Uxbridge Road, Hayes

Thermal Comfort Analysis

Ensphere Group Ltd on behalf of
Shurgard UK Ltd

Ensphere Group Ltd
52 Grosvenor Gardens,
London, SW1W 0AU
+44 (0) 20 7846 9040
www.enspheregroup.com

ensphere

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Contents

1. Executive Summary

1.1 This report presents the thermal comfort analysis for a proposed scheme at Uxbridge Road, Hayes, UB4 0HD.

1.2 The proposals include the partial demolition and extension to an existing building to provide additional self-storage floorspace (Use Class B8) with associated new car and cycle parking, refuse storage, landscaping and other associated works ancillary to the development.

1.3 The main purpose of this report is to investigate how the proposed building performs against the criteria set out in CIBSE TM52:2013: The limits of thermal comfort: avoiding overheating in European buildings. Consideration has also been given to the methodology presented in CIBSE AM11 Building Energy and Environmental Modelling. Dynamic thermal modelling has been undertaken and approved software IES VE 2022 was used for the purpose of the analysis.

1.4 The analysis has been limited to those parts of the building intended for occupation. The majority of the spaces in the proposed scheme are for storage and will be unoccupied and unheated.

1.5 The modelling has been undertaken with regard to the Policy SI4 (Managing Heat Risk) of the London Plan; and the cooling hierarchy presented therein.

1.6 The architecture has sought to minimise cooling requirements through design; passive ventilation is not feasible due to security requirements and the need for windows to remain closed.

1.7 A mechanical ventilation system has therefore been tested for the occupied spaces and it was found not to be adequate to ensure compliance with the requirements of TM52. A localised comfort cooling system is therefore proposed for the office space.

1.8 The analysis demonstrated that the design and services proposed for the specific building are able to achieve the comfort criteria set out by CIBSE TM52:2013 for the 2020's climatic data. The following sections will describe the steps deemed necessary to meet these standards. A climate change scenario was also assessed using 2050s climatic data to understand necessary design mitigations.

2. Introduction

2.1 Ensphere Group Ltd was commissioned by Shurgard UK Ltd to undertake a Thermal Comfort Analysis for a proposed development at Uxbridge Road, Hayes, UB4 0HD.

Proposed Development

2.2 Redevelopment to provide a self-storage facility (Use Class B8) with associated car and cycle parking, refuse storage, landscaping and other associated works ancillary to the development.

Figure 2.1 Site plan of the proposed scheme

Report Objectives

2.3 The objective of this analysis is to establish whether the proposed building can achieve the appropriate thermal comfort levels and maintain a thermally comfortable environment for the building's occupants according to CIBSE TM52:2013: *The limits of thermal comfort: avoiding overheating in European buildings*.

2.4 The report also seeks to address the Council's requirement for an overheating assessment based on CIBSE TM52 requirements using the TM49 Design Summer Years 1-3 (DSY) for 2020s weather file (high emissions, 50% percentile). Future weather files should be also modelled over the time period 2050.

Methodology

2.5 A thermal modelling exercise was undertaken using the dynamic simulation software IES 2022 in accordance with CIBSE AM 11. A desktop analysis was undertaken, and the office space was included in the study.

2.6 The analysis follows the thermal comfort requirements set out in TM52:2013 *The limits of thermal comfort: avoiding overheating in European buildings*, which combines the guidelines defined under CIBSE AM11 *Building Energy and Environmental Modelling*.

2.7 The assessment criteria are described in greater detail in the sections below. The results of the analysis are presented in the appendices.

Clarifications

2.8 The Thermal Comfort Analysis is an assessment as to whether the building is likely to overheat. It is a risk assessment only and should not be interpreted as a guarantee that the building will/ will not overheat. The report needs to be understood as an exercise in reasonable skill and care undertaken to support the design team with the identification (and mitigation) of risk areas.

2.9 This report analyses the building with the design features provided to Ensphere at the time of writing the report. The assessment also includes anticipated building usage based on the template provided by CIBSE TM52.

2.10 The results will only be valid if the parameters used match those of the final building. Design assumptions therefore need to be followed all the way through procurement to installation (e.g. performance and quality of pipework insulation, façade performance, aerodynamic areas of openable windows, blind/external shading performance etc). All assumptions and mitigations must form part of the construction contract, or the model will need to be re-run to prove compliance of any changes. Furthermore, factors such as (a) variations in the weather from the weather files selected; or (b) variations in the operation of the building; may deviate performance away from the modelled results.

2.11 Ensphere will not be liable for work undertaken by other parties and associated with the data used to populate the model (including, but not limited to, architectural design, mechanical & electrical design, construction assumptions and assumptions concerning building operation).

3. CIBSE Guidance

CIBSE GUIDE A

3.1 Table 1.5 within Section 1 *Environmental criteria for design* of CIBSE Guide A gives general guidance and recommendations on suitable summer operative temperature ranges for air-conditioned buildings. For non-air-conditioned buildings, Table 3.1 states benchmark summer peak temperatures and overheating criteria

3.2 According to CIBSE Guide A benchmarks for summer temperatures for offices, the annual number of hours of internal temperatures greater than 25ºC should not be greater than 5% of the total annual occupied hours.

Table 3.1 Benchmark Summer Peak Temperatures & Overheating Criteria

	Benchmark Summer Peak Temperature °C	Overheating Criterion
Offices	25°C	the internal operative temperature should not exceed 25 °C for more than 5% of occupied hours and 28 °C for more than 1% of occupied hours

CIBSE TM52:2013

3.3 The following guidelines define overheating in free-running (i.e. neither heated nor cooled) buildings according to TM52:

Criteria 1: Hours of Exceedance (He)

3.4 The first criterion sets a limit for the number of hours that the operative temperature can exceed the threshold comfort temperature by 1ºK or more during the occupied hours of a typical non-heating season (1 May to 30 September). The exceedance shall not be more than 3 per cent of occupied hours.

$$\Delta T = T_{op} - T_{max}$$

Criterion 2: Daily Weighted Exceedance (We)

3.5 The second criterion deals with the severity of overheating within any one day, which can be as important as its frequency, the level of which is a function of both temperatures rise and its duration. This criterion sets a daily limit for acceptability, which should be less than or equal to 6 in any one day.

Criterion 3: Upper Limit Temperature (T_{upp})

3.6 The third criterion sets an absolute maximum daily temperature for a room, beyond which the level of overheating is unacceptable. To set an absolute maximum value for the indoor operative temperature the value of ΔT, which is the difference between the actual operative temperature in the room at any time (T_{op}) and T_{max} the limiting maximum acceptable temperature, shall not exceed 4°K.

3.7 The aforementioned criteria provide a robust and balanced assessment of the risk of overheating and in order for a room to be classified as compliant, it will need to meet at least two out of the three criteria.

3.8 It has been assumed that the analysed building falls under Category II of CIBSE recommendations (Table 3 2 CIBSE suggested applicability of the categories and their associated acceptable temperature range).

Table 3.2 CIBSE Suggested Applicability of the Categories and their Associated Acceptable Temperature Range

Category	Explanation	Suggested acceptable range (K)	Suggested acceptable limits PMV
I	High level of expectation only used for spaces occupied by very sensitive and fragile persons	± 2	± 0.2
II	**Normal expectation (for new buildings and renovations)**	**± 3**	**± 0.5**
III	A moderate expectation	± 4	± 0.7
IV	Values outside the criteria for the above categories (only acceptable for a limited period)	> 4	> 0.7

4. Input Data

4.1 The Thermal Comfort model is based upon information provided to Ensphere at the time of the assessment (July 2022). The following presents the key input data:

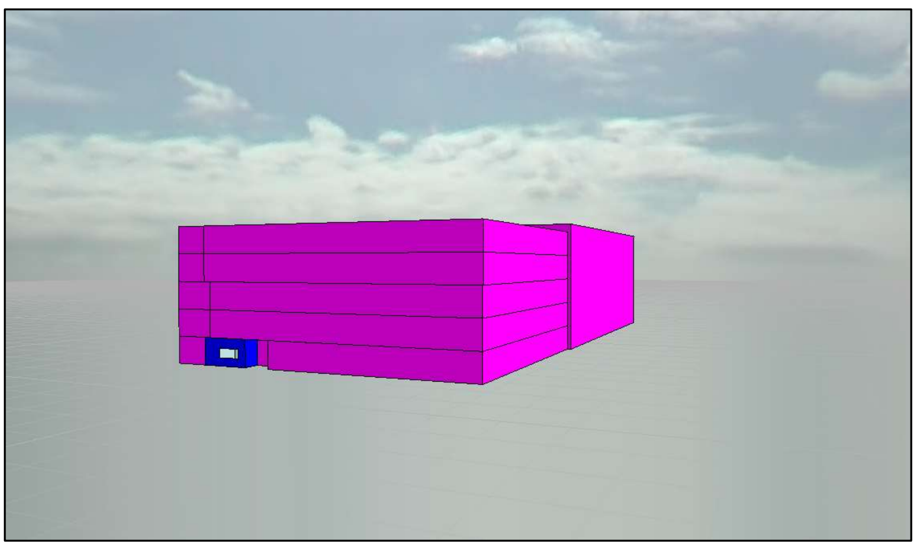
Model Geometry

4.2 A 3D model was produced in IES VE 2022 representing the proposed building. The information included within the model was based on the information provided by the architects and the design team. The drawings used for the modelling of the building are the following:

- 21065GA-SK-020 - Pre-App (ground to 04) and existing elevations.

4.3 The templates used and any assumptions made were based on the guidelines provided by CIBSE TM52:2013.

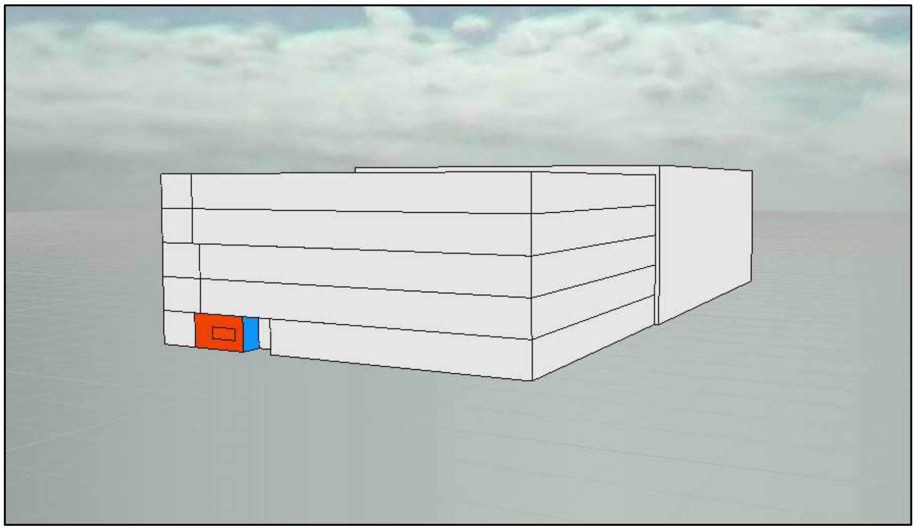
Figure 4.1 Energy model of Uxbridge Road, Hayes



Solar Radiation analysis

4.4 To assist with the identification of areas at greatest risk of overheating an analysis was undertaken to establish the solar gains projected on the building envelope. The image below indicates the area of the building which is exposed to the solar radiation and hence more susceptible to increased heat gains.

Figure 4.2 Solar Radiation Exposure



Weather Data

4.5 The CIBSE weather data used for the analysis are as follows:

- London_LHR_DSY1
- London_LHR_DSY1_2050Med50

Design Input

Building Fabric

4.6 The following table summarises the thermal properties (U-Values) of the building elements applied in the model.

Table 4.1 Proposed U-Values

Element	U-Values (W/m^{2}K)
External Walls	0.20
Ground Floor	0.12
Roof	0.12
External Glazing/Rooflight	1.40
Doors	2.20

Proposed System Input

4.7 The following systems are assigned to the relevant building areas:

Table 4.2 Ventilation Strategy

Systems/ Detail	Description	Location (Specification)
Mechanical Ventilation	Yes (base case)	Office
Air permeability (m^3/hm^2)	-	3

4.8 For security reasons and because the office is located on the ground floor, openable windows are not assumed in the model.

Internal gains

4.9 The internal gains for the occupied spaces (offices) were based on the National Calculation Methodology (NCM). These are summarised below:

Table 4.3 Internal Gains

Space	Occupancy			Lighting Gain (W/m^2)	Equipment gains (W)
	Sensible (W/person)	Latent (W/person)	Density (people)		
Office (open Plan)	73	50	1	15	11.6

Comfort Parameters

4.10 The comfort parameters assumed for the occupied areas are presented in the table below:

Comfort parameters	
Clothing level	0.9
Activity level	1.2
Air speed (m/s)	10

5. Simulation Results

5.1 All of the habitable spaces have been analysed to review the thermal conditions within the rooms.

Base Case (DSY 1 2020 weather) – Mechanical Ventilation Strategy

5.2 The ventilation strategy is based on the design input described in section 4. Mechanical ventilation has been considered in occupied spaces.

5.3 The analysis was undertaken based on information provided by the design team and the NCM thermal templates for offices. It should be noted that the analysis has accounted for internal gains from efficient lighting.

5.4 The results of the analysis presented in Appendix B indicate that the space is not meeting the criteria using a winter setpoint of 23°C and a Summer setpoint of 25°C using mechanical ventilation only.

Mitigation Process – Comfort Cooling Strategy

5.5 The office space was found to fail with an initial 2020 scenario relying solely on mechanical ventilation without openable windows.

5.6 To improve the performance, comfort cooling was introduced.

5.7 The results produced for the above mitigation steps are presented in Appendix C and demonstrate that the room is able to achieve thermal comfort requirement for the 2020's weather scenario.

6. Further weather scenarios

6.1 The building has been further assessed using 2050 weather data, to understand the risk of future overheating and propose potential measures for mitigating the future overheating risk.

Simulation results – 2050 weather

6.2 To understand the overheating risk for future weather scenarios, the mitigation step 1 model was used due to its compliance with TM52.

6.3 The results for this scenario can be found in Appendix D. It demonstrates that the space is able to achieve the thermal comfort requirement for the 2050's weather scenario using comfort cooling.

7. Summary

7.1 This report presents the thermal comfort analysis for the proposed development Uxbridge Road, Hayes, UB4 0HD.

7.2 The objective of this analysis is to establish whether the proposed building can achieve the appropriate thermal comfort levels and maintain a thermally comfortable environment for the building's occupants according to CIBSE TM52:2013: *The limits of thermal comfort: avoiding overheating in European buildings*. Consideration has been given to CIBSE's 2020's weather conditions.

7.3 This report analyses the building with the design features provided to Ensphere by the design team at the time of writing the report. The assessment also includes anticipated building usage based on the template provided by CIBSE TM52.

7.4 The results will only be valid if the parameters used match those of the final building. Design assumptions therefore need to be followed all the way through procurement to installation.

7.5 The modelling has been undertaken with regard to the Policy SI4 (Managing Heat Risk) of the London Plan; and the cooling hierarchy presented therein.

7.6 The architecture has sought to minimise cooling requirements through design; passive ventilation is not feasible due to security requirements and the need for windows to remain closed.

7.7 A mechanical ventilation system has therefore been tested for the occupied spaces and it was found not to be adequate to ensure compliance with the requirements of TM52. A localised comfort cooling system is therefore proposed for the office space.

Appendices

A. General information

Thermal Comfort and Operative Temperatures	The provision of thermal comfort for building occupants involves designing the internal conditions so that the heat loss and heat gain from occupants lie within the bounds that are generally accepted as comfortable. Thermal comfort is defined in the ISO 7730 as "That condition of mind which expresses satisfaction with the thermal environment". This is a definition most people can agree on but also a definition that is not easily converted into physical parameters. The human body can be crudely regarded as a heat engine that converts fuel (food) into energy for its function and creates waste heat that must be dissipated by the body to ensure proper "thermoregulation". The greater the amount of activity, the greater the amount of heat to be dissipated. Typical office work generates up to 110-130W of heat. Heat dissipation from the body takes place by several modes of heat transfer — radiation and convection from the outer surface, evaporation from both the surface and inner parts of the body and respiration involving both sensible and latent heat transfer. To maintain thermal equilibrium, the amount of heat produced or absorbed must equal the heat dissipated. The perception of thermal comfort is based on a range of variables:
Dry bulb air temperature	Is the most commonly quoted factor in relation to thermal comfort. In a 'traditional" building, if the air temperature is within reasonable limits, it is likely that there is a reasonable degree of thermal comfort. This simple relationship between air temperature and comfort is less reliable in lighter weight modern buildings.
Moisture content	Humans will experience discomfort if the moisture content of the air in the room is either too dry, causing drying of the respiratory tract and eyes or too moist so that the body is unable to lose heat through evaporation (sweating) from the skin.
Air movement	The movement of air across the surface of the body affects the convective heat transfer from both the bare and clothed parts; over the exposed skin surfaces the flow of air is a factor in determining the transmission rate of moisture from the surface. If the combined effect of temperature and movement is too great, then too much heat is removed and a subjective feeling of chill or draught results. Conversely, a high air temperature with little air movement will produce a subjective sensation of warmth that, although acceptable locally near a heating unit, is not tolerable throughout the general area of a room.
Operative Temperatures	The CIBSE standard adopted in the UK for the assessment of comfort in an internal space is known as operative temperature (formerly known as dry resultant temperature);

	Toperative = (0.5xTair) + (0.5x Tradiant) This is in effect a simple average and so an increasing air temperature requires a corresponding reduction in radiant temperature if comfort is to be maintained. This can be achieved through reduced areas of glass, external shading, exposed concrete soffits and radiant cooling systems.
Sensible heat	When an object is heated, its temperature arises as heat is added. The increase in heat is called sensible heat. Similarly, when heat is removed from an object and its temperature falls, the heat removed is also called sensible heat. Heat that causes a change in temperature in an object is called sensible heat.
Latent heat	All pure substances in nature are able to change their state. Solids can become liquids and liquids can become gases but changes such as these require the addition of removal of heat. The heat that causes these changes is called latent heat.

B. Simulation Results – CIBSE 2020's Weather Scenario DSY1 (Base case)

Winter			
Location	Operative temperature (TM 52/CIBSE) (°C) - hours in range	Operative temperature (TM 52/CIBSE) (°C) - hours in range	Operative temperature (TM 52/CIBSE) (°C) - hours in range
	> 23.00	> 24.00	> 25.00
GF - OFFICE	202	149	83

Summer			
Location	Operative temperature (TM 52/CIBSE) (°C) - hours in range	Operative temperature (TM 52/CIBSE) (°C) - hours in range	Operative temperature (TM 52/CIBSE) (°C) - hours in range
	> 25.00	> 26.00	> 27.00
GF - OFFICE	963	889	788

Var. Name	Location	Type	Min. Val.	Min. Time	Max. Val.	Max. Time	Mean
Predicted mean vote	GF - OFFICE	Predicted mean vote	-2.28	06:30,06/Dec	3	17:30,25/Jun	0.1
People dissatisfied	GF - OFFICE	Percentage (%)	5	16:30,31/Oct	100	17:30,23/Jul	36.16

C. Simulation Results – CIBSE 2020's Weather

Scenario DSY1 (Mitigation: comfort cooling)

Winter			
Location	Operative temperature (TM 52/CIBSE) (°C) - hours in range	Operative temperature (TM 52/CIBSE) (°C) - hours in range	Operative temperature (TM 52/CIBSE) (°C) - hours in range
	> 23.00	> 24.00	> 25.00
GF - OFFICE	162	0	0

Summer			
Location	Operative temperature (TM 52/CIBSE) (°C) - hours in range	Operative temperature (TM 52/CIBSE) (°C) - hours in range	Operative temperature (TM 52/CIBSE) (°C) - hours in range
	> 25.00	> 26.00	> 27.00
GF - OFFICE	0	0	0

Var. Name	Location	Type	Min. Val.	Min. Time	Max. Val.	Max. Time	Mean
Predicted mean vote	GF - OFFICE	Predicted mean vote	-1.69	16:30,23/Mar	1.55	18:30,25/Jul	0.01
People dissatisfied	GF - OFFICE	Percentage (%)	5	04:30,06/Dec	61.2	04:30,06/Dec	13.55

D. Simulation Results – CIBSE 2050's Weather Scenario

Winter			
Location	Operative temperature (TM 52/CIBSE) (°C) - hours in range	Operative temperature (TM 52/CIBSE) (°C) - hours in range	Operative temperature (TM 52/CIBSE) (°C) - hours in range
	> 23.00	> 24.00	> 25.00
GF - OFFICE	305	252	208

Summer			
Location	Operative temperature (TM 52/CIBSE) (°C) - hours in range	Operative temperature (TM 52/CIBSE) (°C) - hours in range	Operative temperature (TM 52/CIBSE) (°C) - hours in range
	> 25.00	> 26.00	> 27.00
GF - OFFICE	1054	1019	967

Var. Name	Location	Type	Min. Val.	Min. Time	Max. Val.	Max. Time	Mean
Predicted mean vote	GF - OFFICE	Predicted mean vote	-1.88	06:30,06/Dec	3	17:30,21/May	0.53
People dissatisfied	GF - OFFICE	Percentage (%)	5	10:30,26/Mar	100	17:30,22/Jul	39.1

E. Simulation Results – CIBSE 2050's Weather Scenario (Mitigation: comfort cooling)

Winter			
Location	Operative temperature (TM 52/CIBSE) (°C) - hours in range	Operative temperature (TM 52/CIBSE) (°C) - hours in range	Operative temperature (TM 52/CIBSE) (°C) - hours in range
	> 23.00	> 24.00	> 25.00
GF - OFFICE	234.5	0	0

Summer			
Location	Operative temperature (TM 52/CIBSE) (°C) - hours in range	Operative temperature (TM 52/CIBSE) (°C) - hours in range	Operative temperature (TM 52/CIBSE) (°C) - hours in range
	> 25.00	> 26.00	> 27.00
GF - OFFICE	0	0	0

Var. Name	Location	Type	Min. Val.	Min. Time	Max. Val.	Max. Time	Mean
Predicted mean vote	GF - OFFICE	Predicted mean vote	-1.88	06:30,06/Dec	3	17:30,21/May	0.53
People dissatisfied	GF - OFFICE	Percentage (%)	5	10:30,26/Mar	100	17:30,22/Jul	39.1

F. General Notes

The report is based on information available at the time of the writing and discussions with the client during any project meetings. Where any data supplied by the client or from other sources have been used it has been assumed that the information is correct. No responsibility can be accepted by Ensphere Group Ltd for inaccuracies in the data supplied by any other party.

The review of planning policy and other requirements does not constitute a detailed review. Its purpose is as a guide to provide the context for the development and to determine the likely requirements of the Local Authority.

No site visits have been carried out, unless otherwise specified.

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Ensphere Group Ltd
52 Grosvenor Gardens,
London, SW1W 0AU
+44 (0) 20 7846 9040
www.enspheregroup.com