The Scottish Passivhaus Equivalent Standard

Workshop Summary Paper

Built Environment
—
Smarter Transformation

12 March 2024

The Scottish Passivhaus Equivalent Standard Workshops were facilitated by BE-ST on behalf of Scottish Building Standards Division. The workshops were held between Sept 2023 - Jan 2024.

These workshops are intended to help Scottish Government officials understand how a Scottish equivalent to the Passivhaus standard may look.

Introduction

In response to Alex Rowley MSP's Proposed Domestic Building Environmental Standards (Scotland) Bill (confirmed December 2022, debated January 2023), the Minister for Zero Carbon Buildings, Active Travel and Tenants' Rights confirmed that the Scottish Government will make legislation by December 2024 to deliver further improvement to the energy efficiency of new buildings, drawing inspiration from the internationally recognised Passivhaus standard.

This aligns with the Shared Policy Programme agreement on the "explicit support for passivhaus and equivalent standards" and the recommendation from our Climate Assembly "to ensure that, within the next 5 years, all new housing is built to Passivhaus standards (or an agreed Scottish equivalent)".

To develop proposals, a further review of energy standards within building regulations was initiated at the beginning of 2023 and will consider standards for both new homes and new non-domestic buildings.

A submission to Ministers summarising early engagement with a range of industry stakeholders, an updated statement of intent and a proposal for the development of the review was made in May 2023.

A Working Group was convened with a role to offer advice and expertise to the Scottish Government to help define how an equivalent to the Passivhaus standard will look in Scotland.

The main Working Group held its first meeting on 21 June 2023 with sub working group formed focussing on two key workshop themes:

- To develop a package of measures that use reliable solutions to optimise building fabric and service performance, reduce delivered energy demand and provide a healthy indoor environment
- That the design and construction of new buildings must be supported by quality assurance and verification processes that result in buildings that meet the high standards set

Workshop Programme

Workshop 1 - Space heating demand

Workshop 2 - Airtightness

Workshop 3 - Primary energy demand/energy use intensity

Workshop 4 - Design calculations, compliance methodologies and the performance gap

Workshop 5 - Ventilation and overheating

Workshop 6 - Quality assurance and compliance

Workshop 7 - Industry engagement workshop

A selection of discussion points at each workshop is provided in this paper. The full workshop notes are available here.

Workshop contributing parties included: Architects, Passivhaus Consultants & Designers, Passivhaus Trust, Researchers, New Build Contractors, Scottish Building Standards Division and Scottish Passivhaus Equivalent Working Group Members.

W 1. Space Heating Demand

To ascertain certain standards and the levels that are being delivered including:

- With reference to how the 2023 standards are dictating the design of buildings in terms of fabric and services performance, what is currently being delivered?
- With reference to how the 2023 standards are dictating the design of buildings in terms of space heating demand in kWh/m2/yr, what is currently being delivered?
- Where could reasonable and scalable progress be made over the period 2025/26?
- What are the benefits of assigning a space heating demand limit?
- What are the benefits of using a notional building approach with back-stop performance criteria?

Feedback and Discussion Points:

- The use of a notional building in the Standard Assessment Procedure (SAP) is considered logical due to the standardized house types used by developers. However, there's a suggestion that SAP should incorporate some elements from the Passive House Planning Package (PHPP) to enhance its effectiveness.
- SAP is widely used in the sector, and moving away from it could have disastrous consequences. However, current performance measurement via SAP makes data comparisons difficult.
- Many developers advocate for a fabric-led approach to compliance, focusing on building envelope performance, which aligns with data from Energy Performance Certificates (EPCs).
- Anecdotally, the 2023 standards are achieving their intended goal of significantly improving energy efficiency.
- There are issues with the ventilation strategy in social housing.
- Adopting PHPP could greatly benefit the move to Passivhaus Scottish Equivalent standards, especially considering consumer interest in energy bills over generic kWh requirements. Fuel prices should be considered in assessing space heating or total energy demand.
- Abandoning the Notional Dwelling approach might increase housing construction costs in colder locations, affecting remote communities. Conversely, absolute targets could standardize energy demand and running costs across locations.
- There are specific gaps in mechanical ventilation certification, with the Republic of Ireland introducing third-party validation requirements for design and commissioning.
- Currently floor and ceiling u-values are lower than PHPP backstop.

- Most developers already have Psi values assessed for common detailing - NHBC etc we need to watch we don't bring in details that are not feasible at scale.
- 2023 standards should be looking at space heating demand of around 30 kWh/m2/Yr.
- Achieving around 20 -25 kWhrs for housing of differing styles would seem feasible, much beyond this is losing benefit and costing too much.
- MVHR seen as challenging due to lack of suppliers/skills and failures /maintenance issues in social housing sector.

W 2. Airtightness

To discuss what is currently being delivered across the built environment when targeting airtightness levels in new buildings and what could reasonably be achieved by 2025/26 and understand what actions within the design and construction of new buildings result in the target air tightness level being achieved, including:

- What levels of airtightness are currently being achieved across domestic and non-domestic buildings?
- Where could reasonable and scalable progress be made over the period 2025/26?
- What are the benefits of assigning a specific air-tightness level when setting energy targets for new buildings?
- Identify any risks and opportunities associated with targeting certain airtightness levels

Feedback and Discussion Points:

- MVHR do we have enough ventilation products available to cope with demand. Mould and damp are increased risks where tenants do not understand the difference in the behaviours required for a more airtight home.
- Achieving the desired level of design air tightness in construction requires attention to key aspects throughout the design and construction process.
- In design, the absence of thermal bridging and air tightness are closely linked, necessitating a consistent approach. Early design input during the feasibility stage is crucial, and collaboration between architects, trades, and labour on site is essential.
- Detailed information is needed to facilitate implementation on site, with separate lines for ventilation, air-tightness, and structural elements. Standard details and empowerment by regulations to enforce compliance are recommended.
- Engagement with structural engineers on thermal bridging, along with simple and clear design standards, is important. Air tightness lines should be visible on drawings, and simplicity in details is encouraged.
- During construction, quality procedures, tool box talks, interim air tightness tests, and the presence of an air tightness champion are necessary. Sequencing of work must ensure the integrity of the air tightness layer, with consideration for simplified façade details.
- Improvements in junction designs and robust, easily understood detailing are essential in design. Closed panel construction can mitigate risks associated with sequencing on site, offering a solution for maintaining air tightness integrity.

- Current levels of air tightness under current regulations between 3 and 5, recent Passivhaus school in steel had 0.53, also little doubt 0.6 can be achieved by 2025.
- Culture of air tightness on site has changed in the last 10 years, it used to be a box ticking exercise now contractors are much more aware of it through testing. This should be taught as part of apprenticeships. Culture change is key 0.6 requires a complete change on site of how to do the work. Aim for zero then 0.6 becomes achievable.
- Reducing air tightness to 0.6 has a massive effect on heat demand, 2.7 kw from circa 47kw if you work to current standards. Saves huge amounts of energy and comfort levels are good.
- MVHR systems require maintenance and need to be designed with access in a good location. Insurance risks, if a scare story gets out someone got sick from not changing filters.

W 3. Primary Energy Demand/Energy Use Intensity

To discuss primary energy renewable/energy use intensity on the performance targets for a European climate and how these are achieved at both design and building completion stage, including target setting and quality assurance & certification.

Feedback and Discussion Points:

- More discussion needed around lifestyle and how people use their homes including occupant behaviour.
- Relationship between the size of the house and energy use. Also, careful consideration needed for domestic hot water demand.
- Passivhaus does tend to achieve and often exceed the designed energy targets, whereas with building regulations that isn't always the case, hence the performance gap.
- Culture change – we need to measure and present energy consumption for this to be meaningful.
- Training and Knowledge of designers/installers and end users is critical over the next few years.
- Push fabric first principles and adjust the energy performance, demand measurement of data monitoring, as we don't know the performance gap.
- Conflicting arguments on cost - need better indication of what these are going to be.
- To maximise benefits of MVHR households need to be realistic about living with that technology and changing shape of their lifestyle.
- Affordable housing- grid capacity and electricity. need to think what is scalable in certain areas. Issue with grids and Passivhaus standards not lining up, there is a need for better alignment.
- Risks - difficult to talk about targets without ending up talking about cost of living, rural issues, EPC. Target setting might work in isolation, but does it work in the real world? Currently lacks clarity as we are working on hypothetical assumptions
- Need to also to think about the potential unintended consequences of airtightness and upgraded insulation on fabric.
- Flexibility of approach is lost when setting definitive targets and will change the way building regulations have been implemented to-date.
- When presenting cost comparisons, we should reference the baseline, house type and m2.
- There's a call for detailed analysis on the actual operational costs of Passivhaus buildings, with concerns over the lack of substantiated data despite previous estimates by the Passivhaus Trust (PHT).
- In Passive House Planning Package (PHPP), the effectiveness of solar thermal versus photovoltaic (PV) systems depends on factors like roof

space and hot water (HW) usage, with PV often preferred due to easier performance monitoring and fault detection.

- Solar thermal systems can impact summer overheating and pose challenges in monitoring and insulation. Considerations of additional costs to customers, such as increased electricity usage for Mechanical Ventilation with Heat Recovery (MVHR) systems, and potential impacts on mortgage payments are raised.
- When comparing costs, referencing the baseline, house type, and size is recommended. Furthermore, lifecycle costs, payback periods, and the financial implications of carbon reduction efforts need consideration.
- Concerns about the accuracy of Standard Assessment Procedure (SAP), data reliability and evidence are questioned, emphasising the need for robust analysis in evaluating energy efficiency measures.

W 4. Design Calculations, Compliance Methodologies & The Performance Gap

To discuss the comparative benefits and risks of the various design and compliance tools used and in particular how the choice of particular design metrics may support an appropriate design response, including:

- What are the differences in conventions and input assumptions that result in the variations in output between the various design and compliance tools?
- To discuss the differences in relevant design assumptions and boundary conditions.
- The differences in methodologies for calculating space heating demand and total energy use (EUI/BDER/DDER).

Feedback and Discussion Points:

- Move towards a qualified Engineer/Architect only approach to sign off calculations rather than the very variable levels of competence within Assessors to improve the accuracy of all modelling tools.
- There is still a discussion around do we have complete airtight buildings. still a reluctance around installation of MVPH
- I'm aware Scottish Government have recently finished consulting on revisions to EPC metrics (also due to do this soon in England) - consistency of messaging across new build and EPCs should be considered
- To state the obvious, the Passivhaus standard is more than the metrics and the PHPP model - it is a quality control process which is fairly resource intensive and adopted by those who voluntarily submit themselves to that intensive process
- Moving from a voluntary standard to a mandatory one will produce bad faith attempts which the standard needs to be robust to. The quality control is essentially model-independent, and it is vital to the eventaul standard working.
- Very important to note that the Home Energy Model does not make a single set of fixed assumptions - these can be modified, and we/someone could produce a version of HEM which is bespoke to Scottish passive-equivalent standard
- Part of the strength of PHPP is that you have a Passive House Designer on the team responsible for the performance of the building, the detailing and the evidence
- Competency of modelling users has been an issue for many years, being accredited for providing an EPC does not make you a good designer regardless of tool used, yet this would be an issue for the large number of existing assessors and their livelihoods.

W 5. Ventilation and Overheating

Discuss and compare the ventilation and overheating technical requirements as set by Passivhaus and those in the current Scottish Building Standards Technical Handbooks for domestic and non-domestic buildings, including:

- To identify any unintended consequences of targeting a certain ventilation solution.
- What does good and best practice currently look like in Scotland for the design, installation and commissioning of ventilation systems in buildings.
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- What does good and best practice currently look like in Scotland for the design, installation and commissioning of ventilation systems in buildings?
- Discuss what information is provided to occupants on the ventilation strategy for their dwelling, how it works and what maintenance will be required so it continues to function as intended.

Feedback and Discussion Points:

- Challenge is that Air Tightness is assessed differently between PHPP & SAP - difficult to understand like for like
- MVHR technology is advancing capable of resolving some of the technical concerns i.e. self-balancing/ volume control to compensate for filter contaminants
- Current regulations accommodate MVHR and could be expanded to align with the PH requirements/ standards for PH. All need to be aligned with airtightness targets which will naturally need to go deeper if we are to align more closely with PH Standard.
- The PH methodology enables the integration of avoiding overheating principle during the design process. It's not particularly onerous to satisfy (domestic at least) but ensures its integrated. The building standards has resulted in a huge number of lightweight buildings with overheating issues as it has not featured.
- Passivhaus homes have been demonstrated through POE to weather summer overheating well - insulated fabric acts as a battery for better controlled indoor environment
- The performance of dMEV and natural ventilation depend on multiple parameters, including floor-plan layouts, curtains, blinds, trickle vents, stack effects, etc. This means that they generally under-perform.
- We run the risk of creating super tight homes that require the intervention/knowledge of users. If the system is ignored through subsequent home ownership, then it will cause issues.
- Issues with all systems - we need better designers, installers, etc for all ventilation systems.
- Monitoring and data collection of any kind is good. Just need to be careful the homes don't become overrun with technology and services.
- Monitors and guidance on what to do at different CO2 levels important. MVHR would alleviate reliance on this due to constant supply & extract.

- A "cheat sheet" should be created that explains to the occupier on how to operate, understand and maintain their ventilation system; can be included in a homeowner handover pack.
- The reliance on electricity for ventilation systems raises issues of reliability, particularly in affordable housing, but remote monitoring can help mitigate risks.
- There's a pressing need to prioritise air tightness and Mechanical Ventilation with Heat Recovery (MVHR) systems in new construction to avoid future challenges and costs associated with retrofitting. Despite technological advancements in other aspects of life, there's a lag in uptake within the housing sector, raising questions about barriers to adoption.
- Concerns exist regarding the potential exclusion of alternative ventilation systems under new Passivhaus (PH) equivalent regulations, highlighting the importance of regulations based on outcomes rather than prescribing specific solutions. There's a noticeable gap between industry practices and desired standards, emphasizing the need for improved quality assurance measures, particularly in commissioning ventilation systems for domestic buildings. Compliance plans should be evidence-based to ensure the attainment of desired outcomes for certification.

W 6. Quality Assurance and Compliance

To discuss what current and best practice looks like when assuring the quality of new building design and construction, including:

What are the key components of a successful project as regards delivery of energy and environmental performance?

How do you currently demonstrate to a third party that the design and execution of a new build is delivered in a competent and informed manner to achieve the outcomes sought by building regulations?

What methods are currently being employed to de-risk the energy-related aspects of design and construction and provide assurance that the compliant solutions are properly considered and delivered as intended?

How could current good and best industry practice form part of a potential energy standards Compliance Plan 'plug-in'.

What role could the current certifier of design and construction schemes play in a Passivhaus equivalent standard?

Feedback and Discussion Points:

- Quality assurance control needs to be embedded in construction.
- Not enough rigour to SAP assessment/Section 6 certification. Partly because of disconnect between contractor & design.
- Evidence that the things you do are tried, tested and deliverable e.g. a standardisation framework that identifies and addresses risk
- Buy in to the same shared outcome, effective communication at all stages.
- A photograph isn't just a photograph, it puts onus on person to install correctly and demonstrating competence.
- Developers already have their own build stage checks that are thorough in addition to NHBC and Local Authority checks.
- Everyone needs to share best practice across industry and set an intuitive process
- Does a lack of standardisation risk delivery of quality homes
- Role of certifier, is there enough of them, how long will it take to train them, what will this look like
- Social housing demand massive how can it be done at scale.
- Passivhaus certifier is external and independent of design team (no allegiances).
- Establish a process/audit trail for all as minimum standard.

Industry Engagement Workshop

Industry wide engagement session for industry out with the sub working group to contribute to the Passivhaus Scottish Equivalent conversation, this engagement session was followed up by a practical training session delivered at BE-ST's National Retrofit Centre of Excellence by Passivhaus designer Rupert Daley.

Feedback and Discussion Points:

- A package of measures that use reliable solutions to optimise building fabric and service performance, reduce delivered energy demand and provide a healthy indoor environment.
- The design and construction of new buildings must be supported by quality assurance and verification processes that result in buildings that meet the high standards set.
- What do we actually mean by Passivhaus equivalent and what is the role of MMC
- Don’t know what good is – what evidence is there of good practice. Is there a disconnect around section 6 certification