Planning Overheating Report

20 Flaxman Terrace, London WC1

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Document Approval				
	Signature	Name	Title	Date
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Authorised By		Kevin Leonard	Director	30.10.20

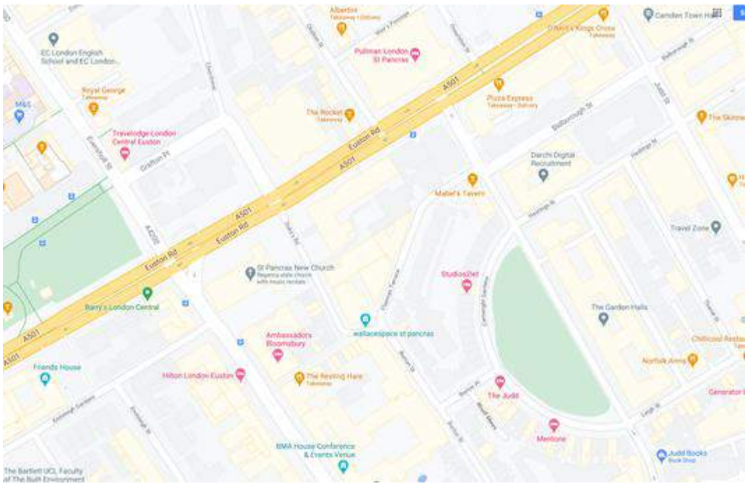
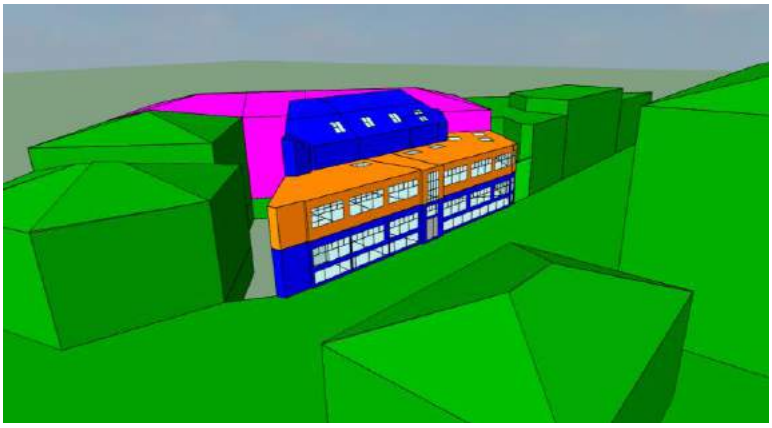
CONTENTS

1. INTRODUCTION

This report is to detail the results of the dynamic thermal modelling investigation carried out to determine the risk of overheating at 20 Flaxman Terrace in line with Camden Council's Local Plan Policy CC2: Adapting to climate change, and the Cooling Hierarchy, in order to determine the requirement for the installation of comfort cooling during the ongoing refurbishment of the existing office spaces.

2. SITE LOCATION

The location of the building is as follows:

Address	20 Flaxman Terrace London WC1H 9AT
Google Map Site Location	
Illustrative Render	

3. THE PROPOSED DEVELOPMENT

3.1. 20 Flaxman Terrace

20 Flaxman Terrace is a part 2-, part 3-storey commercial building, wholly in office use, comprising two elements: an original 1900s warehouse, and a 1950s front and side extension with a modern frontage and feature entrance onto the northern side of Flaxman Terrace.

The building forms a triangular plot shaped by the configuration of Flaxman Terrace, Duke's Road and Cartwright Gardens.

3.2. Planning Statement

Planning Application 2020/0941/P:

Planning Statement. 20 Flaxman Terrace, WC1H 9AT, Salaft Properties Limited: Installation of roof level acoustic plant enclosure for existing VRV/VRF condenser unit and 3 No. new VRV/VRF units together with 3 No. small split condenser units. (February 2020)

It is proposed to install VRV/VRF condenser units alongside an existing condenser unit within a purpose built four-sided acoustic enclosure which will also ensure that they are not visible from the upper floors of neighbouring buildings.

The submitted noise assessment states that the proposed units will not give rise to any unacceptable noise impacts and will not have a detrimental effect on the amenities of the occupiers of any nearby properties.

3.3. Planning Response – Camden Planning email 14th May 2020

"Climate Change":

Our Local Plan Policy CC2 Adapting to climate change, amongst many things, requires all development to adopt appropriate climate change adaptation measures such as reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy. It goes on to explain that Active cooling (air conditioning) will only be permitted where dynamic thermal modelling demonstrates there is a clear need for it after all of the preferred measures are incorporated in line with the cooling hierarchy.

The cooling hierarchy includes (from high to low):

- 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 current proposal involves the installation of 7x plant equipment including 4x VRV/VRF air conditioning units with no existing units installed.

The applicant should demonstrate, in statement and drawings, why other methods higher up in the cooling hierarchy are not suitable for the subject building and that Active cooling is necessary."

4. OVERHEATING RISK ASSESSMENT

4.1. Methodology

The calculations have been undertaken using the Virtual Environment thermal modelling package published by Integrated Environmental Solutions (IES VE 2019).

A 3D model of the building has been built in VE using the plans, sections and elevations provided from a building survey undertaken during a previous planning application.

The building services thermal comfort criteria detailed in the following sections of the report have been used to inform the model, and the ApacheSim dynamic simulation module has been used – in association with SunCast shading simulation module and the MacroFlo natural ventilation simulation module – to undertake Dynamic Thermal Simulation calculations, as required by local planning policy.

The room thermal comfort criteria have been determined as follows:

- Winter and Summer design setpoints have been taken from various documents according to the various room types.
- Usage profiles for heating, cooling and ventilation have been assumed to be a normal working day of 8am to 6pm (0800-1800),
- Building profiles for occupancy, lighting and equipment heat gains have been assumed to be a normal working day as above, from Monday to Friday,
- Room occupancy and equipment have been taken from proposed floor plans or from survey information.

4.2. Weather Files

The calculations for have been completed using an Industry Standard CIBSE Weather File for London City location, 2020s, High emissions scenario, 50th percentile DSY1.

4.3. Mechanical Services Design Criteria

The model results demonstrated within this report are based on the information and input data within the following table:

KEY DESIGN CRITERIA		
Temperature and Humidity		
Outdoor Design Conditions	London City location, 2020s, High emissions scenario, 50^{th} percentile DSY1.	
Internal Operative Temperatures °C	CIBSE Guide A Table A1.5	
Area or Room	Minimum	Maximum
Offices	21°C	TM52 Criteria
Circulation/Stairwells	19°C	TM52 Criteria
Toilets	19°C	N/A
Ventilation		
Ventilation Rates	CIBSE Guide A Table A1.5	
Area or Room	Supply	Infiltration[1]
Offices	10 l/s/p	0.75 ach
Circulation/Stairwells	N/A	0.75 ach
Toilets	-5 ach	0.75 ach
Air Permeability Rate	20 ($m^3/h/m^2$@50Pa)[1]	
Natural Ventilation (NV)	Simulated using IES VE MacroFlo module based on opening windows	
1) Typical air infiltration rate at ambient pressure, equivalent to air permeability rate of 20 $m^3/h/m^2$@50Pa from CIBSE Guide A Table 4.18 for a "leaky building".		

4.4. Internal Heat Gains

In order to simulate the thermal comfort within the employment floorspaces, they have been populated with occupants and heat gains from equipment and lighting.

The occupant numbers are based on the number of desks taken from the fully loaded drawings of the proposed areas, and/or surveys of the existing offices, and the equipment heat gains have again been taken from the fully loaded drawings, and/or estimated to include such AV and IT equipment that might reasonably be expected within a typical office space.

The equipment and heat gains used within the model are tabulated below:

TYPICAL INTERNAL HEAT GAINS		
Occupants		
Occupants Typical	Taken from fully-loaded drawings of survey of existing desk numbers	
Occupant Heat Gins	90 W/p Sensible	60 W/p Latent
Lighting		
Lighting Typical - Offices	8 W/m^2	
Lighting Typical – Circulation/Toilets	5 W/m^2	
Equipment		
Small Power:	Based on fully loaded floor plans	
Typical PC workstation/monitor	100W	
Typical laptop	25W (diversified 80% in meeting rooms)	
Typical desktop printer	100W	
Typical officer printer/scanner	300W	
Typical flat screen TV	50W	
Comms Room	5000W	

4.5. Construction U-Values and g-Values

The model results demonstrated within this report are based on the construction information within the following table:

Fabric Element	U-Value	Comments
Roof – Flat	3.38	Asphalt on concrete 200mm
Roof – Flat	2.28	Asphalt on concrete 400mm
Roof – Pitched/dormer	3.06	Tile/felt on rafters/ plasterboard
External Walls 1900s	1.39-2.18	Solid brick
External Walls 1950s	1.26-1.49	Uninsulated cavity
Internal Walls	1.07-1.69	
Basement Floor	0.28	Concrete
Internal Floor	1.93-3.16	Concrete, various thickness
Windows – U-Value	5.56	IES VE database: Single glazed including metal frames
Windows – g-Value	0.70	IES VE database
Rooflights – U-Value	5.73	IES VE database: Single glazed polycarbonate including frames
Rooflights – g-Value	0.70	IES VE database
Doors	3.70	Metal door
Internal Blinds - (Venetian - Closed)	0.6 0.3	Shading Coefficient Radiant Fraction

The U-Values and g-Values within the table above have been taken from the IES VE construction database, based on the thickness of walls estimated from the architectural survey drawings of the existing building provided by the design team.

The materials chosen have been based on visual surveys taken from site photographs and estimates based on the age of the respective parts of the building.

5. BASELINE RESULTS

To provide a measure against which the introduction of the overheating mitigating measures as described with the cooling hierarchy can be compared, a **Baseline** calculation been undertaken with heating included, in order to meet thermal comfort criteria in winter, but with no cooling or ventilation, whilst rooms have been subject to internal occupant, lighting and equipment heat gains detailed above during the stated occupancy hours.

Interpreting the Results

To determine whether the occupied spaces meet the limiting comfort criteria for winter and summer, the results have been shown as follows:

Criteria	Results Shown	Results Description
Winter	Minimum operative temperature results during occupied hours	Results above the winter internal design criteria will be deemed to have passed the investigation
Summer	Number of CIBSE TM52[1] overheating Criteria 1, 2 or 3 failing, and: Room TM52 status	2 out of 3 criterion failures constitute an overall TM52 failure indicating summertime overheating (Occupied hours May to September only)

[1] TM52 results shown for information purposes only in rooms with only transient occupancy, such as circulation areas or toilets, which are not deemed to occupied spaces.

CIBSE TM53 – Overheating in European Buildings

TM52 sets out 3 criteria by which a building could be classed as overheating should 2 of the criteria fail.

- Criterion 1: Sets a limit for the number of hours during which the operative temperature can exceed the comfort threshold temperature by 1°C or above to 3% of the occupied hours, during the period of May to September inclusive.
- Criterion 2: Deals with the severity of overheating within any one day, the level of which is a function of both temperature rise and its duration.
- Criterion 3: Sets an absolute maximum daily temperature for a room, beyond which the level of overheating is unacceptable, of 4°C above the thermal comfort threshold.

For the purposes of this report, the Criteria as set out in TM52 discussed above will be used to assess the risk of overheating.

Results Table 1 – Baseline Results

The following table includes results from an annual simulation with heating only, in order to meet thermal comfort criteria in winter, but with no natural or mechanical ventilation, or cooling provision within the rooms – i.e. the building is 'free running' in summer.

Rooms determined to have passed the overheating risk assessment are highlighted in Green; those rooms determined to have failed the overheating risk assessment are highlighted in Red.

TABLE 1 - BASELINE RESULTS - Heating, No Cooling, No Ventilation

DESIGN CRITERIA				DYNAMIC SIMULATION RESULTS		CIBSE TM52 RESULTS		
				WINTER	SUMMER	SUMMER		
Room	Occupied Space/Type	Winter Comfort Criteria Temp (degC)	Summer Comfort Criteria Temp (degC)	Minimum Dry Resultant Temp (°C)	Maximum Dry Resultant Temp (°C)	TM52 Criteria Failing	TM52 Pass/Fail	Notes
L-1 Meeting 1	Occupied	21	TM52	21	34.66	1 & 2 & 3	Fail	
L-1 Meeting 2	Occupied	21	TM52	21	33.71	1 & 2 & 3	Fail	
L-1 Meeting 3	Occupied	21	TM52	21	34.83	1 & 2 & 3	Fail	
L-1 Office Front	Occupied	21	TM52	21	36.36	1 & 2 & 3	Fail	
L-1 Office Rear	Occupied	21	TM52	21	32.91	1 & 2	Fail	
L-1 Stair Main	Transient	19	TM52	19	30.55	-	Pass	
L-1 Toilets	Transient	19	TM52	19	30.94	2	Pass	
L00 Boardroom	Occupied	21	TM52	20.99	37.78	1 & 2 & 3	Fail	
L00 Comms Existing	N/A	21	TM52	22.97	23.06	-	Pass	Temperature controlled to 25C
L00 Cupboard 1	N/A	-	-	12.35	29.86	-	Pass	Non-occupied area
L00 Cupboard 2	N/A	-	-	10.89	29.62	-	Pass	Non-occupied area
L00 Entrance Main	Transient	19	TM52	19	32.35	1 & 2	Fail	
L00 Entrance Rear	Transient	19	TM52	19	32.95	1 & 2	Fail	
L00 Meeting-Library Existing	Occupied	21	TM52	20.99	37.58	1 & 2 & 3	Fail	
L00 Office Front	Occupied	21	TM52	21	37.19	1 & 2 & 3	Fail	
L00 Office Rear	Occupied	21	TM52	21	36.35	1 & 2 & 3	Fail	
L00 Post Area	Occupied	21	TM52	20.99	33.28	1 & 2	Fail	
L00 Quiet Area	Occupied	21	TM52	21	32.92	1 & 2	Fail	
L00 Reception-Waiting	Occupied	21	TM52	21	33.51	1 & 2	Fail	
L00 Stair	Transient	19	TM52	19	32.74	1 & 2	Fail	
L00 Store	N/A	-	-	14.06	30.55	-	Fail	Non-occupied area
L00 Tea Point	Occupied	21	TM52	21	32.58	1 & 2	Fail	
L00 WC 1	Transient	19	TM52	18.99	32.79	1 & 2	Fail	
L00 WC 2	Transient	19	TM52	19	34.15	1 & 2 & 3	Fail	
L00 WC Disabled	Transient	19	TM52	19	30.64	-	Pass	
L01 Creative	Occupied	21	TM52	21	33.82	1 & 2	Fail	
L01 Cupboard	N/A	-	-	12.51	30.69	-	Pass	Non-occupied area
L01 Edit Suite	Occupied	21	TM52	21.18	43.67	1 & 2 & 3	Fail	
L01 Lobby	Transient	19	TM52	19	31.98	1 & 2	Fail	
L01 Office Back	Occupied	21	TM52	21	35.39	1 & 2 & 3	Fail	
L01 Office Front 1	Occupied	21	TM52	21	38.84	1 & 2 & 3	Fail	
L01 Office Front 2	Occupied	21	TM52	21	37.85	1 & 2 & 3	Fail	
L01 Office Open	Occupied	21	TM52	21	34.95	1 & 2 & 3	Fail	
L01 Stair 2	Transient	19	TM52	19	32.75	1 & 2	Fail	
L01 Stairs Main	Transient	19	TM52	18.99	33.19	1 & 2	Fail	
L01 Tea Point	Occupied	21	TM52	20.97	37.51	1 & 2 & 3	Fail	
L01 Toilets Male	Transient	19	TM52	18.99	32.76	1 & 2	Fail	
L01 TV	Occupied	21	TM52	20.99	36.62	1 & 2 & 3	Fail	
L02 Creative	Occupied	21	TM52	20.98	39.72	1 & 2 & 3	Fail	
L02 Cupboard	N/A	-	-	9.47	31.7	2	Pass	Non-occupied area
L02 Lobby	Transient	19	TM52	18.99	33.88	1 & 2	Fail	
L02 Meeting	Occupied	21	TM52	20.98	39.07	1 & 2 & 3	Fail	
L02 Stair 2	Transient	19	TM52	18.99	34.66	1 & 2 & 3	Fail	

As can be seen, the Baseline results show that most of the occupied spaces fail the TM52 criteria, and will therefore suffer a high risk of overheating in summer, when no mitigating measures are included in the calculations.

6. THE COOLING HIERARCHY

Pursuant to Camden Council's Local Plan Policy CC2: Adapting to climate change, and the associated Cooling Hierarchy, the levels of the Hierarchy detailed below have been investigated in turn, with each mitigating measure discussed for 'pros and cons' and calculations undertaken where the measures have been deemed appropriate to the building, in order to help reduce the risk of overheating in the occupied spaces.

6.1. Minimise Internal Heat Generation Through Energy Efficient Design

- The internal offices will incorporate modern efficient office equipment – e.g. Modern IT equipment, flat screens monitors, laptops, LED lighting etc. to minimise internal heat gains.

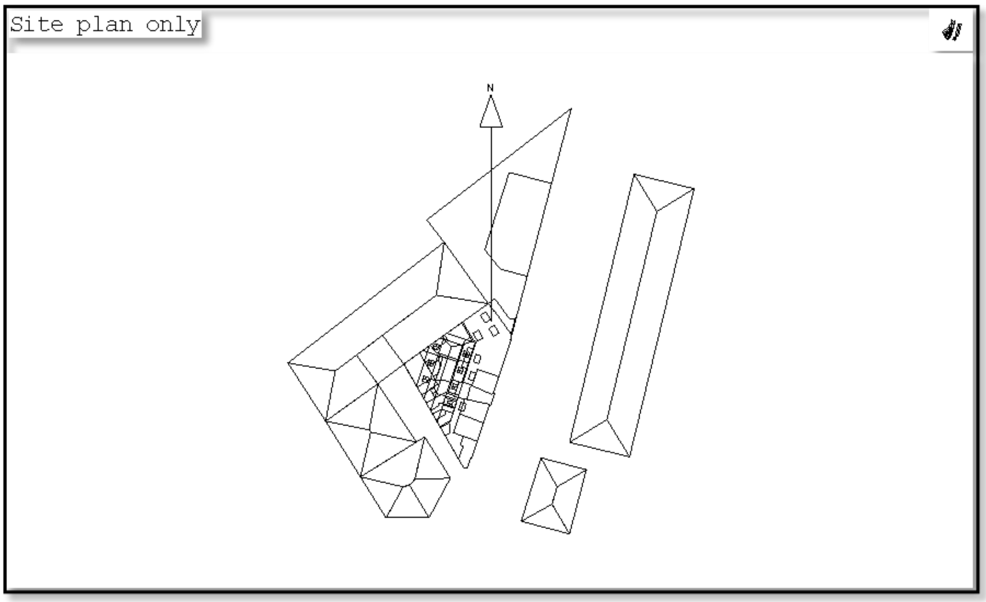
- Internal pipework serving domestic water installations will be insulated to modern standards, to prevent the transfer of heat from the pipework to the space.

The Baseline calculations undertaken, as detailed within Section 5.0 above, include internal heat gains from office equipment based on modern efficient office equipment.

6.2. Reduce the Amount of Heat Entering a Building

Reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls:

<u>Orientation:</u>



- The building is existing, and as such, the orientation cannot be altered.

No further calculations will therefore be undertaken to investigate the effects of altering the building's orientation.

Shading:

- The building is existing, and as such is subject to shading from adjacent buildings. The building shares a party wall on its north-west face; is closely adjacent to buildings on its north-east and south-west faces, and is overlooked on its south-east face by buildings on the opposite side of Flaxman Terrace.
- The windows in the existing building are provided with internal venetian blinds. However, internal blinds can inhibit the usefulness of providing passive ventilation via opening windows. As the glazing is to remain as existing, it is not possible to provide more modern windows that incorporate blinds between the faces of double or triple glazed units.
- The use of internal blinds usually requires artificial lighting to be used, even with suitable ambient daylight, which adds to the energy requirement, and hence the carbon footprint of the building,
- It is assumed that the addition of external shading measures would require submission to Planning, therefore this option has not been considered.

Calculations will therefore be undertaken to investigate the effects of internal shading on the risk or overheating within the occupied spaces, as well as incorporating shading from adjacent buildings.

Fenestration:

- The building includes glazing on the exposed south-east and south-west elevations. The main area of glazing is the street frontage on the south east elevation. However, the glazing is existing, and as such, the location, direction and size of the glazing is not proposed to be altered.

No further calculations will therefore be undertaken to investigate the effects of altering the building's existing glazing.

Insulation:

- The building is existing, and as such, the construction fabric is as existing. It is not proposed to upgrade the existing fabric.

No further calculations will therefore be undertaken to investigate the effects of upgrading the building's existing external fabric.

Green Roofs:

- The original Victorian part of the building has a pitched roof, as does the 3-storey part of the 1950s extension, therefore these areas would be unsuitable for retrofit of a green roof. The upper storey of the 1950s extension has a flat roof, however with a number of protruding rooflights.

  For this part of the roof to be retrofitted with a green roof, the structural build-up of the existing 1950s roof would need to be evaluated to see if it would bear the weight of a new green roof.

No further calculations will therefore be undertaken to investigate the effects of adding a green roof to the building's existing external flat roof

Results Table 2 – Results Including Measures to Reduce Heat Entering

The following table includes results from an annual simulation with no natural or mechanical ventilation or cooling provision within the rooms, but with internal venetian blinds provided to the windows.

TABLE 2 - RESULTS INCLUDING HEATING AND WINDOW BLINDS - No Cooling, No Mechanical Ventilation								
DESIGN CRITERIA				DYNAMIC SIMULATION RESULTS		CIBSE TM52 RESULTS		
				WINTER	SUMMER	SUMMER		
Room	Occupied Space/Type	Winter Comfort Criteria Temp (degC)	Summer Comfort Criteria Temp (degC)	Minimum Dry Resultant Temp (°C)	Maximum Dry Resultant Temp (°C)	TM52 Criteria Failing	TM52 Pass/Fail	Notes
L-1 Meeting 1	Occupied	21	TM52	21	33.95	1 & 2 & 3	Fail	
L-1 Meeting 2	Occupied	21	TM52	21	32.97	1 & 2	Fail	
L-1 Meeting 3	Occupied	21	TM52	21	34.39	1 & 2 & 3	Fail	
L-1 Office Front	Occupied	21	TM52	21	35.57	1 & 2 & 3	Fail	
L-1 Office Rear	Occupied	21	TM52	21	32.53	1 & 2	Fail	
L-1 Stair Main	Transient	19	TM52	19	30	-	Pass	
L-1 Toilets	Transient	19	TM52	19	30.55	-	Pass	
L00 Boardroom	Occupied	21	TM52	21	36.81	1 & 2 & 3	Fail	
L00 Comms Existing	N/A	21	TM52	22.99	23.03	-	Pass	Temperature controlled to 25C
L00 Cupboard 1	N/A	-	-	12.31	29.44	-	Pass	Non-occupied area
L00 Cupboard 2	N/A	-	-	10.86	29.33	-	Pass	Non-occupied area
L00 Entrance Main	Transient	19	TM52	19	31.82	1 & 2	Fail	
L00 Entrance Rear	Transient	19	TM52	19	32.65	2	Pass	
L00 Meeting-Library Existing	Occupied	21	TM52	21	36.62	1 & 2 & 3	Fail	
L00 Office Front	Occupied	21	TM52	21	36.48	1 & 2 & 3	Fail	
L00 Office Rear	Occupied	21	TM52	21	35.85	1 & 2 & 3	Fail	
L00 Post Area	Occupied	21	TM52	21	32.83	1 & 2	Fail	
L00 Quiet Area	Occupied	21	TM52	21	32.12	1 & 2	Fail	
L00 Reception-Waiting	Occupied	21	TM52	21	33.08	1 & 2	Fail	
L00 Stair	Transient	19	TM52	19	32.3	1 & 2	Fail	
L00 Store	N/A	-	-	14	30	-	Fail	Non-occupied area
L00 Tea Point	Occupied	21	TM52	21	32.17	1 & 2	Fail	
L00 WC 1	Transient	19	TM52	18.99	32.39	1 & 2	Fail	
L00 WC 2	Transient	19	TM52	18.99	33.8	1 & 2	Fail	
L00 WC Disabled	Transient	19	TM52	19	30.04	-	Pass	
L01 Creative	Occupied	21	TM52	21	33.24	1 & 2	Fail	
L01 Cupboard	N/A	-	-	12.4	30.03	-	Pass	Non-occupied area
L01 Edit Suite	Occupied	21	TM52	21.16	43.16	1 & 2 & 3	Fail	
L01 Lobby	Transient	19	TM52	19	31.4	1 & 2	Fail	
L01 Office Back	Occupied	21	TM52	21	34.91	1 & 2 & 3	Fail	
L01 Office Front 1	Occupied	21	TM52	21	38.35	1 & 2 & 3	Fail	
L01 Office Front 2	Occupied	21	TM52	21	37.17	1 & 2 & 3	Fail	
L01 Office Open	Occupied	21	TM52	21	34.06	1 & 2 & 3	Fail	
L01 Stair 2	Transient	19	TM52	19	32.27	1 & 2	Fail	
L01 Stairs Main	Transient	19	TM52	18.99	32.81	1 & 2	Fail	
L01 Tea Point	Occupied	21	TM52	21	36.53	1 & 2 & 3	Fail	
L01 Toilets Male	Transient	19	TM52	18.99	32.14	2	Pass	
L01 TV	Occupied	21	TM52	21	35.81	1 & 2 & 3	Fail	
L02 Creative	Occupied	21	TM52	20.99	39.35	1 & 2 & 3	Fail	
L02 Cupboard	N/A	-	-	9.39	31.26	2	Pass	Non-occupied area
L02 Lobby	Transient	19	TM52	18.99	33.56	2	Pass	
L02 Meeting	Occupied	21	TM52	20.98	38.74	1 & 2 & 3	Fail	
L02 Stair 2	Transient	19	TM52	18.99	34.44	1 & 2 & 3	Fail	

As can be seen, with the inclusion of internal blinds on the office windows, the number of occupied spaces that pass the TM52 criteria has increased. However:

- These spaces are all ancillary spaces with low occupancies and internal heat gains,

- Within the main office spaces with high occupancy densities and equipment heat gains, the risk of summer overheating remains high.

Therefore further mitigating measures will need to be investigated.

6.3. Manage Heat Through Exposed Internal Thermal Mass and High Ceilings Design

Exposed Internal Thermal Mass and High Ceilings

- The concrete ceilings within the existing building have generally been left exposed within the office spaces.

- The building is existing, and as such, the height of the ceilings cannot be altered.

No further calculations will therefore be undertaken to investigate the effects of exposed internal thermal mass and ceiling heights.

6.4. Passive Ventilation

Passive ventilation is ventilation that has been provided to an internal space without the means of energy use by mechanical equipment such as fans or air handling units. Passive ventilation, otherwise known as natural ventilation, can be provided to a space by means of pathway from outside to insides, such as an air duct, or via openings in the external facade such as airbricks, louvres or opening windows.

Opening Windows

- The building is existing, and as such, the external glazing is to remain as existing.

- The building is enclosed on the north east and north west faces, reducing the opportunity for cross-ventilation, and natural ventilation from external windows is only effective to about 6m into the space, meaning that the internal areas in the back half of the building will be unlikely to benefit from natural ventilation.

- The windows on the front façade have opening lights to the top third, approx., with top-mounted hinges. The windows on the south west façade are sash windows or have opening lights with side-mounted hinges.

- Cooling via natural ventilation from ambient external air will only be experienced if the replacement air from outside is cooler than the internal conditions, which reduces the effectiveness in summer.

- The use of opening windows in inner city areas can have pollution and/or acoustic implications for the building occupants. Heavy rain can also cause occupants to close windows to avoid ingress of water, and excessive air movement causing the blinds to move around can be distracting to occupants.

- It is not envisaged that the existing windows within the toilets will be used for ventilation purposes.

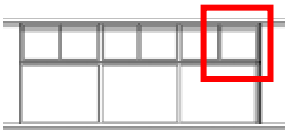
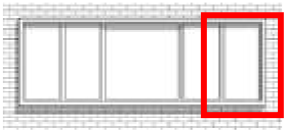
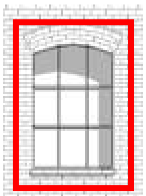
Calculations will therefore be undertaken to investigate the effects of natural ventilation via opening windows on the risk of overheating within the occupied spaces.

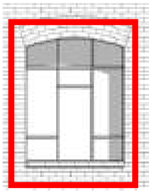
<u>Results Table 3 – Results Including Passive Ventilation</u>

The opening lights of the external windows in the building are as existing, and therefore will not have been designed to comply with the minimum requirements of Building Regulations Approved Document F (Ventilation) in order to provide 4 air changes per hour of 'purge ventilation' to the rooms during hot weather.

For the purposes of the calculations therefore, the rooms within the model with opening windows will have been modelled using MacroFlo, the IES VE thermal modelling package's natural ventilation simulation module. The windows will be modelled to be open if the room internal operative temperature rises above 25°C.

The window opening details will be based on the following information:

DETAILS OF OPENING WINDOWS USED IN THE CALCULATIONS					
Window	**Location**	**Opening Lights**	**Opening Type**	**Opening Area**	**Opening Angle**
Small Opening	1950s Front elevation		Top hung	85%	10°
Large Opening	1950s Courtyard		Side hung	75%	10°
Sash Opening	1900s Courtyard		Lower sash vertical opening	15%	N/A

DETAILS OF OPENING WINDOWS USED IN THE CALCULATIONS					
Window	**Location**	**Opening Lights**	**Opening Type**	**Opening Area**	**Opening Angle**
Rear Opening	1900s Courtyard rear		Side hung	20%	10°

The following table includes results from an annual simulation with no mechanical ventilation or cooling provision within the rooms, but with internal venetian blinds provided to the windows, <u>and natural ventilation via opening windows where available within the occupied spaces</u>.

TABLE 3 - RESULTS INCLUDING HEATING, BLINDS AND NATURAL VENTILATION - No Cooling, No Mechanical Ventilation

DESIGN CRITERIA				DYNAMIC SIMULATION RESULTS		CIBSE TM52 RESULTS		
				WINTER	SUMMER	SUMMER		
Room	Occupied Space/Type	Winter Comfort Criteria Temp	Summer Comfort Criteria Temp	Minimum Dry Resultant Temp	Maximum Dry Resultant Temp	TM52 Criteria Failing	TM52 Pass/Fail	Notes
		(degC)	(degC)	(°C)	(°C)			
L-1 Meeting 1	Occupied	21	TM52	21	33.15	1 & 2	Fail	
L-1 Meeting 2	Occupied	21	TM52	21	32.1	1 & 2	Fail	
L-1 Meeting 3	Occupied	21	TM52	21	33.75	1 & 2 & 3	Fail	
L-1 Office Front	Occupied	21	TM52	21	34.75	1 & 2 & 3	Fail	
L-1 Office Rear	Occupied	21	TM52	21	31.93	1 & 2	Fail	
L-1 Stair Main	Transient	19	TM52	19	29.43	-	Pass	
L-1 Toilets	Transient	19	TM52	19	30.24	-	Pass	
L00 Boardroom	Occupied	21	TM52	21	35.35	1 & 2 & 3	Fail	
L00 Comms Existing	N/A	21	TM52	22.99	23.03	-	Pass	Temperature controlled to 25C
L00 Cupboard 1	N/A	-	-	12.34	29.03	-	Pass	Non-occupied area
L00 Cupboard 2	N/A	-	-	10.8	29.11	-	Pass	Non-occupied area
L00 Entrance Main	Transient	19	TM52	19	31.24	2	Pass	Pass with Natural Ventilation
L00 Entrance Rear	Transient	19	TM52	19	32.43	2	Pass	
L00 Meeting-Library Existing	Occupied	21	TM52	21	35.12	1 & 2 & 3	Fail	
L00 Office Front	Occupied	21	TM52	21	34.84	1 & 2 & 3	Fail	
L00 Office Rear	Occupied	21	TM52	21.01	33.31	1 & 2 & 3	Fail	
L00 Post Area	Occupied	21	TM52	21	32.37	1 & 2	Fail	
L00 Quiet Area	Occupied	21	TM52	21	31.47	2	Pass	Pass with Natural Ventilation
L00 Reception-Waiting	Occupied	21	TM52	21	32.82	1 & 2	Fail	
L00 Stair	Transient	19	TM52	19	30.57	-	Pass	
L00 Store	N/A	-	-	13.99	29.56	-	Fail	Non-occupied area
L00 Tea Point	Occupied	21	TM52	21	32.58	1 & 2	Pass	
L00 WC 1	Transient	19	TM52	18.99	32.13	2	Pass	Pass with Natural Ventilation
L00 WC 2	Transient	19	TM52	19	33.54	1 & 2	Fail	
L00 WC Disabled	Transient	19	TM52	19	29.5	-	Pass	
L01 Creative	Occupied	21	TM52	21	32.59	1 & 2	Fail	
L01 Cupboard	N/A	-	-	12.38	29.44	-	Pass	Non-occupied area
L01 Edit Suite	Occupied	21	TM52	21.1	42.29	1 & 2 & 3	Fail	
L01 Lobby	Transient	19	TM52	19	30.79	2	Pass	Pass with Natural Ventilation
L01 Office Back	Occupied	21	TM52	21	33.93	1 & 2 & 3	Fail	
L01 Office Front 1	Occupied	21	TM52	21	36.79	1 & 2 & 3	Fail	
L01 Office Front 2	Occupied	21	TM52	21	35.04	1 & 2 & 3	Fail	
L01 Office Open	Occupied	21	TM52	21	33.54	1 & 2	Fail	
L01 Stair 2	Transient	19	TM52	19	31.47	1 & 2	Fail	
L01 Stairs Main	Transient	19	TM52	18.99	32.34	1 & 2	Fail	
L01 Tea Point	Occupied	21	TM52	21	34.72	1 & 2 & 3	Fail	
L01 Toilets Male	Transient	19	TM52	18.99	31.69	2	Pass	
L01 TV	Occupied	21	TM52	21	34.99	1 & 2 & 3	Fail	
L02 Creative	Occupied	21	TM52	20.99	37.32	1 & 2 & 3	Fail	
L02 Cupboard	N/A	-	-	9.38	30.4	-	Pass	Non-occupied area
L02 Lobby	Transient	19	TM52	18.99	33.26	2	Pass	
L02 Meeting	Occupied	21	TM52	20.98	37.15	1 & 2 & 3	Fail	
L02 Stair 2	Transient	19	TM52	18.99	33.89	1 & 2	Fail	

As can be seen, with the inclusion of natural ventilation via opening windows, a number of additional rooms now pass the TM52 criteria. However:

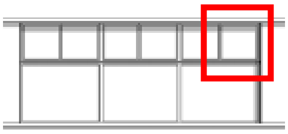
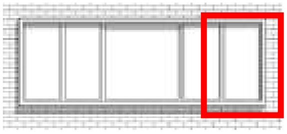
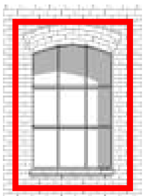
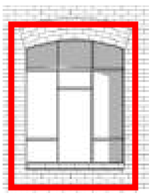
- These spaces are all ancillary spaces with low occupancies and internal heat gains,

- Within the main office spaces with high occupancy densities and equipment heat gains, the risk of summer overheating remains high.

Therefore increased natural ventilation will be investigated.

Results Table 3a – Results Including Increased Passive Ventilation

In order to investigate the effects of increased natural ventilation on the risk of overheating within the occupied spaces, the window opening details within the model have been increased, within reason, to their maximum extent, as follows:

DETAILS OF OPENING WINDOWS USED IN THE CALCULATIONS					
Window	**Location**	**Opening Lights**	**Opening Type**	**Opening Area**	**Opening Angle**
Small Opening	1950s Front elevation		Top hung	85%	**45°**
Large Opening	1950s Courtyard		Side hung	75%	**80°**
Sash Opening	1900s Courtyard		Lower sash vertical opening	**40%**	N/A
Rear Opening	1900s Courtyard rear		Side hung	20%	**80°**

The following table includes results from an annual simulation with no mechanical ventilation or cooling provision within the rooms, but with internal venetian blinds provided to the windows, and where windows have been opened to a greater extent to provide increased levels of natural ventilation, where available within the occupied spaces.

TABLE 3a - RESULTS INCLUDING HEATING, BLINDS AND INCREASED NATURAL VENTILATION - No Cooling, No Mechanical Ventilation								
DESIGN CRITERIA				DYNAMIC SIMULATION RESULTS		CIBSE TM52 RESULTS		
				WINTER	SUMMER	SUMMER		
Room	Occupied Space/Type	Winter Comfort Criteria Temp	Summer Comfort Criteria Temp	Minimum Dry Resultant Temp	Maximum Dry Resultant Temp	TM52 Criteria Failing	TM52 Pass/Fail	Notes
		(degC)	(degC)	(°C)	(°C)			
L-1 Meeting 1	Occupied	21	TM52	21	32.46	1 & 2	Fail	
L-1 Meeting 2	Occupied	21	TM52	21	31.43	1 & 2	Fail	
L-1 Meeting 3	Occupied	21	TM52	21	33.12	1 & 2	Fail	
L-1 Office Front	Occupied	21	TM52	21	33.63	1 & 2 & 3	Fail	
L-1 Office Rear	Occupied	21	TM52	21	31.38	1 & 2	Fail	
L-1 Stair Main	Transient	19	TM52	19	28.81	-	Pass	
L-1 Toilets	Transient	19	TM52	19	29.82	-	Pass	
L00 Boardroom	Occupied	21	TM52	21	34.19	1 & 2 & 3	Fail	
L00 Comms Existing	N/A	21	TM52	22.99	23.03	-	Pass	Temperature controlled to 25C
L00 Cupboard 1	N/A	-	-	12.34	28.47	-	Pass	Non-occupied area
L00 Cupboard 2	N/A	-	-	10.8	28.67	-	Pass	Non-occupied area
L00 Entrance Main	Transient	19	TM52	19	30.65	2	Pass	Pass with Natural Ventilation
L00 Entrance Rear	Transient	19	TM52	19	31.95	2	Pass	
L00 Meeting-Library Existing	Occupied	21	TM52	21	33.98	1 & 2 & 3	Fail	
L00 Office Front	Occupied	21	TM52	21	33.55	1 & 2	Fail	
L00 Office Rear	Occupied	21	TM52	21.01	32.75	1 & 2	Fail	
L00 Post Area	Occupied	21	TM52	21	32.08	2	Pass	Pass with increased Natural Ventilation
L00 Quiet Area	Occupied	21	TM52	21	31.01	-	Pass	Pass with Natural Ventilation
L00 Reception-Waiting	Occupied	21	TM52	21	32.36	2	Pass	Pass with increased Natural Ventilation
L00 Stair	Transient	19	TM52	19	29.81	-	Pass	Pass with Natural Ventilation
L00 Store	N/A	-	-	13.99	28.89	-	Fail	Non-occupied area
L00 Tea Point	Occupied	21	TM52	21	32.08	2	Pass	
L00 WC 1	Transient	19	TM52	18.99	31.79	2	Pass	Pass with Natural Ventilation
L00 WC 2	Transient	19	TM52	19	33.16	1 & 2	Fail	
L00 WC Disabled	Transient	19	TM52	19	28.89	-	Pass	
L01 Creative	Occupied	21	TM52	21	31.9	1 & 2	Fail	
L01 Cupboard	N/A	-	-	12.38	28.8	-	Pass	Non-occupied area
L01 Edit Suite	Occupied	21	TM52	21.1	41.64	1 & 2 & 3	Fail	
L01 Lobby	Transient	19	TM52	19	30.16	-	Pass	Pass with increased Natural Ventilation
L01 Office Back	Occupied	21	TM52	21	33.28	1 & 2	Fail	
L01 Office Front 1	Occupied	21	TM52	21	35.57	1 & 2 & 3	Fail	
L01 Office Front 2	Occupied	21	TM52	21	33.36	1 & 2	Fail	
L01 Office Open	Occupied	21	TM52	21	32.7	2	Pass	Pass with increased Natural Ventilation
L01 Stair 2	Transient	19	TM52	19	30.82	2	Pass	Pass with increased Natural Ventilation
L01 Stairs Main	Transient	19	TM52	18.99	31.91	2	Pass	Pass with increased Natural Ventilation
L01 Tea Point	Occupied	21	TM52	21	33.87	1 & 2	Fail	
L01 Toilets Male	Transient	19	TM52	18.99	31.16	2	Pass	
L01 TV	Occupied	21	TM52	21	34.05	1 & 2 & 3	Fail	
L02 Creative	Occupied	21	TM52	20.99	35.58	1 & 2 & 3	Fail	
L02 Cupboard	N/A	-	-	9.38	29.63	-	Pass	Non-occupied area
L02 Lobby	Transient	19	TM52	18.99	32.97	2	Pass	
L02 Meeting	Occupied	21	TM52	20.98	35.84	1 & 2 & 3	Fail	
L02 Stair 2	Transient	19	TM52	18.99	33.44	1 & 2	Fail	

As can be seen, with the inclusion of additional natural ventilation via opening windows, a number of additional rooms now pass the TM52 criteria. However:

- These additional spaces are generally spaces adjacent to the offices such as the Post area or Reception area which have lower occupant densities and equipment heat gains than the open plan offices.

  This is also the case for the Level 01 Open Office area, which again, has a lower occupant density and internal heat gain,

- Within the main office spaces with high occupancy densities and equipment heat gains, the risk of summer overheating remains high.

Therefore, further mitigating measures will need to be investigated.

6.5. Mechanical Ventilation

Mechanical ventilation is ventilation that uses energy to introduce external or conditioned air into an internal space by such methods as local fans or centralised air handling units with ductwork distribution systems. Mechanical ventilation (MV) systems can by more efficient than natural ventilation, in that the air is introduced or removed directly from each space and can be directed to the location of a particular heat load.

Air can be heated, cooled or humidified if required within the mechanical plant, and heat can be extracted from outgoing air and introduced into incoming air to reduce heating loads. MV will be required where high occupancies necessitate the provision of fresh air for occupant health and wellbeing, as required by legislation.

Mechanical Ventilation

- Mechanical extract can help remove excess heat from a building, with make-up supply air either being introduced through natural ventilation via opening windows, or via mechanical supply ventilation.
- It is envisaged that mechanical extract ventilation will be provided within the toilet and tea areas.
- Cooling from unconditioned ambient external supply air will only be experienced if the air from outside is cooler than the internal conditions, which may reduce the effectiveness in summer.
- The building is existing and as such, it may not be possible within the constraints of the existing building structure and layout to provide horizontal and vertical duct runs or localised plant for mechanical ventilation distribution.
- Centralised mechanical ventilation is likely to require ventilation plant to be located externally – most likely on the existing roof - which has been seen to cause concern for the planners, as it has visual and acoustic implications for adjacent properties.
- Localised supply and extract air handling units mounted within the building would negate the need for external plant, but would require either inlet and exhaust ducts to run external to the building, or local louvres to be set into the external fabric of the building, which could require a submission to Planning, and could have visual and acoustic implications for adjacent properties.

Calculations will therefore be undertaken to investigate the effects of providing mechanical ventilation on the risk of overheating within the occupied spaces.

Results Table 4 – Results Including Mechanical Ventilation

Details of the supply and extract ventilation can be found in the Mechanical Services Design Criteria table in Section 4.3. Extract ventilation will be provided to the toilets, whilst fresh air supply ventilation will be provided to the occupied spaces based on occupancy numbers.

It will be assumed that the ventilation will be provided by localised packaged air plant mounted at high level on the floorplates. The units will be assumed to include heat recovery from the outgoing air in winter – to be bypassed in summer to prevent additional heat gain – as well as heating elements to heat the supply air to room temperature.

Heating within the room will be assumed to be provided by local heating such as radiators, as existing.

Passive ventilation via opening windows will not be included within the calculations.

The following table includes results from an annual simulation with no natural ventilation or cooling provision within the rooms, but with internal venetian blinds provided to the windows, and mechanical ventilation to provide fresh air ventilation within the occupied spaces.

TABLE 4 - RESULTS INCLUDING HEATING, BLINDS AND MECHANICAL VENTILATION - No Cooling, No Natural Ventilation								
DESIGN CRITERIA				DYNAMIC SIMULATION RESULTS		CIBSE TM52 RESULTS		
				WINTER	SUMMER	SUMMER		
Room	Occupied Space/Type	Winter Comfort Criteria Temp	Summer Comfort Criteria Temp	Minimum Dry Resultant Temp	Maximum Dry Resultant Temp	TM52 Criteria Failing	TM52 Pass/Fail	Notes
		(degC)	(degC)	(°C)	(°C)			
L-1 Meeting 1	Occupied	21	TM52	21	32.16	1 & 2	Fail	
L-1 Meeting 2	Occupied	21	TM52	21	31.33	-	Pass	Pass with Mechanical Ventilation
L-1 Meeting 3	Occupied	21	TM52	21	32.45	1 & 2	Fail	
L-1 Office Front	Occupied	21	TM52	21	33.6	1 & 2 & 3	Fail	
L-1 Office Rear	Occupied	21	TM52	21	31.47	1 & 2	Fail	
L-1 Stair Main	Transient	19	TM52	19	28.93	-	Pass	
L-1 Toilets	Transient	19	TM52	19	30.51	-	Pass	
L00 Boardroom	Occupied	21	TM52	21	34.65	1 & 2 & 3	Fail	
L00 Comms Existing	N/A	21	TM52	22.99	23.03	-	Pass	Temperature controlled to 25C
L00 Cupboard 1	N/A	-	-	12.26	28.87	-	Pass	Non-occupied area
L00 Cupboard 2	N/A	-	-	10.82	28.81	-	Pass	Non-occupied area
L00 Entrance Main	Transient	19	TM52	19	30.92	2	Pass	Pass with Mechanical Ventilation
L00 Entrance Rear	Transient	19	TM52	19	32.08	2	Pass	
L00 Meeting-Library Existing	Occupied	21	TM52	20.99	34.55	1 & 2 & 3	Fail	
L00 Office Front	Occupied	21	TM52	21	34.72	1 & 2 & 3	Fail	
L00 Office Rear	Occupied	21	TM52	21	34.11	1 & 2 & 3	Fail	
L00 Post Area	Occupied	21	TM52	21	32.31	1 & 2	Fail	
L00 Quiet Area	Occupied	21	TM52	21	31.22	2	Pass	Pass with Mechanical Ventilation
L00 Reception-Waiting	Occupied	21	TM52	21	32.1	1 & 2	Fail	
L00 Stair	Transient	19	TM52	19	30.62	2	Pass	Pass with Mechanical Ventilation
L00 Store	N/A	-	-	13.95	29.39	-	Fail	Non-occupied area
L00 Tea Point	Occupied	21	TM52	21	31.33	2	Pass	
L00 WC 1	Transient	19	TM52	19	32.23	2	Pass	Pass with Mechanical Ventilation
L00 WC 2	Transient	19	TM52	19	33.44	1 & 2	Fail	
L00 WC Disabled	Transient	19	TM52	19	30.09	-	Pass	
L01 Creative	Occupied	21	TM52	21	32.19	1 & 2	Fail	
L01 Cupboard	N/A	-	-	12.39	29.49	-	Pass	Non-occupied area
L01 Edit Suite	Occupied	21	TM52	21.02	41.14	1 & 2 & 3	Fail	
L01 Lobby	Transient	19	TM52	19	30.66	-	Pass	Pass with Mechanical Ventilation
L01 Office Back	Occupied	21	TM52	21	33.42	1 & 2	Fail	
L01 Office Front 1	Occupied	21	TM52	21	36.47	1 & 2 & 3	Fail	
L01 Office Front 2	Occupied	21	TM52	21	35.9	1 & 2 & 3	Fail	
L01 Office Open	Occupied	21	TM52	21	33.29	1 & 2	Fail	
L01 Stair 2	Transient	19	TM52	19	31.22	1 & 2	Fail	
L01 Stairs Main	Transient	19	TM52	18.99	32.28	1 & 2	Fail	
L01 Tea Point	Occupied	21	TM52	21	35.63	1 & 2 & 3	Fail	
L01 Toilets Male	Transient	19	TM52	18.99	32.25	2	Pass	
L01 TV	Occupied	21	TM52	21	34.47	1 & 2 & 3	Fail	
L02 Creative	Occupied	21	TM52	20.99	38.01	1 & 2 & 3	Fail	
L02 Cupboard	N/A	-	-	9.37	30.63	-	Pass	Non-occupied area
L02 Lobby	Transient	19	TM52	18.99	33.39	2	Pass	
L02 Meeting	Occupied	21	TM52	20.98	37.82	1 & 2 & 3	Fail	
L02 Stair 2	Transient	19	TM52	18.99	33.99	1 & 2 & 3	Fail	

As can be seen, with the inclusion of mechanical ventilation, a number of rooms now pass the TM52 criteria. However:

- These spaces are generally ancillary spaces such as lobby areas, or common spaces adjacent to the offices such as the Quiet area or Reception area which have lower occupant densities and equipment heat gains than the open plan offices,

- Within the main office spaces with high occupancy densities and equipment heat gains, the risk of summer overheating remains high.

Therefore further mitigating measures will need to be investigated.

6.6. Natural and Mechanical Ventilation

Results Table 5 – Results Including Natural and Mechanical Ventilation

The following table includes results from an annual simulation with no cooling provision within the rooms, but with internal venetian blinds provided to the windows, Natural Ventilation via opening windows and mechanical ventilation to provide fresh air ventilation within the occupied spaces.

TABLE 5 - RESULTS INCLUDING HEATING, BLINDS, NATURAL AND AND MECHANICAL VENTILATION - No Cooling								
DESIGN CRITERIA				DYNAMIC SIMULATION RESULTS		CIBSE TM52 RESULTS		
				WINTER	SUMMER	SUMMER		
Room	Occupied Space/Type	Winter Comfort Criteria Temp (degC)	Summer Comfort Criteria Temp (degC)	Minimum Dry Resultant Temp (°C)	Maximum Dry Resultant Temp (°C)	TM52 Criteria Failing	TM52 Pass/Fail	Notes
L-1 Meeting 1	Occupied	21	TM52	21	31.62	2	Pass	Pass with NV and MV
L-1 Meeting 2	Occupied	21	TM52	21	30.82	-	Pass	Pass with Mechanical Ventilation
L-1 Meeting 3	Occupied	21	TM52	21	32.1	2	Pass	Pass with NV and MV
L-1 Office Front	Occupied	21	TM52	21	32.8	1 & 2	Fail	
L-1 Office Rear	Occupied	21	TM52	21	30.96	2	Pass	Pass with NV and MV
L-1 Stair Main	Transient	19	TM52	19	28.42	-	Pass	
L-1 Toilets	Transient	19	TM52	19	30.06	-	Pass	
L00 Boardroom	Occupied	21	TM52	21	33.52	1 & 2	Fail	
L00 Comms Existing	N/A	21	TM52	22.99	23.03	-	Pass	Temperature controlled to 25C
L00 Cupboard 1	N/A	-	-	12.31	28.27	-	Pass	Non-occupied area
L00 Cupboard 2	N/A	-	-	10.78	28.45	-	Pass	Non-occupied area
L00 Entrance Main	Transient	19	TM52	19	30.32	-	Pass	Pass with Mechanical Ventilation
L00 Entrance Rear	Transient	19	TM52	19	31.73	2	Pass	
L00 Meeting-Library Existing	Occupied	21	TM52	20.99	33.39	1 & 2	Fail	
L00 Office Front	Occupied	21	TM52	21	33.28	1 & 2	Fail	
L00 Office Rear	Occupied	21	TM52	21	32.39	2	Pass	Pass with NV and MV
L00 Post Area	Occupied	21	TM52	21	31.6	2	Pass	Pass with NV and MV
L00 Quiet Area	Occupied	21	TM52	21	30.48	-	Pass	Pass with Mechanical Ventilation
L00 Reception-Waiting	Occupied	21	TM52	21	31.94	2	Pass	Pass with NV and MV
L00 Stair	Transient	19	TM52	19	29.33	-	Pass	Pass with Mechanical Ventilation
L00 Store	N/A	-	-	13.96	28.65	-	Fail	Non-occupied area
L00 Tea Point	Occupied	21	TM52	21	31.76	2	Pass	
L00 WC 1	Transient	19	TM52	19	31.59	2	Pass	Pass with Mechanical Ventilation
L00 WC 2	Transient	19	TM52	19	32.74	2	Pass	Pass with NV and MV
L00 WC Disabled	Transient	19	TM52	19	29.31	-	Pass	
L01 Creative	Occupied	21	TM52	21	31.47	2	Pass	Pass with NV and MV
L01 Cupboard	N/A	-	-	12.37	28.66	-	Pass	Non-occupied area
L01 Edit Suite	Occupied	21	TM52	21.02	40.31	1 & 2 & 3	Fail	
L01 Lobby	Transient	19	TM52	19	29.89	-	Pass	Pass with Mechanical Ventilation
L01 Office Back	Occupied	21	TM52	21	32.56	1 & 2	Fail	
L01 Office Front 1	Occupied	21	TM52	21	34.93	1 & 2 & 3	Fail	
L01 Office Front 2	Occupied	21	TM52	21	33.27	1 & 2	Fail	
L01 Office Open	Occupied	21	TM52	21	32.51	2	Pass	Pass with NV and MV
L01 Stair 2	Transient	19	TM52	19	30.38	-	Pass	Pass with NV and MV
L01 Stairs Main	Transient	19	TM52	18.99	31.74	2	Pass	Pass with NV and MV
L01 Tea Point	Occupied	21	TM52	21	33.68	2	Pass	Pass with NV and MV
L01 Toilets Male	Transient	19	TM52	18.99	31.48	2	Pass	
L01 TV	Occupied	21	TM52	21	33.56	2	Pass	Pass with NV and MV
L02 Creative	Occupied	21	TM52	20.99	35.33	1 & 2 & 3	Fail	
L02 Cupboard	N/A	-	-	9.37	29.47	-	Pass	Non-occupied area
L02 Lobby	Transient	19	TM52	18.99	32.94	2	Pass	
L02 Meeting	Occupied	21	TM52	20.98	35.55	1 & 2 & 3	Fail	
L02 Stair 2	Transient	19	TM52	18.99	33.31	1 & 2	Fail	

6.7. Occupied Rooms After The Cooling Hierarchy

Results Table 5a – Occupied Rooms After the Cooling Hierarchy

The following table includes results for occupied rooms only from an annual simulation with no cooling provision within the rooms, but with internal venetian blinds provided to the windows, natural ventilation via opening windows and mechanical ventilation to provide fresh air ventilation within the occupied spaces.

TABLE 5a - SUMMARY OF OFFICES AND ADJACENT ROOMS								
DESIGN CRITERIA				DYNAMIC SIMULATION RESULTS		CIBSE TM52 RESULTS		
				WINTER	SUMMER	SUMMER		
Room	Occupied Space/Type	Winter Comfort Criteria Temp	Summer Comfort Criteria Temp	Minimum Dry Resultant Temp	Maximum Dry Resultant Temp	TM52 Criteria Failing	TM52 Pass/Fail	Notes
		(degC)	(degC)	(°C)	(°C)			
L-1 Meeting 1	Occupied	21	TM52	21	31.62	2	Pass	Pass with NV and MV
L-1 Meeting 2	Occupied	21	TM52	21	30.82	-	Pass	Pass with Mechanical Ventilation
L-1 Meeting 3	Occupied	21	TM52	21	32.1	2	Pass	Pass with NV and MV
L-1 Office Front	Occupied	21	TM52	21	32.8	1 & 2	Fail	
L-1 Office Rear	Occupied	21	TM52	21	30.96	2	Pass	Pass with NV and MV
L00 Boardroom	Occupied	21	TM52	21	33.52	1 & 2	Fail	
L00 Meeting-Library Existing	Occupied	21	TM52	20.99	33.39	1 & 2	Fail	
L00 Office Front	Occupied	21	TM52	21	33.28	1 & 2	Fail	
L00 Office Rear	Occupied	21	TM52	21	32.39	2	Pass	Pass with NV and MV
L00 Post Area	Occupied	21	TM52	21	31.6	2	Pass	Pass with NV and MV
L00 Quiet Area	Occupied	21	TM52	21	30.48	-	Pass	Pass with Mechanical Ventilation
L00 Reception-Waiting	Occupied	21	TM52	21	31.94	2	Pass	Pass with NV and MV
L00 Tea Point	Occupied	21	TM52	21	31.76	2	Pass	
L01 Creative	Occupied	21	TM52	21	31.47	2	Pass	Pass with NV and MV
L01 Edit Suite	Occupied	21	TM52	21.02	40.31	1 & 2 & 3	Fail	
L01 Office Back	Occupied	21	TM52	21	32.56	1 & 2	Fail	
L01 Office Front 1	Occupied	21	TM52	21	34.93	1 & 2 & 3	Fail	
L01 Office Front 2	Occupied	21	TM52	21	33.27	1 & 2	Fail	
L01 Office Open	Occupied	21	TM52	21	32.51	2	Pass	Pass with NV and MV
L01 Tea Point	Occupied	21	TM52	21	33.68	2	Pass	Pass with NV and MV
L01 TV	Occupied	21	TM52	21	33.56	2	Pass	Pass with NV and MV
L02 Creative	Occupied	21	TM52	20.99	35.33	1 & 2 & 3	Fail	
L02 Meeting	Occupied	21	TM52	20.98	35.55	1 & 2 & 3	Fail	

As can be seen, with the inclusion of natural and mechanical ventilation, of the 23 occupied rooms:

- all 5 of the common spaces adjacent to the offices such as the Quiet, Post, Tea and Reception areas which have lower occupant densities and equipment heat gains than the open plan offices, now pass the TM52 criteria,

However:

- of the 18 main office spaces with high occupancy densities and equipment heat gains, 10 of these spaces (55%) still fail the TM52 criteria and are therefore at risk of overheating in summer.

7. CONCLUSION

A 3D model of 20 Flaxman Terrace has been created to perform a thermal modelling analysis to investigate the requirement for comfort cooling within the occupied spaces, in accordance with the Planning Response from Camden Planning, as detailed within their email of 14th May 2020, which specifies the requirement to follow the 'Cooling Hierarchy' in order to mitigate the risk of overheating in summer the occupied spaces, before comfort cooling will be considered.

The investigation has been carried out using the Virtual Environment modelling software published by IES (VE 2019).

The investigation has reviewed each level of the cooling hierarchy, including minimising internal heat generation; reducing the heat entering the building through orientation, shading, fenestration, insulation and green roofs/walls; managing heat within the building through exposed internal thermal mass; passive ventilation; and mechanical ventilation.

The building is an existing 1900s building with a 1950s extension, therefore altering the building's orientation, glazing sizes and the existing building fabric were not investigated. Therefore the investigation reviewed the effects on the risk of overheating in summer when window shading via internal blinds, passive ventilation via opening windows, and providing mechanical fresh air ventilation for occupant health and wellbeing.

The risk of overheating was estimated by subjecting the calculation results to the thermal comfort criteria as discussed within the CIBSE Technical Memorandum document TM52 – Overheating in European Buildings.

Cooling Hierarchy Mitigation Measures

The calculation results have shown when the following mitigation measures were investigated, that:

- Including internal blinds did not reduce the risk of overheating in the occupied spaces,
- Providing natural ventilation via opening windows reduced the occurrence of overheating within the occupied rooms with lower occupancy densities and internal heat gains, but did not reduce the risk within the higher density open plan offices,
- Providing mechanical ventilation to the rooms for occupant fresh air reduced the occurrence of overheating within the occupied rooms with lower occupancy densities and internal heat gains, but did not reduce the risk within the higher density open plan offices,
- Providing both natural ventilation via opening windows and mechanical ventilation to the rooms for occupant fresh air reduced the occurrence of overheating within the occupied rooms with lower occupancy densities and internal heat gains and some of the higher density open plan offices, but left over 55% of these areas still with a high risk of overheating.

However, a review of the above mitigation measure within the context of the existing building suggests that:

- Internal blinds can inhibit the usefulness of providing passive ventilation via opening windows, as the blinds can prevent the external air from entering the space, and usually requires artificial lighting to be used, even with suitable ambient daylight, which adds to the energy requirement of the building, and hence the carbon footprint of the building,

- Opening windows in inner city areas can have pollution and/or acoustic implications for the building occupants. Heavy rain can also cause occupants to close windows to avoid ingress of water, and excessive air movement causing the blinds to move around can be distracting to occupants,

- Natural ventilation from external windows is only effective to about 6m into the space, meaning that the internal areas or external rooms with no windows would be unlikely to benefit from natural ventilation.

- Cooling via natural ventilation from ambient external air will only be experienced if the replacement air from outside is cooler than the internal conditions.

- Mechanical extract can help remove excess heat from a building, and cooling can be experienced by supplying external air into the building. However, cooling from unconditioned ambient external supply air will only be experienced if the air from outside is cooler than the internal conditions, after which, without mechanical cooling, additional heat gain will be experienced. Therefore, in the summer months this could add heat to the building making the overheating issue worse.

- It may not be possible within the constraints of the existing building structure and layout to provide horizontal and vertical duct runs or localised plant for mechanical ventilation distribution.

- Centralised mechanical ventilation is likely to require ventilation plant to be located externally – most likely on the existing roof - which has been seen to cause concern for the planners, as it has visual and acoustic implications for adjacent properties.

- Localised packaged air handling units located internally would negate the need for external plant, but would require either inlet and exhaust ducts to run externally to the building, or local louvres to be set into the external fabric of the building, which could require a submission to Planning for consent, and could have visual and acoustic implications for adjacent properties.

<u>Comfort Cooling</u>

The calculation results show that the risk of overheating is still present within over 55% of the occupied office areas with high occupant densities and internal heat gains.

The review of the overheating mitigation measures suggests that whilst providing a combination of internal blinds, natural and mechanical ventilation will reduce overheating in some areas, it may not always be possible for the occupant controlled mitigation measures (blinds and opening windows) to be practically applied, and even if these were applied it would not resolve overheating in all areas.

Therefore, in order to guarantee occupant thermal comfort, active cooling will be provided within the occupied spaces by high efficiency VRF systems.

The replacement of the existing gas-fired heating system with a much more energy efficient VRF system with a design heating Seasonal Coefficient of Performance of around 4.1, is likely to have an advantageous effect on the building's heating energy usage. A cooling design Seasonal Energy Efficiency Rating of around 6.7 will mean that comfort cooling to the occupied spaces will be provided in an energy efficient manner. Reductions experienced in heating energy usage and associated carbon dioxide emissions will benefit both the building occupier and be in support of Camden's Climate Change Adaption policies.

In conclusion, the results of the investigation suggest that:

- **Whilst every effort has been made to mitigate overheating risks via the passive measures as detailed above, it has not been possible to alleviate these risks altogether within the occupied spaces of 20 Flaxman Terrace. Therefore, the provision for comfort cooling will be incorporated,**

- **In order to guarantee occupant thermal comfort, active cooling will be provided within the occupied spaces by high efficiency VRF systems. The heating and cooling seasonal efficiencies for the plant will be 4.1 and 6.7 respectively.**