



Tai Tarian

Heol-y-Glo, Tonna

RIBA Work Stage 3 PHPP Analysis

Project Ref: 2641

August 2025

Revision: -



architecture
urban design
sustainability
civil engineering
structural engineering

Section 1: Introduction

Spring Design were appointed by Tai Tarian to progress planning proposals for a vacant site in Heol-y-Glo, Tonna with a secondary objective of unlocking an adjacent landlocked development parcel.

Accommodating the necessary drainage infrastructure and an access road through the site, Spring developed designs for a three storey, L-shaped block containing 9 no. one bedroom apartments.

To reduce energy demand in alignment with **PPW12**’s Energy Hierarchy for Planning and as the alternative to EPC A defined within **WDQR 2021**, Spring Design were tasked with targeting the 40 kWh/m²/yr heating demand threshold of the AECB CarbonLite Building Standard.

Energy modelling of the block was undertaken using the Passive House/ PassivHaus Planning Package (PHPP). This document presents the results of that exercise to inform the construction specification and ensure the cost-effective delivery of low energy buildings by prioritising a fabric-first approach.



Architects, Civils, Structures & AECB CarbonLite Modellers	Spring Design Consultancy
Planning Consultants	TBC
Employer’s Agents	TBC
Arboriculturalists	TBC
Ecologists	TBC
Fire Consultant	TBC
Geotechnical	Intégral Géotechnique
Landscape Architects	TBC
SAP Assessor	TBC
Service Engineers	TBC
Topographical Surveyor	Senior Surveys
Transport Engineers	TBC



Excerpts of 2641-00(03)409-A - View 09 and 2641-(03)100-D- Site Layout (not to scale)

Section 2: Executive Summary

As the development is comprised exclusively of apartments a single PHPP is the most appropriate way to model the accommodation while following the Passivhaus methodology.

As summarised in the adjacent table the dwellings achieve the space heating demand of the **AECB CarbonLite Building Standard** as clarified within **WDQR 2021 FAQ Addendum 2023**. This aligns with Welsh Government policy and the alternative method to EPC A outlined in **WDQR 2021** in reducing the heating demand of dwellings. The building possesses a favourable ratio of internal volume to thermal envelope (form factor) which contributes to the significant headroom.

The building demonstrates 12% risk of overheating when modelled with windows closed: this is significantly beyond what would be required for certification to the AECB CarbonLite New Build Standard. As explained opposite, this goes beyond regulatory requirements (which would account for night purge ventilation) and could therefore reduce.

Section 3: Notional Specification outlines the assumed values used to inform the PHPP modelling exercise. These values should be considered the minimum specification to be achieved to deliver this development and any alternative proposals must be tested within PHPP to establish its impact on the calculated energy performance.

As the discussion contained within **Section 4: Energy Modelling**, changes to the specified assumptions can significantly impact the energy balance which will directly influence the heating demand. It is therefore critical to carefully manage product substitutions within the tendering process to avoid diluting the energy efficiency aspirations.

Models representing more than one dwelling will not capture the granular detail of individual dwellings within a larger block as they aggregate the energy balance into a single output, e.g. outer units with larger extents of exposed surface area are likely to have a higher heating demand than inner units. Should individual assessment of typologies (i.e. ground or top floor or corner flats) be required, Spring can undertake this as an additional work package.

Blocks	GIA TFA	Form Factor	Target Air Permeability	Space Heating Demand	Heat Load	Energy Use Intensity (EUI)	Overheating [†]	WDQR 2021 compliance
HT 211 <i>Flats 01 - 09</i>	563 m ² 496 m ²	2.23	1.5 m ³ /m ² /hr	21 kWh/m ² /yr	14 W/m ²	40 kWh/m ² /yr	13%	Y

[†] All dwellings are modelled without additional purge ventilation via windows through summer to demonstrate the worst-case scenario for overheating in current climatic conditions. This represents modelling beyond regulatory requirements which incorporate the effects of night purge ventilation to help cool dwellings: modelling could be augmented with opened windows and immediately reduce the calculated risk. Conversely, an additional summer temperature increase could be applied to test future climate scenarios and ensure climate resilience.

All flats will require additional assessment by **TM59 Design methodology for the assessment of overheating risk in homes** to demonstrate compliance with **WDQR 2021**.

Section 3: Notional Specification

PHPP requires the input of a large body of data to populate the model to calculate the energy balance and heating demand. The Passivhaus methodology clearly defines this process to ensure consistent results.

Standard rates of occupancy have been applied for energy modelling.

The values presented should be considered the minimum standard to be achieved. Any alternative proposals must be scrutinised to ensure conformity with PHPP input (e.g. use of $\lambda = 90/90$ values for calculating u-values) and tested within the model to check there is no detrimental impact to the calculated heating demand.

Stated u-values must be calculated via Passivhaus methodology. This is distinct from SAP methodology and therefore produces different values. Similarly, psi-values are calculated to external dimensions for Passivhaus rather than internal dimensions for SAP. All junctions should therefore report to both methodologies to simplify PHPP and SAP calculations.

Excepting door and window installations, all thermal bridges have been assigned a psi-value of 0.050 W/mK. Door and window junctions are assigned a psi-value of 0.040 W/mK with 0.35 W/mK for thresholds. These psi-values should be surpassed by well-resolved architectural detailing, lowering heat loss and space heating demand further.

All information is presented for coordination to ensure alignment with the materials and products available within existing supply chains to safeguard project viability.

Factor	Limit		Units	Notes
Building Fabric				
External fabric u-values	floor	0.110	W/m²K	Appendix E threshold
	walls	0.130	W/m²K	Appendix E threshold
	roofs	0.110	W/m²K	Appendix E threshold
Thermal bridges (ψ–value)		0.050	W/mK	see adjacent commentary
Air permeability		1.50	m³ @ 50 Pa	AECB CarbonLite Building Standard threshold
Doors & Windows				
Frames U _f		1.14	W/m²K	Munster uPVC
Glazing U _g		1.12	W/m²K	Double low-E glazing 16mm Argon
		0.63	g-value	
Entrance doors		1.00	W/m²K	Appendix E threshold
Door/ window reveals		0.153	m	all installed within timber structure (therefore insulation zone)
Ventilation				
Air supply rate		30	m³/h per person	balanced mechanical ventilation with heat recovery
MVHR unit		83.00	% heat recovery	EnviroVent energisava 300
Supply & exhaust ducts	length	TBC	m	measured individually for each dwelling
	diameter	0.160	m	
Ventilation duct insulation		0.050	m	assume non-reflective ArmaFlex closed cell insulation
		0.040	W/mK	
Heating, DHW & Distribution				
Heating appliance		45	°C	ASHP - heat delivered by low temperature radiators
Domestic hot water		60	°C	
HWT & pipe insulation		0.050	m	assume non-reflective ArmaFlex closed cell insulation
		0.040	W/mK	
Summer Ventilation				
MVHR				summer bypass controlled by temperature
Windows				closed - see notes in Section 2. Executive Summary

Section 4: Energy Modelling - Introduction

Passivhaus methodology requires the PHPP model to evaluate the performance of a building maintaining an internal temperature of 20°C and an hygienic air exchange rate of 30m³/h per occupant. This establishes a clear set of controlled conditions that allows direct comparisons between different buildings.

Critical outputs from PHPP quantifying energy performance are Heating Demand, Heat Load, Energy Use Intensity (EUI) and Overheating.

Heating Demand describes the quantum of energy required to maintain a constant internal temperature for a property measured in kilowatt hours (energy consumed) per square metre (area) per annum (kWh/m²/yr). This figure is derived from the Energy Balance and represents the heating input required: this is not the same as the amount of energy consumed in heating the building as the efficiency of the heating system is not considered.

Head Load expresses the instantaneous energy required to maintain the building at a constant temperature and is measured as a function of energy per square metre (W/m²).

Energy Use Intensity (EUI) accounts for the sum of all energy use by a building on an annual basis based on Gross Internal Area (GIA). This can be delivered via the grid or by on-site renewables and accounts for space heating, hot water, lighting and all unregulated usage in occupation (e.g. all appliance usage) - factoring in system in/ efficiencies - but excludes EV charging. EUI enables the calculation of total energy use and by extension potential electricity bills.

Overheating refers to the percentage of time annually the internal space exceeds 25°C. **Section 3: Notional Specification** describes the modelled assumptions to calculate overheating risk (refer to Summer Ventilation).

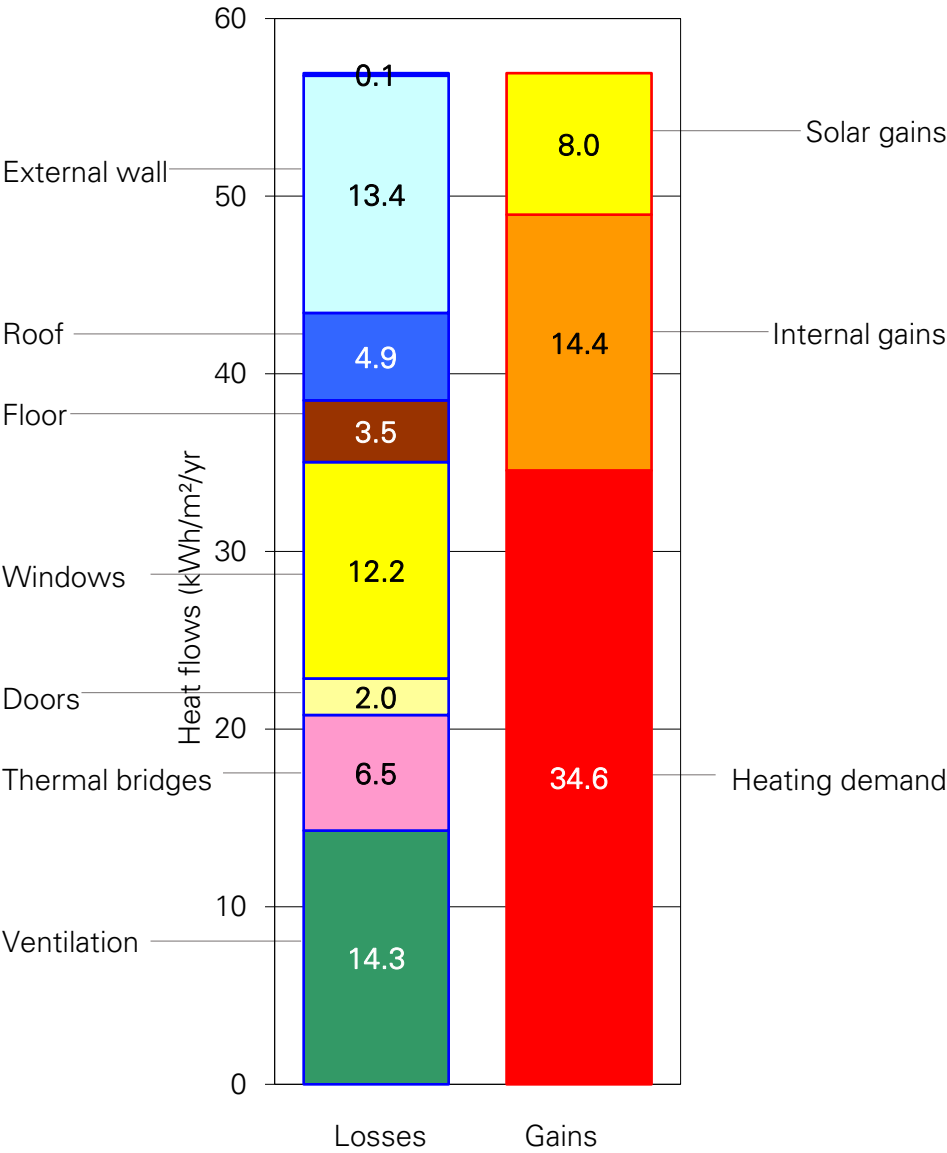
The adjacent graph expresses the balance of heat losses and gains to maintain an internal temperature of 20°C. By identifying and quantifying where losses and gains occur it provides insight into the performance of building elements that can inform further optimisation.

cumulative losses = cumulative gains

cumulative losses = solar + internal gains + heating demand

cumulative losses = heating demand - (solar + internal gains)

EXAMPLE: Energy balance heating (annual method)



Interrogating the Energy Balance Heating enables the identification of the best and worst performing parts of the building. As in the above example, it can be clearly seen that heat is primarily lost through the ventilation - both intentional and unintentional - (14.3 kWh/m²/yr), fabric of the external doors and windows (14.2 kWh/m²/yr) and then through the external walls (13.4 kWh/m²/yr). Minor additional losses are incurred via thermal bridges (6.5 kWh/m²/yr) and the roof (4.9 kWh/m²/yr) and floor (3.5 kWh/m²/yr).

This analysis assists in identifying where the most cost-effective optimisations are likely to be available. In the example above, mitigating or eliminating thermal bridges through improved detailing is likely to offer the easiest route to further reducing heating demand. The larger losses through the fabric (external doors and windows, external walls) would require an improved specification which may not be feasible.

An approximate figure for the electricity bill per dwelling unit is also presented. This has been calculated using the following steps.

Total electricity use = GIA x EUI
= kWh/yr per dwelling

Total electricity bill = Total electricity use x £0.2573 per kWh
= £TBC per dwelling ex. standing charge

Passivhaus methodology would calculate regulated and unregulated energy use with standardised occupancy rates. This modelling has applied the assumption of full occupancy to present a more conservative estimate of total electricity costs.

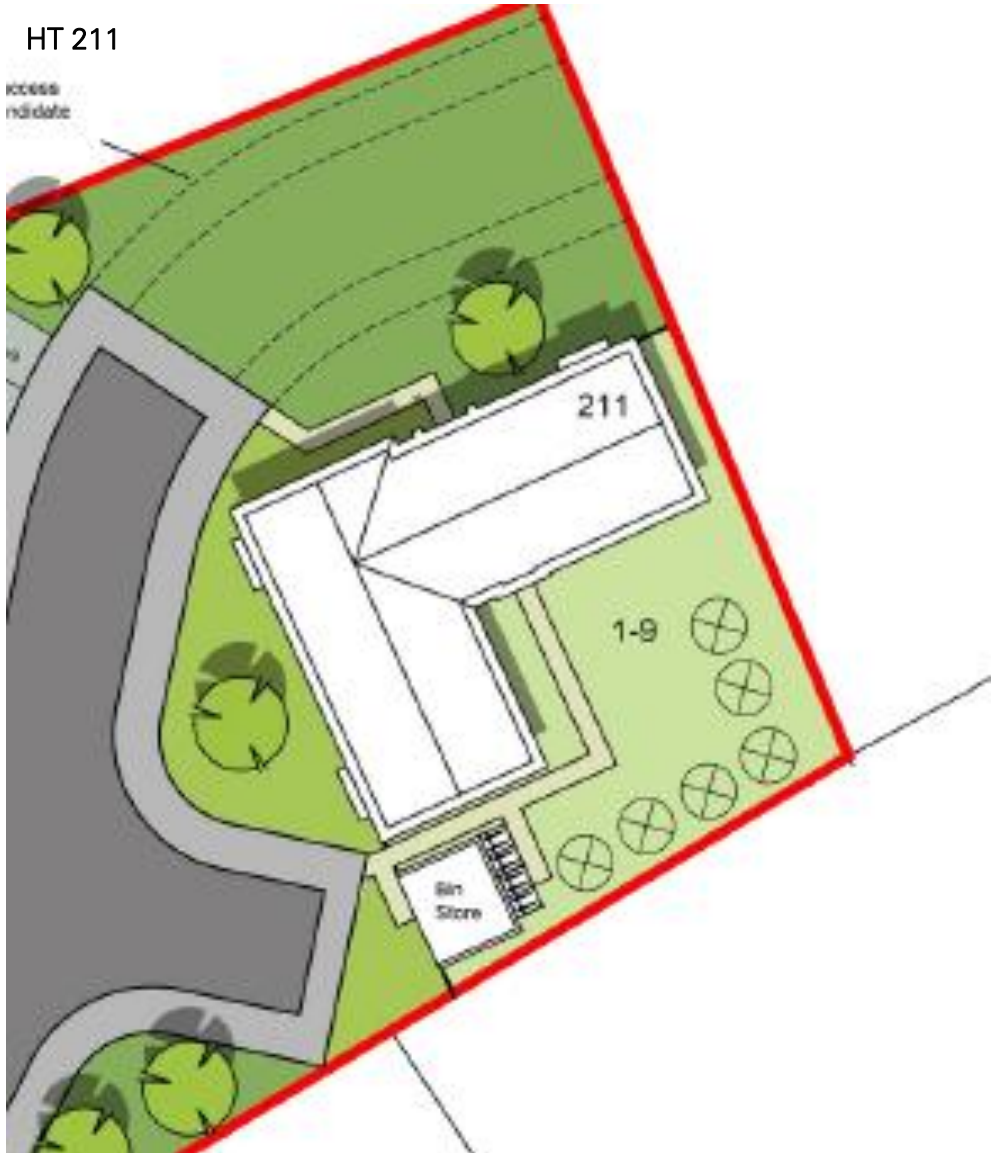
Unit prices per kWh reflects Q3 2025 costs set by Ofgem for customers paying by Direct Debit. Costs would be substantially inflated for those residents using prepayment meters.

Models representing more than one dwelling will not capture the granular detail of individual dwellings as they aggregate the energy balance into a single output. Those flats with larger exposed surface area (bottom and top floor flats) will have higher heating demand and would therefore incur higher heating bills than mid-floor units.

Individual assessment of units (i.e. individual flats or mid-terrace dwellings) could be progressed as an additional work package.

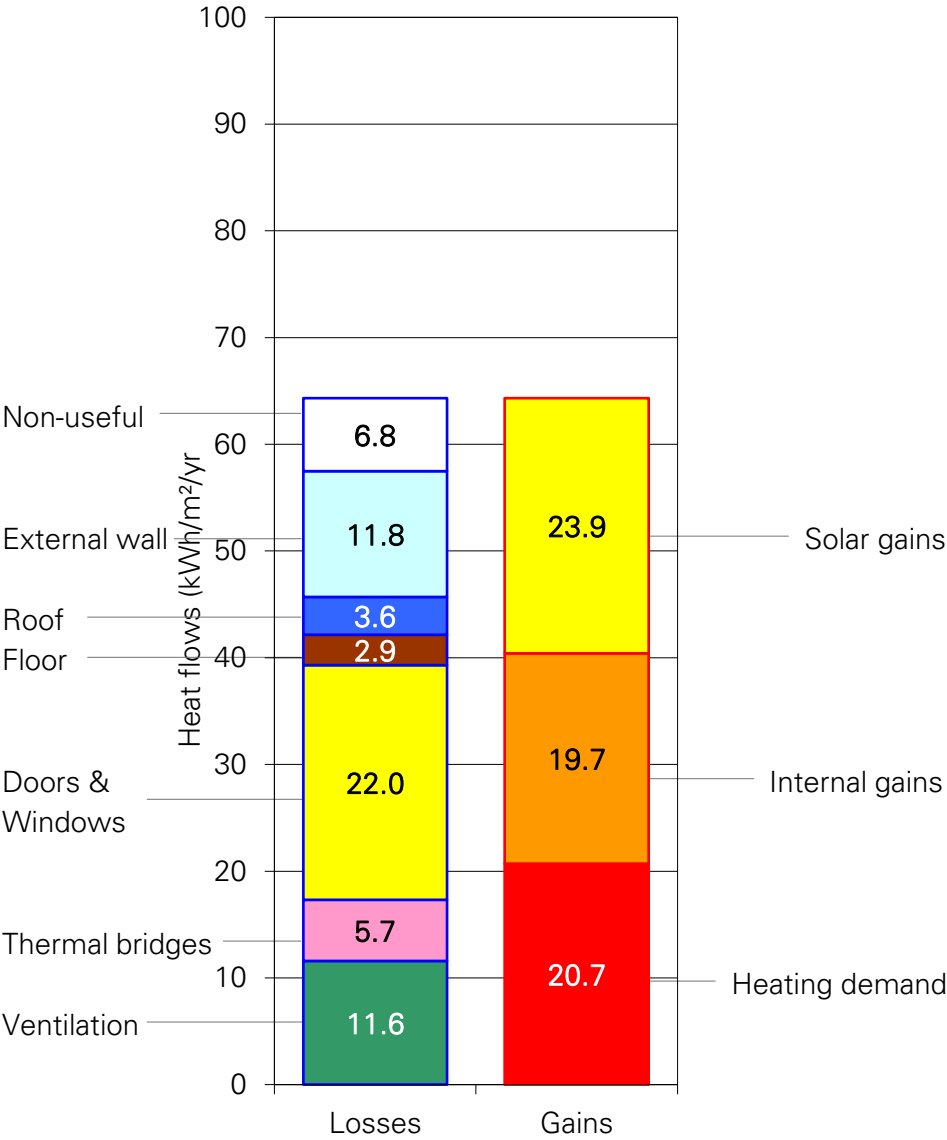
Section 4: Energy Modelling - Plots 01-09

HT 211



Heating demand	21 kWh/m²/yr
Heat load	14 W/m²
Overheating risk	13%
EUI	40 kWh/m²/yr
GIA	50.0 m² per dwelling
Total electricity use	2,017 kWh/yr per dwelling <i>GIA x EUI</i>
Total electricity bill	£519.06 per dwelling ex. standing charge <i>Total electricity use x £0.2573 per kWh</i>

Energy balance heating (monthly method)

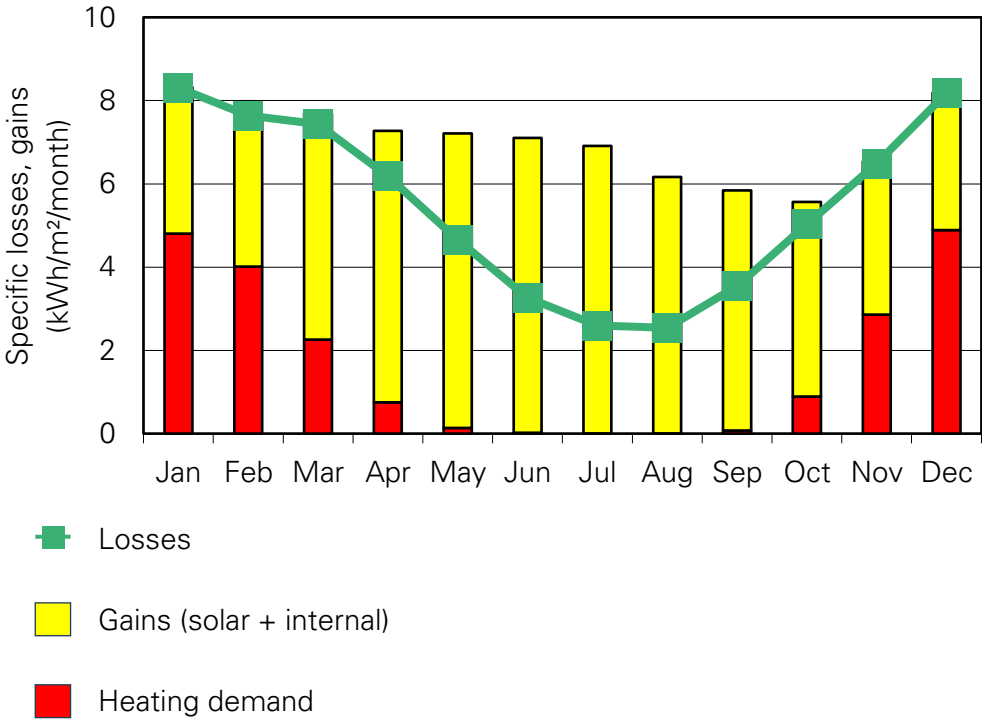


Heat is primarily lost through doors and windows (22.0 kWh/m²/yr) followed by the fabric of external walls (11.8 kWh/m²/yr) and then ventilation (11.6 kWh/m²/yr). Minor contributions come from non-useful heat gains (6.8 kWh/m²/yr) and thermal bridges (5.7 kWh/m²K) followed by the roof (3.6 kWh/m²/yr) and floor (2.9 kWh/m²/yr).

As doors and windows are the most significant area of heat loss, fenestration design and/ or specification could be optimised to improve energy efficiency. Additional benefits could be cost-effectively derived by mitigating thermal bridges through technical design or by upgrading the MVHR specification.

These units have a calculated a risk of overheating of 13% without the added benefit of night/ purge ventilation. This reinforces the notion that fenestration design could be optimised.

Energy balance heating (monthly method)



Monthly assessment of heat losses and gains demonstrates the variability of heating demand throughout the year. As would be expected, December and January have the highest requirement for input with a heating demand of c. 5 kWh/m²/month.



Section 5: Discussion

Located in Tonna with Cefn Morfudd rising to an altitude of 283m immediately to the South, these units nonetheless readily meet the space heating demand of 40 kWh/m²/yr.

Optimisation of the fenestration design and specification could deliver the most cost-effective reductions to space heating demand and simultaneously mitigate overheating risk.

All units are modelled without the additional purge ventilation available via windows to demonstrate the worst-case scenario for overheating in current climatic conditions: models could be augmented to account for opened windows and immediately reduce the reported risk. Additionally, a summer temperature increase could also be applied in PHPP to test future climate scenarios and ensure climate resilience.

A requirement of **WDQR 2021** is that all flats must be assessed via **TM59 Design methodology for the assessment of overheating risk in homes** to demonstrate sufficient mitigation of overheating risk. This will need to be undertaken by an external consultant.

Section 3: Notional Specification outlines the assumed values used to inform the PHPP modelling exercise. These values must be considered the minimum specification to be achieved to deliver this development and any alternative proposals must be tested within PHPP to establish its impact on the calculated energy performance.

As the discussion contained within **Section 4: Energy Modelling**, changes to the specified assumptions can significantly impact the energy balance - both positively and negatively - which will directly influence the heating demand. It is therefore critical to carefully manage product substitutions within the tendering process to avoid diluting the energy efficiency aspirations.

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All flats will require additional assessment by **TM59 Design methodology for the assessment of overheating risk in homes** to demonstrate compliance with **WDQR 2021**.



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