RIBA
Passivhaus Overlay

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Passivhaus Trust

RIBA Architecture.com

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Cover image: Lucy Cavendish College, Student Accommodation, Certified Passivhaus, R H Partnerships Architects.

Image: © Nick Guttridge

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Introduction

The urgent need to reduce carbon emissions and reduce the impact of climate breakdown is well understood; any failure to deliver a meaningful reduction in carbon emissions is a failure to address the needs of future generations. Parliament has declared a climate emergency and the UK Government has committed to reducing the nation's emissions by 100% (relative to 1990 levels) by 2050. As professionals working in the built environment, we understand our industry's sizeable influence on national greenhouse gas emissions. The onus is therefore on us to deliver designs that are in line with this trajectory while providing comfortable and high-quality buildings.

There is increasing recognition within the construction industry of the energy performance gap. Not surprisingly this awareness has led a to growing interest in the evidence-based approach to design and construction on both new build and retrofit projects which is exemplified by the international Passivhaus standard[1].

Sustainability approaches in the RIBA Plan of Work 2020

As part of the commitment to embed sustainability within the profession, key sustainability principles are integrated throughout the RIBA Plan of Work, amplifying the need to consider and develop sustainability strategies from the outset.

Rather than setting specific sustainability targets, the Plan of Work 2020 signposts and acts as a strategic sustainability framework outlining topics for projects to develop and enhance at greater depth. An approach that is advocated throughout is the adoption of a more **outcome-based approach** to sustainable design. Supplementary guidance in the range of overlays and tools offer more focused single-issue support.

Plan of Work Overlays: supplementary guidance

To support project teams with the detail necessary to embed and deliver sustainability outcomes on projects, RIBA has developed a range of tools and guidance that gather specific actions under one remit. For example, the *Plan for Use Guide* (2021) provides greater detail on the activities needed to plan ahead for occupation and building use, and the *Design for Manufacture and Assembly (DfMA) Overlay* (2021) focuses on off-site and modern methods of construction efficiencies.

For clients and project teams wishing to pursue Passivhaus certification, a more focused guide is needed. Therefore, the RIBA, in conjunction with the Passivhaus Trust, commissioned this Passivhaus Overlay to help clients and project teams avoid risk and make informed, intelligent decisions at the right time in order to achieve Passivhaus certification in a streamlined and (cost) effective way.

[1] See, for example, *Closing the gap between design and as-built performance: end of term report*, Zero Carbon Hub (2014); R. Gupta et al., 'Magnitude and extent of building fabric thermal performance gap in UK low energy housing', *Applied Energy* vol. 222 (2018); D. Johnston et al., 'Are the energy savings of the Passive House standard reliable? A review of the as-built thermal and space heating performance of Passive House dwellings from 1990 to 2018', *Energy Efficiency*, Springer (2020)

What this document is

The Passivhaus Overlay is a concise document, which does not act as an introductory guide to the Passivhaus standard. Such guidance has been published by the Passivhaus Trust, accompanied by documented case studies which show the wide array of building typologies that have been certified to date.

If you are new to the Passivhaus standard and want to learn more, familiarise yourself with these guides and read them in conjunction with the Passivhaus Overlay for the RIBA Plan of Work. You will find a full list of references in the **Further Reading** section of this guide.

Lessons learned from Passivhaus design and construction can benefit all low energy building projects, whether or not they are aiming for Passivhaus certification. A Passivhaus approach can identify opportunities for cost and fabric efficiencies as well as energy efficiencies, raise quality in design and construction, and close energy performance gaps.

Lessons from Passivhaus design and construction

Good low energy buildings, including those that meet the Passivhaus standard, require us to reappraise the process of building design and construction. By drawing upon the experience of professionals that consistently apply the Passivhaus standard we can learn what these projects do differently, understand why it is a model of good practice, and gain an appreciation of how it successfully closes energy performance gaps.

A survey undertaken by the RIBA North East Sustainable Futures Forum demonstrated that the Passivhaus design process encourages project teams to consider certain important aspects of design at an earlier stage than the norm. While only a small group was surveyed, the results indicate some of the strategic differences between a 'standard' design approach and the strategic approach adopted by Passivhaus Designers. Figure 1 below illustrates the earliest and latest RIBA Stages when key performance criteria are considered, while Figure 2 presents the results of the survey.

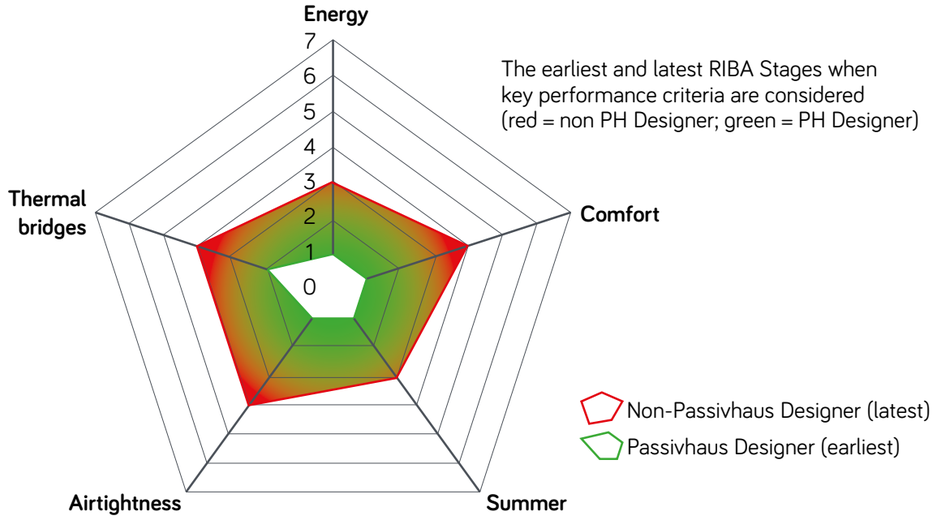

Figure 1: The contrast between the earliest (green line) and latest (red line) RIBA Stages when key performance criteria are considered by Passivhaus Designers and non-Passivhaus designers/architects

“The Passivhaus requirements to front load & complete the design in the preconstruction phase results in many added benefits, including early procurement of sub-contractors and full co-ordination of the digital model. This should, in practice, enable a more efficient build process resulting in less site modification and waste, and ultimately a smoother commissioning and handover process.”

Morrison Construction

Enterprise Centre, Research and Business Hub Certified Passivhaus
Architype
Image © Dennis Gilbert

At what stage in the RIBA Plan of Work do you first consider the 5 key performance criteria?

Survey feedback shown in % below:

	RIBA Stage:	0	1	2	3	4	5	6	7
Non-Passivhaus designers Key perf. criteria	Energy		25	50	25				
	Comfort			33	50	17			
	Summer			67	33				
	Airtightness			20	20	60			
	Thermal bridges			15	43	43			

	RIBA Stage:	0	1	2	3	4	5	6	7
Passivhaus designers Key perf. criteria	Energy		67	33					
	Comfort		33	67					
	Summer		33	67					
	Airtightness		33	67					
	Thermal bridges			100					

Figure 2: Survey data

The survey results presented above support earlier observations made by Boyd Paulson[2] in 1976 which established the relationship between cost and opportunity. Paulson's observations have been developed in the cost/effect curves over time graph in Figure 3 on page 8.

Firstly, the blue line shows how the opportunity for change is greatest early in a project and diminishes as a project progresses. Secondly the red line shows how the cost of change increases as a project progresses, and exponentially once the project is on site. The grey profile shows a traditional design workflow. The point at which workflow is reducing is also the point where the cost of change radically increases (illustrated by the large red dot). This is typically the point when a project goes to tender. If this is not within budget, then redesign may occur in order to avoid cost overruns while on site.

The green curve suggests a different workflow, one which reflects the approach used by Passivhaus Designers, where greater effort is made at the earlier RIBA work stages. This early intervention and coordinated front loading of the design process (which serves to mitigate risk and improve overall design quality) marks a distinct alternative to the conventional workflow, where designs are underdeveloped when tenders are let.

“Adding in Passivhaus requirements later in the process, particularly after planning, limits changeable design elements to the more expensive options such as higher performing windows, solar shading and so on. If Passivhaus is introduced at an earlier stage then cost-effective solutions can be found in orientation, form factor etc.”

Scott Moore, QS at Baker Ruff Hannon

[2] Boyd Paulson, ‘Designing to reduce construction costs’, *Journal of the Construction Division, Proceedings of the American Society of Civil Engineers*, vol. 102, no. CO4 (1976)

Goldsmith Street, Social housing, Certified Passivhaus
Mikhail Riches
Image © Tim Crocker

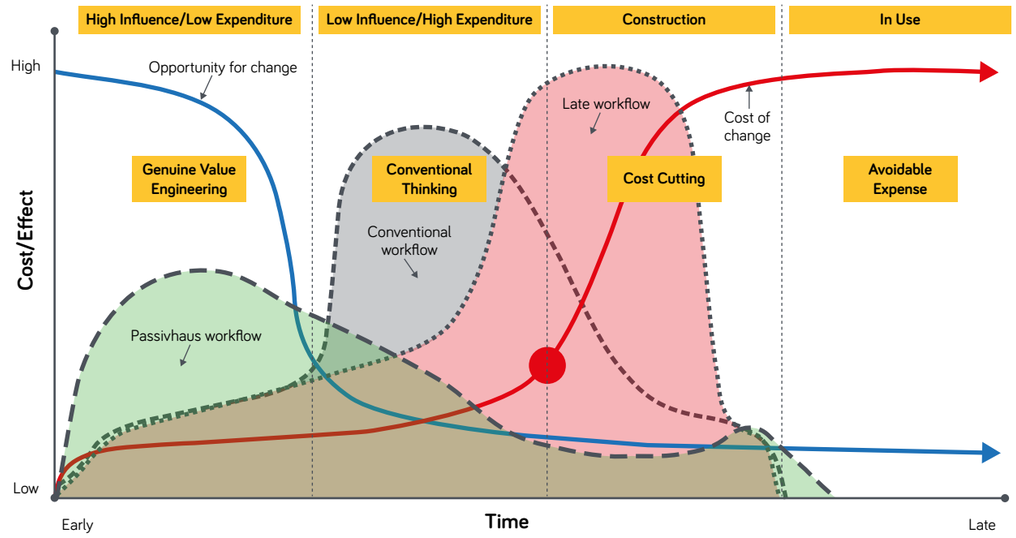

Figure 3: Inspired by Boyd Paulson, 1976

The salmon-coloured profile illustrates the impact of a late design workflow, as witnessed on some design and build projects. Clearly, this scenario should be avoided, regardless of whether the project seeks to achieve the Passivhaus standard or not.

The Passivhaus design process

Despite the fact that workflows and procurement strategies vary between different building types, when it comes to mitigating risk and optimising building design for a successful outcome and Passivhaus certification, some general trends can be observed. It is with this understanding that Figure 4 shows the 'typical' Passivhaus project workflow.

There are two important considerations that warrant highlighting:

A) Passivhaus Planning Package (PHPP) prototyping and options analysis can be done before an architectural design has been developed. This is not traditional design practice, and may at first appear counter-intuitive. However, experience suggests that this approach helps the design team identify the relationships between the range of design constraints which affect any given project, and subsequently aids the development of a site-specific design which responds to these constraints. To inform the design process each building type and site will have an optimal range of useful Design Metrics, generally including, although not limited to, parameters such as form factor, glazing ratio, ventilation rate, length of intake/exhaust ductwork, internal gains etc. Each building typology has an optimal range of factors, ratios, rates etc. and thus early prototyping and options analysis during RIBA Stages 1 and 2 helps the design team to identify and develop these metrics so that the design process can be expedited, costly redesign can be avoided, and construction budgets can be met. The added bonus of such an approach is that this form of analysis also facilitates the reduction of embodied carbon by identifying opportunities to streamline material quantities through resource efficiency right from the outset (as shown in Figure 6 later).

B) Depending on the scale and complexity of a given project, the nature of the design solution and the extent of change that may be proposed, a Stage 5 review *may* not require the input of the Passivhaus Certifier.

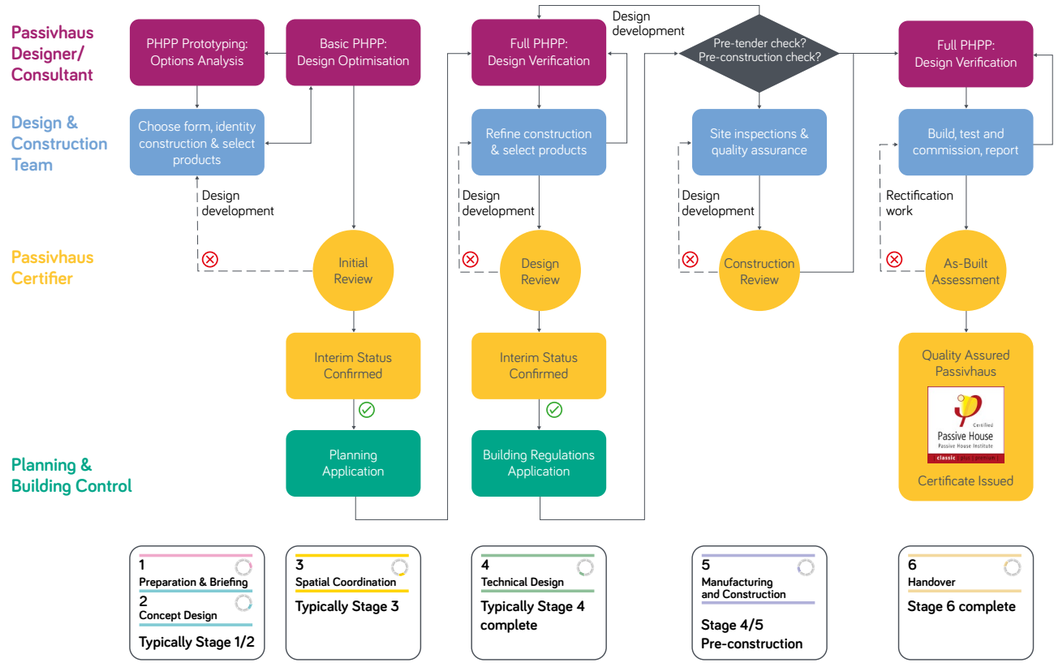

Figure 4: Flow Chart showing a simplified PHPP workflow.

Structure of the Overlay

The Passivhaus Overlay is broken down into four rows of guidance that apply to the project team.

Core Objectives: as per RIBA Plan of Work

Delivery Strategy: itemises key strategic actions that are undertaken by the project team. Actions which complement the overall philosophy of the Passivhaus standard are noted as 'advisory'

Core Quality Assurance Tasks: recognises the strategic considerations that are appropriate to Passivhaus certification

Procurement Tasks: identifies who should be appointed at which time

This structure is graphically represented in Figure 5.

Passivhaus Overlay for the RIBA Plan of Work

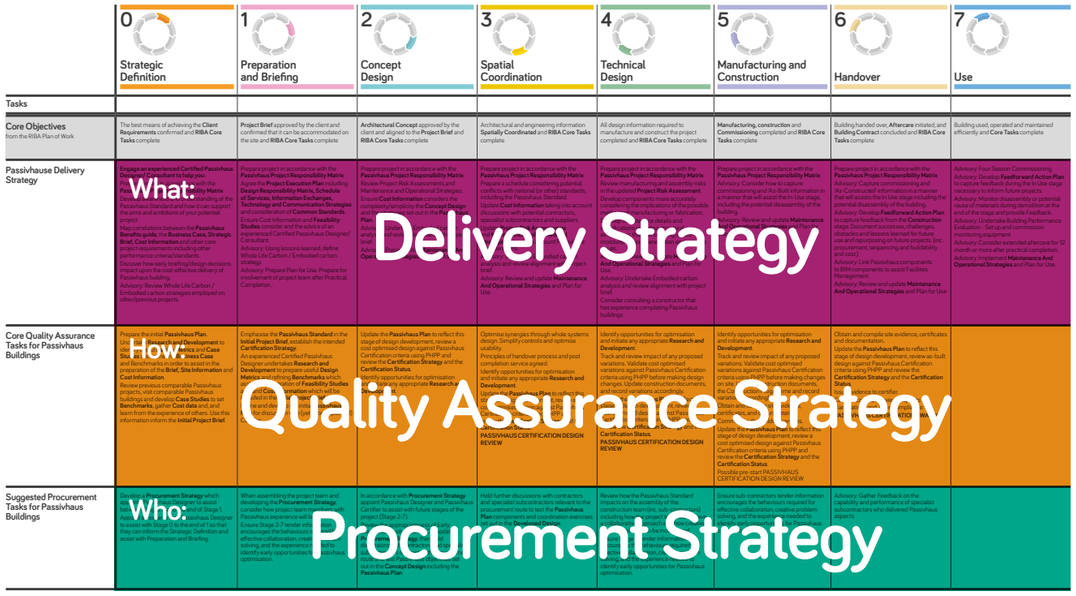

Figure 5: Visual representation demonstrating the structure of the Passivhaus Overlay.

> "With a simple well-developed design we can go in with a small risk register. Normally as contractors we get nothing like that – you can even just get the planning drawings!"
>
> **Passivhaus Contractor**

Synergies offered by the Passivhaus Overlay process

Applying the Passivhaus Overlay and pursuing the Passivhaus standard has beneficial consequences insofar as it can support a reduction in whole life carbon emissions and assist with satisfying the RIBA 2030 Climate Challenge criteria. Figure 6 below describes the relationship between Passivhaus decision-making (which drives a reduction in operational energy and operational carbon emissions) and decision-making which drives a reduction in embodied carbon. This is further explored in the Passivhaus Trust's report *Passivhaus and embodied carbon* (2022).

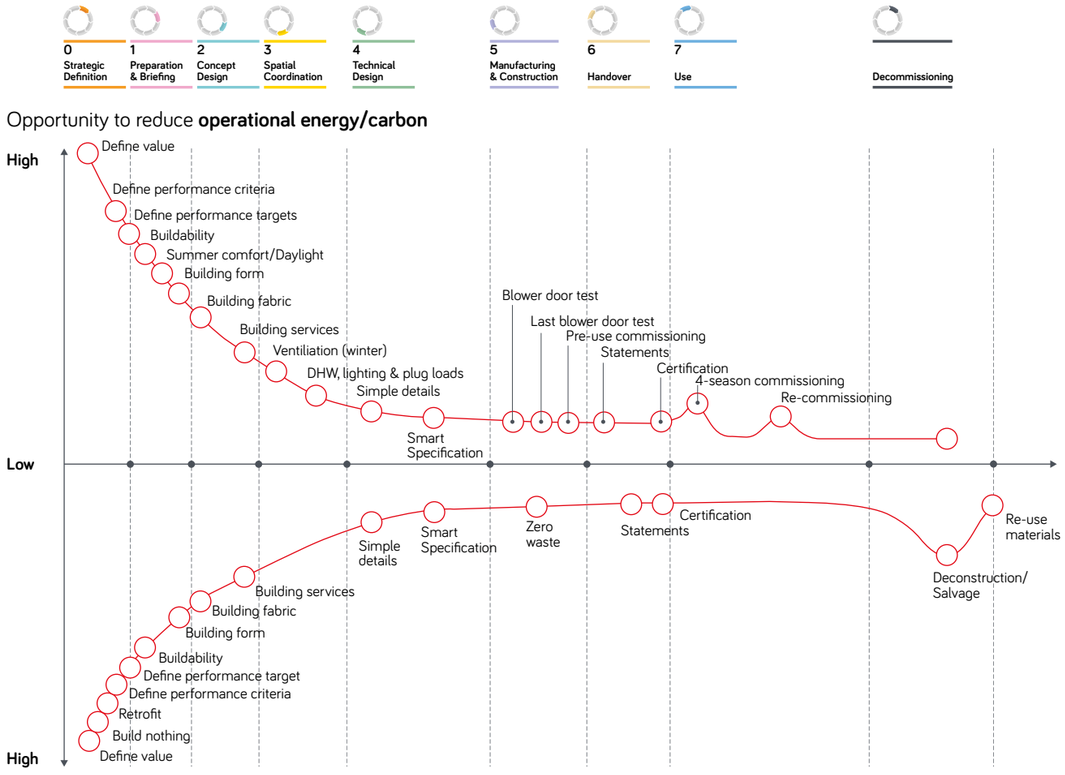

Figure 6: Visual representation of the opportunity for the Passivhaus Overlay to support the delivery of low carbon buildings.

“Ultimately, what we build is to the benefit of communities and Passivhaus buildings epitomise people-centred buildings. Forward-thinking councils and developers across the UK are paving the way and utilising Passivhaus design to provide resilient and sustainable communities, and I am proud that Exeter City Council is one of them – we can all have a legacy that we can be proud of.”

Emma Osmundsen
Managing Director of Exeter City Living Ltd
Exeter City Council

St Sidwell's Point Leisure Centre | Passivhaus Certification pending
Client & Design Architect: Exeter City Council | Delivery Partner: Space & Place
Image © Tom Hargreaves photography

Passivhaus Overlay

	0 Strategic Definition	1 Preparation and Briefing	2 Concept Design	3 Spatial Coordination	4 Technical Design	5 Manufacturing and Construction	6 Handover	7 Use
Tasks								
Core Objectives from the RIBA Plan of Work	The best means of achieving the **Client Requirements** confirmed and **RIBA Core Tasks** complete	**Project Brief** approved by the client and confirmed that it can be accommodated on the site and **RIBA Core Tasks** complete	**Architectural Concept** approved by the client and aligned to the **Project Brief** and **RIBA Core Tasks** complete	Architectural and engineering information **Spatially Coordinated** and **RIBA Core Tasks** complete	All design information required to manufacture and construct the project completed and **RIBA Core Tasks** complete	**Manufacturing, construction** and **Commissioning** completed and **RIBA Core Tasks** complete	Building handed over, **Aftercare** initiated, and **Building Contract** concluded and **RIBA Core Tasks** complete	Building used, operated and maintained efficiently and **RIBA Core Tasks** complete
Delivery Strategy	Engage an experienced **Certified Passivhaus Designer/Consultant** to help you: Prepare project in accordance with the **Passivhaus Project Responsibility Matrix** Develop awareness and understanding of the Passivhaus standard and how it can support the aims and ambitions of your potential project Map correlations between the **Passivhaus Benefits Guide**, the **Business Case, Strategic Brief, Cost Information** and other core project requirements including other performance criteria/standards Discover how early briefing/design decisions impact upon the cost-effective delivery of Passivhaus building *Advisory: review whole life carbon / embodied carbon strategies employed on other/previous projects*	Prepare project in accordance with the **Passivhaus Project Responsibility Matrix** Agree the **Project Execution Plan** including **Design Responsibility Matrix, Schedule of Services, Information Exchanges, Technology and Communication Strategies** and consideration of **Common Standards** Ensure **Cost Information** and **Feasibility Studies** consider the advice of an experienced certified Passivhaus Designer/ Consultant *Advisory: using lessons learned, define whole life carbon / embodied carbon strategy* *Advisory: prepare **Plan for Use**. Prepare for involvement of project team after **Practical Completion***	Prepare project in accordance with the **Passivhaus Project Responsibility Matrix** Review **Project Risk Assessments** and **Maintenance and Operational Strategies** Ensure **Cost Information** considers the complexity/simplicity of the **Concept Design** and the strategies set out in the **Passivhaus Plan** *Advisory: undertake embodied carbon analysis and review alignment with project brief* *Advisory: Prepare initial **Maintenance and Operational Strategies** and **Plan for Use***	Prepare project in accordance with the **Passivhaus Project Responsibility Matrix** Prepare a schedule considering potential conflicts with national (or other) standards, including the Passivhaus standard Update **Cost Information** taking into account discussions with potential contractors, specialist subcontractors and suppliers Update **Project Risk Assessments** and **Maintenance and Operational Strategies** taking into account Passivhaus considerations *Advisory: undertake embodied carbon analysis and review alignment with project brief* *Advisory: review and update **Maintenance and Operational Strategies** and **Plan for Use***	Prepare project in accordance with the **Passivhaus Project Responsibility Matrix** Review manufacturing and assembly risks in the updated **Project Risk Assessment** Develop components more accurately considering the implications of the possible methods of manufacturing or fabrication Develop the interface details and specifications including structural, airtightness, thermal bridging, water/ moisture/ vapour penetration and acoustic issues *Advisory: review and update **Maintenance and Operational Strategies** and **Plan for Use*** *Advisory: undertake embodied carbon analysis and review alignment with project brief* *Consider consulting a constructor that has experience completing Passivhaus buildings*	Prepare project in accordance with the **Passivhaus Project Responsibility Matrix** *Advisory: consider how to capture commissioning and 'As-Built information in a manner that will assist the In-Use stage, including the potential disassembly of the building* *Advisory: review and update **Maintenance and Operational Strategies** and **Plan for Use***	Prepare project in accordance with the **Passivhaus Project Responsibility Matrix** *Advisory: capture commissioning and 'As-Constructed' information in a manner that will assist the In Use stage including the potential disassembly of the building* *Advisory: develop **Feedforward Action Plan** to capture feedback from the **Construction** stage. Document successes, challenges, obstacles and lessons learned for future use and repurposing on future projects (inc. procurement, sequencing and buildability and cost)* *Advisory: link Passivhaus components to BIM components to assist **Facilities Management*** *Advisory: review and update **Maintenance and Operational Strategies** and **Plan for Use***	Advisory: Seasonal Commissioning Advisory: develop Feedforward Action Plan to capture feedback during the In Use stage necessary to inform future projects Advisory: monitor disassembly or potential reuse of materials during demolition at the end of the stage and provide Feedback Advisory: undertake Building Performance Evaluation - set up and commission monitoring equipment Advisory: consider extended aftercare for 12 months or more after practical completion Advisory: implement Maintenance and Operational Strategies and Plan for Use
Core Quality Assurance Tasks	Prepare the initial **Passivhaus Plan** Undertake **Research and Development** to identify useful **Design Metrics** and **Case Studies** and refine the **Business Case** and **Benchmarks** in order to assist in the preparation of the **Brief, Site Information** and **Cost Information** Review previous comparable Passivhaus projects, visit comparable Passivhaus buildings and develop **Case Studies** to set **Benchmarks**, gather **Cost Data**, and learn from the experience of others. Use this information to inform the **Initial Project Brief**	Emphasise the **Passivhaus Standard** in the **Initial Project Brief**, establish the intended **Certification Strategy** An experienced certified **Passivhaus Designer/Consultant** undertakes **Research and Development** to prepare useful **Design Metrics** and refine **Benchmarks** which assist the preparation of **Feasibility Studies** and **Cost Information** which will be included in the **Initial Project Brief** Refine and develop the initial **Passivhaus Plan** for discussion with (yet to be appointed) **Passivhaus Certifier**	Update the **Passivhaus Plan** to reflect this stage of design development, review a cost optimised design against Passivhaus certification criteria using the **Passivhaus Planning Package** (PHPP) and review the **Certification Strategy** and the **Certification Status** Identify opportunities for optimisation and initiate any appropriate **Research and Development**	Optimise synergies through whole systems design Simplify controls and optimise usability Principles of handover process and post completion service agreed Identify opportunities for optimisation and initiate any appropriate **Research and Development** Update the **Passivhaus Plan** to reflect this stage of design development, review a cost optimised design against Passivhaus Certification criteria using **PHPP** and review the **Certification Strategy** and the **Certification Status** **PASSIVHAUS CERTIFICATION DESIGN REVIEW**	Identify opportunities for optimisation and initiate any appropriate **Research and Development** Track and review impact of any proposed variations. Validate cost optimised variations against Passivhaus certification criteria using **PHPP** before making design changes. Update construction documents, and record variations accordingly Update the **Passivhaus Plan** to reflect this stage of design development, review a cost optimised design against Passivhaus Certification criteria using **PHPP** and review the **Certification Strategy** and the **Certification Status** **PASSIVHAUS CERTIFICATION DESIGN REVIEW**	Identify opportunities for optimisation and initiate any appropriate **Research and Development** Track and review impact of any proposed variations. Validate cost optimised variations against Passivhaus Certification criteria using **PHPP** before making changes on site. Update construction documents, the **Construction Programme** and record variations accordingly Obtain and compile site evidence, certificates, and documentation Commission the building services Update the **Passivhaus Plan** to reflect this stage of design development, review a cost optimised design against Passivhaus Certification criteria using **PHPP** and review the **Certification Strategy** and the **Certification Status** Possible pre-start **PASSIVHAUS CERTIFICATION DESIGN REVIEW**	Obtain and compile site evidence, certificates and documentation Update the ***Passivhaus Plan*** to reflect this stage of design development, review as-built design against Passivhaus Certification criteria using **PHPP** and review the **Certification Strategy** and the **Certification Status** Issue evidence to **Passivhaus Certifier** **Passivhaus Certifier** conducts review, requests clarifications and, upon compliance: **PASSIVHAUS CERTIFICATION AWARDED**	
Procurement Tasks	Develop a **Procurement Strategy** which appoints a **Passivhaus Designer/ Consultant** to assist between Stage 0 and the end of Stage 1 Appoint an experienced **Passivhaus Designer/Consultant** to assist with Stage 0 to the end of 1 so that they can inform the **Strategic Definition** and assist with **Preparation and Briefing**	When assembling the project team and developing the **Procurement Strategy**, consider how project team members with Passivhaus experience will be selected Ensure Stage 2-7 tender information encourages the behaviours required for effective collaboration, creative problem solving, and the experience needed to identify early opportunities for Passivhaus optimisation	In accordance with **Procurement Strategy** appoint **Passivhaus Designer/Consultant** and **Passivhaus Certifier** to assist with future stages of the project (Stage 2-7) Review the appropriateness of **Early Contractor Involvement** (ECI), update **Procurement Strategy**, then hold discussions with contractors and specialist subcontractors relevant to the procurement route and test Passivhaus objectives set out in the **Concept Design** including the **Passivhaus Plan**	Hold further discussions with contractors and specialist subcontractors relevant to the procurement route to test the **Passivhaus Plan** components and coordination exercises set out in the **Developed Design**	Review how the Passivhaus standard impacts on the assembly of the construction team (inc. sub-contractors) including how the project team will achieve a collaborative approach and how creative problem solving can be incentivised Ensure Stage 5 tender information encourages the behaviours required for effective collaboration, creative problem solving, and the experience needed to identify early opportunities for Passivhaus optimisation	Ensure sub-contractors tender information encourages the behaviours required for effective collaboration, creative problem solving, and the experience needed to identify early opportunities for Passivhaus optimisation	*Advisory: gather **Feedback** on the capability and performance of specialist subcontractors who delivered Passivhaus aspects*	

Passivhaus Project Responsibility Matrix

To support the delivery of the Passivhaus Overlay, a Project Responsibility Matrix has been developed that allocates roles and responsibilities to various parties within the Project Team. Having clarity on responsibilities and roles within the process is fundamental for the successful implementation of the overall Passivhaus Overlay process.

	0 Strategic Definition	1 Preparation and Briefing	2 Concept Design	3 Spatial Coordination	4 Technical Design	5 Manufacturing and Construction	6 Handover	7 Use
Client	Appoint an experienced **Passivhaus Designer/ Consultant** to support the project up to the end of Stage 1 Supported by a **Passivhaus Designer/ Consultant**, undertake **Research and Development**, prepare **Case Studies, Site Appraisals** etc.	Commission supplementary brief development as required	Appoint design team (inc. **Passivhaus Certifier** and **Passivhaus Designer/ Consultant**) to support the project between Stage 2 and 7					
Architecture and Engineering		Appoint architect and building services engineer up to the end of Stage 1 Develop design scenarios considering value engineering, as informed by **Passivhaus Designer/Consultant**	Develop and refine design liaising with **Passivhaus Designer/Consultant** and take onboard feedback from previous **Information Exchange** and progress design accordingly	Liaise with **Passivhaus Designer/ Consultant** and take onboard feedback from previous **Information Exchange** and progress design accordingly Synthesise design with feedback from pre-planning application discussions	Liaise with **Passivhaus Designer/ Consultant** and take onboard feedback from previous **Information Exchange**, catalogue all junctions and interfaces and progress technical design accordingly	Liaise with **Passivhaus Designer/ Consultant** and take onboard feedback from previous **Information Exchange** and progress design accordingly	Liaise with **Passivhaus Designer/ Consultant** and assist with the preparation and collation of evidence	
Passivhaus Designer/ Consultant	**Stakeholder Workshop** Develop a strategic **Passivhaus Plan** that will inform the implementation of the **Strategic Brief** Review Passivhaus design strategies employed on other/previous projects Support the development and refinement of case studies that inform the **Initial Project Brief**	Introduce new members of the **Project Team** to Passivhaus standard. Design input begins Use the **Passivhaus Planning Package (PHPP)** to identify and test project specific constraints arising from climate zone, site constraints, and project objectives (inc. location, orientation, and form). Subsequently develop and optimise useful **Design Metrics** and refine **Benchmarks** which assist the preparation of **Feasibility Studies, Cost Information** and the **Initial Project Brief** Support development and refinement of case studies that inform the **Initial Project Brief** Prepare the initial **Passivhaus Plan** for discussion with (yet to be appointed) **Passivhaus Certifier**	Introduce new members of the **Project Team** to the Passivhaus standard and refine **Design Metrics** using preliminary **PHPP** analysis, lessons learned and case studies Liaise with project team, collate evidence, update the **Passivhaus Plan** to reflect this stage of design development, review design against Passivhaus certification criteria using **PHPP**, review the **Certification Strategy**, and report the **Certification Status**	Liaise with project team, collate evidence, update the **Passivhaus Plan** to reflect this stage of design development, review design against Passivhaus certification criteria using **PHPP**, review the **Certification Strategy**, and report the **Certification Status** Provide strategic information to support planning application	Liaise with project team, collate evidence, update the **Passivhaus Plan** to reflect this stage of design development, review design against Passivhaus certification criteria using **PHPP**, review the **Certification Strategy**, and report the **Certification Status** Agree a suitable airtightness testing regime	Liaise with project team collate evidence, update the **Passivhaus Plan** to reflect this stage of design development, review design against Passivhaus certification criteria using **PHPP**, review the **Certification Strategy**, and report the **Certification Status** Undertake **Site Inspections** and witness blower door tests and commissioning of mechanical systems as agreed	Liaise with project team collate evidence, update the **Passivhaus Plan** to reflect this stage of design development, review design against Passivhaus Certification criteria using **PHPP** and review the **Certification Strategy** report the **Certification Status** *Advisory: assist with the refinement of the quick start / user guide*	
SAP/iSBEM				Initial model	Updated model		Compliance model	
Contractor			Contractor may be appointed to suit procurement methodology			Constructor to nominate **Airtightness and Thermal Integrity Champion (ATTIC)**. Provide evidence that critical materials, components, and equipment have been delivered/installed and that defects are addressed Reduce risk: undertake interim pressure test prior to obstructing air barrier Undertake completion airtightness test and commission mechanical/electrical equipment (settings/controls to be consistent with simulation model of the final design)	Arrange blower door tests Arrange MVHR/ventilation commissioning **Site Manager** to write/sign letter of compliance	
Passivhaus Certifier			Liaise with **Passivhaus Designer/ Consultant** / project team	Liaise with **Passivhaus Designer/ Consultant** / project team **PASSIVHAUS CERTIFICATION DESIGN REVIEW**	Liaise with **Passivhaus Designer/ Consultant** / project team **PASSIVHAUS CERTIFICATION DESIGN REVIEW**	Liaise with **Passivhaus Designer/ Consultant** / design and construction team Possible PASSIVHAUS CERTIFICATION DESIGN REVIEW	Liaise with **Passivhaus Designer/ Consultant** / design and construction team **PASSIVHAUS CERTIFICATION DESIGN REVIEW**	
Information Exchanges at the end of the stage	**Passivhaus Plan**	Develop BIM output core data for export to **PHPP** **Passivhaus Plan** **Schedule of Services** **Design Responsibility Matrix**	Documentation supporting the **Passivhaus Plan** including design variations	Documentation supporting the **Passivhaus Plan** including design variations and the intended construction/assembly sequence	Documentation supporting the **Passivhaus Plan** including design variations and the intended construction/assembly sequence	Documentation supporting the **Passivhaus Plan** including **Construction Programme** and variation orders	Passivhaus evidence submitted to **Passivhaus Certifier** **PASSIVHAUS CERTIFICATION AWARDED**	

Passivhaus Plan

The **Passivhaus Plan** is used to identify the types of information that are required and the RIBA Stages at which they are useful. A live document synthesising the team's input and outlining the next steps, it provides a structure which can used when reporting the status of the **Compliance Risk Management Information**.

The headings and many of the sub-headings are harmonised with standard Uniclass headings and codes and are therefore not a new 'burden' upon a project team, rather they represent good practice. The Passivhaus Plan confirms when this information becomes useful in order to help project teams reduce risk and deliver better quality projects. The Passivhaus Plan and its reporting is managed by the Passivhaus Designer/Consultant. Working with the client team and the Passivhaus Certifier, the Passivhaus Designer/Consultant will establish the level of development required for each RIBA Stage. Then, as appropriate, the Passivhaus Designer/Consultant will review available evidence against Passivhaus certification criteria, review the Certification Strategy and then endeavour to inform the development of relevant strategies. The Passivhaus Plan includes the following:

Table 1: PASSIVHAUS PLAN	RIBA STAGE							
	0	1	2	3	4	5	6	7
CERTIFICATION STRATEGY								
• Passivhaus standard (Passivhaus / EnerPHit)	■	■	■					
• Passivhaus classification (Classic, Plus, Premium)	■	■	■					
• Peak Load or Specific Heat Demand method (or EnerPHit component method)	■	■	■					
• Compliance Risk Management Information			■	■	■	■	■	
• Compliance and certification documents						■	■	
PROJECT SPECIFIC PASSIVHAUS PLAN/S: (Develop as appropriate – refer to Table 3 below)	■	■	■	■	■	■	■	
SITE STRATEGY								
• Site appraisals	■	■						
• Site information (site altitude, site grid reference)		■						
• Urban design & site layout		■	■					
• Orientation & solar access / sun path diagrams		■	■	■	■			
FABRIC STRATEGY								
• Form factor (A/V ratio) & massing, complexity		■	■	■	■			
• Daylight and solar gains-informed glazing and shading strategy		■	■	■	■			
• Structural engineering design strategy		■	■	■	■			
• Thermal performance requirements (walls, floors, roofs, windows, doors etc.)		■	■	■	■	■		
• Construction strategy / buildability statement:		■	■	■	■	■	■	
– Airtightness and Thermal Integrity Strategy		■	■	■	■	■		
– Airtightness and thermal bypass risk schedule			■	■	■	■		
– Thermal bridge risk schedule			■	■	■	■		
– Thermal bridge calculations (high risk)			■	■	■			
– Thermal bridge calculations (confirmatory)					■	■	■	
– Construction Programme			■	■	■	■	■	

Table 1 (cont.): PASSIVHAUS PLAN	RIBA STAGE							
	0	1	2	3	4	5	6	7
SERVICES STRATEGY								
• Heating and cooling design strategy			■	■	■	■	■	
• Hot and cold water supply design strategy			■	■	■	■	■	
• Ventilation design strategy (summer, winter and inter-seasonal)			■	■	■	■	■	
• Lighting strategy			■	■	■	■	■	
• •Low-voltage power supply strategy			■	■	■	■	■	
SERVICES STRATEGIES (cont.)								
• Ancillary building services strategies (fire, security, controls etc.)			■	■	■	■	■	
• Renewable energy strategy (where required)			■	■	■	■	■	
MAINTENANCE AND OPERATIONAL STRATEGIES (align with RIBA Plan for Use)								
• Maintenance strategy: ventilation		■	■	■	■	■	■	
• Maintenance strategy: lighting and small power				■	■	■	■	
• Maintenance strategy: mechanical, electrical, instrumentation, controls and automation (MEICA) – fire, security, controls etc.				■	■	■	■	
• Maintenance strategy: renewables (where required)				■	■	■	■	
• Operational strategy: summer comfort usability plan		■	■	■	■	■	■	
• Operational strategy: End User Operating Information				■	■	■	■	
• Operational strategy: handover strategy				■	■	■	■	
• Operational strategy: Building Performance Evaluation (BPE) plan	■	■	■	■	■	■	■	■
• Operational strategy: Commissioning strategy and Commissioning Programme					■	■	■	
SUMMER COMFORT STRATEGY								
• Summer Comfort Strategy (coordination of certification, fabric, services and maintenance)		■	■	■	■	■	■	
SITE EVIDENCE STRATEGY								
• Site visit schedule					■	■	■	
• Site inspection reports (inc. progress photographs)						■	■	
• Compliance statement(s): initial blower door test						■		
• Compliance statement: completion blower door test						■		
• Compliance statement: commissioning report for mechanical systems						■	■	
• Air leakage test certificate						■	■	
• Commissioning strategy, programme, information and reports						■	■	
• Change Control Management: schedule of design changes since commencement on site						■		
• Site Manager's Compliance Statement							■	
TOOLBOX TALKS								
• Site managers and site operatives						■		
• Suppliers/manufacturers						■		

Table 1 (cont.): PASSIVHAUS PLAN	RIBA STAGE							
	0	1	2	3	4	5	6	7
THERMAL PERFORMANCE STRATEGY: PASSIVHAUS PLANNING PACKAGE (PHPP)								
– Options analysis (informed by Site Strategy)								
– Certification criteria status								
• Peak Load (PL)								
• Specific Heat Demand (SHD)								
• Summer Comfort								
• Primary Energy / Primary Energy Renewable								
– Fabric Strategy analysis: U-values, MVHR, thermal bridging, etc.								
– Fabric Strategy analysis - detailed development: U-values, MVHR, thermal bridging, etc.								
STANDARDS SYNTHESIS								

KEY:

Applies to all building types

Applies to large, complex domestic and non-domestic buildings.

> The City of Edinburgh Council have adopted Certified Passivhaus as a proven approach. It provides clarity around design and construction expectations, thereby ensuring building performance and user comfort expectations are delivered.

Edinburgh City Council

Entopia Building, Deep Retrofit Office, Certified EnerPHit Architype Image: © SCLK Photography Ltd

Project Specific Passivhaus Plan

Depending upon the building type, size, scale, and complexity, one or more Project Specific Passivhaus Plans may be applicable on a given project. While specific requirements may differ on a project-by-project basis, and should be agreed with the Passivhaus Designer/Consultant, the matrix below (Table 3) provides a starting point.

How to develop a Project Specific Passivhaus Plan:

1. At RIBA Stage 0 hold a project team meeting to agree the applicability of the Project Specific Passivhaus Plans listed in Table 3 (take a printout of this page to the meeting)
2. At the end of the meeting, mark up Table 3 to show which Project Specific Passivhaus Plans are pertinent to the project (this will provide structure for the brief and the ensuing scope of services)
3. As appropriate, review and refine the need for Project Specific Passivhaus Plans during the evolution of a project – i.e. Stage 1 and beyond
4. For every Project Specific Passivhaus Plan, use Table 4 to inform the level of development at each RIBA Stage

Table 3: MATRIX OF PROJECT SPECIFIC PASSIVHAUS PLAN/S	Social housing	Rented property	Flats/apartments etc.	Schools	Offices	Retail	Existing buildings	Hospitals / healthcare	Leisure centres
Community, Landlord and Tenant Liaison Plan									
Fitout/Equipment Procurement Strategy									
Plug Loads and Internal Gains Management									
EnerPHit Management Plan									
Bespoke Typology Plan									

> A clear link between level of design at the time of pricing was also identified, with more detailed design information generating more cost-effective prices. This is likely to be due to a reduction in risk pricing as design is further defined.

Passivhaus Trust

Table 4: PROJECT SPECIFIC PASSIVHAUS PLAN	RIBA STAGE							
	0	1	2	3	4	5	6	7
Community, Landlord and Tenant Liaison Plan								
Fitout/Equipment Procurement Strategy								
Plug Loads and Internal Gains Management Plan								
EnerPHit Management Plan								
• Investigate								
– Building survey (RICS Level 4 or similar)								
– Asbestos survey report and management strategy								
– Radon: desktop study, tests and/or monitoring reports								
– Flood risk management information								
• Strategy								
– Conservation strategy (conservation area / listed building status)								
– Rising and penetrating damp management strategy								
– Internal / external insulation strategy								
– Lock-in Risk Assessment								
– Interfaces/junctions strategy (continuity of air barrier and insulation)								
– Phased retrofit plan								
• Model								
– PHPP: Whole building model								
– PHPP: Phased retrofit building model								
Bespoke Typology Plan								

> “As contractors the Passivhaus approach is a quality standard helping us to deliver projects profitably by avoiding costly defects and call backs. At Makar we prioritise getting things right first time, and to a high standard of quality. This is why we follow Passivhaus principles.”

MAKAR

Glossary of Terms:

Term/task	Definition
Airtightness and Thermal Integrity Champion	With specific attention to Passivhaus-related matters, their role is to support and oversee the construction process, where necessary gathering evidence, liaising with the Passivhaus Designer/Consultant, sub-contractors and trades.
Airtightness and Thermal Integrity Strategy	The Airtightness and Thermal Integrity Strategy is not just red (airtightness) and blue (wind barrier) line strategy drawings which encapsulate the insulation, it also includes all construction details, a regime for training trades, testing mock-ups prior to implementation and planning the blower door test regime (particularly relevant for larger buildings). More detailed guidance is available in the *Passivhaus Trust's Demystifying airtightness: good practice guide* (2020) and *Thermal bypass risks: a technical review* (2022).
Bespoke Typology Plan	Not all building typologies fit within the normal range of criteria established by the Passivhaus Institut. To confirm whether bespoke certification criteria will apply, an experienced Passivhaus Designer/Consultant will need to review the brief and the associated performance requirements. They will then advise whether the Passivhaus Institut requires consultation.
Building Performance Evaluation (BPE)	The process of gathering quantitative and qualitative data and interpreting that information in order to draw conclusions about the performance of one or more of a building's attributes. It is advantageous to undertake BPE to gather data about the existing building. BS:40101 (BSI, 2022) establishes a framework for undertaking Building Performance Evaluation. It can be useful to review energy use (e.g. CIBSE TM22) and occupant satisfaction (BUS), and then, as appropriate, follow up with temperature and humidity monitoring, thermographic surveys and air leakage tests. This information can be used for designing out existing problems (changing control systems, updating technology, and training occupants), providing feedback to the project team, and informing Seasonal Commissioning of mechanical/electrical equipment.
Certification Review	Undertaken by Passivhaus Certifier to determine the status of the project and to assess compliance with the standard. May include a PHPP review and Compliance Risk Management Information.
Certification Strategy	A live document that is developed, used and updated to establish the client's aims and ambitions with regard to Passivhaus standard, Passivhaus classification, certification method (Peak Load or Specific Heat Demand), energy target (Primary Energy or Primary Energy Renewable), summer and winter comfort, airtightness, air quality, noise and Compliance Risk Management Information.
Compliance Risk Management Information	A live document that is used to manage the status of the project and information exchanged between the design team, contractor, the Passivhaus Designer/Consultant and the Passivhaus Certifier. It includes a record of relevant change orders which may influence certification.
Design Metrics	To inform the design process each building type and site will have an optimal range of useful Design Metrics, generally including, although not limited to, parameters such as form factor, glazing ratio, ventilation rate, length of intake/exhaust ductwork, internal gains etc. Each building typology has an optimal range of factors, ratios, rates etc. and thus early prototyping and options analysis by means of the PHPP model during RIBA Stages 1 and 2 helps the design team to identify and develop these metrics so that the design process can be expedited, costly redesign can be avoided, and construction budgets can be met.
End User Operating Information	During the process of handing over a new or retrofitted building various user groups should be provided with non-technical and technical training as well as useful guides which explain how the building should be operated. Over time this information may need to be adapted as lessons are learned and new opportunities are recognised. As such End User Operating Information should be considered a live document. The RIBA Plan for Use can be used to inform the development of the End User Operating Information.

Term/task	Definition
EnerPHit Management Plan	This plan includes an assessment of retrofit strategy and certification strategy (single phase or step-wise), surveys to gather data about the existing building, and strategies to address the specific demands of the building and site. This whole building retrofit plan includes modelling the existing building in the Passivhaus Planning Package (PHPP) to provide detailed calculations of the existing fabric performance of the building. Importantly, all approaches to retrofit, including EnerPHit, require some augmentation to deliver robust solutions addressing all aspects of the retrofit performance gap and unintended consequences. Consider: energy use (e.g. CIBSE TM22), a BUS survey, dimensional, moisture, thermographic and air leakage, building condition. Where appropriate analyse data using metrics that map onto Passivhaus benchmarks. Integrate with moisture risk assessments.
Fabric Strategy	This comprises form factor, glazing and shading and structural engineering strategies, and thermal performance requirements, as well as the Airtightness and Thermal Integrity Strategy, thermal bridge assessments and the Construction Programme. With a focus upon construction technology and buildability, develop an integrated approach which supports the airtightness strategy, thermal integrity strategy and thermal bridging mitigation strategy. Well implemented strategies avoid complexity, simplify construction, and reduce costs, avoid risks and the shorten the Construction Programme. To support this process, review plans, cross sections, longitudinal sections etc. and identify all junctions and interfaces. Consider how the building's form and complexity impact upon the construction sequence and may compromise the airtightness testing regime, the standard of airtightness, the thermal integrity, and the extent of thermal bridging. At each stage and before work starts on site, to help ensure the right materials, plant and operatives are deployed in the right place at the right time, pay attention to the properties, characteristics and suitability of materials, products, components, and sub-assemblies, including their tolerances, impact upon interfaces, their fabrication and manufacturing techniques, their logistics (including the lifting, handling, transport and delivery methodology) and assembly. If possible, also seek to eliminate scaffolding and wet or hot works. Where appropriate, and liaising with the Passivhaus Designer/Consultant, agree which thermal bridges require calculation.
Fitout/ Equipment Procurement Strategy	This is a live document that is developed, used and updated to manage and inform the procurement strategy for appliances and equipment. This is necessary because the significant impact on summer comfort, and therefore overheating risks, that can result from electrical loads make procurement strategies for appliances and equipment particularly important in low energy buildings (including those targeting the Passivhaus standard).
Maintenance and Operational Strategies	These define how systems will be maintained and by whom, and should also cover commissioning and user guidance. The maintenance and operational requirements of various systems inform and influence the initial project brief. Therefore, knowing who and how systems will be maintained, and filters will be changed, impacts upon the location and space planning of the mechanical ventilation heat recovery units. Also, to assist with the measurement, calibration and commissioning of building services equipment, a Commissioning Plan and Programme should be developed, reviewed, updated, and implemented by the project team. Commissioning may be undertaken at various points prior to completion – to allow fault finding/remediation – and then at agreed intervals during the defects liability period (and later) – to verify that the systems comply with the construction documents/contract and design intent. More broadly, to support the daily use and operation of the building, appropriate guidance for each user group should be provided in the form of a quick start user guide. Refer to RIBA Plan for Use for supporting information.
Landlord, Occupant & Tenant Management Plan	A live document that is developed, used and updated to consider usability and maintenance strategy (access to plant etc.) This is particularly pertinent for landlords as it can influence access to and the position of MVHR units. Input is required from the maintenance department from a formative stage. This plan is important for all buildings (including those achieving the Passivhaus standard).

Term/task	Definition
Level of Development	Proportionate to the risks involved, the Passivhaus Designer/Consultant and client team need to determine the level of design development that the client team wish to review so that the Design Reviews for these aspects can be incorporated into the Design Programme.
Lock-in Risk Assessment	Lock-in occurs when infrastructure, technology and product design choices are responsible for avoidable GHG emissions. In this context the term refers to moderate improvements in energy efficiency which are undertaken on retrofit projects. Once such measures have been undertaken it becomes unsustainable, uneconomical and impractical to change the building, leading to substandard performance for at least 30 or 40 years. To avoid lock-in the standard of energy efficiency achieved by each measure must be future-proof. A lock-in risk assessment considers a range of scenarios, the construction sequence, phasing, maintenance plans and financial planning, and seeks to achieve the best possible outcome over the lifecycle of the building. Sometimes it may be more beneficial to postpone a measure, so that it may be undertaken properly later, rather than using a moderate improvement which fits within a restricted, but existing budget. Where possible less energy-intensive technology and product design choices should be used to 'leapfrog' emissions-intensive intermediate technology and jump straight to cleaner solutions.
Passivhaus Designer/ Consultant	An accredited person who works as a part of the design team. With specific attention to Passivhaus related matters, their role is to support, oversee, advise, and check the design and construction process, where necessary liaising with stakeholders, the design and construction teams, and the Passivhaus Certifier. A qualified person is given the title Passivhaus Designer if they hold an additional design qualification (e.g. is an architect); otherwise, they are given the title Passivhaus Consultant.
Passivhaus Certifier	An accredited independent third party employed to review the design and quality assurance measures undertaken by the project team. Upon satisfactory completion a building can be certified.
Passivhaus Tradesperson	An accredited person who works as a part of the construction team. Their training covers all the essential aspects of low-energy construction and what it means practically when implemented on site, including an understanding of energy standards and Passivhaus fundamentals, key aspects for achieving Passivhaus – insulation, high-performance glazing, airtightness, thermal bridging and ventilation – and how to ensure quality is delivered on site.
Passivhaus Planning Package (PHPP)	The Passivhaus Planning Package is used to calculate energy use and to help assess whether thermal comfort criteria are being achieved. The Passivhaus Designer/Consultant builds PHPP models to support the design process. For reviews and certification, the Passivhaus Certifier builds their own model to help verify the design and identify design assumptions.
Peak Load (PL):	The heating load which has to be satisfied on either the coldest or cloudiest day of the year. Normally stated as W/m^2.
Plug Loads and Internal Gains Management Plan	This is a live document that is developed, used and updated to reflect the best available understanding of the building's intended occupancy types, electrical equipment loads and occupancy patterns. This will inform an understanding of time utilisation and the resulting hot water and electrical loads, monthly performance profiles and targets for building systems (heating, hot water, cooling, fans, pumps etc.), and allow appropriate sub-metering strategies to be developed). This document is important in all low energy buildings (including those achieving the Passivhaus standard).
Primary Energy (PE)	Energy found in natural resources which has not yet been subject to a human engineered conversion process.
Primary Energy Renewable (PER)	Energy which is generated by renewable resources while also recognising the impact of other factors such as storage losses and climate data.
Research and Development	A process of analytical investigation which identifies, tests and optimises strategic objectives, develops useful Design Metrics and Case Studies, and refines the Business Case, Benchmarks, Feasibility Studies and Concept Designs, in order to assist in the preparation of the Brief, Site Information and Cost Information.

Term/task	Definition
Site Evidence Strategy	This is a plan for capturing site evidence including inspections, photos, airtightness testing regime, commissioning and handover programme. When appropriate, witness statements are prepared after a Passivhaus Designer/Consultant attends site, witnesses a specific/critical activity being undertaken, or addresses any questions or uncertainties that may arise (interpretation of standards/protocols etc). Their purpose is to confirm the works were undertaken in accordance with the construction documents/contract.
Site Manager's Compliance Statement	The Passivhaus standard requires Site Managers to provide a signed statement which confirms that the building they have constructed complies with the contract documents and that all changes have been tracked and reported to the design team and Passivhaus Designer/Consultant prior to being submitted to the Passivhaus Certifier. A Passivhaus building cannot be certified without this statement.
Specific Heat Demand (SHD)	The amount of energy required for space heating over a period of time (often one year). Normally stated as kWh/m^2.a.
Standards Synthesis	Not all design standards and criteria integrate in a tidy manner. For this reason, it is important to review standards, identify, manage, and mitigate conflicts and avoid the risk of non-compliance. In some cases, dispensations may be sought. Examples may include: (1) Seeking dispensation from a suitable party, say Building Control (2) Designing to satisfy the most onerous standard, and then managing the consequences upon other standards i.e. there may be a cascade of consequences and decision making which needs to be managed – this may involve one or more party, or (3) obtaining client feedback and agreeing to change or clarify the brief).
Stakeholder Workshop	An event, or series of events, used to explain what Passivhaus buildings are, why they are different and how and why the Passivhaus standard is used to deliver these buildings. The workshop also allows stakeholders to engage in a constructive discussion about cost and value and for the Passivhaus Designer/Consultant to address misconceptions, help stakeholders make informed, intelligent decisions and help them plan their next steps.
Structural Strategy	With a focus upon the interfaces between primary and secondary structure develop the airtightness strategy, thermal integrity strategy and thermal bridging mitigation strategy by scheduling risks and then reducing complexity by considering the erection sequence, developing a detailed understanding of material properties and characteristics, and their suitability/impact upon PHPP models and project risks. Where appropriate, liaising with the Passivhaus Designer/Consultant, agree which thermal bridging calculations require calculation.
Summer Comfort Strategy	The Passivhaus Trust recommends all projects go through a summer comfort risk assessment and stress testing, following the guidance in Avoiding summer overheating and making use of the free Passivhaus Trust PHPP plugin as well as stress testing in PHPP10. For dwellings PHPP analysis is usually adequate. For larger and/or more complex buildings overheating risks should also be assessed with supplementary dynamic modelling in accordance with boundary conditions required by the Passivhaus Certifier. This may include CIBSE TM52/ CIBSE TM59.
Toolbox Talks	Site workshops which are used to educate site personnel, including site manages and trades, about the quality assurance requirements of the project and obtain feedback that will help to avoid problems which could arise during the construction process.

Further reading:

Passivhaus Trust

Passivhaus Primers https://pht.guide/primers

Passivhaus: a route to net zero – operational carbon

Passivhaus: a route to net zero – retrofit

Passivhaus: a route to net zero – embodied carbon

Passivhaus Trust publications

Thermal bypass risks: a technical review (2022) https://pht.guide/thermalbypass

Passivhaus and embodied carbon (2022) https://pht.guide/embodiedcarbon

Modelling assumptions for steel projects (2022) https://pht.guide/steel

Passivhaus benefits (2021) https://pht.guide/benefits

Passivhaus retrofit in the UK (2021) https://pht.guide/retrofit

Avoiding summer overheating (2021) https://pht.guide/summer

Demystifying airtightness: good practice guide (2020) https://pht.guide/airtightness

Passivhaus construction costs (2019) https://pht.guide/costs

Passivhaus: the route to zero carbon? (2019) https://pht.guide/zerocarbon

Good practice guide to insulation (2017) https://pht.guide/insulation

How to build a Passivhaus: rules of thumb (2015) https://pht.guide/howto

Passivhaus Trust campaigns and resources

Passivhaus for social housing

Passivhaus retrofit

Passivhaus for educational buildings

Passivhaus and zero carbon

Passivhaus and embodied carbon

Efficiency First

RIBA

Plan for Use guide
https://www.architecture.com/knowledge-and-resources/resources-landing-page/plan-for-use-guide

Design for Manufacture and Assembly (DfMA) Overlay to the Plan of Work
https://www.architecture.com/knowledge-and-resources/resources-landing-page/dfma-overlay-to-the-riba-plan-of-work

Sustainable Outcomes Guide
https://www.architecture.com/knowledge-and-resources/resources-landing-page/sustainable-outcomes-guide

Passivhaus Training

Accredited Passivhaus training

Passivhaus Designer/Consultant and Passivhaus Tradesperson Training: Coaction https://coaction.org.uk

Other Certified Passivhaus training https://www.passivhaustrust.org.uk/certified_training_events.php

On demand training from the Passivhaus Trust

Introduction to Passivhaus

Getting to net zero

Passivhaus retrofit masterclass lecture series

Keeping cool: avoiding overheating risks

Large & complex Passivhaus masterclass lecture series

On demand training from RIBA

Passivhaus series CPD https://riba-academy.architecture.com/ilp/pages/description.jsf?menuId=1106#/users/@self/catalogues/150435/programmes/975635/description

George Davies Centre for Nanoform, Certified Passivhaus Associated Architects Image: © Associated Architects LLP

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Emily Partridge, Architype

Sarah Delany, NBS

Ruth O'Leary, NBS

Copy editing by:

Laura Soar, Passivhaus Trust

RIBA
Passivhaus Overlay

Royal Institute of British Architects
66 Portland Place
London
W1B 1AD

Charity No. 210566
Telephone: +44 (0)20 7580 5533
info@riba.org

Passivhaus Trust

RIBA Architecture.com