Passivhaus Trust
The UK Passive House Organisation

Dynamic Thermal Modelling for Summer Comfort

UK Certifiers' Circle Guidance

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Acknowledgements

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http://bit.ly/PHTpatronmembers

Summary

Passivhaus buildings are comfortable year round, and should be cooler than typical buildings in summer and extreme heat wave events. Calculations and simulation should be used to inform the design to ensure good summer comfort, rather than seen as compliance tools.

For multi-residential or non-residential buildings the single zone steady state PHPP calculation is sometimes not sufficient to effectively evaluate summer comfort and overheating risk during design for individual zones. In these cases the Passivhaus Certifier may require a dynamic thermal modelling risk assessment *in addition* to correct input of the PHPP calculation. This is at the discretion of the Certifier. The PHPP stress test tool (PHPP 10.0 onwards) can also be used to demonstrate that the whole building achieves summer comfort, and is a useful, faster method of testing design decisions. For earlier versions of PHPP, stress testing is included in the Passivhaus Trust's Summer PHPP plugin, available at https://pht.guide/summer.

In the UK a dynamic thermal model will often be carried out to demonstrate compliance with the building regulations Part O, and for schools BB101. This follows the CIBSE TM59 methodology for residential buildings, or the CIBSE TM52 methodology for non-residential buildings.

For Passivhaus certification the CIBSE/Part O methodologies should be followed. However, there are some specific requirements detailed below. Dynamic simulation is complex and is very dependent on the assumptions used. Meeting the minimum requirements of Part O alone is not sufficient to demonstrate summer comfort in Passivhaus buildings. See further detail on Passipedia at https://t.ly/_XEl.

Extent of calculations

ADDITIONAL REQUIREMENTS OVER TYPICAL PART O REPORTING	
Areas modelled	The rooms modelled will be reviewed by the Passivhaus Certifier. The Certifier may ask for further calculations if the areas included are not felt to be representative of the highest risk. Rooms with significant heat gains must be included in the assessment and results reported – for example, rooms with hot water circulation pipes or glazed stairwells.
	All shared facilities or non-residential use types must be included in the simulation.
Weather files	Follow CIBSE TM52/59: building should pass using DSY 1, 2020s, high emissions, 50th percentile.
	It is recommended that a second weather file should be tested and reported against, particularly with higher risk buildings and borderline cases. Future years should be tested for resilience, but are not required.
Occupancy	If the use or occupancy of the building is known to be likely to be different to the standard Part O or CIBSE TM52/59 requirements then a second modelling iteration should be carried out and compliance demonstrated.
Simulation period	Extend to capture all times when operative temperature would be >25°C.

Reporting assumptions and results

A formal overheating report PDF documenting all assumptions and results must be submitted at RIBA Stage 4, or before. Calculations are typically completed during the design stage pre-planning and pre-tender. However, the report should be updated if there are any relevant changes to the design during construction – for example, changes to opening areas, frame proportions or heat gains into the building. Multiple iterations may be required to refine the calculations.

The assumptions used in the overheating modelling must match the design and PHPP, or be on the conservative side for summer comfort.

ADDITIONAL REQUIREMENTS OVER TYPICAL PART O REPORTING	
Hours above 25°C	Total hours in the simulation period that room operative temperature is above 25°C for each room. Report total number of hours in simulation period and % of hours in the calendar year.
Internal heat gains	Report assumptions for the total internal gain allowance (W) per room. Breakdown between equipment, building services and people where appropriate.
	Supporting calculations for any significant internal heat gains.
Window opening	Window opening area (effective) for any opening windows or vents. This must include the impact of restrictors and guarding or louvres covering the window.
	Report total number of hours that windows are assumed open.
	Report use of movable shading devices and blinds. Where are they assumed used, number of hours shut in simulation period.

Requirements for user manual and handover

The assumptions made in the overheating modelling must be communicated to the user(s), in writing and through training where appropriate on the overheating strategy.

In particular this must highlight:

- the need to leave windows open for longer periods of time, and ahead of hot periods (for example overnight)
- advice on closing blinds during the day in hot periods.

The Passive House Institute provide a template for summer comfort user manuals: https://passipedia.org/planning/summer_comfort/summer_comfort_user_manual.

Modelling tips

- Sense check results. Dynamic simulation can be very susceptible to complexity and impressive outputs hiding simple mistakes.
- Include surrounding rooms and make sure that heat gains/losses between internal spaces are included – for example, a stair with lots of glazing may cause overheating in a neighbouring room.
- MVHR units typically have a mechanical summer bypass that is controlled based on internal and external temperature. Make sure heat recovery is not included when useful cooling is available from outside air (especially at night). This may need a separate ventilation rate/system to enable software to simulate.

Overheating risk

The criteria are only thresholds for the worst acceptable performance, and dynamic thermal modelling only estimates the risk. It is important that the designer and Certifier are satisfied that the building has a manageable degree of overheating risk.

Further measures to reduce overheating risk should always be considered, for example:

- further reduction of internal heat gains, especially from fixed building services
- external fixed or movable shading devices
- additional opening windows beyond those required in calculations (a variety of opening sizes and windows that can be left open securely are recommended)
- a small amount of active cooling on the ventilation air or combined with the heating system where relevant.

More detail can be found in the Passivhaus Trust's guidance *Avoiding Summer Overheating*, which includes design strategies to reduce risk, key indicators of the likelihood of risk, and a detailed risk log, as well as the stress tests mentioned above, available at https://pht.guide/summer.