunCast – This module generates shadows and internal solar insolation from the 3D geometry from any sun position. This can be defined by date, time, orientation, site latitude and longitude. The shading information is stored in a database and used to consider the impact of shading from local shading e.g. brise soleil, and surrounding buildings and landscape features in subsequent thermal simulation calculations. This data is used to increase the accuracy of the thermal simulations and prediction of temperatures, energy consumption and carbon emissions.
- Apache-Sim – The dynamic thermal simulation program based on first-principles mathematical modelling of the heat transfer processes occurring within and around a building and is driven by real weather data. This allows the assessment of building thermal performance, including; annual energy consumption, carbon emissions and room surface temperatures. ApacheSIM is based on first principles models of heat transfer processes.
- Macroflo – This air flow simulation module allows the analysis of designs involving natural ventilation. It simulates airflow driven by stack effect, wind pressure and buoyancy forces to allow the study of façade proposes for natural ventilation.

3.2 Thermal Model Generation

The three-dimensional thermal model of the proposed office development was built based on the following floor plans and elevations received by BW Architecture Ltd on 13/06/2023:

- Existing Ground Floor Plan.pdf
- Existing Roof Plan.pdf
- Existing Section 22-000-DW-200.pdf
- Proposed Elevation (Leeke St).pdf
- Existing Elevations (Leeke St).pdf
- Proposed Elevation (Leeke St).pdf
- Proposed Sections: 22-000-DW-201-A.pdf
- Elevation 22-000-DW-300.dwg
- Plan 22-000-DW-100.dwg
- Section 22-000-DW-201.dwg

The above drawings were used to create the 3D geometric thermal model to represent its physical form and internal spaces. The following building fabric, occupancy profiles, internal heat gains and ventilation strategy were inputted for each zone assessed.

3.3 Dynamic Weather Data

To model the dynamic nature of the proposed developments' thermal response, hourly recorded weather data is used in dynamic thermal simulations. This weather data contains records of radiation, temperature, sunshine duration humidity and wind speed / direction.

The TM52 overheating criterion was assessed using the future CIBSE London Design Summer Year (DSY) for the 2020s, high emissions, 50% percentile weather file. This file contains predicted weather data from the 1st April to the 30th September to represent an extreme sequence of hourly data for summer design.

3.4 Building Construction

The following building parameters were applied to the thermal model in order to carry out the overheating study:

Element	Performance
Ground Floor	0.7 W/m^{2}K
External Walls	1.6 W/m^{2}K
Glazing	5.2 W/m^{2}K, G-value 0.55 with solar film / 0.82 without
Roof	0.18 W/m^{2}K
Glazed Doors	2.2 W/m^{2}K G-value 0.55 with solar film / 0.82 without
Solid Doors	2.6 W/m^{2}K

Table 1 – Fabric Specification

3.5 Room Data Input

The following inputs were included within each assessed zone using templates containing the operational data required to simulate their performance. The below table set out the internal heat gains, infiltration and ventilation inputs assumed within the model.

Element	Performance
Occupancy Gains	Open Plan Office/Cellular Offices: 10m^2/person 1 person =75 W sensible and 50 W latent Plant Room: none
Lighting Gains	Open Plan Office/Cellular Offices: 8 W/m^2 Plant Room: none
Equipment Gains	Open Plan Office/Cellular Offices: 10.00 W/m^2 Plant Room: none
Infiltration	0.25 air changes per hour

Table 2 – Thermal Modelling Inputs

The model inputs detailed in the above table have been made in accordance with appropriate lighting calculations, information provided by the Client, CIBSE Guide A and TM52 benchmark criteria.

3.6 Profiles

Specific profiles were set-up within the thermal model to control when the heating, occupation, lighting and ventilation systems operate in order to assess compliance against TM52 overheating criteria. Each office space was set up to be occupied from 08:30am until 18:00pm with 1 hour for lunch.

4 Results

This Section includes the results from the assessment of overheating risk against CIBSE TM52 criteria. A number of scenarios have been simulated to ensure each stage of Camden's Cooling hierarchy has been assessed.

4.1 Scenario 1 – Overheating without air conditioning

The below table highlights the results of the assessed spaces based on the outline design construction and services information described within the previous Sections of this report:

This scenario uses the London LWC DSY1-2020 High 50 Percentile weather file.

Room	Criteria 1 (% hrs Top – Tmax ≥1K)	Criteria 2 Max Daily Degrees (Hrs)	Criteria 3 (Max ΔT)	Failing Criteria	Overall TM52 Result
L00: Cellular Office 1	0.4	3	1	-	PASS
L00: Cellular Office 2	11.4	24	6	1 & 2 & 3	FAIL
L00: Open Plan Office	2.7	10.2	3	2	PASS

Table 3 – Scenario 1 – overheating without air conditioning

The above results confirm if the existing building uses natural ventilation as its primary source of occupancy comfort, it does not obtain the limiting overheating standards outlined within the CIBSE TM52 (2013) overheating criteria for all the assessed spaces.

Additional consideration was complete on additional comfort metrics such as PMV/PPD and internal temperatures. These also show whilst only natural ventilation is considered the existing building does not achieve satisfactory comfort standards:

Room	Minimum PPD	Maximum PPD	Minimum PMV	Maximum PMV	Overall Result
L00: Cellular Office 1	5	82.96	-1.03	2.15	FAIL
L00: Cellular Office 2	5	99.93	-1.82	3	FAIL
L00: Open Plan Office	5	93.6	-1.09	2.51	FAIL

Table 4 – Scenario 1 TM52 overheating results – PMV and PPD

Room	>20.00	>21.00	>22.00	>23.00	>24.00	>25.00	>26.00
L00: Cellular Office 1	1383.7	1265.8	1051.3	845.5	673.3	474.8	282.2
L00: Cellular Office 2	1345.2	1227.8	1055.7	909.5	750.7	585.3	441
L00: Open Plan Office	1369	1264	1070.2	883.8	723	527.5	364

Table 5 – Scenario 1 TM52 overheating results – Air Temperature results

Room	>20.00	>21.00	>22.00	>23.00	>24.00	>25.00	>26.00
L00: Cellular Office 1	1231	1114.8	906.3	731.7	569.8	397.8	228.2
L00: Cellular Office 2	1183	1074.8	941.7	809	679.5	540.3	417.7
L00: Open Plan Office	1212.8	1105.5	928.2	770.5	607.5	436.7	298.3

Table 6 – Scenario 1 TM52 overheating results – Operative Temperature results

Due to the failure of satisfactory occupancy comfort, additional consideration was required to design a relevant conditioning system, this included consideration within each step of Camden Local Plans cooling hierarchy.

4.2 Cooling Demand Reduction Calculations

Multiple calculations were completed, each considering the steps of the cooling hierarchy guidance, to reduce cooling demand and energy consumption resulting from the use of air conditioning.

The following table summarises the design measures incorporated within the design to reduce the cooling requirement on site and the associated reduction in cooling demand

	Energy Consumption	Reduction
Base Design – Not including the Cooling hierarchy measures	391.9 kWh	-
Design to include solar control	370.56 kWh	-5.45 %
Design including improvement to the lighting design and controls	349.22 kWh	-5.76
Final Design with improvements to plant efficiency	158.12 kWh	-54.72 %
Final Reduction required		**-59.65 %**

Table 7 – Colling Energy Demand Reduction

The final design resulted in a circa 60% reduction in cooling energy consumption through the use of passive design improvements.

Once the final selection was complete additional overheating simulations were considered which includes the actual cooling capacity and final design selection:

4.3 Scenario 2 – Overheating with air conditioning

The CIBSE TM52 overheating assessment has been re-run to include the above passive design measures with the inclusion of air conditioning. This included multiple weather files which consider different possible future scenarios. This scenario uses the London LWC DSY1-2020 High 50 Percentile weather file.

Room	Criteria 1 (% hrs Top – Tmax ≥1K)	Criteria 2 Max Daily Degrees (Hrs)	Criteria 3 (Max ΔT)	Failing Criteria	Overall TM52 Result
L00: Cellular Office 1	0	0	0	-	PASS
L00: Cellular Office 2	0	0	0	-	PASS
L00: Open Plan Office	0	0	0	-	PASS

Table 8 – Scenario 2 TM52 overheating results

Room	Minimum PPD	Maximum PPD	Minimum PMV	Maximum PMV	Overall Result
L00: Cellular Office 1	5	5.77	0.01	0.19	PASS
L00: Cellular Office 2	5	6.97	-0.31	0.29	PASS
L00: Open Plan Office	5.18	6.57	0.09	0.27	PASS

Table 9 – Scenario 2 PMV and PPD results

Room	>20.00	>21.00	>22.00	>23.00	>24.00	>25.00	>26.00
L00: Cellular Office 1	1204.5	919.7	49.7	0	0	0	0
L00: Cellular Office 2	1177.8	982.8	24.3	0	0	0	0
L00: Open Plan Office	1189.7	957.2	55.3	0	0	0	0

Table 10 – Scenario 2 TM52 overheating results – Air Temperature

Room	>20.00	>21.00	>22.00	>23.00	>24.00	>25.00	>26.00
L00: Cellular Office 1	1052.8	781.2	95	0	0	0	0
L00: Cellular Office 2	1037	874	649.7	189.2	17.2	0	0
L00: Open Plan Office	1038.7	830.8	407.3	0	0	0	0

Table 11 – Scenario 2 Operative Temperature results

The results show based on the chosen design and information listed within this report that compliance is met with the TM52 overheating standard. Furthermore, its clear there is a slight increase in temperature within the cellular office 2 due to the rooflight solar gains.

5 Summary

5.1 General

The purpose of this report is to assess compliance with the Camden Local Plan Cooling hierarchy for the proposed office refurbishment at 15-17 Leeke Street, Camden, London. CIBSE TM52 'The limits of thermal comfort: avoiding overheating in European buildings' has also been assessed.

Dynamic thermal simulation has been used to carry out the overheating analysis which is a sophisticated form of predictive building performance modelling. To accurately model the dynamic nature of the proposed developments' thermal response, hourly recorded weather data was used in the form of the future CIBSE London Design Summer Year (DSY) for the 2020s, high emissions, 50% percentile weather file to carry out the initial CIBSE TM52 (2013) assessment.

A number of scenarios were assessed for the proposed development in order to demonstrate compliance with the Camden Local Plan cooling hierarchy and TM52 overheating criteria. These results confirm that after the inclusion of passive design measures to reduce overheating risk and cooling demand, the assessed building still overheats and requires the inclusion of air conditioning to mitigate overheating.

Figure 5 – Ariel view of 15-17 Leeke Street, Camden, London

Figure 6 – Street view of 15-17 Leeke Street, Camden, London

INsignis

INsignis Consulting Engineers Ltd.
48 Dover Street | London | W1S 4FF
t: +44 (0) 203 869 8444
e: admin@insignisconsulting.co.uk
www.insignisconsulting.co.uk