TAYLOR PROJECT SERVICES LLP
BUILDING SERVICES CONSULTANTS

Natural Ventilation (CIBSE TM52) Overheating Assessment

BREEAM Non-Domestic Refurbishment & Fitout 2014

33 Bedford Place

Prepared for Bedford Estates

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Stage 3 Design Assessment

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1.0 EXECUTIVE SUMMARY

This report assesses the risk of summertime overheating for the proposed office refurbishment project at 33 Bedford Place, London, WC1B. The proposal sees the refurbishment of an existing Georgian office across 5 floors (including lower ground and ground floor). This report has been prepared to support the BREEAM Non-Domestic Refurbishment and Fitout 2014 assessment and will investigate thermal comfort and the application of natural ventilation measures within the building.

Simulations have been carried out using the current TAS 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 33 Bedford Place, 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.

The following spaces were assessed using TM52 methodology:

All office areas
Entrance lobby
Reception
Circulations areas
Break Out Spaces

4.0 CONSIDERATION OF COOLING HIERACHY

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 Bedford Estates.

Weather

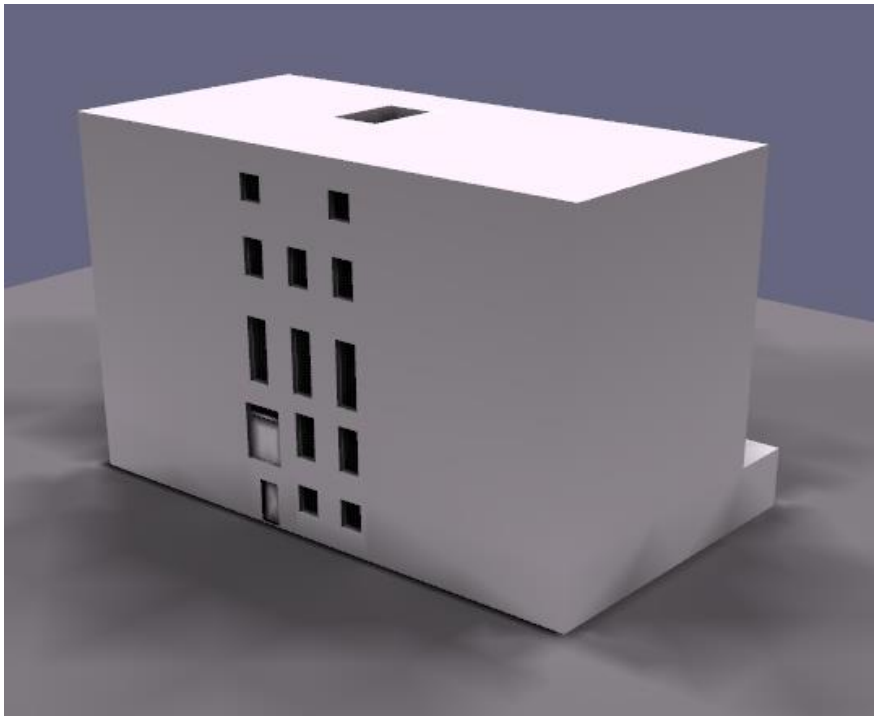
The weather file used for the CIBSE TM52 assessment is the CIBSE London Design Summer Year (DSY).

Modelling Inputs

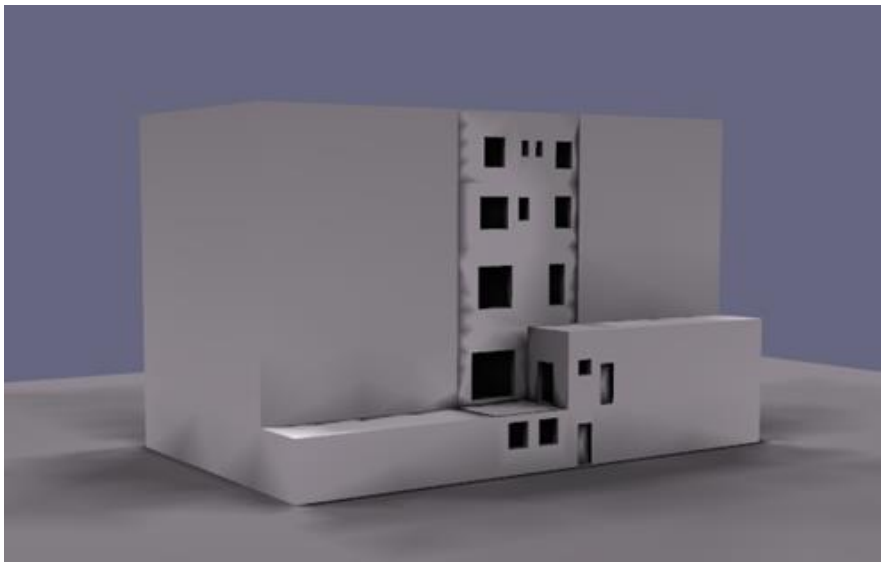
Unless specified, the following data has been assumed, based on NCM (National Calculation Methodology). The methodology states:

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 – 33 Bedford Place



Rear Elevation – 33 Bedford Place

External Design Criteria

External Design Criteria	
Summer Dry Bulb Temperature	+30 degrees Celsius
Winter	-4 degrees Celsius

Building Fabric

Fabric Criteria	Notional Part L2 Values	Existing Element U values	New Element U Values
External Walls	0.35W/m^2k	1.60 W/m^2k	0.25 W/m^2k
Floors	0.25 W/m^2k	0.58 W/m^2k	0.12 W/m^2k
Roofs	0.25 W/m^2k	2.80 W/m^2k	0.12 W/m^2k
Door (<30% Glazing)	2.20 W/m^2k	3.00 W/m^2k	1.50 W/m^2k
Door (30-60% Glazing)	2.20 W/m^2k	3.00W/m^2k	1.50 W/m^2k
Windows	2.20 W/m^2k	6.34 W/m^2k	1.40 W/m^2k
Air Permeability	10.00 m^3/h.m^2	25.00 m^3/h.m^2	10.00 m^3/h.m^2
Thermal Bridging	-	Accredited Construction Details where possible	

No extensions or building elements are being implemented under this application so no new U'Values are being proposed.

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
Entrance lobby	21 ºc	18 ºc
Reception	21 ºc	18 ºc
Circulations areas	N/A	18 ºc
Kitchens	N/A	18 ºc

Internal Gains (NCM)

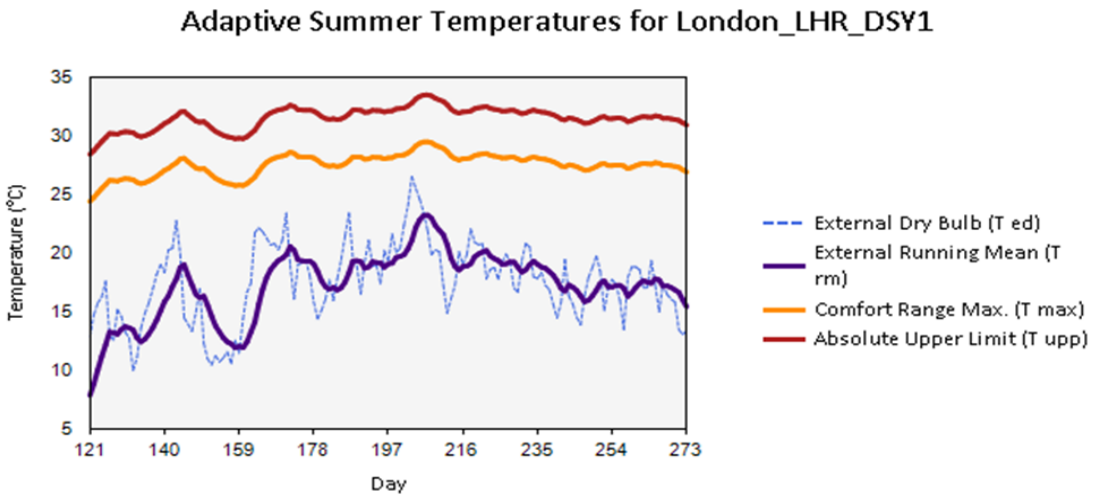
Lighting		Power (Sensible Gain)	
Office Areas	15.0 W/m^2	Office Areas	11.68 W/m^2
Entrance lobby	19.4 W/m^2	Entrance lobby	6.19 W/m^2
Reception	19.4 W/m^2	Reception	6.19 W/m^2
Circulations areas	5.2W/m^2	Circulations areas	1.85 W/m^2
Rear Extension Area	15.0W/m^2 *	Rear Extension Area	11.68 W/m^2
Kitchens	26.0 W/m^2	Kitchens	28.72 W/m^2
Toilets/Showers	10.4 W/m^2	Toilets/Showers	5.48 W/m^2

Occupancy (NCM)

Space	Watts per m^2 person latent/sensible
Offices	5.30/7.74
Entrance lobby	5.51/8.61
Reception	5.51/8.61
Circulations areas	8.21/8.21
Rear Extension Area	5.30/7.74
Kitchen Areas	12.64/6.81
Toilets/Showers	7.87/7.87

6.0 OVERHEATING ANALYSIS AND RESULTS

Adaptive Overheating Report (CIBSE TM52)



The adaptive overheating assessment tests rooms against three criteria. If a room fails any two of the three criteria then it is said to overheat.

1. The first criterion sets a limit for the number of hours that the operative temperature exceeds the comfort temperature by 1°C or more during the occupied hours over the summer period (1st May to 30th September).
2. The second criterion deals with the severity of the overheating within any one day. This sets a daily limit for acceptability.
3. The third criterion sets an absolute maximum daily temperature for the room.

Project Details

Building Designer File (.tbd):	33 Bedford Place – No Openable Windows.tbd
Simulation Results File (.tsd):	33 Bedford Place - No Openable Windows.tsd
Date:	12 July 2022
Building Category:	Category II
Report Criteria:	TM52

6.1 TM52 RESULTS – NO OPENABLE WINDOWS

Results

Zone Name	Occupied Summer Hours	Max. Exceedable Hours	Criterion 1: #Hours Exceeding Comfort Range	Criterion 2: Peak Daily Weighted Exceedance	Criterion 3: #Hours Exceeding Absolute Limit	Result
BSM 1 Office	3672	110	2134	61.0	209	Fail
BSM 2 Office	3672	110	2013	64.0	130	Fail
G 1 Office	3672	110	3606	68.0	2130	Fail
G 2 Office	3672	110	3430	56.0	2206	Fail
First 1 Office	3672	110	3503	61.0	2049	Fail
First 2 Office	3672	110	3593	72.0	2545	Fail
Second 1 Office	3672	110	3648	62.0	2826	Fail
Second 2 Office	3672	110	3640	64.0	2729	Fail
Second 3 Office	3672	110	3642	66.0	2861	Fail
Third 1 Office	3672	110	3456	68.0	1935	Fail
Third 2 Office	3672	110	2849	66.0	1278	Fail
Third 3 Office	3672	110	3233	68.0	1634	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.

6.2 TM52 RESULTS – OPENABLE WINDOWS INCLUDED

Results

Zone Name	Occupied Summer Hours	Max. Exceedable Hours	Criterion 1: #Hours Exceeding Comfort Range	Criterion 2: Peak Daily Weighted Exceedance	Criterion 3: #Hours Exceeding Absolute Limit	Result
BSM 1 Office	3672	110	246	41.0	0	Fail
BSM 2 Office	3672	110	298	51.0	1	Fail
G 1 Office	3672	110	1146	57.0	146	Fail
G 2 Office	3672	110	1104	52.0	180	Fail
First 1 Office	3672	110	964	48.0	125	Fail
First 2 Office	3672	110	1426	52.0	277	Fail
Second 1 Office	3672	110	1546	46.0	404	Fail
Second 2 Office	3672	110	1490	51.0	341	Fail
Second 3 Office	3672	110	1599	49.0	429	Fail
Third 1 Office	3672	110	1601	52.0	400	Fail
Third 2 Office	3672	110	648	46.0	74	Fail
Third 3 Office	3672	110	1294	50.0	263	Fail

The results above show the windows opening 40% which is typical of the sash windows present in the building. 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 7:00pm. From the results you can see that this does reduce the hours in which all the office areas exceed the TM52 Criterion however all zones still fail the criterion. This means cooling will be required for the unit to pass the TM52 criterion.

6.3 TM52 RESULTS – COOLING

Results

Zone Name	Occupied Summer Hours	Max. Exceedable Hours	Criterion 1: #Hours Exceeding Comfort Range	Criterion 2: Peak Daily Weighted Exceedance	Criterion 3: #Hours Exceeding Absolute Limit	Result
BSM 1 Office	3672	110	0	0.0	0	Pass
BSM 2 Office	3672	110	0	0.0	0	Pass
G 1 Office	3672	110	0	0.0	0	Pass
G 2 Office	3672	110	0	0.0	0	Pass
First 1 Office	3672	110	0	0.0	0	Pass
First 2 Office	3672	110	0	0.0	0	Pass
Second 1 Office	3672	110	0	0.0	0	Pass
Second 2 Office	3672	110	0	0.0	0	Pass
Second 3 Office	3672	110	0	0.0	0	Pass
Third 1 Office	3672	110	0	0.0	0	Pass
Third 2 Office	3672	110	0	0.0	0	Pass
Third 3 Office	3672	110	0	0.0	0	Pass

The results above show that all zones would pass with cooling being implemented.

7.0 CONCLUSIONS AND RECOMMENDATIONS

The full results of the CIBSE TM52 analysis summarises the overall results with regards 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 failed the TM52 criteria, by large margin (in criterion 1). This is due to the internal conditions namely the occupancy, small power, infiltration, lighting gains and as the building is Grade II listed there are limited options to alleviate these. When applying openable windows to the model all office zone still fail the TM52 criterion.

The areas that overheat will serviced via a highly efficient heat pump system. The system will provide heating and cooling to the zones.

Summary Conclusion

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