Passive House Design Consideration by Iga Panczyna

Allan Corfield
ARCHITECTS

Who Are ACA?

- Based in Dunfermline & Swindon
- Covering the whole of the UK
- Worked on over 500 projects
- Specialists in low energy residential projects
- £5m of PI
- RIBA Chartered Architects
- Energy Performance & Passive House Design
- Cost Consultancy
- CDM Principle Designer
- Structural Engineering
- VR & 3D design

Today's Topics

1. Performance Standards
1. Fabric First Principles
2. Site Considerations
3. Orientation
4. Windows
5. Construction
6. Passive House Planning Package

1. Performance criteria –

The Future Homes Standard/Net Zero

From 2025 no new homes should be connected to the gas grid, they should instead be heated through low-carbon sources and have ultra-high levels of energy efficiency alongside appropriate ventilations. (committee on climate change)

1. The new Future Homes Standard is aimed to ensure that all new homes built from 2025 will produce 75-80% less carbon emissions than homes built to previous regulations

2. Changes are in place and an uplift in building regulations standards was introduced in England in June 2022 & end of 2023, in Scotland in February 2023 with new homes required to produce 32% less carbon emissions compared to previous standards.


ONLINE VERSION

HM Government

The Building Regulations 2010

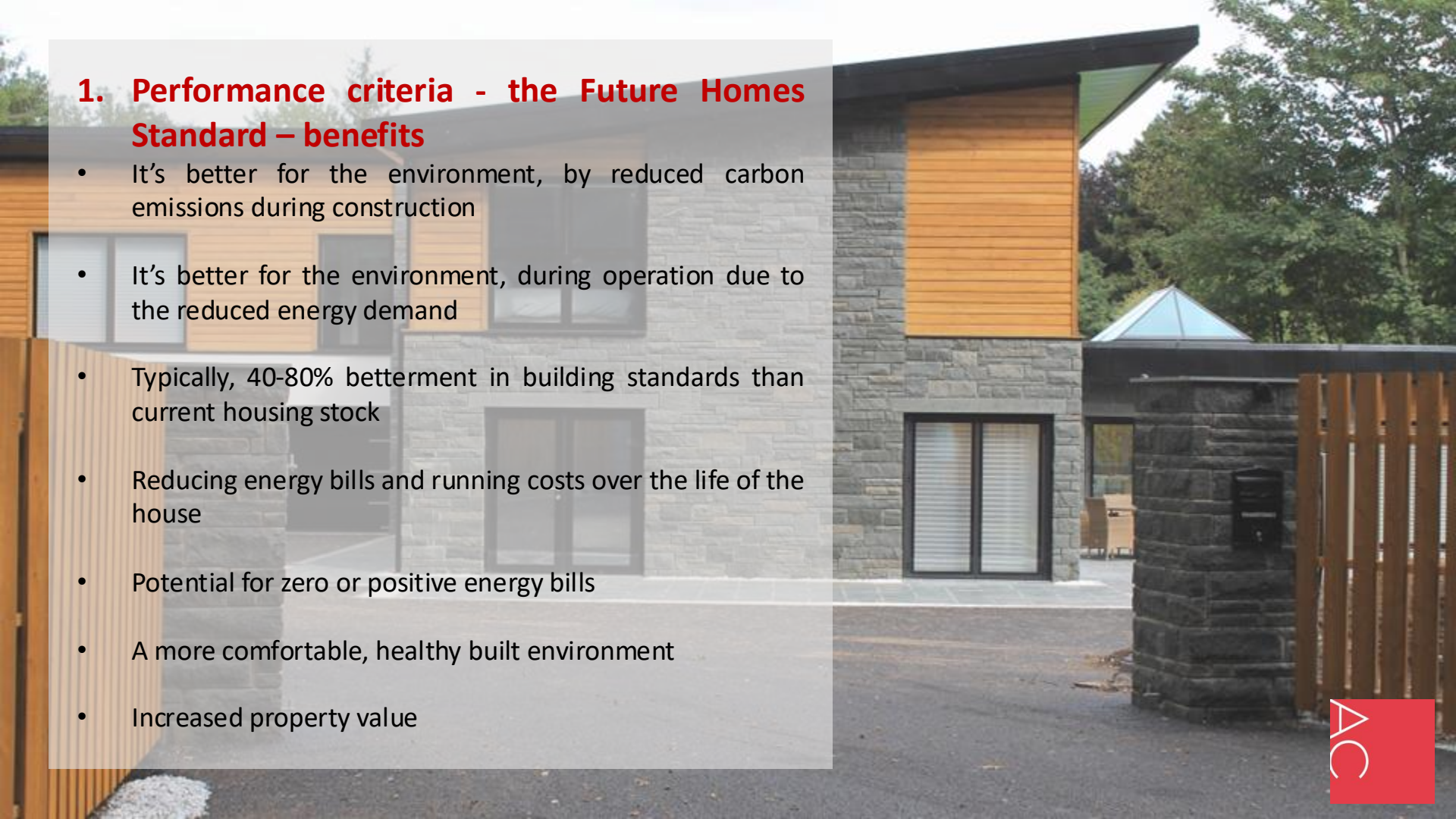
Overheating

APPROVED DOCUMENT

O

Requirement O1: Overheating mitigation
Regulations: 40B

2021 edition – for use in England

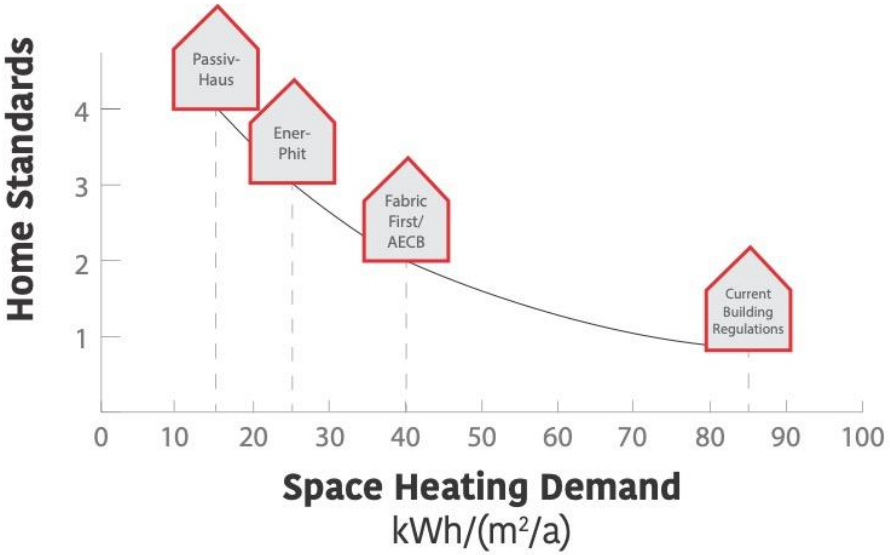


1. Performance criteria - the Future Homes Standard – benefits

- It's better for the environment, by reduced carbon emissions during construction
- It's better for the environment, during operation due to the reduced energy demand
- Typically, 40-80% betterment in building standards than current housing stock
- Reducing energy bills and running costs over the life of the house
- Potential for zero or positive energy bills
- A more comfortable, healthy built environment
- Increased property value

2. Performance criteria – space heating demand

	Scotland / England / Wales Building Regulations	Fabric First Targets	EnerPhit Standard	PHPP Low Energy Standard	Passive House Standard
Space Heating Demand **kWh/m² per year**	85 kWh/m² per year No heating demand standard defined in Building Regulations/ Technical Handbooks	40 kWh/m² per year	25 kWh/m² per year	30 kWh/m² per year	15 kWh/m² per year



Performance vs Costs

Early decisions on performance criteria -

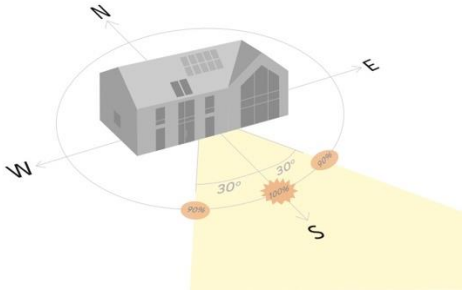
vital to allow efficient design at initial stages to accommodate the performance criteria

- Use professionals who specialise in energy efficient design, detailing and construction methods
- Use PHPP design tool from the initial design stages
- Choose a suitable construction method

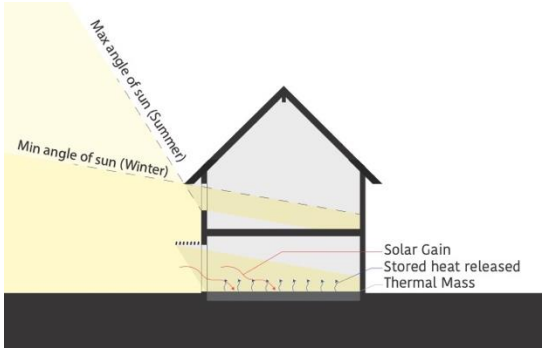
3. The Fabric First Principles

“Is a back-to-basics approach where you concentrate on the external fabric of the building before throwing in eco-bling, in order to make it work.”

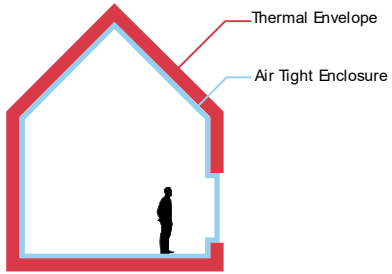
3. Fabric First Principles



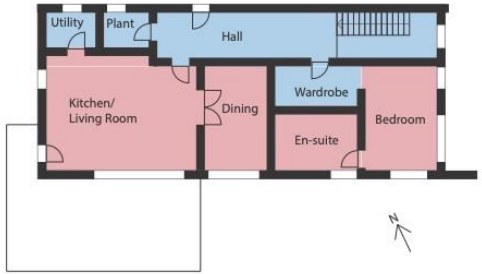
Orientation



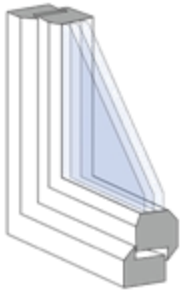
Solar Gain, Passive Shading & Thermal Mass



Insulation
Air Tightness

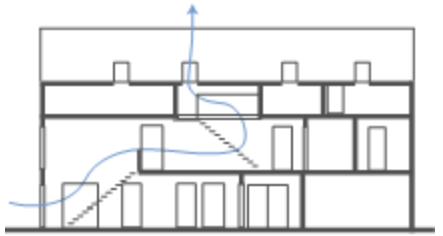


Layout



Windows

Triple Glazed Windows



Natural Ventilation

4. Site Consideration

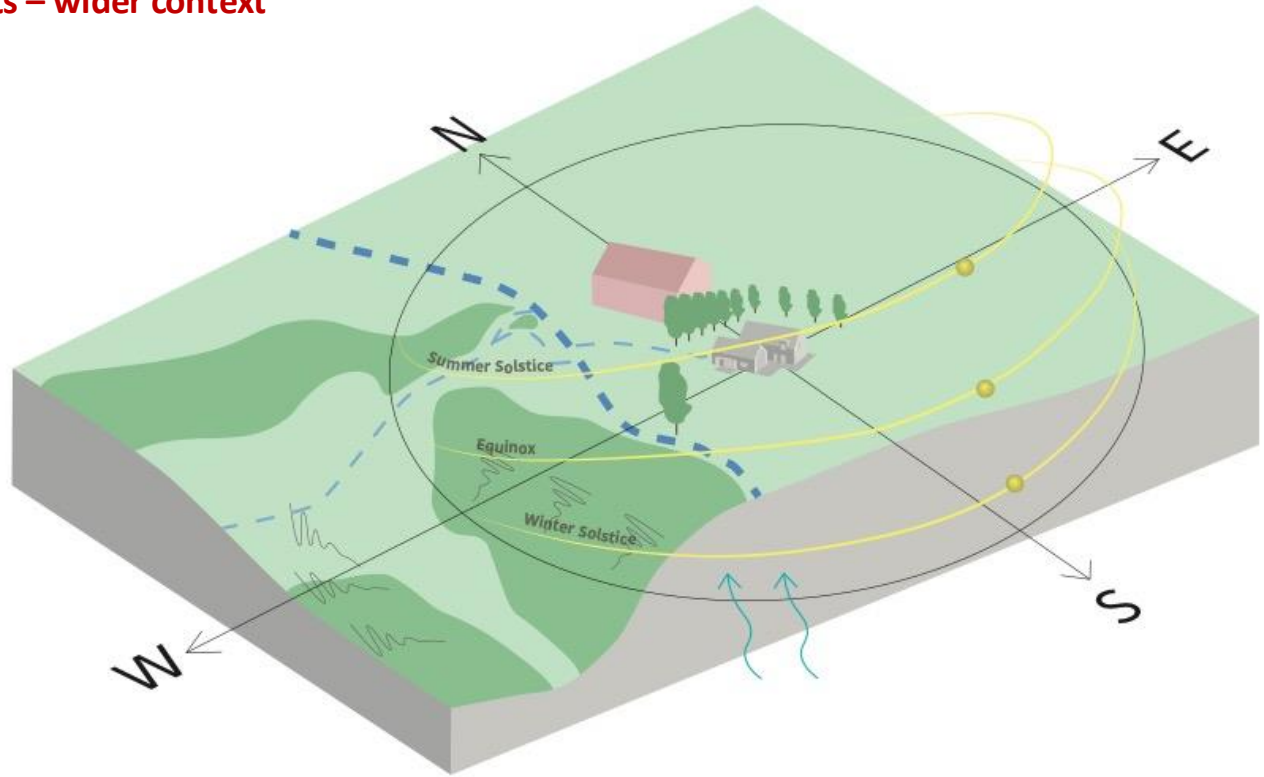
4. Site Considerations

Physical characteristics

- Determine the position of the sun through the year - spectrum for solar gain, the house orientation.
- Establish temperature ranges - seasonal and daily.
- Identify the direction of the prevailing wind.
- Determine seasonal characteristics like cold northerly winds in winter.
- Analyse the impact of the adjacent buildings - proximity/size.
- Identify topographical features that might optimise or degrade the performance of the building - slopes, tree belts, the shape and orientation of the site.

4. Site Considerations

Site constraints – wider context



5. Home Orientation

5. Home Orientation

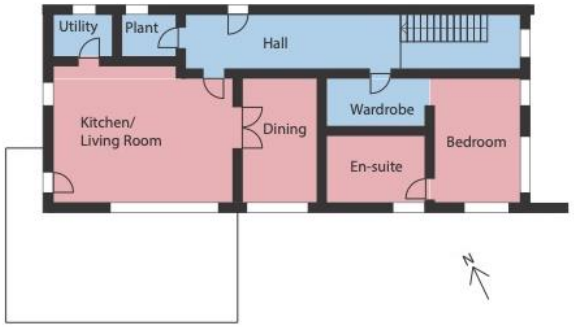
Passive shading

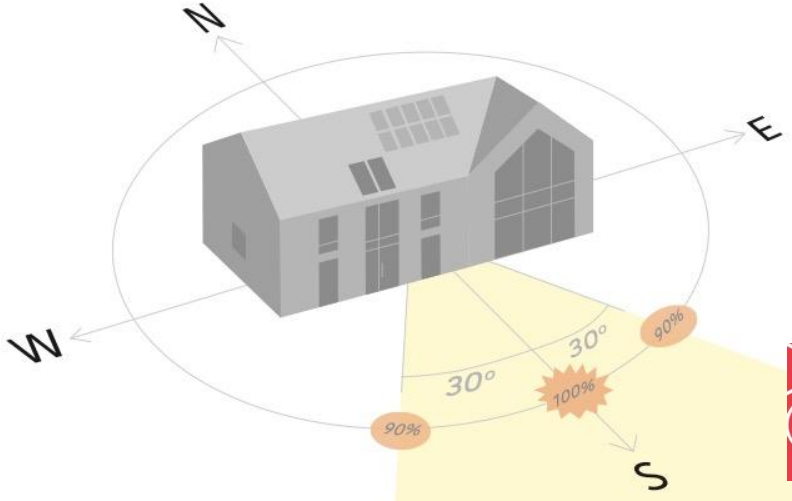
- To fit your site, views, house layout.
- South orientation is the easiest for maximum solar gain and methods of shading.
- The longest elevation with large windows to be orientated within 30 degrees of south.

  (glazing ideally 25-32% on south)
- East and west aspects are more challenging to control overheating with west of the highest risk.

Other

- Maximising wall area on the colder north facade to increase energy efficiency.
- Keep north-facing windows to a minimum to improve thermal efficiency and consider large windows if there are views influencing the design.

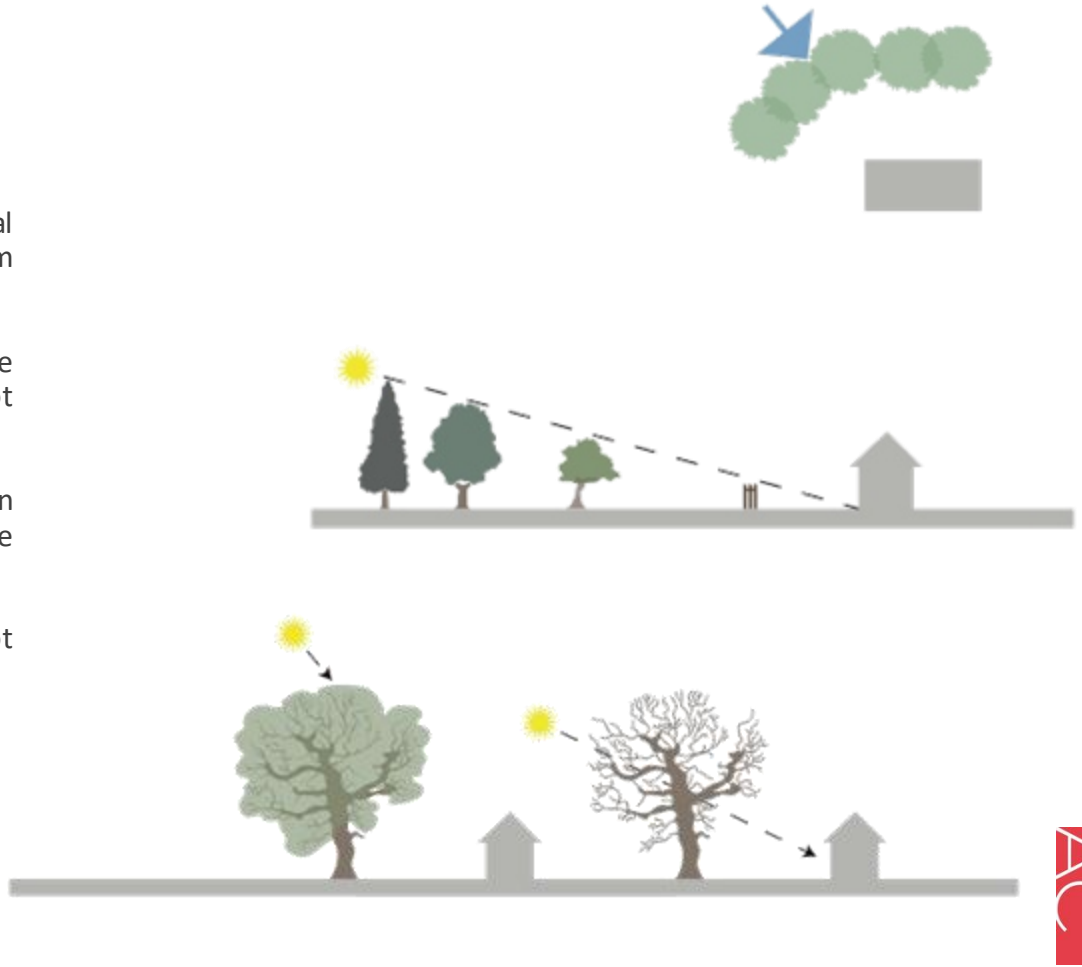




5. Home Orientation

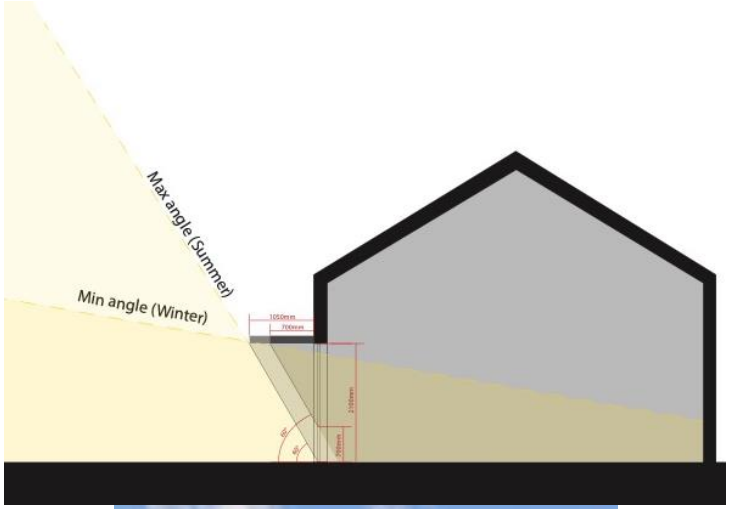
Passive shading

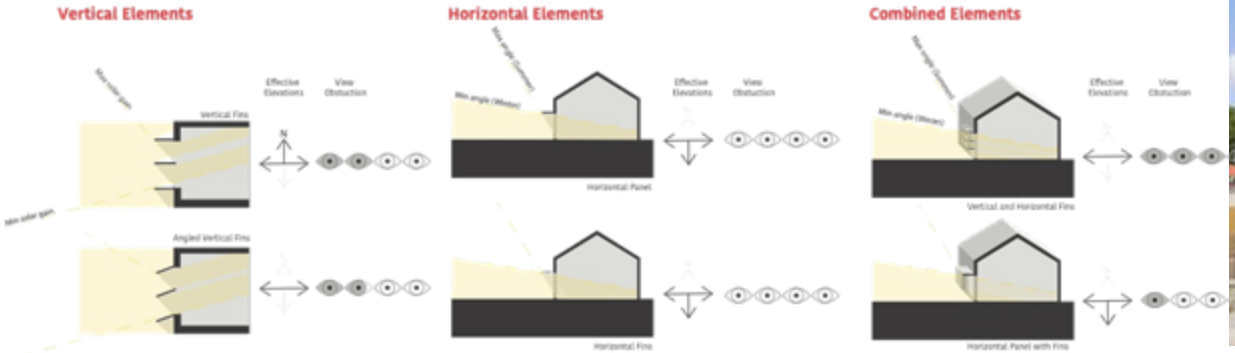
- Use trees and planting to aid optimal shading scenarios as well as to shelter from cold winds.
- Optimise solar gain in winter, making sure the south-facing windows are not overshadowed for the best part of the day.
- Use deciduous trees to optimise shading in the summer, while allowing sun to penetrate at low winter angles.
- Use evergreen trees where solar gain is not needed to provide shelter.



5. Your Home Orientation - Summary

- Use fixed overhangs to control direct solar radiation on the south façade.
- Limit the number of east and west windows because they are very difficult to shade compared to the south side. (ideally 5-15% on east and 5-10% on west)
- Use wall thickness to create deep reveals.
- North façade can be out of shading as it receives very little direct solar radiation.
- Interior shading devices, such as Venetian blinds or vertical louvres, can be used for solar glare however they have a limited ability to stop solar gain.
- Consider surrounding landscape features, type of trees, to help with shading.





6. Form Factor

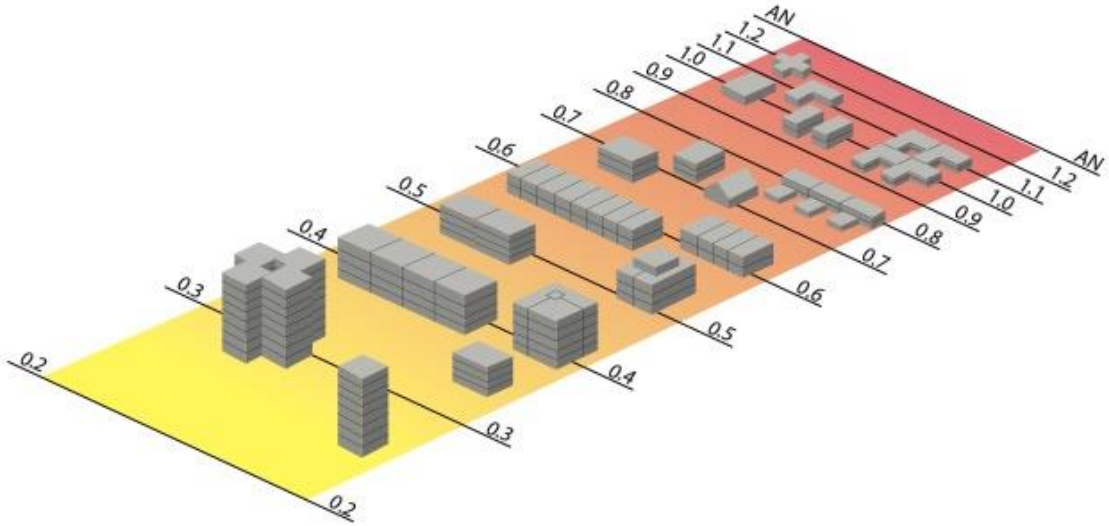
6. Form Factor

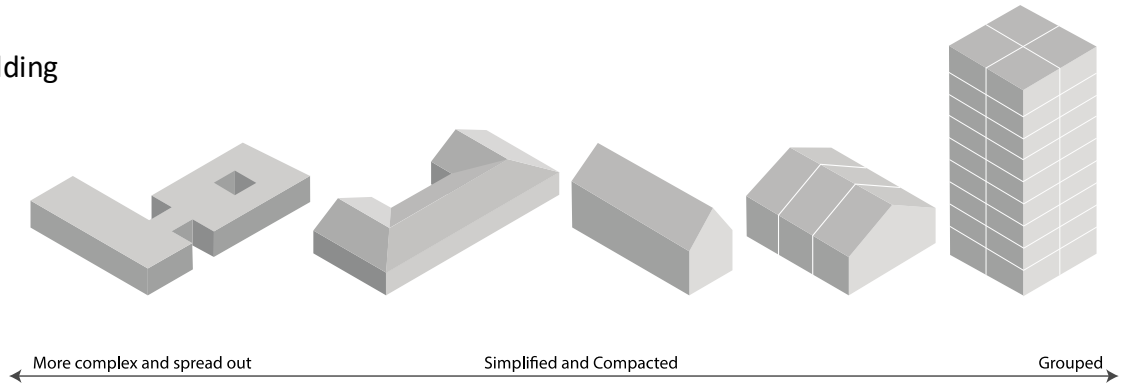
- Ratio of external surface area to usable Floor Area (TFA)

Insulation levels –

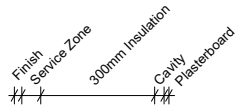
The higher the factor the less efficient design/building form - more insulation required

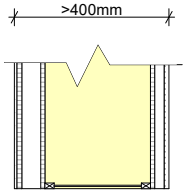
- Form Factor 1 equals approx. 100mm of Insulation
- Check at the early design stages
- Design to minimise the building surface to volume area

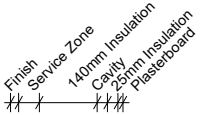


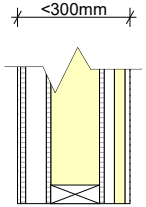


6. Form Factor









Form Factor: 2.7

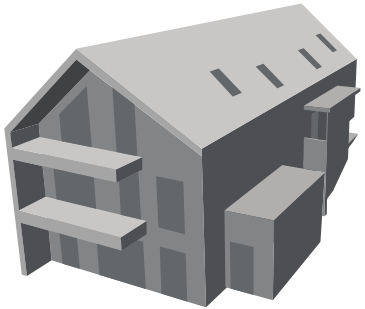
Form Factor: 2.3

Form Factor: 1.6

7. Windows

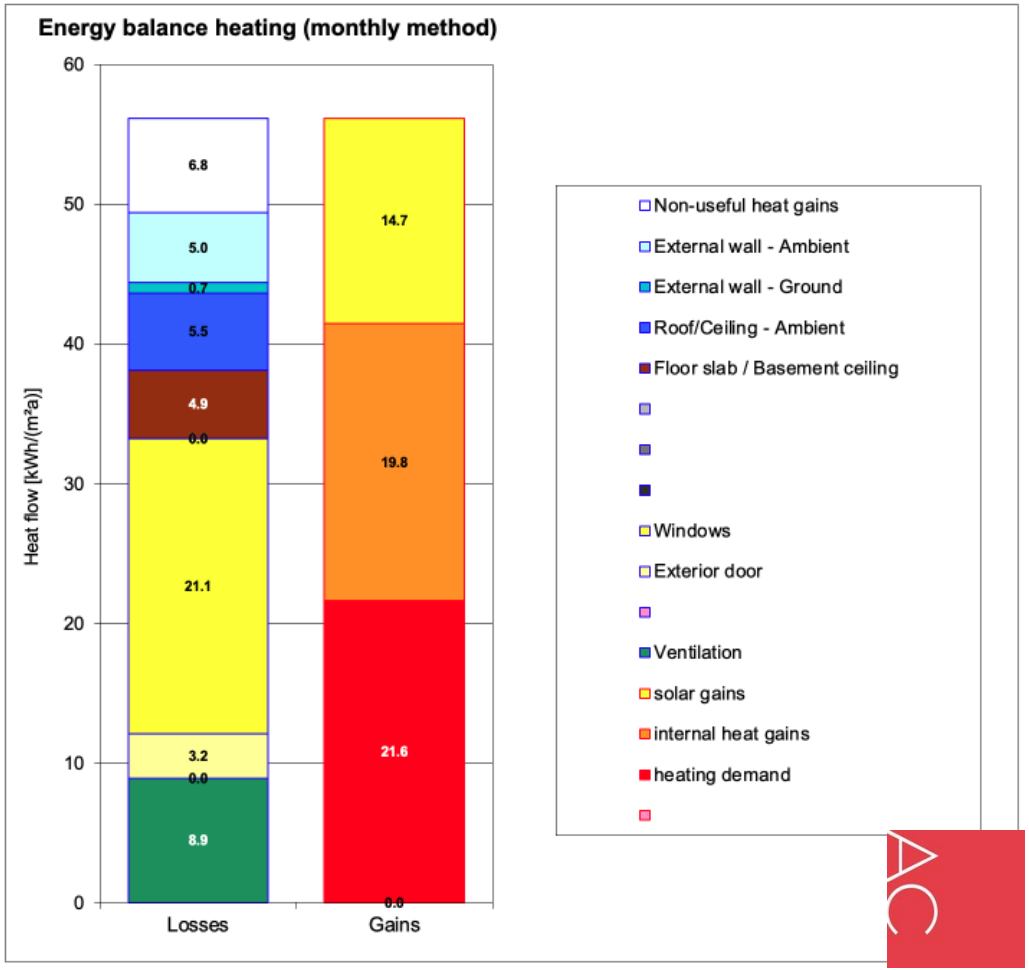
7. Windows

- The Passive House window usually features thermally broken, triple glazing units, with a maximum U – value of 1 (W/m²K), airtight installation.
- Large areas of glazing of high thermal performance, at best, will be 4-6 times worse than your wall.



Form Factor: 1.6

- Full height glazing is a nice feature but can cause overheating risks and heat loss with no additional benefit in daylight.



7. Windows

Instead:

- Be conservative with areas of glazing
- Picture frame views from key areas
- Focus on southerly aspect for larger units
- Windows with low g- value

8. Construction Methods & Ventilation

8. Construction Methods - Insulation & Airtightness

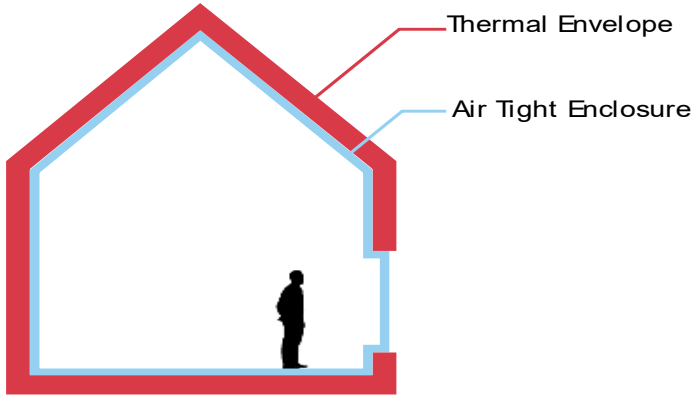
Basic Energy Performance Criteria

	England /Wales Section L	Scotland Section 6	Fabric First Targets	Passive House
Wall U-value (W/m^2K)	0.18	0.15	0.15	below 0.15
Floor U-value (W/m^2K)	0.13	0.12	0.15	below 0.15
Roof U-value (W/m^2K)	0.11	0.09	0.15	below 0.15
Windows/openings	1.2	1.2	1.2	1.0
Air permeability	5 ($m^3/hr/m^2$ at 50 Pa)	5 ($m^3/hr/m^2$ at 50 Pa)	1.5 - 3 ($m^3/hr/m^2$ at 50 Pa) **MVHR required**	0.6 air change rate @50 Pa pressure difference **MVHR required**

U-value - Measure the ease which a material or building assembly allows the heat to pass through

The lower the U-value the better the insulation properties

- Ventilation strategy – considered at the outset (comfort, usability, airtightness)
- Airtightness - no unplanned air gaps within the external fabric of the building that are letting the air in or out.



Insulation
Air Tightness

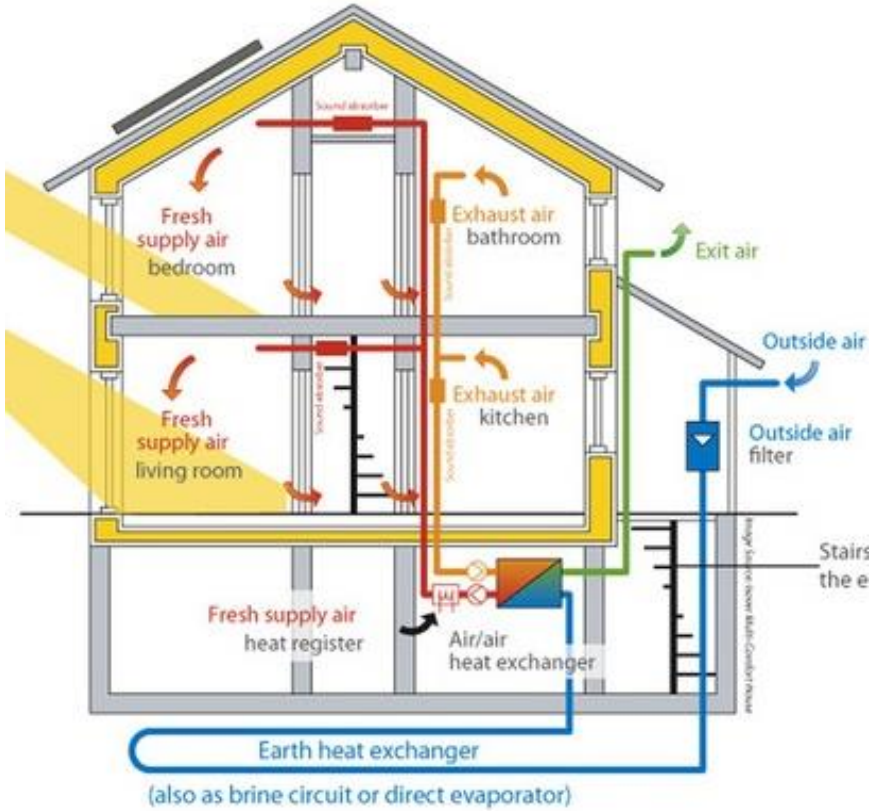
8. Ventilation

MVHR with summer bypass

- Enhanced comfort
- Energy efficiency
- Automatic control
- Contributes to meet PH criteria

To account for

- Space requirements (early design)
- Filter change



8. Construction methods

The main considerations

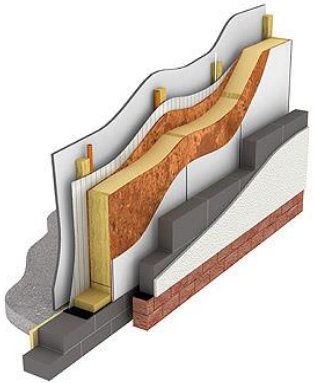
Questions you have to ask yourself –

1. How much involvement are you having in the project?
2. What is your budget?
3. Is speed of build a factor?
4. Site constraint (access for delivery)

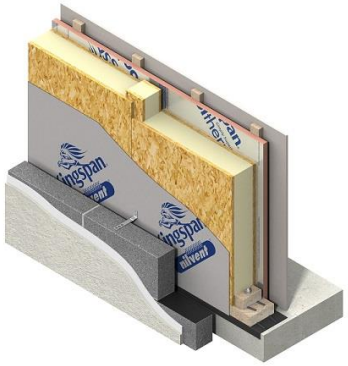
Ideally you want to choose

- Choose a construction type that is naturally airtight
- Highly insulated
- Ideally to a factory tolerance

Timber Frame



SIPS



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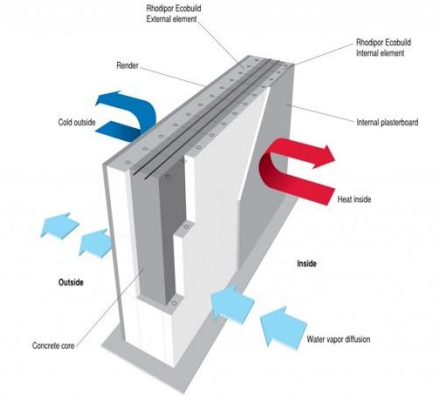


8. Construction Methods

How to Choose

1. Do your research and decide which construction method best suits your requirements - budget, speed, thermal performance etc.

   Then select and get at least 3 quotes from manufacturers of that construction method (builder or factory). Look around their factory, visit ongoing sites, speak to clients. Check Companies House.

2. If you are using off site manufacturing, try and find a company that has everything in-house. i.e. drawings, manufacturing and site teams (not all outsourced).

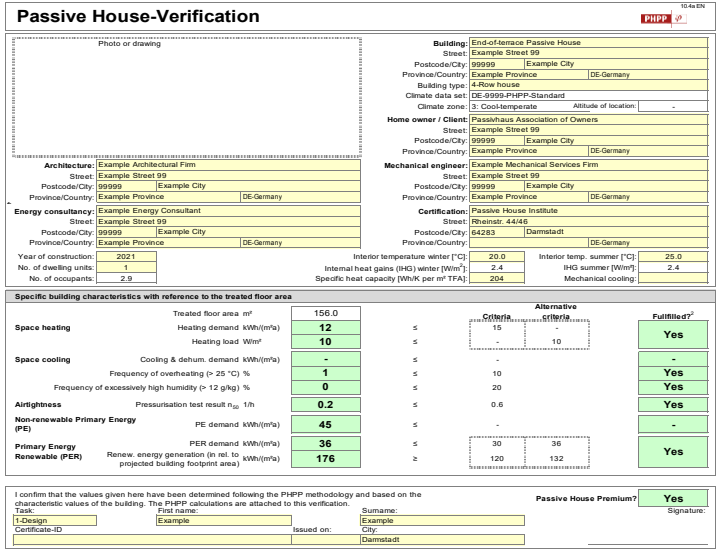
3. Negotiate a fair price and agree on a fixed cost and timeframe. Make sure you go over the quote to understand all the details.

4. At the end of the day choose a company you feel comfortable with!

9. Summary

- Use principle of the passive house
- Engage with the professionals familiar with the low energy efficient design

  (Architects, Engineers) who specialise in energy efficient design
- Early decisions on performance criteria are vital to allow efficient design at early stages
- Use PHPP tool from the outset
- Consider Certification



Passive House-Verification

10.4a EN

PHPP

Photo or drawing

Building:	End-of-terrace Passive House		
Street:	Example Street 99		
Postcode/City:	99999	Example City	
Province/Country:	Example Province		DE-Germany
Building type:	4-Row house		
Climate data set:	DE-9999-PHPP-Standard		
Climate zone:	3. Cool-temperate	Altitude of location:	-
Home owner / Client:	Passivhaus Association of Owners		
Street:	Example Street 99		
Postcode/City:	99999	Example City	
Province/Country:	Example Province		DE-Germany
Architecture:	Example Architectural Firm		
Street:	Example Street 99		
Postcode/City:	99999	Example City	
Province/Country:	Example Province		DE-Germany
Mechanical engineer:	Example Mechanical Services Firm		
Street:	Example Street 99		
Postcode/City:	99999	Example City	
Province/Country:	Example Province		DE-Germany
Energy consultancy:	Example Energy Consultant		
Street:	Example Street 99		
Postcode/City:	99999	Example City	
Province/Country:	Example Province		DE-Germany
Certification:	Passive House Institute		
Street:	Rheinstr. 44/46		
Postcode/City:	64283	Darmstadt	
Province/Country:			DE-Germany

Year of construction:	2021	Interior temperature winter [°C]:	20.0	Interior temp. summer [°C]:	25.0
No. of dwelling units:	1	Internal heat gains (IHG) winter [W/m²]:	2.4	IHG summer [W/m²]:	2.4
No. of occupants:	2.9	Specific heat capacity [Wh/K per m² TFA]:	204	Mechanical cooling:	

Specific building characteristics with reference to the treated floor area

				Alternative Criteria		Fulfilled?
				Criteria	Criteria	
	Treated floor area m²	156.0				
Space heating	Heating demand kWh/(m²a)	12	≤	15	-	Yes
	Heating load W/m²	10	≤	-	10	
Space cooling	Cooling & dehum. demand kWh/(m²a)	-	≤	-		-
	Frequency of overheating (> 25 °C) %	1	≤	10		Yes
	Frequency of excessively high humidity (> 12 g/kg) %	0	≤	20		Yes
Airtightness	Pressurisation test result n_{50} 1/h	0.2	≤	0.6		Yes
Non-renewable Primary Energy (PE)	PE demand kWh/(m²a)	45	≤	-		-
Primary Energy Renewable (PER)	PER demand kWh/(m²a)	36	≤	30	36	Yes
	Renew. energy generation (in rel. to projected building footprint area) kWh/(m²a)	176	≥	120	132	

I confirm that the values given here have been determined following the PHPP methodology and based on the characteristic values of the building. The PHPP calculations are attached to this verification.

Passive House Premium? Yes

Task:	First name:	Surname:	Signature:
1-Design	Example	Example	
Certificate-ID	Issued on:	City:	
		Darmstadt	

PHPP, Verification

PHPP_EN_V10.4a_Example.xlsx

PASSIVE HOUSE DESIGN CONSIDERATIONS WITH IGA PANCZYNA

Passive House Design Considerations

AC Architects will explain the Passive House Design considerations as 'rule of thumb' design principles applicable to achieving an energy-efficient home. Using the Fabric First approach as a guide, learn the simple key elements of Passive House design!

Get access to your FREE self build resources by entering your information on this form

First name *

Last name *

Email *

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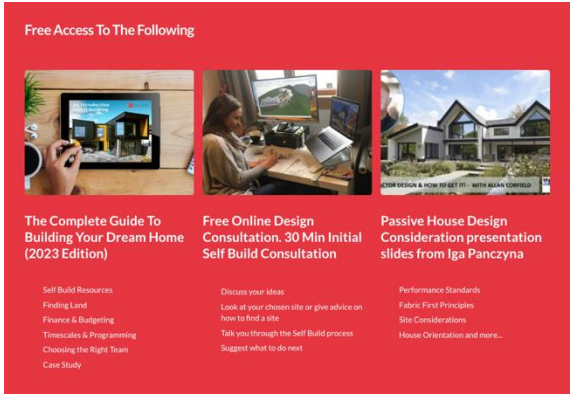

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