



**Building Services
Consulting Engineers**

**PROPOSED RESIDENTIAL
DEVELOPMENT**

AT

**ARTHUR HILL POOL
225 KING'S ROAD
READING**

FOR

READING BOROUGH COUNCIL

**THERMAL COMFORT AND
ENERGY DEMAND ASSESSMENT**

DOCUMENT REVISION RECORD

ORIGINAL DOCUMENT

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ISSUE RECORD

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Executive Summary

The proposed multi-residential development will be located at Arthur Hill in Reading. There will be 15 units in total comprising, 12 one-bedroom units and 3 two-bedroom units. The proposed development has been designed to have extremely low energy consumption similar to that to be expected from a PassivHaus building.

The results for the predicted energy demand for the proposed development have been included in this report and show that the proposed multi-residential development meet the PassivHaus standards for Primary Energy Demand and Space Heating Demand.

Overheating analysis has been carried out on behalf of Reading Borough Council to show that the proposed multi-residential development meets the thermal comfort criteria as set out in CIBSE TM59 for residential spaces. Based on the modelling conducted, the results show that the thermal comfort criteria as set out by CIBSE TM59 for residential spaces has been satisfied.

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 in Section 3. Section 3 includes fabric u-values, internal heat gains, occupancy patterns, air permeability rate, ventilation strategy and window openings used for the thermal model. The equivalent free area for each window type has been included in this report. The Architect shall ensure that these minimum equivalent free areas for each window type are achieved to provide the air flow for thermal comfort.

The energy demand of the proposed development will be minimised through careful design of built form and the careful selection of services to meet operational requirements and ensure an energy-efficient solution. The proposed design will utilise a NIBE F470 heat pump system which will provide heating, hot water, mechanical ventilation with heat recovery and night time cooling. The proposed design incorporates external solar shading and natural ventilation via openable windows and doors as part of the overheating prevention strategy for summertime.

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 most current CIBSE Design Summer Year (DSY) Weather File for Swindon was chosen for the simulation (Swindon CIBSE DSY 1 2020's high emissions 50th percentile range weather file), in accordance with the CIBSE TM59:2017 "Design methodology for the assessment of overheating risk in homes" guidelines.

The building occupancy profiles & parameters published in CIBSE guide TM59:2017 "Design methodology for the assessment of overheating risk in homes" has been used as guidance. Within the apartments, thermal comfort has been assessed against the criteria identified within CIBSE TM59:2017.

It should be noted that as occupancy and building use is based on set parameters outlined in TM59 there is no guarantee the temperatures estimated will match the actual building temperatures as 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.

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1.0 Scenario

The proposed multi-residential development will have 15 units in total comprising, 12 one-bedroom units and 3 two-bedroom units.

The proposed development has been designed to have extremely low energy consumption similar to that to be expected from a PassivHaus building. The results for the predicted energy demand for the proposed multi-residential development have been included in this report to show that the proposed design meets the PassivHaus standards for Primary Energy Demand and Space Heating Demand.

Overheating analysis has been carried out on behalf of Reading Borough Council to show that the proposed multi-residential development meets the thermal comfort criteria as set out in CIBSE TM59 for residential spaces.

The energy demand of the proposed development will be minimised through careful design of built form and the careful selection of services to meet operational requirements and ensure an energy-efficient solution. The proposed design will utilise a NIBE F470 heat pump system which will provide heating, hot water, mechanical ventilation with heat recovery and night time cooling. The proposed design incorporates external solar shading and natural ventilation via openable windows and doors as part of the overheating prevention strategy for summertime.

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. This analysis has been undertaken using the thermal simulation program ApacheSIM Dynamic Simulation and Macroflo (IESVE, 2020) to predict the buildings environmental performance. Solar Penetration Analysis was performed using Suncast (IESVE, 2020).

The most current CIBSE Design Summer Year (DSY) Weather File for Swindon was chosen for the simulation (Swindon CIBSE DSY 1 2020's high emissions 50th percentile range weather file), in accordance with the CIBSE TM59:2017 "Design methodology for the assessment of overheating risk in homes" guidelines.

The parameters used in this calculation are provided within this report in Section 3 and are deemed to be approved by the Reading Borough Council unless advised to the contrary. The building occupancy profiles & parameters published in CIBSE guide TM59:2017 "Design methodology for the assessment of overheating risk in homes" has been used as guidance. Within the apartments, thermal comfort has been assessed against the criteria identified within CIBSE TM59:2017. Please note individual room heating set-points have been set-up in accordance with the recommended temperature ranges set out in CIBSE Guide A Environmental design, Table 1.5.

It should be noted that as occupancy and building use is based on set parameters outlined in TM59 there is no guarantee the temperatures estimated will match the actual building temperatures as 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.

Please see Figures 1 - 5 below for images from the thermal model.

Figure 1: Image showing plan view of thermal model.

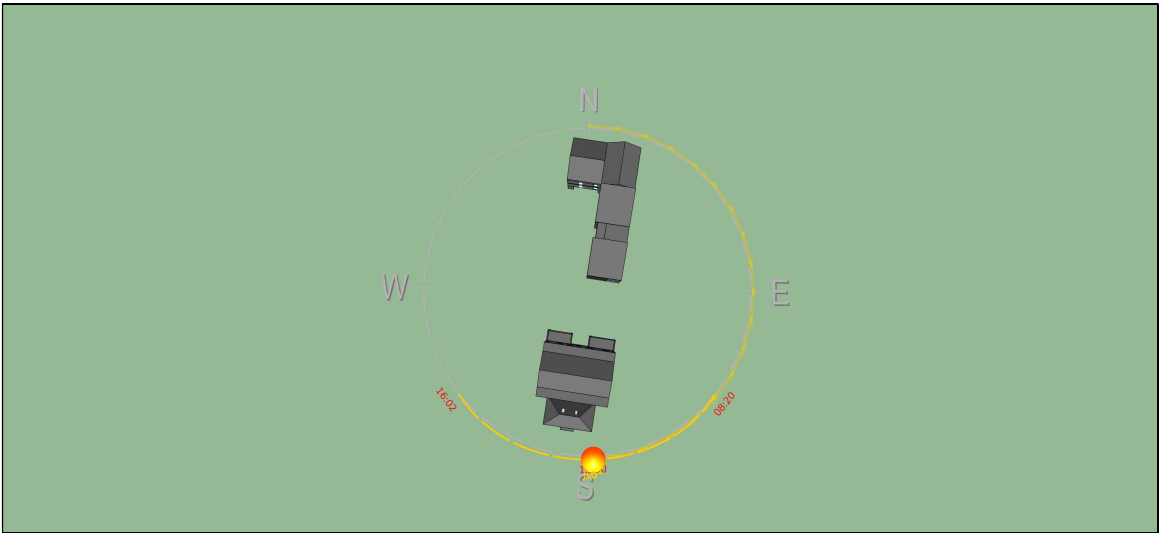


Figure 2: Image showing North elevation view of thermal model.

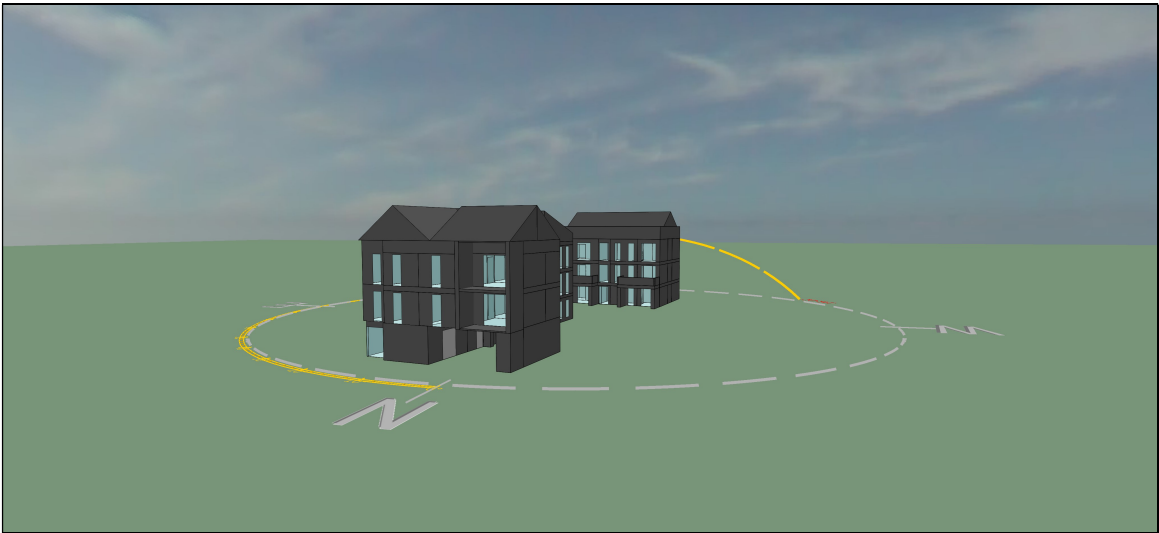


Figure 3: Image showing South elevation view of thermal model.

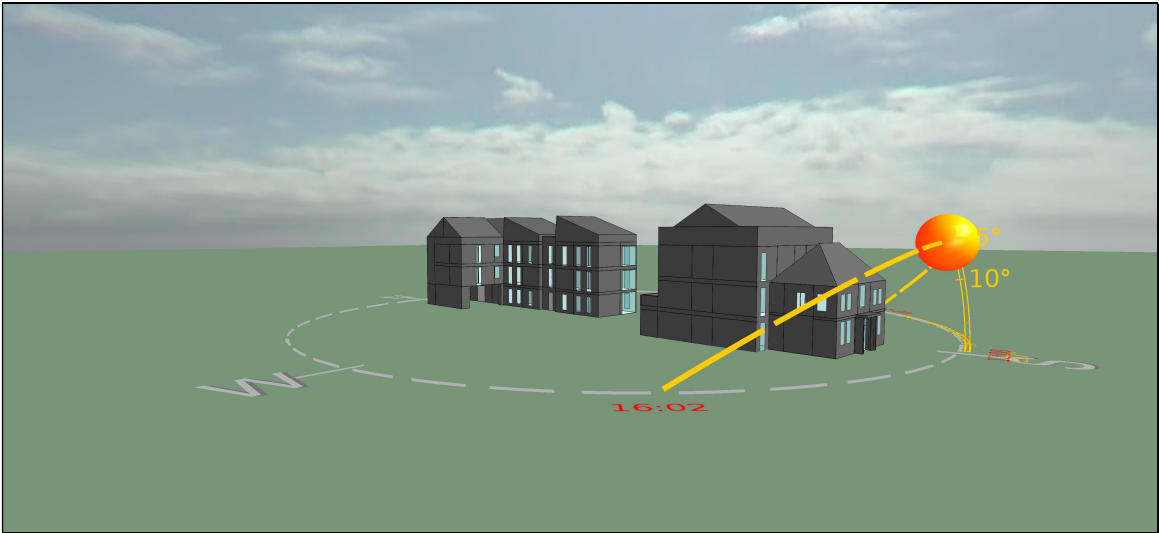


Figure 4: Image showing East elevation view of thermal model.

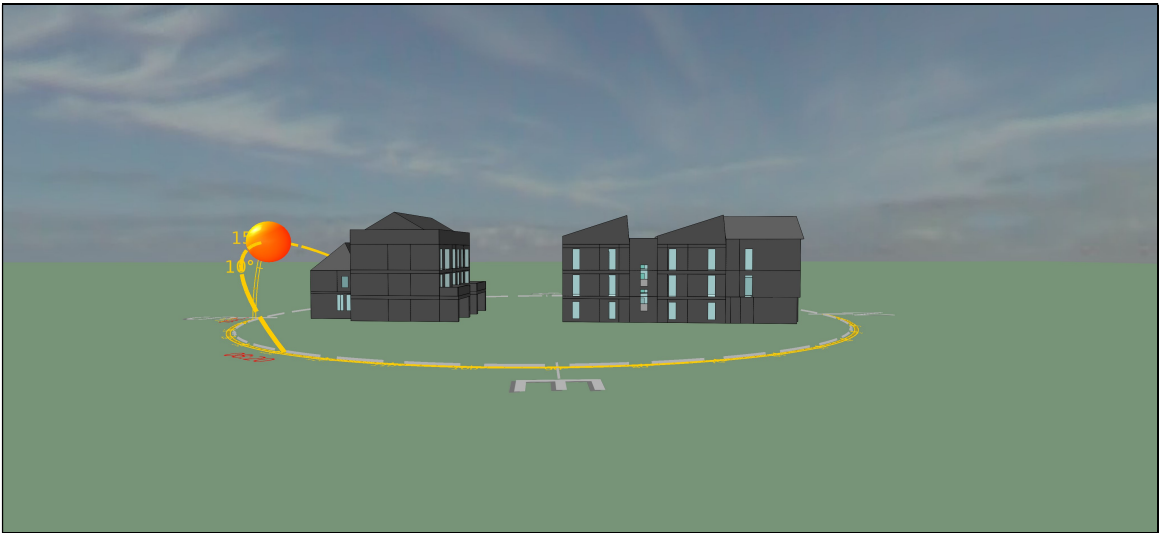
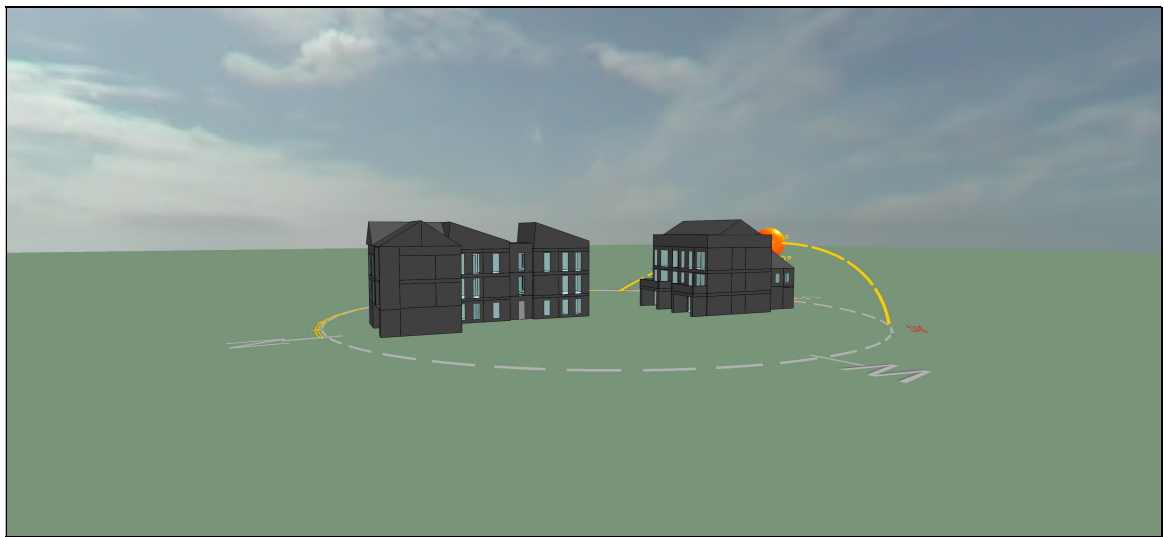


Figure 5: Image showing West elevation view of thermal model.



2.0 Compliance Requirement

Within the apartments, thermal comfort has been assessed against the criteria identified within CIBSE TM59:2017 'Design methodology for the assessment of overheating risk in homes'.

Method – CIBSE TM59:2017

Because the apartments within the proposed multi-residential development will be mainly naturally ventilated during summertime via openable windows and doors, Section 4.2 of CIBSE TM59:2017 applies, which requires both of the following two criteria to be met for domestic properties:

Criteria 1 - Hours of Exceedance (He) for Living Rooms, Kitchens and Bedrooms:

The number of hours, during which the temperature difference (between indoor and outdoor) is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3% of occupied hours (TM52 Criterion 1: Hours of exceedance).

Criteria 2 – For Bedrooms Only:

To guarantee comfort during the sleeping hours the operative temperature in the bedroom from 10pm to 7am shall not exceed 26°C for more than 1% of annual hours. (Note: 1% of the annual hours between 22:00 and 07:00 for bedrooms equates to 32 hours, so 33 or more hours above 26°C will be recorded as a fail).

Criteria's 2 and 3 of CIBSE TM52:2013 may fail to be met, but both the above criteria must be met for apartment bedrooms and apartment living and kitchen areas to pass the overheating check.

The unoccupied rooms, such as bathrooms, 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.

3.0 Thermal Model

Please note, this thermal modelling is based on the current design information / building plans available for the planning stage of the project. Specifications have been taken from current information provided by Reading Borough Council.

3.1 Weather Files

The most current CIBSE Design Summer Year (DSY) Weather File for Swindon was chosen for the simulation (Swindon CIBSE DSY 1 2020's high emissions 50th percentile range weather file). Figure 6 and Figure 7 below illustrates the summertime temperature range (May – September) for dry bulb and wet bulb temperature for Swindon from the weather file.

Figure 6: Graph showing summertime temperature range (May – September) for dry bulb temperature for Swindon CIBSE DSY 1 2020's high emissions 50th percentile range weather file.

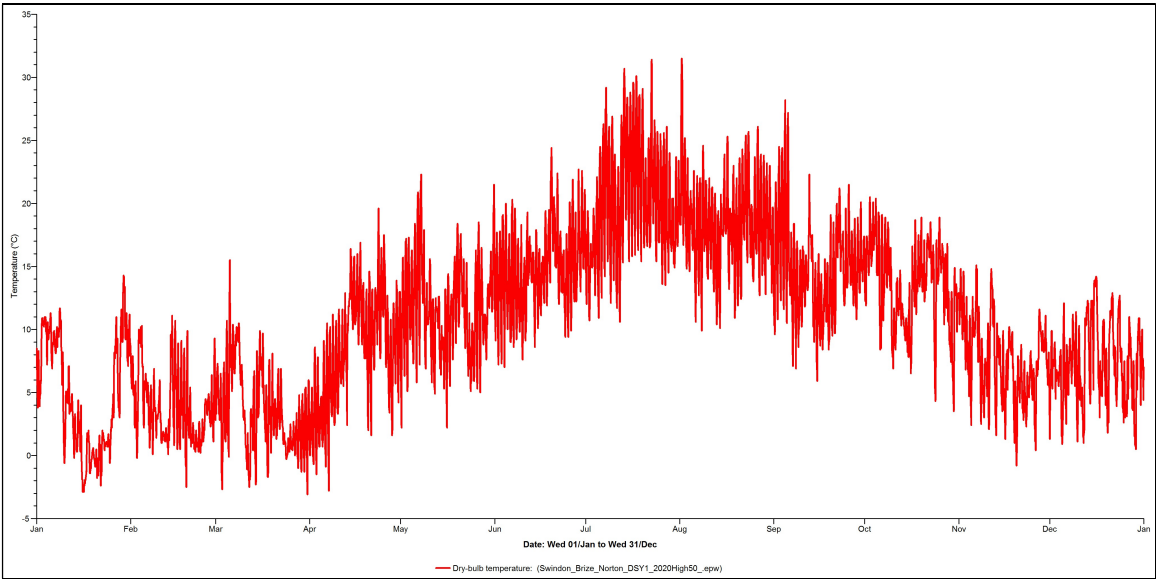


Figure 7: Graph showing summertime temperature range (May – September) for wet bulb temperature for Swindon CIBSE DSY 1 2020's high emissions 50th percentile range weather file.

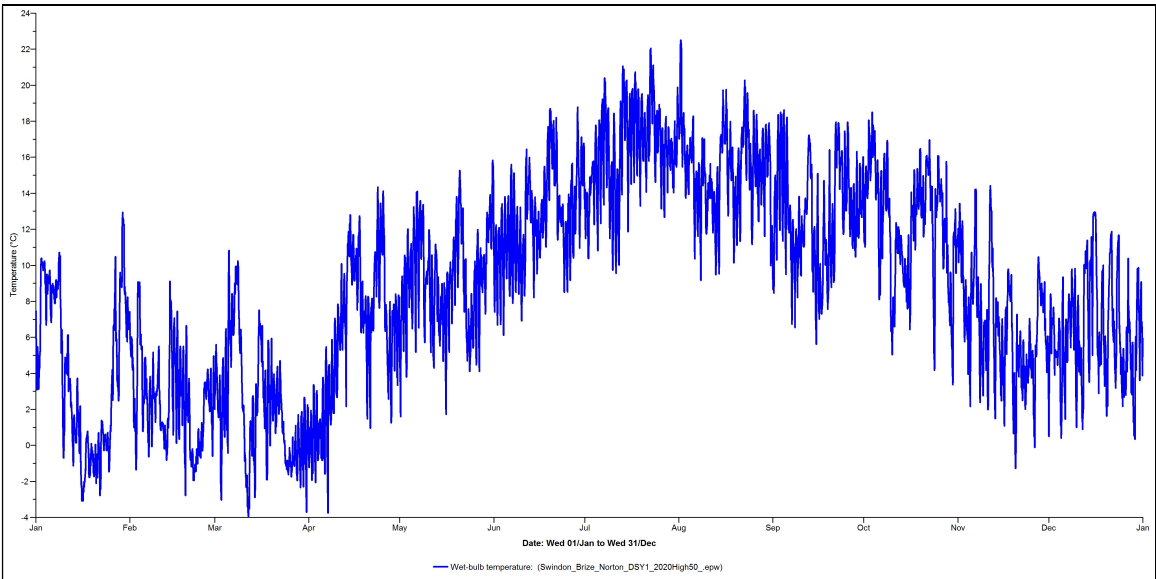


Table 1 below illustrates the maximum dry bulb and wet bulb temperatures for Swindon from the weather file.

Table 1: Summary of maximum dry bulb and wet bulb temperature for Swindon CIBSE DSY 1 2020's high emissions 50th percentile range weather file.

Weather File	Max. Dry Bulb Temperature	Max. Wet Bulb Temperature
Swindon_DSY1_2020High50	31.50	22.52

3.2 Building Layouts

The below drawings, schedules and specifications have been used to generate the thermal model as issued by the Architect.

- 260035cv_03 Survey of Existing Block D
- 8129_SK101_Proposed Site Plan
- 8129_SK104_Proposed Floor Plans Block A and B Ground and First
- 8129_SK105_Proposed Floor Plans Block A and B Second and Roof
- 8129_SK106_Proposed Floor Plans Block C and D Ground and First
- 8129_SK107_Proposed Floor Plans Block C and D Second and Roof
- 8129_SK109_Proposed Elevations Block A and B North and South
- 8129_SK110_Proposed Elevations Block A and B East and West
- 8129_SK111_Proposed Elevations Block C and D North and South
- 8129_SK113_Proposed Section AA and BB
- 8129_SK22_Proposed Section A-A and B-B
- 8129_SK23_Proposed Section C-C
- 8129_SK24_Proposed Section D-D and E-E

3.3 Building Fabric Parameters

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

Please note the building fabric elements for the new building Blocks A, B and C meet the minimum requirements for PassivHaus standards.

Table 2: Summary of building air permeability and building fabric elements used in the thermal model.

Fabric Element	U-value (W/m ² .K)	G-value
Block ABC External Wall	0.15	-
Block ABC Roof	0.15	-
Block ABC Ground Floor	0.15	-
Block ABC Windows Triple Glazed	0.80	0.30
Block ABC Doors	0.80	-
Block D External Wall	0.23	-
Block D Roof	0.18	-
Block D Ground Floor – Uninsulated concrete slab	1.62	-
Block D Windows	1.60	0.40
Block D Rooflights	2.30	0.55
Block ABC New Build - Building Air Permeability @ 50PA		
2.0 (m ³ /(h.m ²))		
Block D Existing Building - Building Air Permeability @ 50PA		
10.0 (m ³ /(h.m ²))		

3.4 Room Input Data

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

The building occupancy profiles & parameters published in CIBSE guide TM59:2017 “Design methodology for the assessment of overheating risk in homes” has been used as guidance.

Please note individual room heating set-points have been set-up in accordance with the recommended temperature ranges set out in CIBSE ‘Guide A’ Environmental design, Table 1.5.

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

Environmental Room Type	Gain Type	Details
Dwelling Hall	Lighting	2 W/m ² Sensible Heat Gain with a 0.45 Radiant fraction has been applied with the hours of operation assumed to be ‘on continuously’ as it is an internal room
	Occupancy	Transient Space - No Constant Occupation
	Equipment	N/a
	Ventilation	N/a (Internal Room)
	Mechanical Systems	NIBE F470 heat pump system Heat recovery efficiency assumed to be at least 0.70 as per SAP guidelines [https://www.ncm-pcdb.org.uk/sap/pcbdbdetails.jsp?pid=34&id=500258&type=323&mid=020031]
Dwelling 1 Bed Kitchen	Lighting	2 W/m ² Sensible Heat Gain with a 0.45 Radiant fraction has been applied with the hours of operation assumed to be between 1800-2300, this assumes good day light is available in the summer months where overheating is assessed. (CIBSE TM59, 2017, Table 2)
	Occupancy	1 occupant, each generating 75W sensible, 55W latent heat gain with a constant occupancy profile of 25% between 0900 to 2200 (CIBSE TM59, 2017, Table 2)
	Equipment	Peak Sensible Gain of 300W between 1800 to 2000, with a 50W Sensible Gain between 2000 to 1800 (CIBSE TM59, 2017, Table 2)
	Ventilation	Mechanical Extract Ventilation in accordance with Part F and Natural Ventilation via Openable Window
	Mechanical Systems	NIBE F470 heat pump system which will provide heating, hot water, mechanical ventilation with heat recovery and night time cooling Heat recovery efficiency assumed to be at least 0.70 as per SAP guidelines [https://www.ncm-pcdb.org.uk/sap/pcbdbdetails.jsp?pid=34&id=500258&type=323&mid=020031]

Dwelling 2 Bed Kitchen	Lighting	2 W/m ² Sensible Heat Gain with a 0.45 Radiant fraction has been applied with the hours of operation assumed to be between 1800-2300, this assumes good day light is available in the summer months where overheating is assessed. (CIBSE TM59, 2017, Table 2)
	Occupancy	2 occupants, each generating 75W sensible, 55W latent heat gain with a constant occupancy profile of 25% between 0900 to 2200 (CIBSE TM59, 2017, Table 2)
	Equipment	Peak Sensible Gain of 300W between 1800 to 2000, with a 50W Sensible Gain between 2000 to 1800 (CIBSE TM59, 2017, Table 2)
	Ventilation	Mechanical Extract Ventilation in accordance with Part F and Natural Ventilation via Openable Window
	Mechanical Systems	NIBE F470 heat pump system which will provide heating, hot water, mechanical ventilation with heat recovery and night time cooling Heat recovery efficiency assumed to be at least 0.70 as per SAP guidelines [https://www.ncm-pcdb.org.uk/sap/pcdbdetails.jsp?pid=34&id=500258&type=323&mid=020031]
Dwelling Double Bedroom	Lighting	2 W/m ² Sensible Heat Gain with a 0.45 Radiant fraction has been applied with the hours of operation assumed to be between 1800-2300, this assumes good day light is available in the summer months where overheating is assessed. (CIBSE TM59, 2017, Table 2)
	Occupancy	2 occupant, each generating 75W sensible, 55W latent heat gain with a modulating occupancy profile of 100% between 0800 to 0900 & 2200 to 2300 70% between 2300 to 0800, 50% between 0900 to 2200 (CIBSE TM59, 2017, Table 2). An allowance of 30% reduced gains is allowed during sleep.
	Equipment	Peak Sensible Gain of 80W between 0800 to 2300, with a 10W Sensible Gain between 2300 to 0800 (CIBSE TM59, 2017, Table 2)
	Ventilation	Mechanical Extract Ventilation in accordance with Part F and Natural Ventilation via Openable Windows/Doors
	Mechanical Systems	NIBE F470 heat pump system which will provide heating, hot water, mechanical ventilation with heat recovery and night time cooling Heat recovery efficiency assumed to be at least 0.70 as per SAP guidelines [https://www.ncm-pcdb.org.uk/sap/pcdbdetails.jsp?pid=34&id=500258&type=323&mid=020031]

Dwelling Single Bedroom	Lighting	2 W/m ² Sensible Heat Gain with a 0.45 Radiant fraction has been applied with the hours of operation assumed to be between 1800-2300, this assumes good day light is available in the summer months where overheating is assessed. (CIBSE TM59, 2017, Table 2)
	Occupancy	1 occupant, each generating 75W sensible, 55W latent heat gain with a modulating occupancy profile of 100% between 0800 to 2300 and 70% between 2300 to 0800 (CIBSE TM59, 2017, Table 2). An allowance of 30% reduced gains is allowed during sleep.
	Equipment	Peak Sensible Gain of 80W between 0800 to 2300, with a 10W Sensible Gain between 2300 to 0800 (CIBSE TM59, 2017, Table 2)
	Ventilation	Mechanical Extract Ventilation in accordance with Part F and Natural Ventilation via Openable Windows/Doors
	Mechanical Systems	NIBE F470 heat pump system which will provide heating, hot water, mechanical ventilation with heat recovery and night time cooling Heat recovery efficiency assumed to be at least 0.70 as per SAP guidelines [https://www.ncm-pcdb.org.uk/sap/pcdbdetails.jsp?pid=34&id=500258&type=323&mid=020031]
Dwelling 1 Bed Lounge	Lighting	2 W/m ² Sensible Heat Gain with a 0.45 Radiant fraction has been applied with the hours of operation assumed to be between 1800-2300, this assumes good day light is available in the summer months where overheating is assessed. (CIBSE TM59, 2017, Table 2)
	Occupancy	1 occupant, each generating 75W sensible, 55W latent heat gain with a constant occupancy profile of 75% between 0900 to 2200 (CIBSE TM59, 2017, Table 2)
	Equipment	Peak Sensible Gain of 150W between 1800 to 2300, a 60W Sensible Gain between 2200 to 2400 & a base sensible gain of 35W for the rest of the day (CIBSE TM59, 2017, Table 2)
	Ventilation	Mechanical Extract Ventilation in accordance with Part F and Natural Ventilation via Openable Windows/Doors
	Mechanical Systems	NIBE F470 heat pump system which will provide heating, hot water, mechanical ventilation with heat recovery and night time cooling Heat recovery efficiency assumed to be at least 0.70 as per SAP guidelines [https://www.ncm-pcdb.org.uk/sap/pcdbdetails.jsp?pid=34&id=500258&type=323&mid=020031]

Dwelling 2 Bed Lounge	Lighting	2 W/m ² Sensible Heat Gain with a 0.45 Radiant fraction has been applied with the hours of operation assumed to be between 1800-2300, this assumes good day light is available in the summer months where overheating is assessed. (CIBSE TM59, 2017, Table 2)
	Occupancy	2 occupant, each generating 75W sensible, 55W latent heat gain with a constant occupancy profile of 75% between 0900 to 2200 (CIBSE TM59, 2017, Table 2)
	Equipment	Peak Sensible Gain of 150W between 1800 to 2300, a 60W Sensible Gain between 2200 to 2400 & a base sensible gain of 35W for the rest of the day (CIBSE TM59, 2017, Table 2)
	Ventilation	Mechanical Extract Ventilation in accordance with Part F and Natural Ventilation via Openable Windows/Doors
	Mechanical Systems	NIBE F470 heat pump system which will provide heating, hot water, mechanical ventilation with heat recovery and night time cooling Heat recovery efficiency assumed to be at least 0.70 as per SAP guidelines [https://www.ncm-pcdb.org.uk/sap/pcdbdetails.jsp?pid=34&id=500258&type=323&mid=020031]
Dwelling Bathroom	Lighting	2 W/m ² Sensible Heat Gain with a 0.45 Radiant fraction has been applied with a modulating lighting profile of 100% between 0700 to 1000, 20% between 1900 to 2300
	Occupancy	Transient Space - No Constant Occupation
	Equipment	N/a
	Ventilation	Mechanical Extract Ventilation in accordance with Part F and Natural Ventilation via Openable Window
	Mechanical Systems	NIBE F470 heat pump system which will provide heating, hot water, mechanical ventilation with heat recovery and night time cooling Heat recovery efficiency assumed to be at least 0.70 as per SAP guidelines [https://www.ncm-pcdb.org.uk/sap/pcdbdetails.jsp?pid=34&id=500258&type=323&mid=020031]
Communal Entrance Lobby and Stairs	Lighting	8 W/m ² Sensible Heat Gain with a 0.45 Radiant fraction has been applied on a continuous (24/7) profile.
	Occupancy	Transient Space - No Constant Occupation
	Equipment	N/a
	Ventilation	N/a
	Mechanical Systems	N/a

3.5 Window Openings

Please see Table 4 for a summary of window openings used for thermal modelling calculations.

Please note this is the opening area required for air to pass through and the window frames, sills or reveals have not been considered.

Table 4: Summary of window openings and profiles used for thermal modelling calculations.

Window Opening Type	Location Description	Equivalent Orifice Area (m ²)	Opening Profile
1	Living Room Window	0.75m ²	Fully open between 9am – 11pm once internal air temperature exceeds 22°C. Open to 20% (Night Latch) between 11pm -8am once internal air temperature exceeds 22°C
2	Living Room Doors	1.88m ²	Fully open between 9am – 11pm once internal air temperature exceeds 22°C
3	Kitchen Window	0.67m ²	Fully open between 9am – 11pm once internal air temperature exceeds 22°C. Open to 20% (Night Latch) between 11pm -8am once internal air temperature exceeds 22°C
4	Bedroom Window	0.58m ²	Fully open between 9am – 11pm once internal air temperature exceeds 22°C. Open to 35% (Night Latch) between 11pm -8am once internal air temperature exceeds 22°C
5	Bedroom Doors	2.58m ²	Fully open between 9am – 11pm once internal air temperature exceeds 22°C
6	Stairwell Window	0.19m ²	Open whenever internal air temperature exceeds 22°C
7	Stairwell Window Block C	0.31m ²	Open whenever internal air temperature exceeds 22°C

4.0 Results and Conclusions for Thermal Comfort

4.1 Results for CIBSE TM59 - Bedrooms

As detailed within section 2 of this report, for the bedrooms to achieve compliance with CIBSE TM59:2017, each bedroom must achieve compliance with both:

- Criteria 1 of CIBSE TM52:2013 which states the external to internal temperature difference must not exceed 1K for more than 3% of the year between May to September, i.e. values < 3 = pass

and

- CIBSE TM59:2017 which states the bedrooms operative temperature must not exceed 26°C for more than 33 hours per year between the hours of 10pm until 7am daily, i.e. values ≤ 33 = pass.

Table 5 below shows the predicted thermal comfort results against the TM59 criteria for each bedroom within the proposed multi-residential development.

Table 5: Results showing performance against the TM59 criteria for each bedroom within the proposed multi-residential development using the Swindon CIBSE DSY 1 2020's high emissions 50th percentile range weather file.

Room Name	TM59 Analysis		
	Criteria 1: Hours of exceedance (He)	Criteria 2: Operative Temperature Hours >26°C between 10pm to 7am daily	Pass/Fail
BLOCK B PLOT 1 BEDROOM	0	21	PASS
BLOCK B PLOT 2 BEDROOM	0.8	24	PASS
BLOCK B PLOT 3 BEDROOM	0.1	17	PASS
BLOCK B PLOT 4 BEDROOM	0.8	20	PASS
BLOCK A PLOT 5 BEDROOM 1	0	14	PASS
BLOCK A PLOT 5 BEDROOM 2	0	13	PASS
BLOCK C PLOT 2 BEDROOM	0	17	PASS
BLOCK C PLOT 3 BEDROOM	0	16	PASS
BLOCK C PLOT 4 BEDROOM	0	24	PASS
BLOCK C PLOT 5 BEDROOM	0	18	PASS
BLOCK D PLOT 1 BEDROOM SINGLE	1.7	7	PASS
BLOCK C PLOT 6 BEDROOM	0	18	PASS
BLOCK C PLOT 7 BEDROOM	0	17	PASS
BLOCK B PLOT 6 BEDROOM	0.1	15	PASS
BLOCK B PLOT 7 BEDROOM	0.8	16	PASS
BLOCK A PLOT 8 BEDROOM 1	0	13	PASS
BLOCK A PLOT 8 BEDROOM 2	0	12	PASS
BLOCK D PLOT 1 DOUBLE BEDROOM	0	27	PASS

4.2 Results for CIBSE TM59 – Living Rooms and Kitchens

As detailed within section 2 of this report, for the Living Rooms and Kitchens to achieve compliance with CIBSE TM59:2017, each room must achieve compliance with Criteria 1 of TM52:2013, which states the external to internal temperature difference must not exceed 1K for more than 3% of the year between May to September, i.e. values < 3 = pass.

Table 6 below shows the predicted thermal comfort results against the TM59 criteria for each Living Room and Kitchen within the proposed multi-residential development.

Table 6: Results showing performance against the TM59 criteria for each Living Room and Kitchen within the proposed multi-residential development using the Swindon CIBSE DSY 1 2020's high emissions 50th percentile range weather file.

Room Name	TM59 Analysis	
	Criteria 1: Hours of exceedance (He)	Pass/Fail
BLOCK B PLOT 1 KITCHEN	1.1	PASS
BLOCK B PLOT 1 LIVING	1.0	PASS
BLOCK B PLOT 2 LIVING	0.9	PASS
BLOCK B PLOT 2 KITCHEN	1.1	PASS
BLOCK B PLOT 3 KITCHEN	0.6	PASS
BLOCK B PLOT 3 LIVING	1.1	PASS
BLOCK B PLOT 4 LIVING	0.9	PASS
BLOCK B PLOT 4 KITCHEN	0.7	PASS
BLOCK A PLOT 5 KITCHEN	0.9	PASS
BLOCK A PLOT 5 LIVING	1.0	PASS
BLOCK C PLOT 2 LIVING	0.6	PASS
BLOCK C PLOT 2 KITCHEN	0.6	PASS
BLOCK C PLOT 3 LIVING	0.5	PASS
BLOCK C PLOT 3 KITCHEN	0.4	PASS
BLOCK C PLOT 5 KITCHEN	0.5	PASS
BLOCK C PLOT 4 KITCHEN	1.0	PASS
BLOCK C PLOT 4 LIVING	0.9	PASS
BLOCK C PLOT 5 LIVING	0.7	PASS
BLOCK D PLOT 1 KITCHEN	2.6	PASS
BLOCK D PLOT 1 LIVING	2.6	PASS
BLOCK C PLOT 6 LIVING	0.8	PASS
BLOCK C PLOT 7 LIVING	0.5	PASS
BLOCK C PLOT 7 KITCHEN	0.4	PASS
BLOCK C PLOT 6 KITCHEN	1.0	PASS
BLOCK B PLOT 6 KITCHEN	1.3	PASS
BLOCK B PLOT 6 LIVING	1.2	PASS
BLOCK B PLOT 7 LIVING	1.2	PASS
BLOCK B PLOT 7 KITCHEN	1.3	PASS
BLOCK A PLOT 8 KITCHEN	0.9	PASS
BLOCK A PLOT 8 LIVING	1.0	PASS

4.3 Results for Non-Mandatory Assessment – Communal circulation spaces

As communal circulation spaces such as entrance lobbies, stairwells and corridors can contribute to overheating within occupied rooms, they have been assessed on a non-mandatory basis.

Whilst there are no mandatory targets for communal circulation spaces, CIBSE suggest communal circulation spaces should not have an operative temperature exceeding 28°C for more than 3% of the total annual hours.

Table 7 shows the predicted thermal comfort results against the TM59 criteria for communal circulation spaces within the proposed multi-residential development.

Table 7: Results showing performance against the TM59 criteria for communal circulation spaces within the proposed multi-residential development using the Swindon CIBSE DSY 1 2020's high emissions 50th percentile range weather file.

Room Name	TM59 Analysis		
	Number of Hours Annually Where Operative Temperature > 28°C	Percentage of Hours Annually Where Operative Temperature > 28°C	Pass/Fail
BLOCK A STAIRS GF	0	0.0	PASS
BLOCK A STAIRS 1F	9	0.2	PASS
BLOCK A STAIRS 2F	0	0.0	PASS
BLOCK B ENTRANCE LOBBY AND STAIRS	9	0.2	PASS
BLOCK C CIRCULATION GF	43	1.2	PASS
BLOCK C CIRCULATION 1F	27	0.7	PASS
BLOCK C CIRCULATION 2F	12	0.3	PASS
BLOCK C STAIRS GF	38	0.7	PASS
BLOCK C STAIRS 1F	54	1.1	PASS
BLOCK C STAIRS 2F	21	0.2	PASS
BLOCK D ENTRANCE LOBBY	57	1.6	PASS

Conclusions

Based on the modelling conducted, the results in Tables 5 and 6 show that the thermal comfort criteria as set out by CIBSE TM59 for residential spaces has been satisfied.

Based on the modelling conducted, the results in Table 7 show that the thermal comfort criteria as recommended by CIBSE TM59 for communal circulation spaces has been satisfied.

5.0 Results and Conclusions for Energy Demand Calculations

Please see Table 8 for results for primary energy demand and space heating demand for the proposed multi-residential development.

Table 8: Results for primary energy demand and space heating demand for Block ABCD using the Swindon CIBSE DSY 1 2020's high emissions 50th percentile range weather file.

Energy Type	Proposed multi-residential apartment Blocks ABCD	PassivHaus Standards	Meets PassivHaus Standards?
Primary Energy Demand	43 kWh/m ²	≤ 120 kWh/m ²	Yes
Space Heating Demand	7 kWh/m ²	≤ 15 kWh/m ²	Yes

Conclusions

From Table 8, the results show that the proposed multi-residential apartment Block A, B, C and D meet the PassivHaus standards for Primary Energy Demand and Space Heating Demand.

6.0 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.

This analysis has been undertaken using the thermal simulation program ApacheSIM Dynamic Simulation (IESVE, 2020) to predict the buildings environmental performance. Solar Penetration Analysis was performed using Suncast (IESVE, 2020).

The most current CIBSE Design Summer Year (DSY) Weather File for Swindon was chosen for the simulation (Swindon CIBSE DSY 1 2020's high emissions 50th percentile range weather file), in accordance with the CIBSE TM59:2017 "Design methodology for the assessment of overheating risk in homes" guidelines.

The parameters used in this calculation are provided within this report in Section 3 and are deemed to be approved by Reading Borough Council unless advised to the contrary. The building occupancy profiles & parameters published in CIBSE guide TM59:2017 "Design methodology for the assessment of overheating risk in homes" has been used as guidance. Within the apartments, thermal comfort has been assessed against the criteria identified within CIBSE TM59:2017.

It should be noted that as occupancy and building use is based on set parameters outlined in TM59 there is no guarantee the temperatures estimated will match the actual building temperatures as 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.

Summary

The proposed multi-residential development, will be located at Arthur Hill in Reading. There will be 15 units in total comprising, 12 one-bedroom units and 3 two-bedroom units. The proposed development has been designed to have extremely low energy consumption similar to that to be expected from a PassivHaus building.

The results for the predicted energy demand for the proposed development have been included in this report and show that the proposed multi-residential development meet the PassivHaus standards for Primary Energy Demand and Space Heating Demand.

Overheating analysis has been carried out on behalf of Reading Borough Council to show that the proposed multi-residential development meets the thermal comfort criteria as set out in CIBSE TM59 for residential spaces. Based on the modelling conducted, the results show that the thermal comfort criteria as set out by CIBSE TM59 for residential spaces has been satisfied.

References

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

CIBSE, (2015), *CIBSE Guide A: Environmental Criteria for Design*. Birmingham, CIBSE.

CIBSE, (2017), *Design methodology for the assessment of overheating risk in homes CIBSE TM59*. Birmingham, CIBSE.

CIBSE, (2013), *The limits of thermal comfort: avoiding overheating in European buildings CIBSE TM52*. Birmingham, CIBSE.