SWECO

Thermal Comfort Report

Tottenham Hale Fitout Retail Unit 1

September 2026

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Appendices

Appendix A – Fitout Unit Detailed results for winter and summer operative temperatures

Appendix B – Fitout Unit Detailed results for PMV and PPD study

Appendix C –Baseline retail unit Detailed results for winter and summer operative temperatures

Appendix D –Baseline retail unit Detailed results for PMV and PPD study

1. Executive Summary

This Thermal Comfort Assessment report has been prepared on behalf of LO GYMS TNH LTD by Sweco UK for the Tottenham Retail Unit 1, North Island in the London Borough of Haringey in preparation for the discharge of **Condition A6 Overheating and Model Report**:

An Overheating Model and Report in respect of each non-residential unit within Plot A shall be submitted in writing to and for approval by the Local Planning Authority prior to the occupation of that unit.

Each submission shall assess the overheating risk (using future weather temperature projections) and demonstrate how the risks have been mitigated and removed through design solutions. This assessment will use TM59 (for domestic) or TM52 (for non-domestic). Both models shall be run using the London Weather File TM49.

The submission shall include details of the design measures incorporated within the scheme within Plot A (including details of the feasibility of using external solar shading and passive cooling and ventilation) to ensure adaptation to higher temperatures are addressed, and the units do not overheat. The submissions shall include the following (where applicable):

A. *Full listing (based on unit number relating to planning drawings) of units modelled and the overheating risk before measures are installed;*
B. *The measures installed to reduce overheating risk:*
    i. *the standard and the impact of the solar control glazing;*
    ii. *that all heating pipework is appropriately insulated*
    iii. *that passive cooling and ventilation features have been included*
    iv. *highlight the mitigation strategies to overcome any overheating risk*
    v. *that there is space for pipe work or localised building services and that this is designed in to the building to allow the retrofitting of centralised or localised cooling and ventilation equipment if needed.*

Details required:

1. ***Modelling of unit prior to measures***
2. ***Measures installed to reduce overheating risk:***
    i. *the standard and the impact of the solar control glazing;*
    ii. *that all heating pipework is appropriately insulated;*
    iii. *that passive cooling and ventilation features have been included;*
    iv. *highlight the mitigation strategies to overcome any overheating risk;*
    v. *that there is space for pipe work or localised building services and that this is designed in to the building to allow the retrofitting of centralised or localised cooling and ventilation equipment if needed.*

3. Justification for air conditioning

The submissions shall preclude the use of air conditioning unless exceptional justification is given for design based upon current weather projection (CIBSE DSY 1). The development within Plot A shall be constructed in accordance with the approved submission.

This report aims to provide an overview of thermal comfort within the retail unit at the development, demonstrating compliance with GLA's Cooling Hierarchy, CIBSE Guide A and following the requirements of the CIBSE TM52 for thermal comfort check in non-domestic spaces.

A detailed thermal comfort analysis using dynamic simulation modelling was carried out in terms of summer and winter operative temperatures and HVAC systems response to peak demand. The results show that all retail unit areas comply with the overheating criteria under current DSY 1 and future summer scenario for year DSY 2 and DSY 3 (with LHR DSY weather file). The occupants will feel the internal environment to be normal, i.e., not cold, or warm, for all the climate predictions assessed with less than 10% of people feeling dissatisfied in most of the operating hours.

Several design features are implemented to minimise energy demand and improve thermal comfort for the occupants:

Passive Measures:

- Solar control layer applied to glazing, achieving 0.4 g-value
- Deep window recess at 275mm providing passive shading to the glazing
- Good performance U-Values exceeding Part L limiting requirements to lower the space heating and cooling demand

Active Measures:

- Limited active cooling is proposed to
- Auxiliary ventilation provided with 14 l/s/person rate.

2. Overheating Assessment

2.1. Thermal Comfort Design and Overheating Criteria

The mixed-use development must assess overheating against the following criteria as further detailed in this section.

Table 2-1 Overheating Criteria

Space	Overheating Criteria
Retail unit areas	CIBSE TM52 for naturally ventilated spaces CIBSE Guide A for mechanically ventilated spaces



Figure 2-1 CIBSE Guide A and BREEAM UK Manuals

2.2. Mitigating overheating in non-domestic areas

2.2.1. CIBSE Guide A

In a changing climate, overheating in buildings, especially those without mechanical cooling, is a serious and potentially increasing problem. According to CIBSE Guide A, a mechanically cooled building should aim to provide an indoor environment where the PMV index is near to or equal to zero.

It will be considered as overheating if the value of the PMV index is above 0.5 (equivalent to a PPD of 10%). Where a value of PMV is not available, the maximum operative temperatures are given in Table 1.8 in CIBSE Guide A for various types of space, using assumed values of the metabolic rate and an assumed clothing insulation of 1.0 for winter and 0.5 for summer. The predicted indoor temperatures should not exceed the tabulated values for more than 3% of occupied hours. This metric will be used for the retail unit.

For summer conditions, simulations should be made using design summer years as recommended in CIBSE TM49:2014.

For naturally ventilated buildings CIBSE Guide A refers to CIBSE TM52 for means of assessing the risk of overheating, as detailed in the next section.

2.2.2. CIBSE TM52

CIBSE TM 52: 2013 is used to check overheating in non-residential naturally ventilated buildings.

The assessment consists of three criteria which are detailed below. Of which passing two of the three criteria results into compliance essentially indicate low or no risk of overheating.

ΔT is the difference between actual operative room temperature (TOP) and the maximum acceptable room temperature (T_{max}). The T_{max} is calculated by:

$$\mathbf{T_{max} = 0.33 \times T_{rm} + 21.8}$$

Where T_{rm} is the outdoor running mean temperature (°C).

Criterion 1: Hours of Exceedence (H_e)

The number of hours (H_e) during which ΔT is greater than or equal to one degree (K) during the non-heating period (1st May to 30th September inclusive) shall not be more than 3% of occupied hours

Criterion 2: Daily Weighted Exceedence (W_e)

To allow for the severity of overheating, the weighted exceedence (W_e) shall be less than or equal to 6 in any one day, where:

$$W_e = (\Sigma h_e) \times WF \qquad = (h_{e0} \times 0) + (h_{e1} \times 1) + (h_{e2} \times 2) + (h_{e3} \times 3) + \ldots + (h_{ey} \times y)$$

where: $WF = 0$ *if* $\Delta T \leq 0$

otherwise: $WF = \Delta T$ *and* h_{ey} *is the time (hrs) when* $WF = y$

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

To set an absolute maximum value for the indoor operative temperature, the value of ΔT shall not exceed 4K

It is recommended that; if naturally ventilated, any retail unitly occupied spaces pass 2 of the 3 above presented criteria to indicate the absence of overheating within the occupancy space.

The retail unit area within the Proposed Development have mechanical cooling proposed, so CIBSE Guide A criteria should be followed. However, all appropriate steps within the cooling hierarchy have been followed to reduce associated cooling loads.

2.2.3. Mechanically Cooled Areas

CIBSE Guide A Environmental Design 2015 recommends summer operative temperatures for a range of air-conditioned building types in Table 1.5. For retail units they range between 21-25°C in summer, and 19-21°C in the winter.

A variation of +/- 1K within the day would attract little notice, while a variation of +/- 2K would be noticed and might cause some complaint at the extremes.

These temperature ranges corresponded to a predicted mean vote (PMV) of ±0.5 and predicted percentage dissatisfied of 10%.

This will ensure that the assessment of the new fitout retail unit better reflects the actual carbon emissions associated with their expected operation. The impact of these new emission factors is significant in that technology generating on-site electricity (such as gas-engine CHP) will not achieve the carbon savings they have to date.

Table 1.5 Recommended comfort criteria for specific applications — *continued*

Building/room type	Customary winter operative temperatures for stated activity and clothing levels*			Customary summer operative temperatures (air conditioned buildings†) for stated activity and clothing levels*			Suggested air supply rate / (L·s⁻¹ per person unless stated otherwise)	Filtration grade‡	Maintained illuminance¶ / lux	Noise criterion§		
	Temp. / °C	Activity / met	Clothing / clo	Temp. / °C	Activity / met	Clothing / clo				NR	dBA§	dBC§
Retailing:												
— shopping malls	12–19[11]	1.8	1.2	21–25[11]	1.8	0.6	10[2]	G4–G5	50–300	40–50	45–55	70–80
— small shops, department stores[18]	19–21	1.4	1.0	21–25	1.3	0.6	10[2]	F5–F7	500	35–40	40–45	65–70
— department stores (upper floors)	19–21	1.4	1.0	21–25	1.3	0.6	10[2]	F5–F7	500	35–40	40–45	65–70
— supermarkets[19]	19–21	1.4	1.0	21–25	1.3	0.6	10[2]	F5–F7	750/1000	40–45	45–50	70–75

Figure 3-2 Table 1.5 Extract from CIBSE Guide A, Operative Temperature Limit - Retail units

A mechanically cooled building or space should not exceed the predicted indoor temperature values tabulated in table 1.8 for more than 3% of occupied hours for thermal comfort (CIBSE Guide A, 2015), assuming clothing insulation of 1.0 for winter and 0.5 for summer.

Table 1.8 Maximum temperatures (category II expectation) for indoor environment in indoor spaces; clothing is assumed to be 1.0 clo in winter and 0.5 clo in summer (see Table 1.7 for category definitions) (data source: BS EN 15251 (BSI, 2007)

Type and use of space	Assumed activity level (/ met)	Maximum temperature for stated clothing level	
		Winter clo = 1.0	Summer clo = 0.5
Residential (sedentary)	1.2	24.0	26.0
Residential (active)	1.5	22.0	—
Offices	1.2	24.0	26.0
Public spaces (auditoria, café etc.)	~1.2	24.0	26.0
Classrooms	1.2	24.0	26.0
Kindergarten	1.4	22.5	25.5
Shops	1.6	22.0	25.0

Figure 2-4 Table 1.8, Extract from CIBSE Guide A - Activity and CLO

In this study retail unit is mechanically ventilated. Considering a variation of +/- 1K from the operative temperature ranges provided within CIBSE Guide A, the lower and upper temperature limits for those uses for winter and summer respectively is targeted at:

- Retail area: Winter: 19°C / Summer: 25°C

2.2.4. Predicted Mean Vote (PMV) and Predicted Percentage Dissatisfied (PPD)

"A human being's thermal sensation is mainly related to the thermal balance of his or her body as a whole. This balance is influenced by physical activity and clothing, as well as the environmental parameters: air temperature, mean radiant temperature, air velocity and air humidity. When these factors have been estimated or measured, the thermal sensation of the body as a whole can be predicted by calculating the predicted mean vote (PMV). The PMV is an index that predicts the mean value of the votes of a large group of persons on the 7-point thermal sensation scale (see Table 1), based on the heat balance of the human body. Thermal balance is obtained when the internal heat production in the body is equal to the loss of heat to the environment. In a moderate environment, the human thermoregulatory system will automatically attempt to modify skin temperature and sweat secretion to maintain heat balance."

The predicted percentage dissatisfied (PPD) index provides information on thermal discomfort or thermal dissatisfaction by predicting the percentage of people likely to feel too warm or too cool in each environment. The PPD can be obtained from the PMV, refer to Figure 3-5. The assessment considers the following thermal comfort parameters:

Table 1 — Seven-point thermal sensation scale

+ 3	Hot
+ 2	Warm
+ 1	Slightly warm
0	Neutral
– 1	Slightly cool
–2	Cool
– 3	Cold

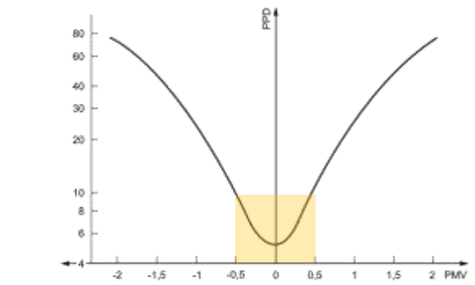


Figure 1 — PPD as function of PMV

Figure 2-5 PMV and PPD criteria (Source: CIBSE Guide A 2015)

Regarding summer thermal comfort indication of predicted mean vote (PMV) and predicted percentage dissatisfied (PPD), as defined in EN ISO 7730:2005, the results are indicated as a range in the table below in which retail units and retail unit lobby were assessed under future weather predictions with a high emission scenario.

Table 2-2 PMV/PPD for retail unit spaces

Weather File	Use	PMV	PPD
DSY 1 LHR 2020 High 50 percentile	Retail Space	±0.50	5-10%
DSY 2 LHR 2020 High 50 percentile			
DSY 3 LHR 2020 High 50 percentile			

2.2.5. Weather Files

In line with the GLA Energy Assessment Guidance this report shows overheating analysis considering 3 weather data scenarios relevant to the site location in accordance with CIBSE TM49: Design Summer Years for London (2014). The Proposed Development is located in London Borough of Haringey and therefore must use London Heathrow (LHR) data, in accordance with CIBSE TM49.

It can be noted that DSY 2 and DSY 3 weather files have prolonged hours of high temperatures over the summer season. The design intention is to comply with 50 percentile weather file and provide recommendations of adaptation measures to achieve thermal comfort for future weather scenarios in the summer.

Table 2-3 May to September, outdoor temperatures for Inner London zones.

May to September (LHR)							
Dry-bulb temperature (°C) - % hours in range							
	> 26.0	> 27.0	> 28.0	> 29.0	> 30.0	> 31.0	> 32.0
LHR DSY 1	6.6	3.8	2.2	1.1	0.4	0.1	0.0
LHR DSY 2	9.1	5.9	4.3	3.1	2.3	1.5	1.1
LHR DSY 3	14.5	10.8	7.8	5.3	3.1	2.0	1.0

3. Design Features for Thermal Comfort

3.1. Thermal Modelling

Sweco have used Integrated Environmental Systems (IES VE) dynamic simulation software to produce the simulation results for this report. The IES software has been approved for use as a Dynamic Simulation Model (DSM) software package. As part of its approval process, the IES software had to demonstrate that it satisfies all the tests and other requirements defined within sections 2 and 3 of "CIBSE TM33:2006, CIBSE standard tests for the assessment of building services design software".

IES VE software is also listed within CIBSE AM 11: Building Energy and Environmental Modelling as an accredited tool for dynamic simulation modelling.

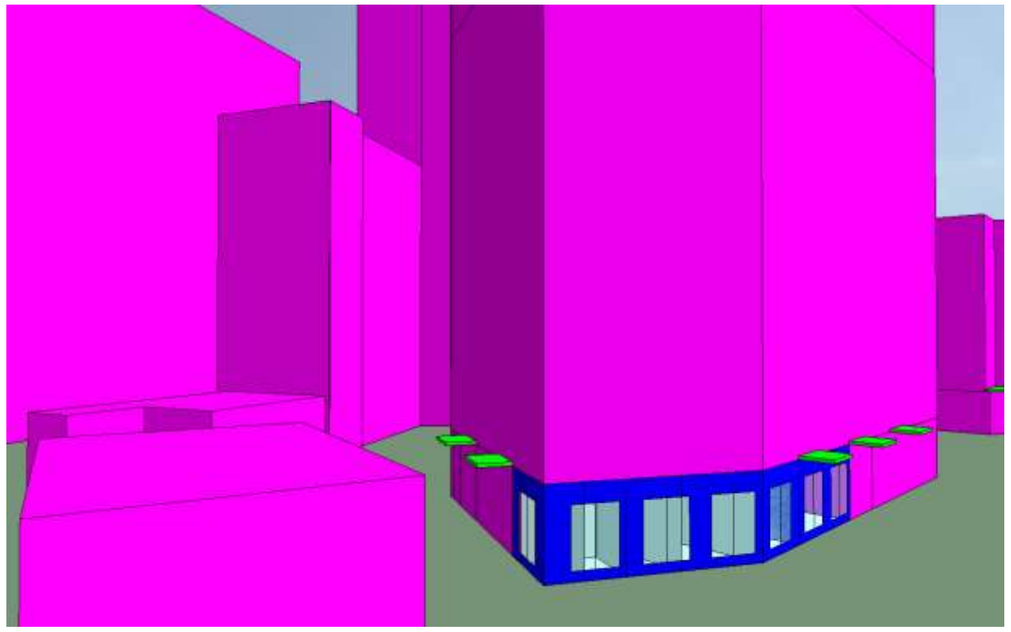


Figure 3-1 3D View of the IES Model for the Proposed Development

3.1.1. Building Envelope and Shading

This section summarises the early design guidance for building fabric and façade design of the proposed development, understanding that complying with Building Regulations Part L 2013 and wider policies is directly reliant upon applying optimum fabric thermal transmittance and good external glazing performance.

The building element properties applied to the thermal models are outlined in the following tables.

Table 5.2.4.1: Building fabric thermal performance inputs for the retail unit retail unit development

Parameter		Part L2 2013 Limiting Value	Part L2 Notional Building Parameters	Fitout unit (Actual) Values	Baseline retail unit
Building Airtightness (@ 50Pa)		10 $m^3/h/m^2$	3 $m^3/h/m^2$	3 $m^3/h/m^2$	10 $m^3/h/m^2$
U-values	Wall	0.35 W/m^2K	0.18 W/m^2K	0.22 W/m^2K	0.35 W/m^2K
	Roof	Retail units do not have a roof which is exposed due to being sited under residential units.			
	Floor	0.25 W/m^2K	0.15 W/m^2K	0.15 W/m^2K	0.15 W/m^2K
	Curtain wall (retail)	2.2 W/m^2K	1.4 W/m^2K	1.4 W/m^2K	2.2 W/m^2K
Glazing U-value		2.2 W/m^2K	1.4 W/m^2K	1.4 W/m^2K	2.2 W/m^2K
Glazing g-value (BS EN 410)		0.6		0.40 (Retail)	0.6
Glazing Visible Light Transmittance		-	71%	65%	>70%
Thermal Mass		N/A		Medium	Medium

3.1.2. Internal Loads and Operational Profiles

The tables below break down the internal gains and related operational profiles for retail unit under fit-out and baseline setup.

Table 3-1 Internal Gains applied to Baseline and fit-out retail unit.

Location	Lighting (W/m^2)	Equipment (W/m^2)	Occupant density	Operational Profile
Fit-out retail unit	5	8	6 m^2/per	From 8am to 6pm
Baseline	5	12	6 m^2/per	From 8am to 6pm

3.1.3. Auxiliary Ventilation Rates

Fresh air supply is assigned to the retail unit below as background ventilation. Infiltration rate is around 0.15 air changes per hour for the new build retail unit. These infiltration values have been assumed based on standard industry practice for new bults.

Table 3-2 Auxiliary Ventilation Rates

Location	Auxiliary Ventilation
Baseline retail unit and Retail Fitout	14 L/s per person (in line with BREEAM requirements)

3.2. Heating, Cooling and Ventilation Strategy of Fit-out unit

The heating and cooling strategy for retail unit is primarily be achieved through standalone VRF unit.

The ventilation strategy is via high level Mechanical Ventilation Heat Recovery (MVHR) unit. This unit will interface with louvres in the external façade to convey air from outside into the occupied spaces while simultaneously exhausting a similar amount of indoor air.

4. Thermal Comfort Results

This section summarises the results for the retail unit areas assessed against CIBSE's guidance in line with the London Plan's requirements and following BREEAM Hea 04 methodology.

The simulation is carried out on all occupied spaces in the retail unit representing the building performance.

4.1. Analysis Scenarios

The following scenarios presented in *Table 4-1* were considered for the thermal comfort analysis of the Proposed Development.

The analysis considers the baseline retail unit and fit-out retail areas to be mechanically ventilated to assess thermal comfort. All retail areas have mechanical cooling, and the thermal comfort assessment considered the following scenarios without internal blinds to the retail unit spaces.

The compliant scenario under LHR 2020 50% DSY 1 weather file (scenario 1) is then analysed against the other percentile weather files with increased summer temperatures: DSY 2 (scenario 2) and DSY 3 (scenario 3).

Table 4-1 Scenarios of overheating analysis for retail unit

Scenario	Retail Unit			
	Cooling Setpoint (°C)	Avg. Cooling capacity W/m²	Heating Setpoint (°C)	Avg. Heating capacity W/m²
Baseline	23	100	22	80
1 Retail Fitout	23	120	22	100
2 Retail Fitout	23	120	22	100
3 Retail Fitout	23	120	22	100

4.2. Fitout Results – Summer Thermal Comfort

The thermal modelling results demonstrate that the building design and services strategy for cooling can deliver thermal comfort levels in the retail unit following the criteria set out in CIBSE Guide A, Environmental Design Table 1.5 by using Design Summer Year (DSY) weather file LHR, 2020s, high emissions, 50% scenario. The results are presented below:

Table 4-2 Overheating assessment results – Retail unit Areas

Weather Files	Scenario	Rooms Assessed	Rooms Failing	Compliance
		Retail Unit	Retail Unit	
LHR DSY1	Baseline	3	1	FAIL
LHR DSY1	1	3	0	PASS
LHR DSY2	2		0	PASS
LHR DSY3	3		0	PASS

The fit-out retail unit area complies with the criteria for weather scenario LHR 2020 50% DSY 1 when the cooling setpoint is 23°C. As per standard M&E design, this set point sits within the band 24°C ±2, and the spaces pass with a designed average cooling capacity of 120 W/m² for fit-out retail unit in the DSY1 weather scenario but fails in baseline retail unit setup under same weather scenario. These conditions work to achieve the thermal comfort criteria under more intense summer heat conditions, DSY 2 and DSY 3 as well.

Please refer Appendix A for more detailed Fitout results and Appendix C for baseline retail unit results.

The last two rows illustrate the scenarios that pass both criteria for each weather file, including DSY2 and DSY3, as these represent intense summer periods for assessing the impact of projected climate change. While the scenarios are not required for compliance, the assessed scenarios represent future heating periods. All the areas assessed can ensure thermal comfort conditions for current and future weather scenarios.

Please refer to Appendix D for DSY2 and DSY3 results for the baseline retail unit 1 scenario.

4.3. Fitout Results – Winter Thermal Comfort

Under winter heating, the fit-out retail unit spaces analysed achieve thermal comfort by increasing the setpoint, still in the range of M&E system design to 22°C with an average limited capacity of 100 W/m² under DSY1 weather scenario.

Table 4-3 summarises the results of the scenarios assessed to determine the risk of underheating and thermal comfort conditions during the winter with heating.

CIBSE Guide A outlines 3% as the maximum allowance of annual occupied hours that the operative temperature can go below **19°C in retail units** during active hours in winter.

Table 4-3 Winter Thermal Comfort results' summary for the Proposed Development

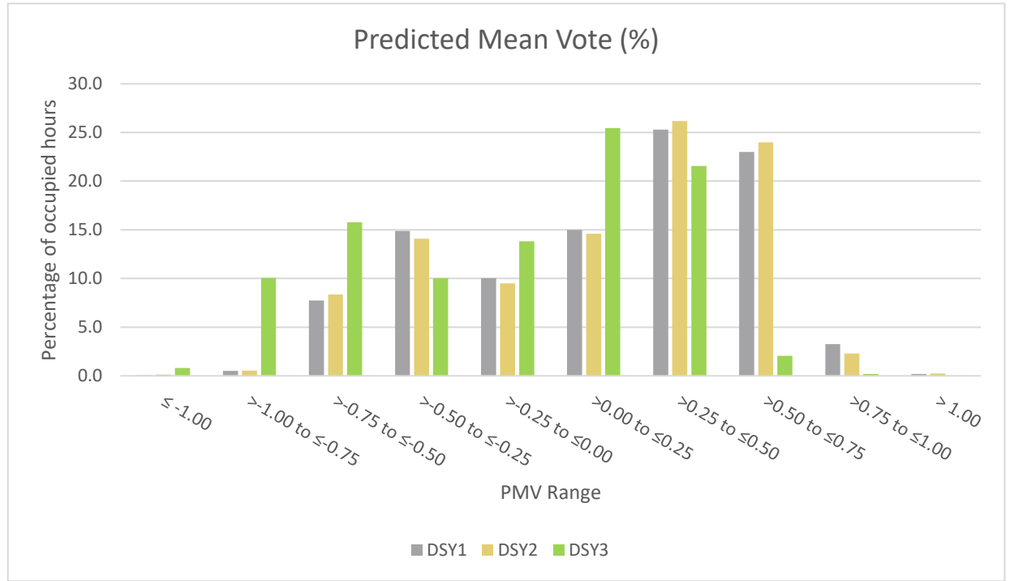
Weather Files	Scenario	Rooms Assessed	Rooms Failing	Compliance
		Retail unit	Retail unit	
LHR DSY1	Baseline	3	1	FAIL
LHR DSY1	1	3	0	PASS
LHR DSY2	2		0	PASS
LHR DSY3	3		1	FAIL

4.4. Fitout PMV and PPD Results

Results indicate that fit-out retail unit spaces are within PMV band value of ±0.5 for the compliant thermal analysis scenario under LHR 2020 50% DSY 1 weather file. This reflects the design strategy in place to improve thermal comfort for the occupants. The values remain in the comfort range for the other two weather files with higher temperatures in summer making this building futureproof for extreme weather scenarios.

Based on the results, the occupants of the areas assessed will feel the environment to be normal, i.e., not cold or warm under current and future weather conditions. The designed HVAC cooling system can meet the set point rapidly due to high plant response.

Detailed PMV and PPD results for the Fitout Development can be found in Appendix B of this report, while the results for the baseline retail unit are provided in Appendix D.



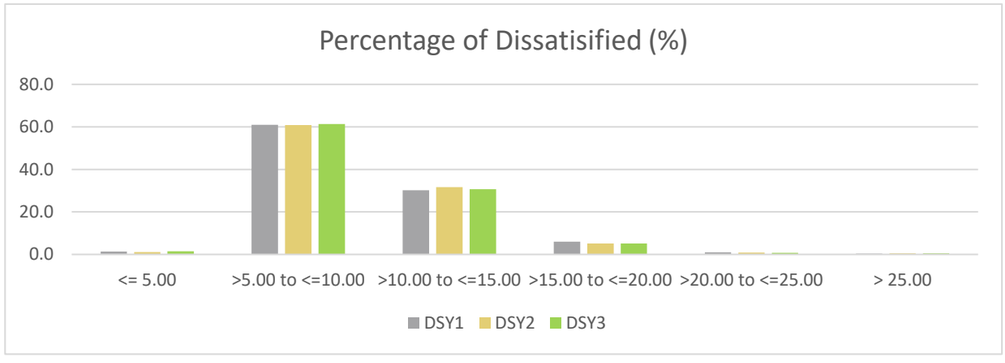


Figure 5-1 PMV and PPD results for the Fitout Retail Unit.

5. Conclusion and Recommendations

5.1. Implemented Passive Measures to the Retail Unit

Policy SI 4 of The London Plan (2021) states that major development proposals should reduce potential overheating, and reliance on air-conditioning systems, and demonstrate this in accordance with the following cooling hierarchy:

Table 5-1: London Plan Cooling Hierarchy, and Proposed Development strategy.

Cooling Hierarchy	Proposed Strategy
Reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation, and green roofs, and walls.	The g-value has been reduced which reduces the solar gain to the unit whilst maintaining good balance with daylight.
Minimise internal heat generation through energy-efficient design.	LED lightings are installed to reduce internal heat gains.
Manage the heat within the unit through exposed internal thermal mass, and high ceilings	Maximised the floor to ceiling height for the retail unit areas.
Mechanical ventilation	Highly efficient mechanical ventilation with efficient heat recovery and potential for 'free cooling' is used for fresh air supply all year round.
Active cooling systems	Energy-efficient design through the use of the VRF system.

5.2. Implemented Active Measures

A thermal comfort assessment is indicative of the building design and services strategy and wherever the comfort cooling can deliver thermal comfort levels in occupied spaces in accordance with the criteria set out in CIBSE Guide A Environmental Design Table 1.5 by using Design Summer Year (DSY) weather file London DSY1, DSY2 and DSY3.

Effectively addressing overheating can significantly enhance occupant comfort and energy efficiency. When overheating is not managed, it can lead to challenges such as discomfort for users, increased energy consumption, and potential damage to the building materials.

The measures applied within the scheme proactively reduce the overheating risk through strategic ventilation, and the use of lower g-values. The project can create a healthier and more pleasant indoor environment. This not only enhances the building's sustainability but also contributes to the overall success of the development by ensuring that it meets modern standards and user expectations. A free-running unit relying solely on natural ventilation scenario would not be able to reach adequate levels of thermal comfort due to the deep floor plan of the building which reduces the ventilation effectiveness.

5.3. Recommendations mitigating overheating for extreme weather

This report shows that the development is at low risk of overheating for retail unit under weather file DSY 1 however does not comply under DSY 2, and DSY 3. This when coupled with uncertainties and unpredictability of climate conditions, additional strategies are recommended for future retrofitting to provide desirable levels of comfort in projected years by considering extreme weather conditions due to climate change.

Table 6-2: Recommended measures to mitigate overheating in extreme weather scenarios

Cooling Hierarchy	Proposed Strategy
Plant/Trees	Incorporating greenery at street level would help to reduce temperatures, not just by avoiding radiation to reach below canopy areas, but also from the evapotranspiration process.
Enhance cooling system capacity	Opportunity to upgrade the cooling system capacity in the future, in the event of outdoor temperature increase.
Use of electric fans	Easy to install solution which can significantly improve occupant's thermal comfort perception.
Education/Behaviour	Internal gains can be reduced by switching off equipment and lighting in areas that are not being used.

Appendix A

Fitout Retail Unit Detailed results for winter and summer operative temperatures

Design Summer Year (DSY) weather file London Heathrow 2020s, high emissions, 50% DSY 1, DSY 2, and DSY3 scenarios.

PROJECT NUMBER AND NAME

CIBSE Guide A Operative Temperature Check (IES)

Occupied Spaces:	Retail Unit
Notes:	
Weather file:	LHR

DSY1

Operative temperature (°C) - % hours in range		
Location	Summer	Winter
	SetP 23	SetP 22
	> 25	<19
G0 - Therapy Room 1	0.3	2.0
G0 - Therapy Room 2	0.0	2.8
G0 - Training room	0.0	0.1

DSY2

Operative temperature (°C) - % hours in range		
Location	Summer	Winter
	SetP 23	SetP 22
	> 25	<19
G0 - Therapy Room 1	0.2	2.5
G0 - Therapy Room 2	0.0	2.9
G0 - Training room	0.0	0.2

DSY3

Operative temperature (°C) - % hours in range		
Location	Summer	Winter
	SetP 23	SetP 22
	> 25	<19
G0 - Therapy Room 1	0.3	2.3
G0 - Therapy Room 2	0.0	4.1
G0 - Training room	0.0	0.3

Appendix B

Fitout Retail Unit Detailed results for PMV and PPD study

Design Summer Year (DSY) weather file London Heathrow 2020s, high emissions, 50% DSY 1, DSY 2, and DSY3 scenarios.

PROJECT NUMBER AND NAME
CIBSE Guide A Operative Temperature Check (IES)

Occupied Spaces: Retail Unit
Thermal model:
Weather file: LHR

Retail Unit - DSY1
London_LHR_DSY1_2020high50.ep
Predicted mean vote (PMV) - % of hours in range

Room Name	<= -1.00	>-1.00 to <=-0.7	>-0.75 to <=-0.5	>-0.50 to <=-0.2	>-0.25 to <=0.0	>0.00 to <=0.2	>0.25 to <=0.5	>0.50 to <=0.7	>0.75 to <=1.0	> 1.00
G0 - Therapy Room 1	0	0.4	3.5	26.4	42.5	23.8	2.6	0.8	0.1	0
G0 - Therapy Room 2	0.2	0.6	1.3	2.7	23.4	37.8	33.9	0	0	0
G0 - Training room	0	0	4	31.8	41.4	22.8	0	0	0	0
Average	0.07	0.33	2.93	20.30	35.77	28.13	12.17	0.27	0.03	0.00

Retail Unit - DSY2
London_LHR_DSY2_2020high50.ep
Predicted mean vote (PMV) - % of hours in range

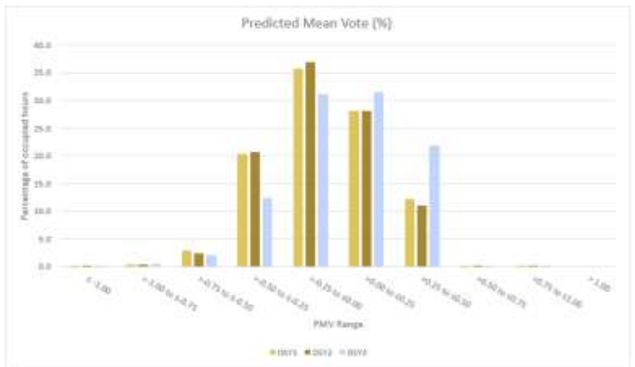
Room Name	<= -1.00	>-1.00 to <	>-0.75 to <	>-0.50 to <	>-0.25 to <	>0.00 to <	>0.25 to <	>0.50 to <	>0.75 to <	> 1.00
G0 - Therapy Room 1	0.1	0.5	2.3	27.8	44	21.7	3	0.5	0.1	0
G0 - Therapy Room 2	0.4	0.6	1.3	2.1	24.2	41	30.3	0	0	0
G0 - Training room	0	0.1	3.6	32.2	42.4	21.7	0	0	0	0
Average	0.17	0.40	2.40	20.70	36.87	28.13	11.10	0.17	0.03	0.00

Retail Unit - DSY3
London_LHR_DSY3_2020high50.ep
Predicted mean vote (PMV) - % of hours in range

Room Name	<= -1.00	>-1.00 to <	>-0.75 to <	>-0.50 to <	>-0.25 to <	>0.00 to <	>0.25 to <	>0.50 to <	>0.75 to <	> 1.00
L01_Office Peri E	0.1	0.6	1.2	2.4	23.5	38.3	32.9	0.7	0.2	0
L01_Office Int 2	0.5	1	1.2	2.8	24.5	37.4	32.7	0	0	0
L01_Office Int 1	0	0.1	3.6	31.9	45.5	18.9	0	0	0	0
Average	0.20	0.57	2.00	12.37	31.17	31.53	21.87	0.23	0.07	0.00

PMV - % of hours in range

Weather file	≤ -1.00	>-1.00 to ≤-0.75	>-0.75 to ≤-0.50	>-0.50 to ≤-0.25	>-0.25 to ≤0.00	>0.00 to ≤0.25	>0.25 to ≤0.50	>0.50 to ≤0.75	>0.75 to ≤1.00	> 1.00
DSY1	0.1	0.3	2.9	20.3	35.8	28.1	12.2	0.3	0.0	0.0
DSY2	0.2	0.4	2.4	20.7	36.9	28.1	11.1	0.2	0.0	0.0
DSY3	0.2	0.6	2.0	12.4	31.2	31.5	21.9	0.2	0.1	0.0



PROJECT NUMBER AND NAME

CIBSE Guide A Operative Temperature Check (IES)

Occupied Spaces:	Retail Unit
Thermal model:	
Weather file:	LHR

Retail Unit - DSY1

London_LHR_DSY1_2020High50.epw

Percentage Dissatisfied - % of hours in range

Room Name	<= 5.00	>5.00 to <=10.00	>10.00 to <=15.0	>15.00 to <=20.0	>20.00 to <=25	> 25.00
G0 - Therapy Room 1	7.5	87.6	4	0.6	0.2	0
G0 - Therapy Room 2	4.9	92.9	1	0.8	0.2	0.2
G0 - Training room	7.7	88.1	4.2	0	0	0
Average	6.70	89.53	3.07	0.47	0.13	0.07

Retail Unit - DSY2

London_LHR_DSY2_2020High50.epw

Percentage Dissatisfied - % of hours in range

Room Name	<= 5.00	>5.00 to <	>10.00 to	>15.00 to	>20.00 to	> 25.00
G0 - Therapy Room 1	6.8	89.3	2.7	0.8	0.2	0.2
G0 - Therapy Room 2	5.2	92.5	1.2	0.5	0.3	0.4
G0 - Training room	7	89.1	3.9	0.1	0	0
Average	6.33	90.30	2.60	0.47	0.17	0.20

Retail Unit - DSY3

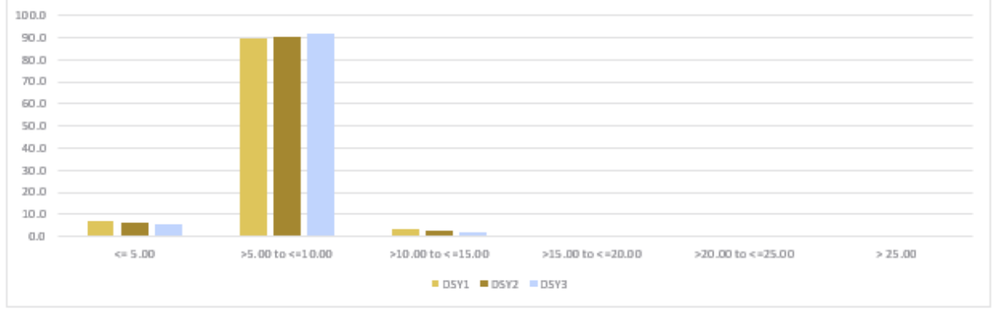
London_LHR_DSY3_2020High50.epw

Percentage Dissatisfied - % of hours in range

Room Name	<= 5.00	>5.00 to <	>10.00 to	>15.00 to	>20.00 to	> 25.00
G0 - Therapy Room 1	4.3	92.8	1.7	0.7	0.4	0.1
G0 - Therapy Room 2	4.4	92.8	1	0.8	0.4	0.5
G0 - Training room	7	89.1	3.8	0.2	0	0
Average	5.23	91.57	2.17	0.57	0.27	0.20

PPD - % of hours in range

Weather file	<= 5.00	>5.00 to <=10.00	>10.00 to <=15.0	>15.00 to <=20.0	>20.00 to <=25.0	> 25.00
DSY1	6.7	89.5	3.1	0.5	0.1	0.1
DSY2	6.3	90.3	2.6	0.5	0.2	0.2
DSY3	5.2	91.6	2.2	0.6	0.3	0.2



Appendix C

Baseline retail unit Retail Unit Detailed results for winter and summer operative temperatures

Design Summer Year (DSY) weather file London Heathrow 2020s, high emissions, 50% DSY 1, DSY 2, and DSY3 scenarios.

Occupied Spaces: Retail Unit (Shell)
Notes:
Weather file: LHR

DSY1

Location	Summer SetP 23 > 25	Winter SetP 22 <19
G0 - Therapy Room 1	6.4	3.8
G0 - Therapy Room 2	0.8	0.9
G0 - Training room	0	0

DSY2

Location	Summer SetP 23 > 25	Winter SetP 22 <19
G0 - Therapy Room 1	7.7	4.1
G0 - Therapy Room 2	1.6	1.5
G0 - Training room	0	0.3

DSY3

Location	Summer SetP 23 > 25	Winter SetP 22 <19
G0 - Therapy Room 1	7.5	5.8
G0 - Therapy Room 2	0.9	2.6
G0 - Training room	0	0.5

Appendix D

Baseline retail unit Retail Unit Detailed results for PMV and PPD study

Design Summer Year (DSY) weather file London Heathrow 2020s, high emissions, 50% DSY 1, DSY 2, and DSY3 scenarios.

PROJECT NUMBER AND NAME
CIBSE Guide A Operative Temperature Check (IES)

Occupied Spaces: Retail Unit (Shell)
Thermal model:
Weather file: LHR

Retail Unit - DSY1
London_LHR_DSY1_2020High50.epw
Predicted mean vote (PMV) - % of hours in range

Room Name	<= -1.00	>-1.00 to <=-0.75	>-0.75 to <=-0.50	>-0.50 to <=-0.25	>-0.25 to <=0.00	>0.00 to <=0.25	>0.25 to <=0.50	>0.50 to <=0.75	>0.75 to <=1.00	> 1.00
G0 - Therapy Room 1	0.2	1.2	10.9	18	10.5	12.4	20.4	20.8	5	0.6
G0 - Therapy Room 2	0	0.3	8	13.6	10.8	15.1	25	23.6	3.6	0
G0 - Training room	0	0	4.3	13.1	8.8	17.5	30.5	24.6	1.2	0
Average	0.07	0.50	7.73	14.90	10.03	15.00	25.30	23.00	3.27	0.20

Retail Unit - DSY2
London_LHR_DSY2_2020High50.epw
Predicted mean vote (PMV) - % of hours in range

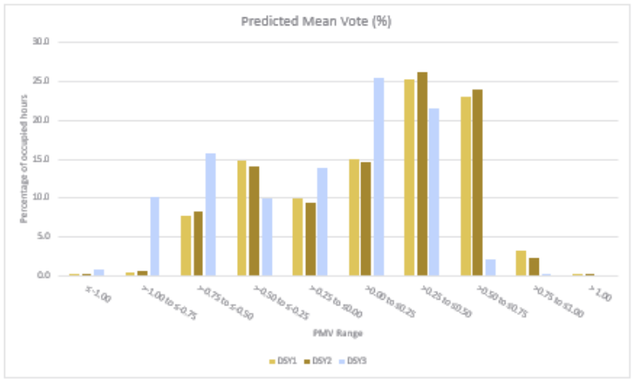
Room Name	<= -1.00	>-1.00 to <=-0.75	>-0.75 to <=-0.50	>-0.50 to <=-0.25	>-0.25 to <=0.00	>0.00 to <=0.25	>0.25 to <=0.50	>0.50 to <=0.75	>0.75 to <=1.00	> 1.00
G0 - Therapy Room 1	0.4	1.1	11.3	17.2	10.1	11.1	22.2	22.2	3.7	0.7
G0 - Therapy Room 2	0	0.4	8.9	12.5	10.3	14.9	25.3	24.9	2.7	0
G0 - Training room	0	0.1	4.9	12.6	8.1	17.8	31	24.9	0.5	0
Average	0.13	0.53	8.37	14.10	9.50	14.60	26.17	24.00	2.30	0.23

Retail Unit - DSY3
London_LHR_DSY3_2020High50.epw
Predicted mean vote (PMV) - % of hours in range

Room Name	<= -1.00	>-1.00 to <=-0.75	>-0.75 to <=-0.50	>-0.50 to <=-0.25	>-0.25 to <=0.00	>0.00 to <=0.25	>0.25 to <=0.50	>0.50 to <=0.75	>0.75 to <=1.00	> 1.00
L01_Office Peri E	1.5	12.6	20.1	3.5	10	20.7	21	3.3	0.6	0
L01_Office int 2	0.7	10.4	14.3	10.5	13.8	24.9	22.7	2	0	0
L01_Office Int 1	0.2	7.2	12.3	10.1	17.7	30.8	21	0.9	0	0
Average	0.80	10.07	15.77	10.03	13.83	25.47	21.57	2.07	0.20	0.00

PMV - % of hours in range

Weather file	≤ -1.00	>-1.00 to ≤-0.75	>-0.75 to ≤-0.50	>-0.50 to ≤-0.25	>-0.25 to ≤0.00	>0.00 to ≤0.25	>0.25 to ≤0.50	>0.50 to ≤0.75	>0.75 to ≤1.00	> 1.00
DSY1	0.1	0.5	7.7	14.3	10.0	15.0	25.3	23.0	3.3	0.2
DSY2	0.1	0.5	8.4	14.1	9.5	14.6	26.2	24.0	2.3	0.2
DSY3	0.8	10.1	15.8	10.0	13.8	25.5	21.6	2.1	0.2	0.0



PROJECT NUMBER AND NAME

CIBSE Guide A Operative Temperature Check (IES)

Occupied Spaces:	Retail Unit (Shell)
Thermal model:	
Weather file:	LHR

Retail Unit – DSY1

London_LHR_DSY1_2020High50.epw

Percentage Dissatisfied - % of hours in range

Room Name	<= 5.00	>5.00 to <=10.00	>10.00 to <=15.0	>15.00 to <=20.0	>20.00 to <=25	> 25.00
G0 - Therapy Room 1	1.5	57.1	31.2	6.9	2.2	1.2
G0 - Therapy Room 2	1.3	60.3	30.8	6.7	0.9	0
G0 - Training room	1.2	65.7	28.6	4.5	0	0
Average	1.33	61.03	30.20	6.03	1.03	0.40

Retail Unit – DSY2

London_LHR_DSY2_2020High50.epw

Percentage Dissatisfied - % of hours in range

Room Name	<= 5.00	>5.00 to <	>10.00 to <	>15.00 to <	>20.00 to	> 25.00
G0 - Therapy Room 1	0.8	57.5	32.1	6.6	1.6	1.4
G0 - Therapy Room 2	1.3	59.5	32.4	5.8	0.9	0.1
G0 - Training room	1.1	65.5	30.5	2.9	0	0
Average	1.07	60.83	31.67	5.10	0.83	0.50

Retail Unit – DSY3

London_LHR_DSY3_2020High50.epw

Percentage Dissatisfied - % of hours in range

Room Name	<= 5.00	>5.00 to <	>10.00 to <	>15.00 to <	>20.00 to	> 25.00
G0 - Therapy Room 1	1.3	57	31.9	6.7	1.8	1.5
G0 - Therapy Room 2	1.4	60.6	31.7	5.6	0.5	0.1
G0 - Training room	1.9	66.3	28.5	3.3	0	0
Average	1.53	61.30	30.70	5.20	0.77	0.53

PPD - % of hours in range

Weather file	<= 5.00	>5.00 to <=10.00	>10.00 to <=15.0	>15.00 to <=20.0	>20.00 to <=25.0	> 25.00
DSY1	1.3	61.0	30.2	6.0	1.0	0.4
DSY2	1.1	60.8	31.7	5.1	0.8	0.5
DSY3	1.5	61.3	30.7	5.2	0.8	0.5

