Building Services
Consulting Engineers

BREEAM HEA04 : THERMAL COMFORT REPORT

AT

BIRDWORLD (ENTRANCE BUILDING)
FARNHAM ROAD
HOLT POUND
GU10 4LD

FOR

BIRDWORLD LTD & HASKINS GARDEN CENTRES LTD

JANUARY 2024

DOCUMENT REVISION RECORD

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1 EXECUTIVE SUMMARY

The purpose of this report is to convey the results from the analysis of the environmental performance of the occupied spaces within the proposed Birdworld Entrance Building. Specifically, it summarises the work undertaken to review the level of overheating that may occur in spaces that are regularly occupied for significant periods of time.

The proposed Birdworld Entrance Building will accommodate a gift shop, office accommodation, staff areas along with circulation and sanitary spaces. All of the occupied spaces within the proposed Birdworld Entrance Building will utilise a high efficiency mechanical heat recovery ventilation system which will provide fresh air to the occupants whilst recovering as much energy as possible. Comfort cooling will be provided to all occupied spaces (except for the Gift Shop) during times when the internal and external environmental conditions limit the use of mechanical ventilation. The Gift Shop will use natural ventilation via openable windows to limit the amount of overheating during summertime.

When compared against the standards of CIBSE Guide A Environmental Criteria for Design, based on the details modelled in this report, occupied spaces achieve appropriate thermal comfort levels. This demonstrates compliance with CIBSE Guide A Environmental Criteria for Design standards. Therefore, the following BREEAM credits are obtainable under BREEAM UK New Construction 2023 Hea04 Thermal Comfort:

Thermal Comfort (Criterion 3)

When simulated using the current weather file:

- Thermal modelling and analysis have been carried out using software in accordance with CIBSE AM11 Building Energy and Environmental Modelling.
- Modelling of the air conditioned/mechanically ventilated building demonstrates that during occupied hours the temperature range meets CIBSE Guide A Environmental Design criteria.
- As all occupied spaces are air conditioned/mechanically ventilated, the Predicted Mean Vote (PMV) and Predicted Percentage of Dissatisfied (PPD) indices have been reported.

Design for future thermal comfort – for a projected climate change environment (Criterion 6)

When simulated using the London GTW CIBSE DSY 2 2020's high emissions 50th percentile range weather file and the London GTW CIBSE DSY 3 2020's high emissions 50th percentile range weather file:

- Thermal modelling demonstrates compliance with CIBSE AM11 Building Energy and Environmental Modelling criteria.
- Modelling of the air conditioned/mechanically ventilated building demonstrates that during occupied hours the temperature range meets CIBSE Guide A Environmental Design criteria.
- As all occupied spaces are air conditioned/mechanically ventilated, the Predicted Mean Vote (PMV) and Predicted Percentage of Dissatisfied (PPD) indices have been reported.

The results highlight that for both PMV and PPD indices under the London GTW CIBSE DSY 1, DSY 2 and DSY3 2020's high emissions 50th percentile range weather scenarios the occupied spaces meet the criteria as per above. Therefore, this report recommends that both credits are awarded.

The parameters used in this calculation are provided within this report and are deemed to be approved by the Client unless advised to the contrary. Please note changes to the modelling inputs and parameters may affect the modelling results. Although every effort has been made to simulate the building with anticipated heat gain values and occupancy profiles, the 'real' building may have differing operations and heat gain patterns with external weather conditions not normal to the historical data provided by the standard CIBSE weather files. It therefore should be noted that there is no guarantee that the thermal comfort assessment will match the occupied building.

2 SCENARIO

The proposed Birdworld Entrance Building will accommodate a gift shop, office accommodation, staff areas along with circulation and sanitary spaces. All of the occupied spaces within the proposed Birdworld Entrance Building will utilise a high efficiency mechanical heat recovery ventilation system which will provide fresh air to the occupants whilst recovering as much energy as possible. Comfort cooling will be provided to all occupied spaces (except for the Gift Shop) during times when the internal and external environmental conditions limit the use of mechanical ventilation. The Gift Shop will use natural ventilation via openable windows to limit the amount of overheating during summertime.

The purpose of this report is to convey the results from the analysis of the environmental performance of the occupied spaces within the proposed Birdworld Entrance Building. Specifically, it summarises the work undertaken to review the level of overheating that may occur in spaces that are regularly occupied for significant periods of time.

The primary criteria used in this study to assess the levels of thermal comfort are derived from the requirements within CIBSE Guide A Environmental Criteria for Design. BREEAM UK New Construction 2023 Hea04 credit requires all occupied spaces to be assessed for Predicted Mean Vote (PMV) and Predicted Percentage of Dissatisfied (PPD) indices and the results reported. Please see Figures 1 - 5 below for images from the thermal model.

Figure 1. Image Showing Plan View of Thermal Model.

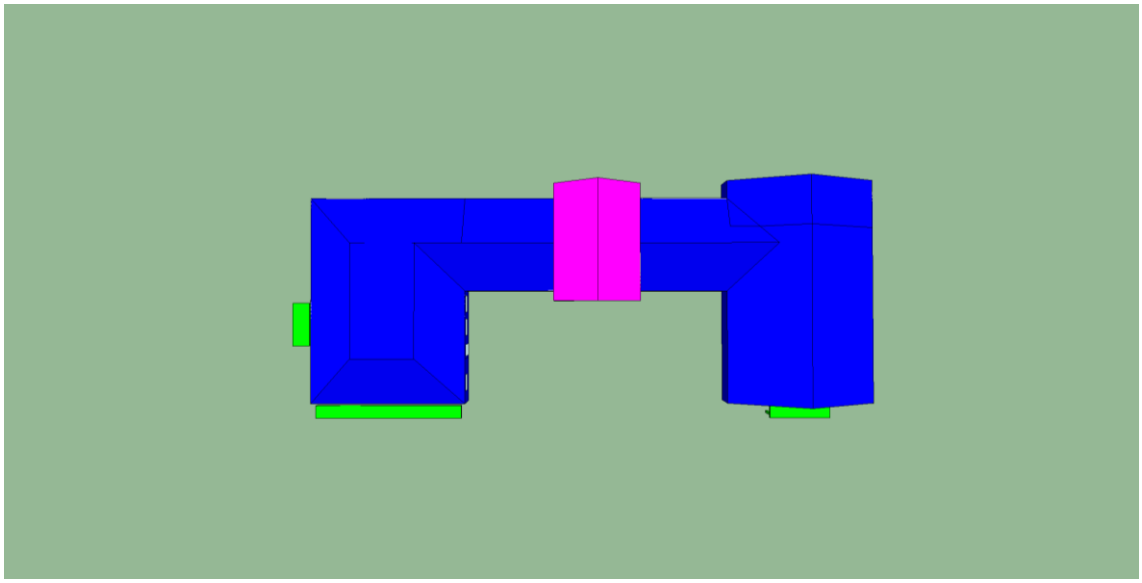


Figure 2. Image Showing North West Elevation View of Thermal Model.

Figure 3. Image Showing North East Elevation View of Thermal Model.

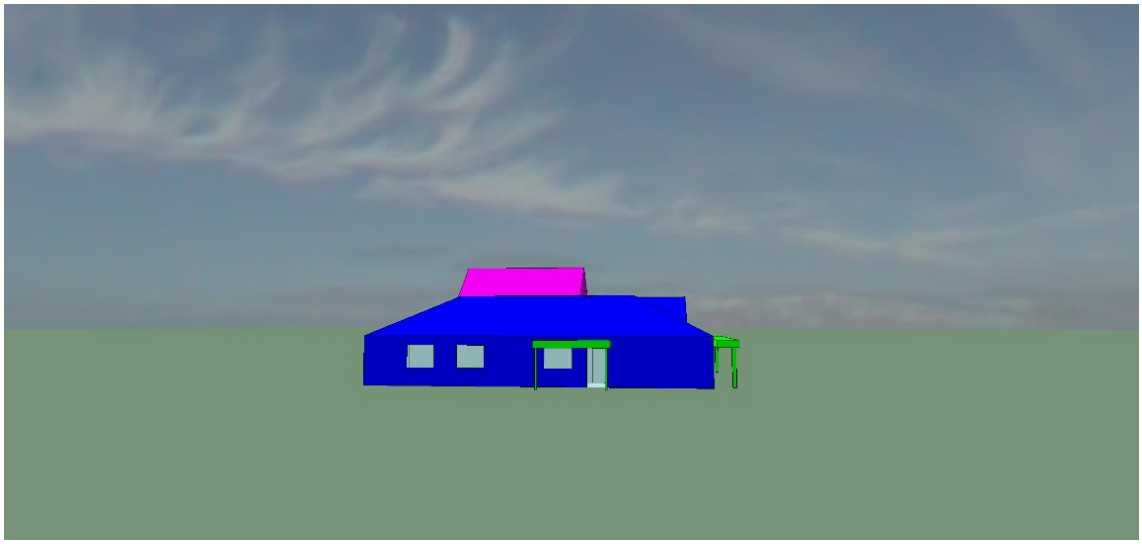
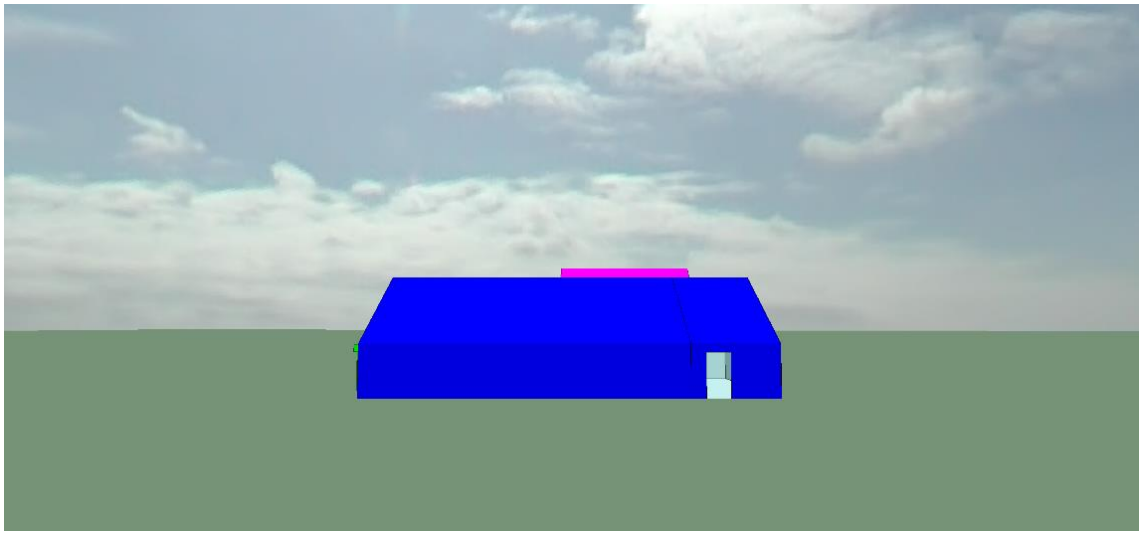


Figure 4. Image Showing South East Elevation View of Thermal Model.

Figure 5: Image showing South West elevation view of thermal model.



3 COMPLIANCE REQUIREMENT

3.1 Introduction to Thermal Comfort and BREEAM UK New Construction (2023)

Under Health and Well-being Section of BREEAM UK New Construction (2023), requirements have been set out for Thermal Comfort (BREEAM Credit Hea 04 Thermal Comfort).

These requirements expect the current thermal comfort criteria as stated in Design Standards such as CIBSE Guide A Environmental Design; or other appropriate industry standard (where this sets a higher or more appropriate requirement/level for the building type) to be met.

CIBSE Technical Memorandum 52 (2013) is the latest guidance from CIBSE on the subject of thermal comfort and sets a higher industry standard for all building types. The criteria of TM52 are based on a more developed academic understanding of overheating than the requirements previously considered, and are much more stringent.

Table 1. Summary of BREEAM Requirements for HEA 04 Thermal Comfort (Source: BREEAM UK New Construction, 2023).

Credit aim

To ensure the building is capable of providing an appropriate level of thermal comfort.

Assessment Criteria

The following is required to demonstrate compliance:

One credit - Thermal modelling

1 Thermal modelling has been carried out using software in accordance with CIBSE AM11 Building Energy and Performance Modelling.

2 The software used to carry out the simulation at the detailed design stage provides full dynamic thermal analysis. For smaller and more basic building designs with less complex heating or cooling systems, an alternative less complex means of analysis may be appropriate (such methodologies must still be in accordance with CIBSE AM11).

3 The modelling demonstrates that:

3.a 1.a For air-conditioned buildings, summer and winter operative temperature ranges in occupied spaces are in accordance with the criteria set out in CIBSE Guide A Environmental Criteria for Design(79), Table 1.5; or other appropriate industry standard (where this sets a higher or more appropriate requirement or level for the building type); or the thermal environment in occupied spaces meet the Category B requirements for PPD, PMV and local discomfort set out in Table A.1 of Annex A of ISO 7730:2005.

3.b For naturally ventilated buildings:

3.b.i 3.b.i Winter operative temperature ranges in occupied spaces are in accordance with the criteria set out in CIBSE Guide A Environmental Criteria for Design, Table 1.5. Or other appropriate industry standard (where this sets a higher or more appropriate requirement or level for the building type).

3.b.ii 3.b.ii The building is designed to limit the risk of overheating, in accordance with the adaptive comfort methodology outlined in either of the following standards as appropriate; CIBSE TM52: The limits of thermal comfort: avoiding overheating in European buildings(80) or CIBSE TM59: Design methodology for the assessment of overheating risk in homes(81).

4	For air-conditioned buildings, the PMV (predicted mean vote) and PPD (predicted percentage of dissatisfied) indices based on the above modelling are reported via the BREEAM assessment scoring and reporting tool.
	One credit – Design for future thermal comfort
5	Criteria 1 to 4 are achieved.
6	The thermal modelling demonstrates that the relevant requirements set out in criterion 3 are achieved for a projected climate change environment.
7	Where criterion 6 above is not met, the project team demonstrates how the building has been adapted, or designed to be easily adapted in the future using passive design solutions in order to subsequently meet the requirements under criterion 6.
8	For air conditioned buildings, the PMV (predicted mean vote) and PPD (predicted percentage of dissatisfied) indices based on the above modelling are reported via the BREEAM assessment and reporting tool.

3.2 Introduction to Thermal Comfort and CIBSE Technical Memorandum 52 (TM52)

The latest guidance from CIBSE on the subject of overheating is CIBSE Technical Memorandum 52 (TM52).

This document recommends a calculation approach which is superior to previous standards. Firstly and most importantly it is based on the CIBSE Design Summer Year (DSY) which simulates a typical “hot” year.

And secondly because it is based on the latest research into the rate at which people adapt to changes in climate. As a result the temperature criteria vary through time, during a cool spell of weather the overheating temperature reduces, whereas in a hotter period when occupants are acclimatised then warmer internal temperatures are permitted.

Within mechanically ventilated and actively cooled rooms, CIBSE TM52 states overheating should be assessed using Predicted Mean Vote (PMV) and Predicted Percentage Dissatisfied (PPD). CIBSE, 2013 suggest designers of category II buildings should aim to remain within limits of “high normal expectation” suggesting an acceptable PMV index of +/-0.5 (or PPD less than or equal to 10%).

The Predicted Mean Vote (PMV) and Predicted Percentage of Dissatisfied (PPD) are both methods of assessing thermal comfort that are based upon the heat transfer that occurs between the environment and the human body. The Predicted Mean Vote (PMV) refers to a thermal scale that runs from Cold (-3) to Hot (+3) based on heat balance principles. Predicted Percentage of Dissatisfied (PPD) predicts the percentage of occupants that will be dissatisfied with the thermal conditions. It is a function of PMV, given that as PMV moves further from 0, or neutral, PPD increases.

The unoccupied rooms such as circulation spaces, store rooms do not have overheating criteria or a suggested maximum temperature as it is envisaged that no one will occupy these rooms for a significant period of time.

4 THERMAL MODEL

4.1 Weather Files

The latest CIBSE weather files have been selected based on the current 2020 CIBSE Design Summer Year dataset. The most current CIBSE Design Summer Year (DSY) Weather File for London was chosen for the simulation (London GTW CIBSE DSY 1 2020's high emissions 50th percentile range weather file) as it represents the closest dataset to the location of this project. The design summer year used represents a typical hot year and is more likely to be reflective of future weather years in the UK. For the purpose of understanding the projected impacts of climate change over the course of the building's lifespan and to satisfy the requirements for the 'Design for Future Thermal Comfort' credit for a projected climate change environment, two further thermal modelling calculations were performed using the London GTW CIBSE DSY 2 2020's high emissions 50th percentile range weather file and the London GTW CIBSE DSY 3 2020's high emissions 50th percentile range weather file.

4.2 Building Fabric Parameters

Please see Table 2 for a summary of the fabric elements used in the thermal model.

Table 2. Summary of fabric elements used in the thermal model.

Fabric Element	U-value (W/m^2.K)	G-value
Roof	0.15W/m^{2}k	-
Wall	0.15W/m^{2}k	-
Floor	0.12W/m^{2}k	-
Glazing	1.20W/m^{2}k	0.73
Personnel Door	1.30W/m^{2}k	-
Vehicle Door	1.30W/m^{2}k	-
Infiltration Rate for overheating calculations = 0.25 air changes per hour based on 5m^3/(h/m^2) @ 50Pa		

4.3 Room Input Data

Please see Table 3 and Table 4 for a summary of room input data used for thermal modelling calculations.

Please note: In all occupied spaces, the heating and cooling set points and equipment sizing have been established through modelling to ensure that both summer and winter operative temperatures are maintained to within the range specified within this report in Table 3 below.

Table 3. Summary of room input data used for thermal modelling calculations.

Environmental Room Type	Gain Type	Details
Office 2 person	Lighting	5W/m^2 and in use '9am-5pm Weekdays'
	Occupancy	2 people @ 75W sensible 55W latent heat gains and in use '9am-5pm Weekdays'
	Equipment	260W and in use '9am-5pm Weekdays'
	Mechanical Ventilation	10l/s/p
	Mechanical Systems	Heated to maintain design temperature of 21 - 23°C Cooled to maintain design temperature of 22 - 25°C

Environmental Room Type	Gain Type	Details
Office Open Plan	Lighting	5W/m^2 and in use '9am-5pm Weekdays'
	Occupancy	12 people @ 75W sensible 55W latent heat gains and in use '9am-5pm Weekdays'
	Equipment	1560W and in use '9am-5pm Weekdays'
	Mechanical Ventilation	10l/s/p
	Mechanical Systems	Heated to maintain design temperature of 21 - 23°C Cooled to maintain design temperature of 22 - 25°C
Environmental Room Type	**Gain Type**	**Details**
Meeting Room	Lighting	5W/m^2 and in use '9am-5pm Weekdays'
	Occupancy	8 people @ 75W sensible 55W latent heat gains and in use '10-11am and 3pm-4pm Daily'
	Equipment	1040W and in use '10-11am and 3pm-4pm Daily'
	Mechanical Ventilation	10l/s/p
	Mechanical Systems	Heated to maintain design temperature of 21 - 23°C Cooled to maintain design temperature of 22 - 25°C
Environmental Room Type	**Gain Type**	**Details**
Staff/Kitchen	Lighting	5W/m^2 and in use '10am-5pm Daily'
	Occupancy	12 people @ 75W sensible 55W latent heat gains and in use @ 25% occupancy rate from '10am-12pm Daily'; @ 100% occupancy rate from '12pm-2pm Daily'; @ 17% occupancy rate from '2pm-5pm Daily'
	Equipment	-
	Mechanical Ventilation	10l/s/p
	Mechanical Systems	Heated to maintain design temperature of 21 - 23°C Cooled to maintain design temperature of 22 - 25°C
Environmental Room Type	**Gain Type**	**Details**
Tills/Information	Lighting	5W/m^2 and in use '9am-6pm Daily'
	Occupancy	3 people @ 75W sensible 55W latent heat gains and in use '9am-6pm Daily'
	Equipment	390W and in use '9am-6pm Daily'
	Mechanical Ventilation	10l/s/p

	Natural Ventilation	Openable windows
	Mechanical Systems	Heated to maintain design temperature of 21 - 23°C
Environmental Room Type	**Gain Type**	**Details**
IT Room	Lighting	-
	Occupancy	-
	Equipment	3000W in use '24/7 Daily'
	Mechanical Ventilation	-
	Mechanical Systems	Heated to maintain design temperature of 21°C

The Gift Shop and Tills/Information area will use natural ventilation via openable windows to limit the amount of overheating during summertime. Please see Table 4 for a summary of the assigned window equivalent opening area within the Gift Shop and Tills/Information area.

Table 4. Assigned window equivalent opening area (m^2) within the Gift Shop and Tills/Information area.

Description	**Equivalent Opening Area per window (m^2)**	**Profile**
3 x Window (1482mm x 1182mm) in Gift Shop and Tills/Information area	1.25	WHENEVER internal room temperature is greater than 22°C AND external temperature is greater than 10°C and less than internal room temperature AND during opening hours only
2 x Window (948mm x 1182mm) in Gift Shop and Tills/Information area	0.78	WHENEVER internal room temperature is greater than 22°C AND external temperature is greater than 10°C and less than internal room temperature AND during opening hours only

Please see Table 5 for a summary of the assigned simulation heating and cooling unit capacity (kW) within the IES thermal model. Please note these heating and cooling capacity limits have been used within the thermal model for all simulations for both current and future weather files.

Table 5: Summary of simulation heating unit capacity (kW) and simulation cooling unit capacity (kW) assigned within the thermal model to each room.

Space	**Simulation heating unit capacity (kW)**	**Simulation cooling unit capacity (kW)**
Office 2 person	0.70	1.60
Office open plan	1.90	7.40
Meeting room	0.60	3.20
Staff Kitchen	1.90	6.00
Tills/Information	7.70	-
IT Room	0.20	4.10

4.4 Room Occupancy Comfort Parameters

The PPD and PMV results below were calculated based on a minimum possible clothing level of 0.6 and a maximum clothing level of 1.25. The metabolic rate assumed was 1.2 which is a typical value for an office type of environment. A clothing level of 0.6 is likely to be as heavily clothed as an occupant will dress in warmer conditions. A clothing level of 1.10 - 1.25 is representative of an occupant potentially wearing trousers, a long sleeved top and a sweater in varying thickness as would be likely during colder months.

The model has been run for a full year using both clothing level scenarios and at each time step the more favourable metric is reported upon. This essentially mimics an occupant swapping clothing levels appropriately depending on conditions as is likely to be the case.

Please see Table 6 for a summary of the occupancy comfort parameters used for thermal modelling calculations.

Table 6. Summary of the Occupancy Comfort Parameters Used for Thermal Modelling Calculations

Room Type	Activity Level (Mets)	Winter Clothing Level (Clo)	Summer Clothing Level (Clo)
Office 2 person	1.2	0.60	1.10
Office open plan	1.2	0.60	1.10
Meeting room	1.2	0.60	1.25
Staff Kitchen	1.2	0.60	1.25
Tills/Information	1.2	0.60	1.15

5 RESULTS AND CONCLUSIONS

5.1 Results for PMV (predicted mean vote) and PPD (predicted percentage of dissatisfied) indices

Modelling has been undertaken to establish the predicted mean vote (PMV) and the Predicted Percentage of Dissatisfied (PPD) indices for each occupied space and the results reported in Tables 7-9 below. This demonstrates compliance with BREEAM (2023) Credit Hea04 criteria as the number of hours outside of the recommended range is under 3% of the total occupied hours and therefore meet CIBSE Guide A standards.

Table 7. Results showing the PMV/PPD indices for the occupied spaces within the proposed Birdworld Entrance Building using the London GTW CIBSE DSY 1 2020's high emissions 50th percentile range weather file.

Space name	% occupied hours meeting PMV/PPD	PMV occupied hours min / max	PPD occupied hours min / max
Office 2 person	100	-0.40 / 0.40	5.38 / 8.32
Office open plan	100	-0.40 / 0.40	5.31 / 8.32
Meeting room	100	-0.21 / 0.15	5.00 / 5.87
Staff Kitchen	100	-0.48 / 0.48	5.00 / 9.79
Tills/Information	99	-0.43 / 1.15	5.00 / 32.92

Table 8. Results showing the PMV/PPD indices for the occupied spaces within the proposed Birdworld Entrance Building for a projected climate change environment using the London GTW CIBSE DSY 2 2020's high emissions 50th percentile range weather file.

Space name	% occupied hours meeting PMV/PPD	PMV occupied hours min / max	PPD occupied hours min / max
Office 2 person	100	-0.40 / 0.40	5.38 / 8.33
Office open plan	100	-0.40 / 0.40	5.32 / 8.31
Meeting room	100	-0.19 / 0.13	5.00 / 5.78
Staff Kitchen	100	-0.48 / 0.48	5.00 / 9.79
Tills/Information	97	-0.43 / 1.63	5.00 / 57.75

Table 9. Results showing the PMV/PPD indices for the occupied spaces within the proposed Birdworld Entrance Building for a projected climate change environment using the London GTW CIBSE DSY 3 2020's high emissions 50th percentile range weather file.

Space name	% occupied hours meeting PMV/PPD	PMV occupied hours min / max	PPD occupied hours min / max
Office 2 person	100	-0.40 / 0.40	5.17 / 8.35
Office open plan	100	-0.40 / 0.40	5.31 / 8.32
Meeting room	100	-0.22 / 0.15	5.00 / 6.01
Staff Kitchen	100	-0.48 / 0.48	5.00 / 9.79
Tills/Information	97	-0.43 / 1.59	5.00 / 55.94

6 LIMITATIONS OF THIS REPORT

This analysis has been performed using IES software which provides full dynamic thermal analysis and is a CIBSE certified Level 5 approved Dynamic Simulation Modelling Software. This analysis has been carried out in accordance with user instructions set out in IES manuals and CIBSE AM11 Building Energy and Environmental Modelling. The building thermal model estimates the buildings environmental conditions and the calculation results are based on the modelling inputs and parameters as detailed herein this report. The most current CIBSE Design Summer Year (DSY) Weather File for London was chosen for the simulation (London GTW CIBSE DSY 1 2020's high emissions 50th percentile range weather file), in accordance with CIBSE Guide A Environmental Criteria for Design guidelines. To satisfy the requirements for the 'Design for Future Thermal Comfort' credit for a projected climate change environment, two further thermal comfort simulations were performed using the London GTW CIBSE DSY 2 2020's high emissions 50th percentile range weather file and the London GTW CIBSE DSY 3 2020's high emissions 50th percentile range weather file.

Fundamentally it is important to consider that computer modelling cannot truly measure whether an individual will be "comfortable". As we are all individuals, by default it is difficult to predict how one individual will react to internal environmental conditions. Gender, age, health, mental state and familiarity with the space all affect the perception of comfort.

The parameters used in this calculation are provided within this report and are deemed to be approved by the Client unless advised to the contrary. Please note changes to the modelling inputs and parameters may affect the modelling results. Although every effort has been made to simulate the building with anticipated heat gain values and occupancy profiles, the 'real' building may have differing operations and heat gain patterns with external weather conditions not normal to the historical data provided by the standard CIBSE weather files. It therefore should be noted that there is no guarantee that the thermal comfort assessment will match the occupied building.

7 SUMMARY

When compared against the standards of CIBSE Guide A Environmental Criteria for Design, based on the details modelled in this report, occupied spaces achieve appropriate thermal comfort levels. This demonstrates compliance with CIBSE Guide A Environmental Criteria for Design standards. Therefore, the following BREEAM credits are obtainable under BREEAM UK New Construction 2023 Hea04 Thermal Comfort:

Thermal Comfort

When simulated using the current weather file:

- Thermal modelling and analysis have been carried out using software in accordance with CIBSE AM11 Building Energy and Environmental Modelling.
- Modelling of the air conditioned/mechanically ventilated building demonstrates that during occupied hours the temperature range meets CIBSE Guide A Environmental Design criteria.
- As all occupied spaces are air conditioned/mechanically ventilated, the Predicted Mean Vote (PMV) and Predicted Percentage of Dissatisfied (PPD) indices have been reported.

Design for future thermal comfort – for a projected climate change environment

When simulated using the London GTW CIBSE DSY 2 2020's high emissions 50th percentile range weather file and the London GTW CIBSE DSY 3 2020's high emissions 50th percentile range weather file:

- Thermal modelling demonstrates compliance with CIBSE AM11 Building Energy and Environmental Modelling criteria.
- Modelling of the air conditioned/mechanically ventilated building demonstrates that during occupied hours the temperature range meets CIBSE Guide A Environmental Design criteria.
- As all occupied spaces are air conditioned/mechanically ventilated, the Predicted Mean Vote (PMV) and Predicted Percentage of Dissatisfied (PPD) indices have been reported.

The results highlight that for both PMV and PPD indices under the London GTW CIBSE DSY 1, DSY 2 and DSY3 2020's high emissions 50th percentile range weather scenarios the occupied spaces meet the criteria as per above. Therefore, this report recommends that both credits are awarded.

8 REFERENCES

BRE, (2023), BREEAM Technical Manual SD5079 Version 6.1.0 BREEAM UK New Construction. London, BRE Global.

CIBSE, (1998), Building Energy and Environmental Modelling Applications Manual AM11. London, CIBSE.

CIBSE, (2021), CIBSE Guide A: Environmental Criteria for Design. London, CIBSE.