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TAYLOR PROJECT SERVICES LLP
BUILDING SERVICES CONSULTANTS

CIBSE TM52 Overheating Assessment

Lupin House,

11-13 Macklin Street,

London

WC2B 5NH

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1.0 EXECUTIVE SUMMARY

This report assesses the risk of summertime overheating at the proposed development at Lupin House. The proposal sees a mixed-use redevelopment of Lupin House, at 11 – 13 Macklin Street, Covent Garden in the London Borough of Camden.

The proposal is for 12 residential apartments over 4 floors from levels 2 to 5 with retained commercial office uses on the lowest 3 floors – ground floor/mezzanine floor (partially) and first floor level.

Dynamic simulation modelling (DSM) has been utilised, to highlight the risk of the building to overheating and design solutions reviewed to mitigate overheating.

Simulations have been carried out using the current DesignBuilder EnergyPlus DSM modelling software to accurately simulate the indoor temperatures and conditions for the purpose of identifying areas of potential overheating.

Note: CIBSE TM52 is used as a design benchmark to demonstrate the performance of the building. The development does not commit to meeting these standards.

Where information has not been available, reference figures have been used based on the National Calculation Methodology (NCM) document.

2.0 CIBSE TM52: LIMITS OF THERMAL COMFORT

In order to assess the overheating risk at 11-13 Macklin Street, the CIBSE TM52 methodology has been followed. The memorandum states:

"Overheating has become a key problem for building design. The need to reduce energy consumption whilst dealing with global climate change has reduced the options available for building comfortable, low-energy buildings. Research has been directed towards methods for increasing indoor winter temperatures, but this can lead to lightweight, highly insulated buildings that respond poorly in the summer.

one problem for designers has been the absence of an adequate definition of overheating in naturally ventilated buildings. In the past overheating has been defined as a number of hours over a particular temperature, irrespective of conditions outside the building. Recent work embodied in European standards suggests that the temperature that occupants will find uncomfortable changes with the outdoor conditions in a predictable way. This research informs the CIBSE guidance presented in this Technical Memorandum (TM). The meaning of the research and the link with overheating are explained and a series of criteria by which the risk of overheating can be assessed or identified are suggested.

The CIBSE Technical Memorandum 52 sets out the definition and compliance with limiting overheating.

The standard introduces three categories of building:

1. Category I – buildings whose occupants are sensitive or fragile
2. Category II – normal expectation, recommended for new build or renovations
3. Category III – moderate expectation, mainly applicable in existing buildings

The standard provides a robust, yet balanced, assessment of the risk of overheating of buildings in the UK and Europe. A room or building that fails any two of the three following criteria is classed as overheating:

Criterion 1 sets a limit of 3% for the number of hours that the operative temperature can exceed the threshold comfort temperature (upper limit of the range of comfort temperature) by one degree or more during the occupied hours of a typical non-heating season (1st May to the 30th September) temperature. The number of hours where ΔT is greater than or equal to one degree (ºK) during the period of May to September inclusive shall not last more than 3% of occupied hours. ΔT is defined as operative temperature less the maximum acceptable temperature.

Criterion 2 deals with the severity of overheating within any one day, which can be as important as its frequency. This is a function of both temperature above maximum temperature and its duration. This criterion sets a daily limit for acceptability. If each hour (or part-hour) in which the temperature exceeds max temperature by at least 1ºK is multiplied by the number of degrees by which it is exceeded, then this 'excess' should not be more than six degree-hours.

Criterion 3 sets an absolute maximum temperature of (Tmax + 4) °C for a room (Tupp), beyond which the level of overheating is unacceptable. To set an absolute maximum value for the indoor operative temperature, the value of (ºK) shall not exceed 4 ºK.

The weather file for the TM52 analysis is the London Design Summer Year (DSY) 2016, obtained by CIBSE data.

4.0 CONSIDERATION OF COOLING HIERARCHY

In accordance with Policy SI 4 of the Draft London Plan, the cooling hierarchy has been used to reduce the potential for overheating and the reliance on air conditioning systems:

4.1 Reduce the amount of heat entering a building

The building is Grade II listed and as such there are limiting upgrades which can be made to the building fabric. This includes the glazing, external walls roof spaces.

4.2 Minimise Internal Heat Generation through Energy Efficient Design

The design and distribution of services have been located into general circulation spaces reducing the implied casual load on the occupied zones. Horizontal pipework runs have been minimised with generous numbers of risers provide. These risers will be existing and as the building is Grade II listed we are unable to vent the risers to minimise heat build up in these spaces.

Best practice insulation levels will be provided to all heating and hot water pipework with the minimisation of dead-legs to avoid standing heat loss from pipework to occupied spaces.

4.3 Manage the Heat Within the Building Through Exposed Internal Thermal Mass and High Ceilings

As this is an existing Georgian building there are no false ceilings and the ceilings are left exposed, remaining constraints of the building are to be adhered to due to the listed nature.

4.4 Provide Passive Ventilation

A TM52 study has been provided in which the windows are 40% openable to combat overheating, unfortunately as modelled the building still fails the criterion.

4.5 Provide Mechanical Ventilation

It is not possible to install mechanical ventilation without seriously affecting the listed fabric of the building, on this basis this has been discounted from our model.

4.6 Provide Active Cooling Systems

Active cooling is provided only to the commercial areas as part of their function. This will utilise high efficiency VRF (Variable Refrigerant Flow) systems, appropriately zoned and thermostatically controlled.

5.0 MODEL INPUTS

Geometry

The geometry for the building has been modelled using EDSL TAS 9.5. The building has been modelled from drawings provided by Apt Architects.

Weather

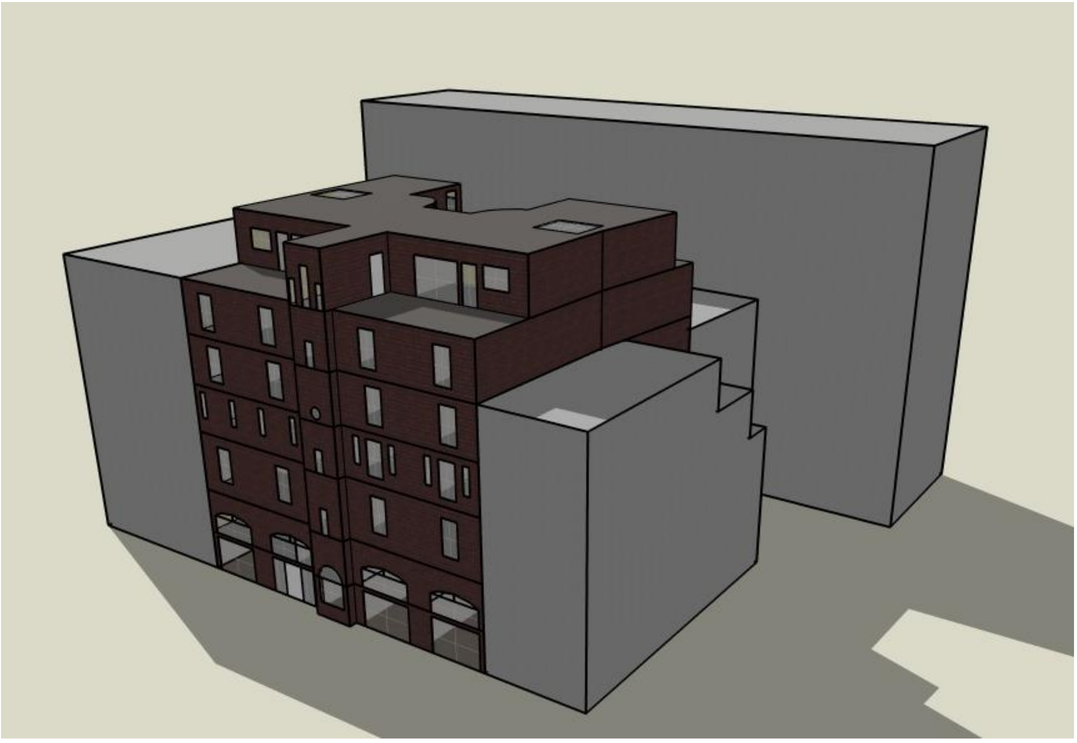
The weather file used for the CIBSE TM52 assessment is the CIBSE London Design Summer Year (DSY) ‘London_LHR_DSY2_2020High50’.

Modelling Inputs

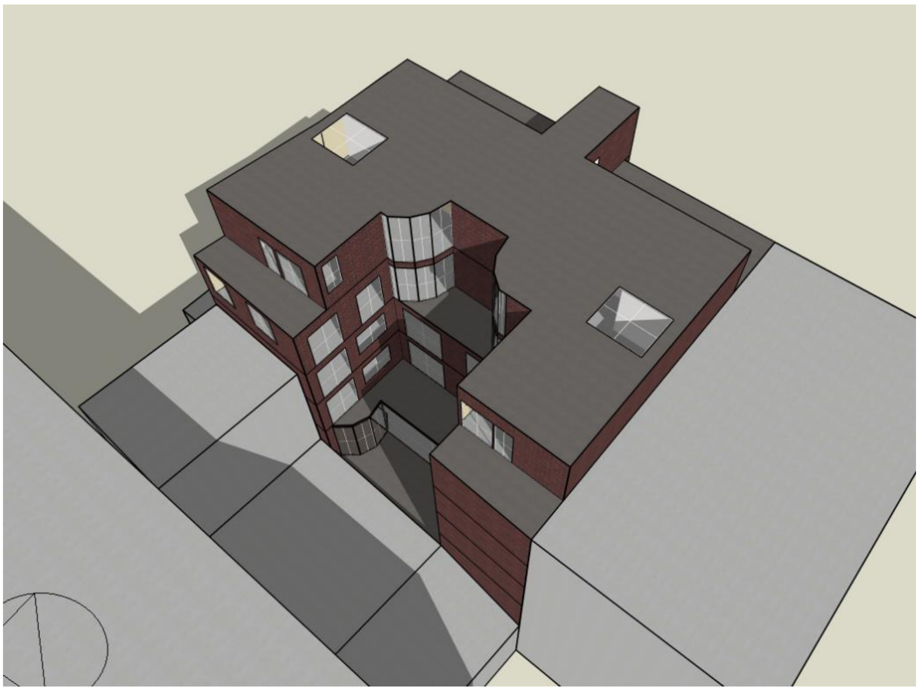
Unless specified, the following data has been assumed, based on NCM (National Calculation Methodology). The methodology states:

1. In order to facilitate estimating energy performance on a consistent basis, a key part of the NCM is an Activity database that defines the activities in various types of space in different classes of building (which closely align with the Town and Country Planning (TCP) Use Classes). One of these standard activities must be assigned to each space in the building
2. The database provides standard occupancy, temperature set-points, outdoor air rates and heat gain profiles for each type of space in the building so that buildings with the same mix of activities will differ only in terms of their geometry, construction, building services, and weather location. Thus, it is possible for the Building Regulation 26 compliance test and EPCs to compare buildings based on their intrinsic potential performance, regardless of how they may actually be used in practice.
3. The fields of information in the database are as follows:
    a. Occupancy times and density; total metabolic rate and percentage which is latent (water vapour)
    b. Set-point temperature and humidity in heating and cooling modes; DSM software will use air temperature as the basis for temperature set-points for the Actual, Notional, and Reference buildings
    c. Set-back conditions for unoccupied periods
    d. Sensible and latent heat gain from other sources
    e. Outside air requirement
    f. Level of illuminance for general lighting and the power density for display lighting
    g. Hot water demand
    h. Type of space for glazing, lighting, and ventilation classification within Building Regulations compliance
    i. A marker indicating whether the activity requires high efficiency filtration, thereby justifying an increased SFP allowance for that space to account for the increased pressure drop.

Modelling Images



Front Elevation – Lupin House



Rear Elevation – Lupin House

Building Fabric

Elements		Pre-Refurb Thermal Elements	Post Refurb Upgraded Thermal Elements (Refurb)	New Thermal Elements (Extension and New)
External walls	U-Value (W/m²K)	1.7	0.55	0.28
Floors	U-Value (W/m²K)	1.2	0.25	0.15
Roofs	U-Value (W/m²K)	2.3	0.16	0.16
Windows / Glazed Doors	U-Value (W/m²K)	4.80 (Single glazed) 3.10 (Double glazed)	1.80 (double glazing)	1.80 (double glazing)
	g-value	0.85 (Single glazed) 0.76 (Double glazed)	0.63	0.63
	Light transmittance	-	0.65	0.65
Party walls	U-Value (W/m²K)	0.75	Solid or fully filled cavity with effective sealing at all exposed edges (0.00)	
Air permeability	$m^3/(h.m^2)$ at 50 Pa	15	10	3
Thermal bridging	-	default	default	default

Internal Temperatures

The following internal temperatures have been input into the DSM model. These have been specified

	Cooling	Heating
Office Areas	21 ºc	18 ºc
Reception	21 ºc	18 ºc

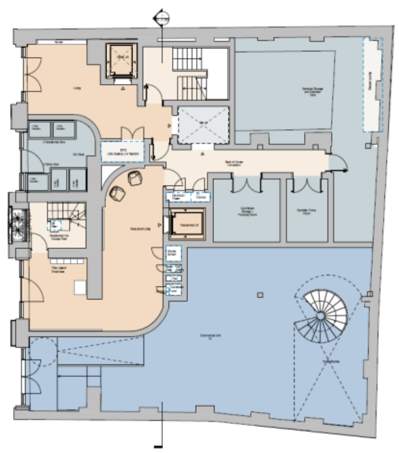
Internal Gains (BCO)

Lighting		Power (Sensible Gain)	
Office Areas	8.0 W/m^2	Office Areas	25 W/m^2
Reception	8.0 W/m^2	Reception	25 W/m^2

Occupancy (BCO)

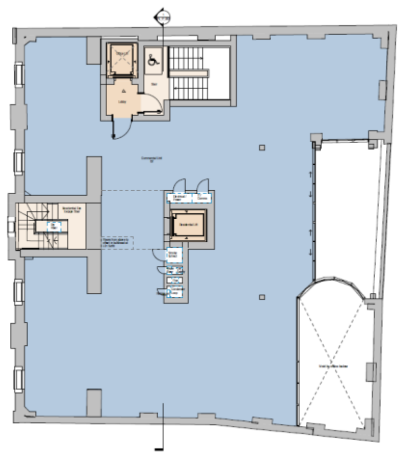
Space	Watts per m^2 person latent/sensible
Offices	5.30/7.74
Reception	5.30/7.74

6.0 Floor Plans



<u>Ground Floor Layout</u>

<u>Mezzanine Floor Layout</u>



<u>First Floor Layout</u>

7.0 OVERHEATING ANALYSIS AND RESULTS

7.1 TM52 RESULTS – NO OPENABLE WINDOWS

Block	Zone	Criterion 1 (%)	Criterion 2 (K.hr)	Criterion 3 (hr)	Pass/Fail
Z1XGroundFloor	CommercialUnit01	100	283.33	1260	Fail
Z1XGroundFloor	RecptionLobby	100	296.17	1260	Fail
Z2XMezzanine	CommercialUnit01	100	275.83	1260	Fail
Z3XFirstFloor	CommercialUnit02	100	270.17	1260	Fail

From the results, all office areas fail the TM52 criterion, with an exceedance in temperature limits and will therefore require treatment to remedy this. The results are based on the unit having no openable windows so this is the first treatment that will be considered, changing all windows to openable.

7.2 TM52 RESULTS – OPENABLE WINDOWS INCLUDED

Block	Zone	Criterion 1 (%)	Criterion 2 (K.hr)	Criterion 3 (hr)	Pass/Fail
Z1XGroundFloor	CommercialUnit01	52.34	42.17	0.17	Fail
Z1XGroundFloor	RecptionLobby	19.64	37.33	0	Fail
Z2XMezzanine	CommercialUnit01	89.29	52.17	0	Fail
Z3XFirstFloor	CommercialUnit02	4.13	17.33	0	Fail

The results above show the openable sash windows of the first floor opening to 30% which is typical of the sash windows present in the building. The rear windows on the first floor are also opened to 10%. The windows have also been automated to start opening at 22°C which approximately simulates occupants manually opening the windows. This is scheduled between the hours of 8:00 am and 7:00 pm. From the results you can see that this does reduce the hours in which all the office/reception areas exceed the TM52 Criterion with the first floor, mezzanine floors and ground floor reception now passing, however, all zones still fail criteria 1 and 2. This means cooling will be required for the unit to pass the TM52 criterion.

7.3 TM52 RESULTS – NO OPENABLE WINDOWS WITH VRF SYSTEM (COOLING)

Block	Zone	Criterion 1 (%)	Criterion 2 (K.hr)	Criterion 3 (hr)	Pass/Fail
Z1XGroundFloor	CommercialUnit01	0	0	0	Pass
Z1XGroundFloor	RecptionLobby	0	0	0	Pass
Z2XMezzanine	CommercialUnit01	0	0	0	Pass
Z3XFirstFloor	CommercialUnit02	0	0	0	Pass

The results above show that subject to the system is correctly designed, implementing a VRF system would mean all zones of the building pass the TM52 Criterion. The VRF system will heat or cool different zones of the building simultaneously with optimised temperature controls.

7.0 CONCLUSIONS AND RECOMMENDATIONS

The full results of the CIBSE TM52 analysis summarise the overall results with regard to the three criteria (explained in the previous sections).

This analysis is carried out for occupied spaces and where there are no occupants (for more than 30 minutes of the day), these spaces have not been considered.

Out of the zones assessed, all the offices and ground floor reception are predicted to experience overheating. This is due to the internal conditions namely the occupancy, small power, infiltration, lighting gains and due to the existing buildings design and to maintain the aesthetics of the building there are limited options to alleviate these.

Overall, the report demonstrates that a VRF Heat Pump system will enable sufficient cooling in the building to comply with the TM52 criteria and prevent overheating. The proposals have strictly followed the London cooling hierarchy, beginning with design. However, due to the specific and niche site constraints, including the existing parameters of the building (building envelope, orientation, siting, and scale), heritage, amenity, and design, the building does not have the benefit of being able to be entirely re-developed in order to enable greater cooling from non-active means. A VRF system which enables cooling is therefore recommended. The building is also located within an air quality management area which means that passive ventilation is restricted to purge ventilation only. Cooling the building via a Heat pump is considered the most suitable and appropriate solution to cool the building, taking into consideration the entirety of the scheme, and will still ensure a lower carbon footprint compared with other more energy-intensive active cooling devices.

Summary Conclusion

- Office Areas overheat when naturally ventilated
- Heat pumps will be used to heat and cool all occupied areas