Passivhaus Introduction

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WHAT IS PASSIVHAUS

Passivhaus was established in Europe as a recognised benchmark for the construction standard of environmentally efficient buildings, the term “Passivhaus” refers to a construction standard, and is a refinement of the low energy house standard.

The Passivhaus Standard is rooted in sound building physics and is based upon over 20 years of research and development. With over 20,000 buildings completed to this standard in Europe, it offers a robust, proven and cost effective method to help the UK achieve its challenging Carbon reduction targets for the built environment.

The Passivhaus approach improves on the standard low energy building design improving on, amongst others, very high levels of insulation, super-insulated opening windows, airtight building fabric, cold bridges etc. This results in properties which stay comfortable 'passively' for most of the year without the need for conventional heating systems.

PASSIVHAUS BENEFITS

A typical Passivhaus uses the same energy as a normal hair dryer to heat the building in winter and cool the building in summer, for instance an average house would cost £1000 per year for its energy costs, for a Passivhaus built with Integrity, this will reduce to less than £100.

In October 2010, The Secretary of State for Energy and Climate Change, Chris Huhne stated the following :
"...the Passivhaus standard represent a watershed moment in our relationship with the built environment" and that he "would like to see every new home in the UK reach the Passivhaus standard..."

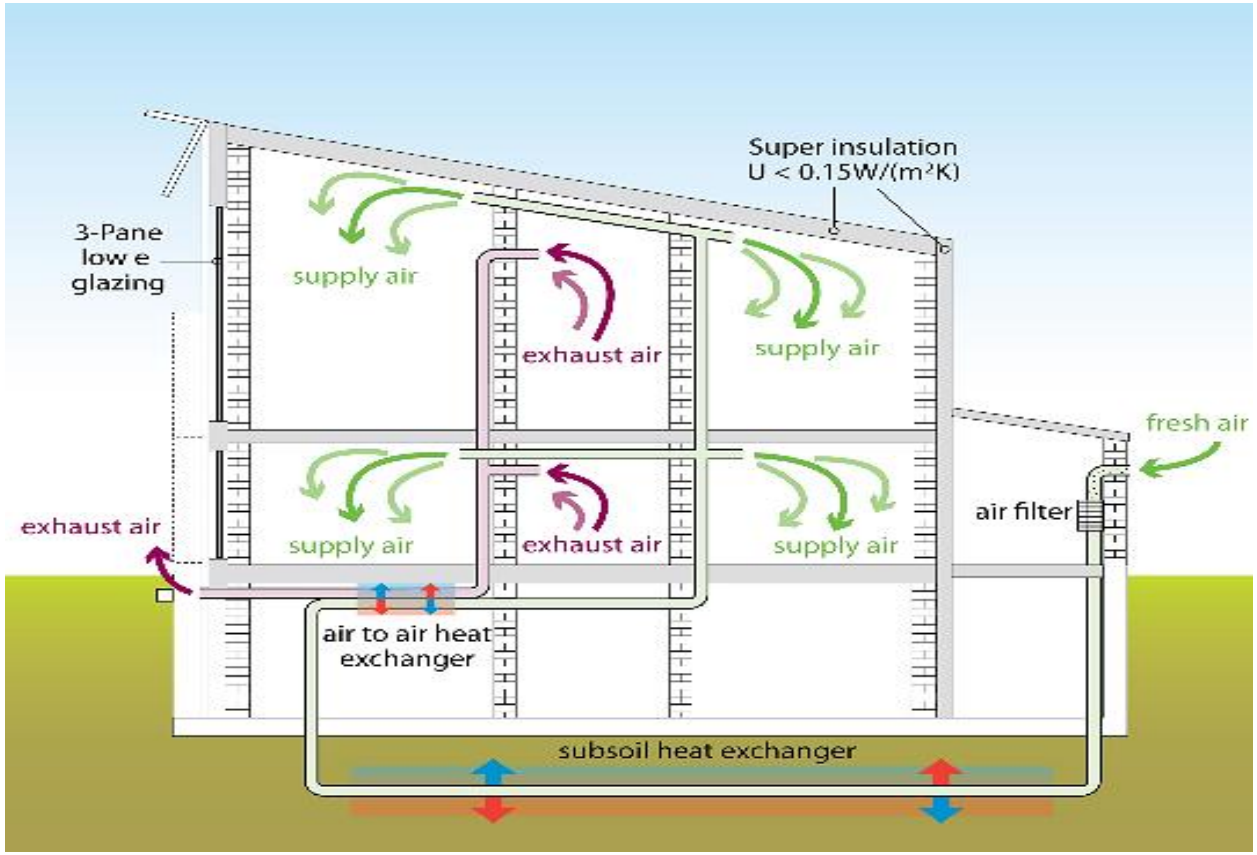
Government Green Deal is a central plank of the Coalition Government's green strategy and aims to encourage mass adoption of energy efficiency measures across UK homes. It will introduce a '**pay as you save**' scheme that means energy efficiency work could be repaid through a charge on a home's energy meter offset by the savings made on fuel bills.

The Passivhaus approach improves on the standard low energy building design improving on, amongst others, very high levels of insulation, super-insulated opening windows, airtight building fabric, cold bridges etc. This results in properties which stay comfortable 'passively' for most of the year without the need for conventional heating systems.

Benefits of a Passivhaus include:

- Maximum energy efficiency
- Significantly reduced heating costs
- Passivhaus heating requires similar energy to run as a hair dryer
- High user comfort
- Constant fresh, filtered air in all rooms
- Fine particulate air filter in the incoming air supply for pollen-free air
- Easy accessibility for maintenance and servicing
- Minimal acoustic values
- No unpleasant domestic odours
- No humidity problems

PRINCIPLES OF A MECHANICAL HEAT RECOVERY VENTILATION SYSTEM



Warm extracted (stale) air flows via the extract ventilation system and delivers heat to plates. This stale air leaves the unit cooled. On the opposite side of the exchanger plates, filtered fresh air flows in separate channels. This fresh air absorbs the heat from the plates and will leave the exchanger unit with a higher temperature (but still unpolluted).

Passive Houses are:

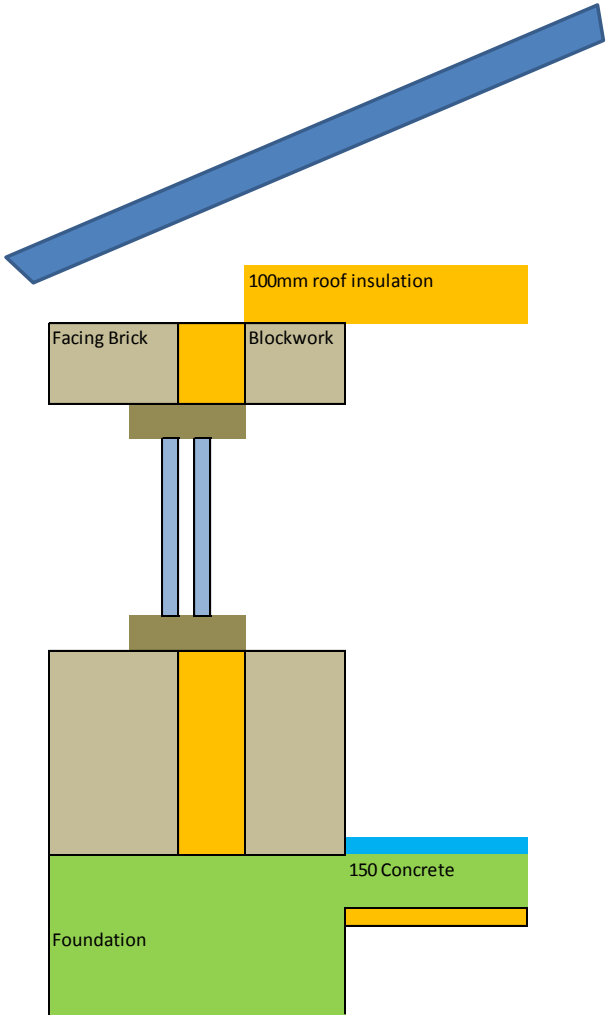
- Designed to have a heating load of less than 15 kWh/m^2yr. (new build 55+)
- Houses with south facing windows providing more heat than they loose.
- Airtight (less than 1 air changes per hour)
- Have a mechanical ventilation and heat recovery unit, that extracts heat from exhaust air to heat the fresh input air
- Well insulated – triple glazing (u<0.8), fabric U<0.15
- Have good detailing and are thermal bridge free
- Have good summer shading and ventilation

The PassivHaus Planning Package (PHPP)

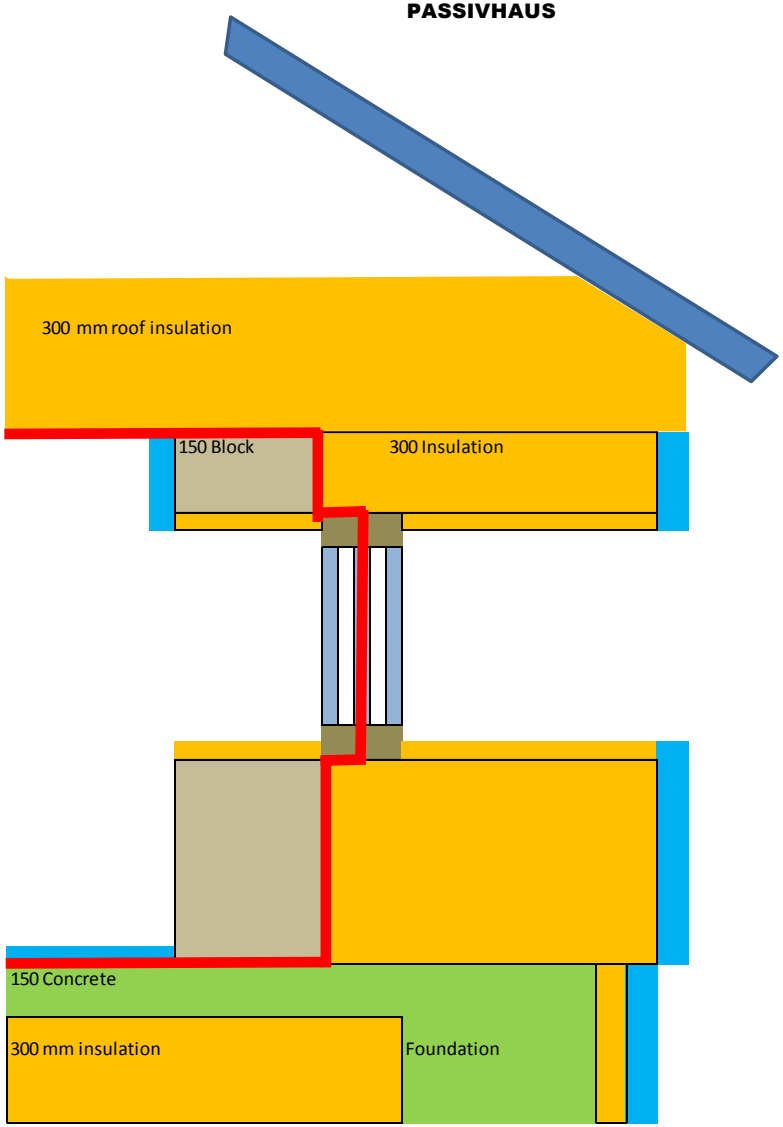
PHPP is a design tool produced by the PassivHaus Institute in Germany
PHPP contains a series of tools for:

- calculating energy balances
- designing comfortable ventilation
- calculating the heating and cooling load
- summer comfort calculations

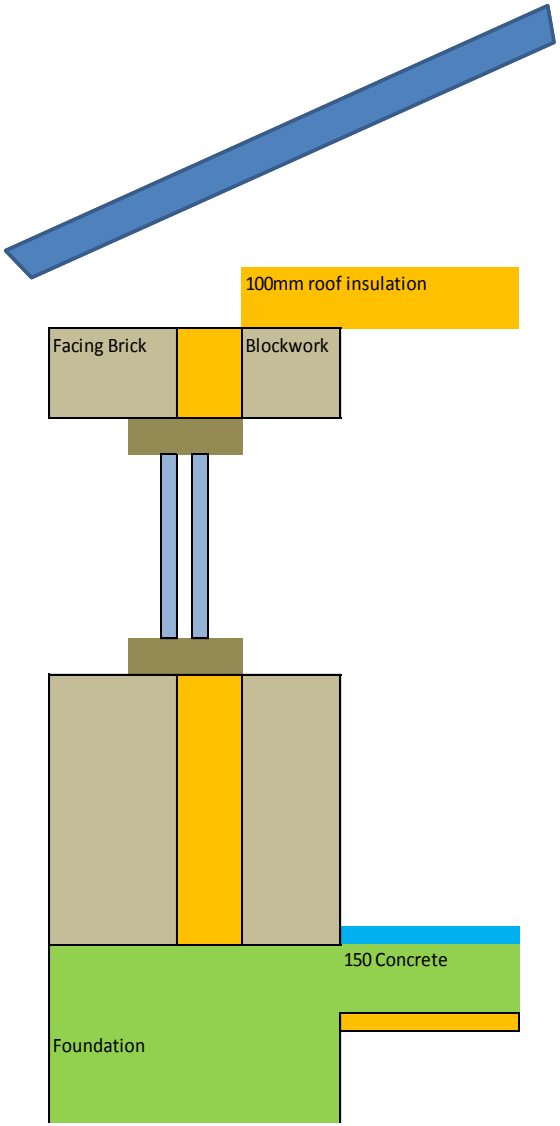
CONVENTIONAL HOUSE



PASSIVHAUS



CONVENTIONAL HOUSE



Passivhaus standards significantly exceed the following current Government annual energy output proposals

	kWhr / m2 / yr	
Apartment block / mid terrace	**30 - 35**	**+ 133 %**
Semi - detached house	**35 - 40**	**+ 166 %**
Detached house	**40 - 45**	**+ 200 %**
Current best practice new hous	**55 +**	**+ 266 %**
Passivhaus standard	**15**	**0 %**

The average yearly fuel bill is anticipated to be an average of £1,000

The CO2 emissions are also anticipated to be reduced by at least 80% for a Passivhaus

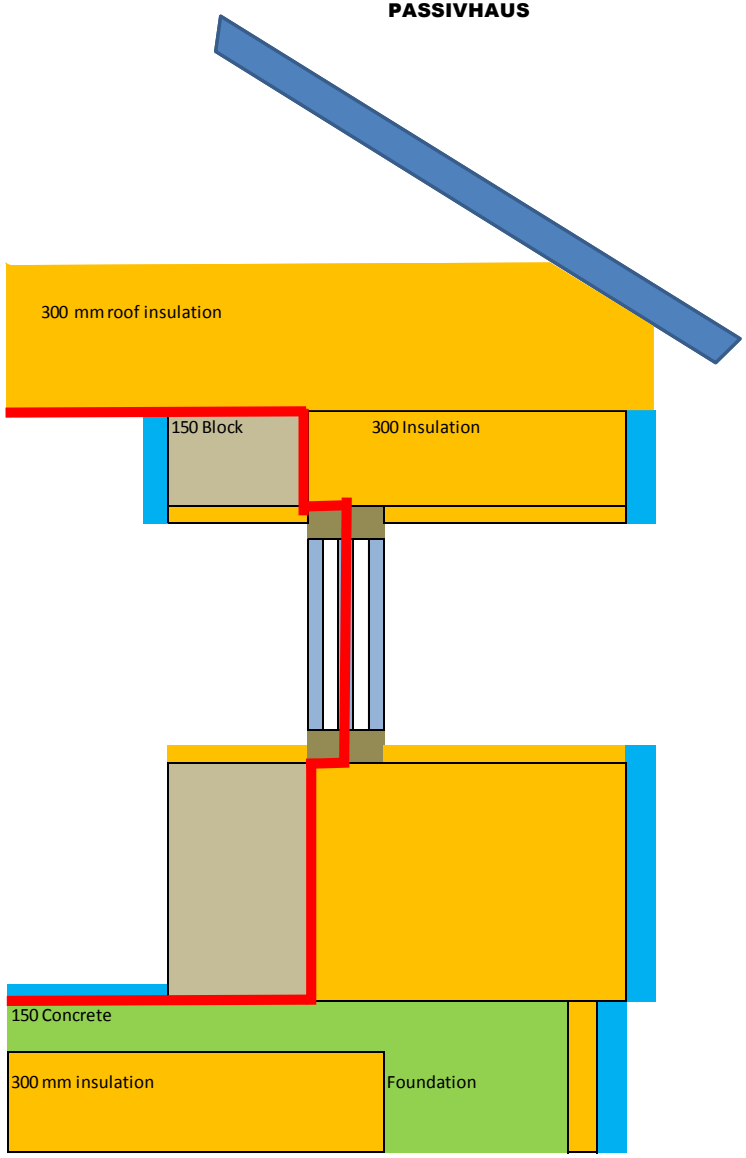
The term "Passivhaus" refers to a construction standard. The standard can be met using a variety of technologies, designs and materials, and is a refinement of the low-energy standard.

A Passivhaus is just a normal modern house, correctly designed and erected, scientifically calculated and verified during and after construction

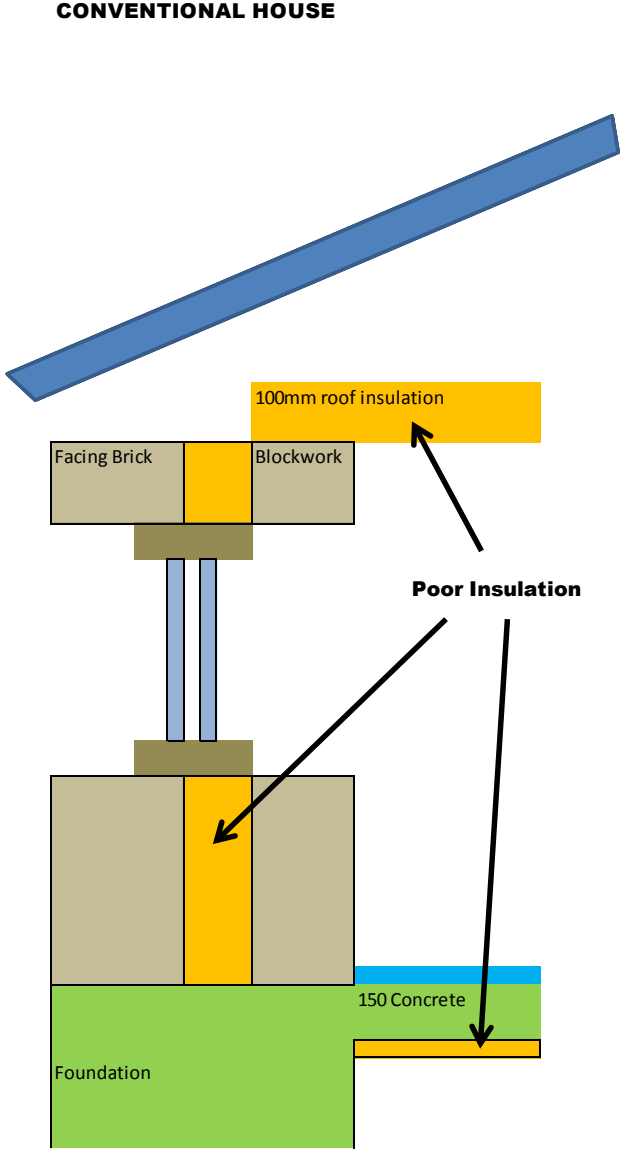
THE BENEFITS OF PASSIVHAUS INCLUDE:

- **Maximum energy efficiency**
- **Significantly reduced heating costs**
- **High user comfort**
- **Constant fresh filtered air in all rooms**
- **Easy accessibility for maintenance and servicing**
- **No humidity problems**

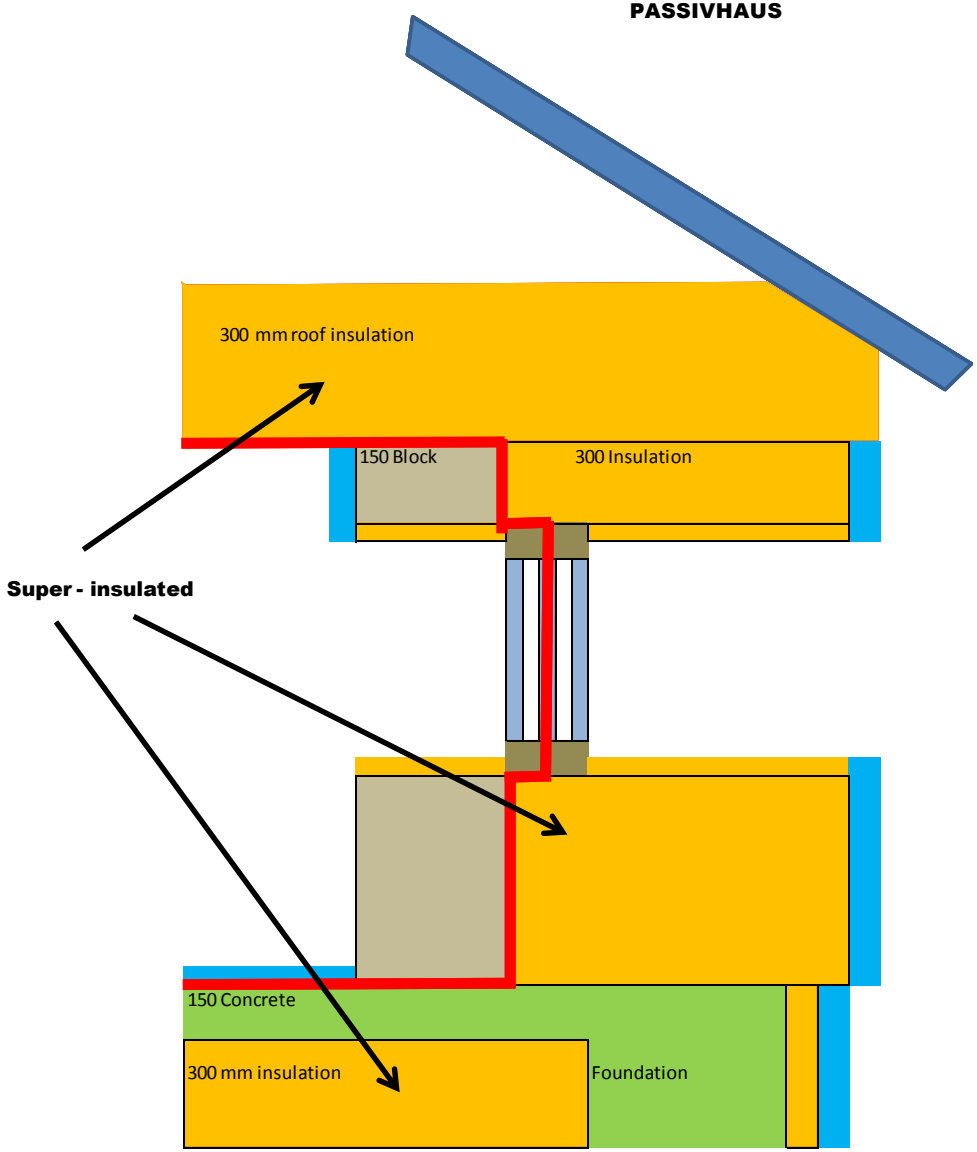
PASSIVHAUS



CONVENTIONAL HOUSE

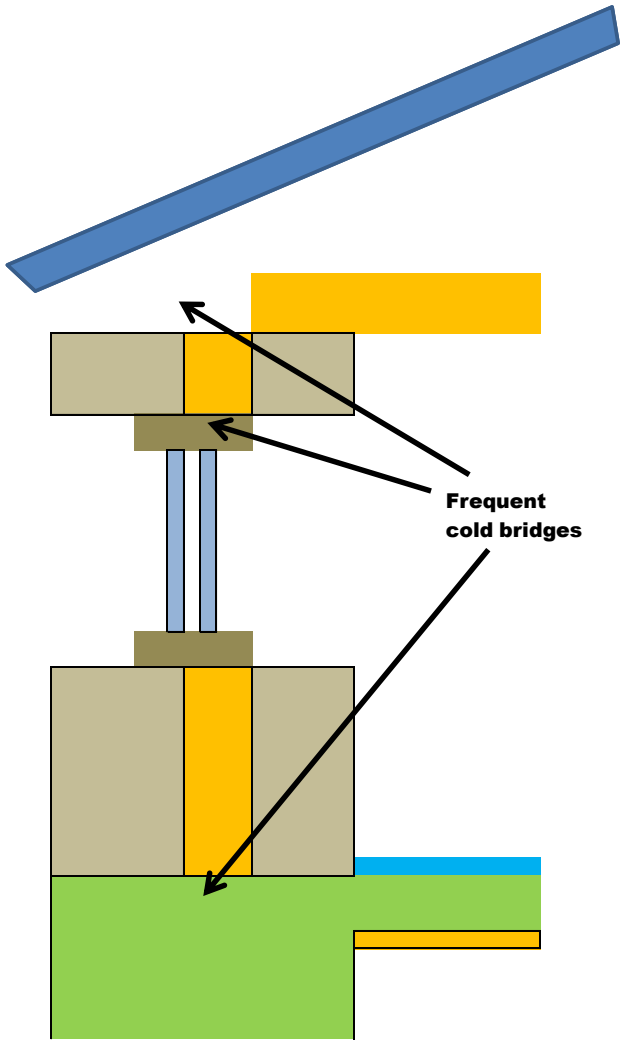


PASSIVHAUS



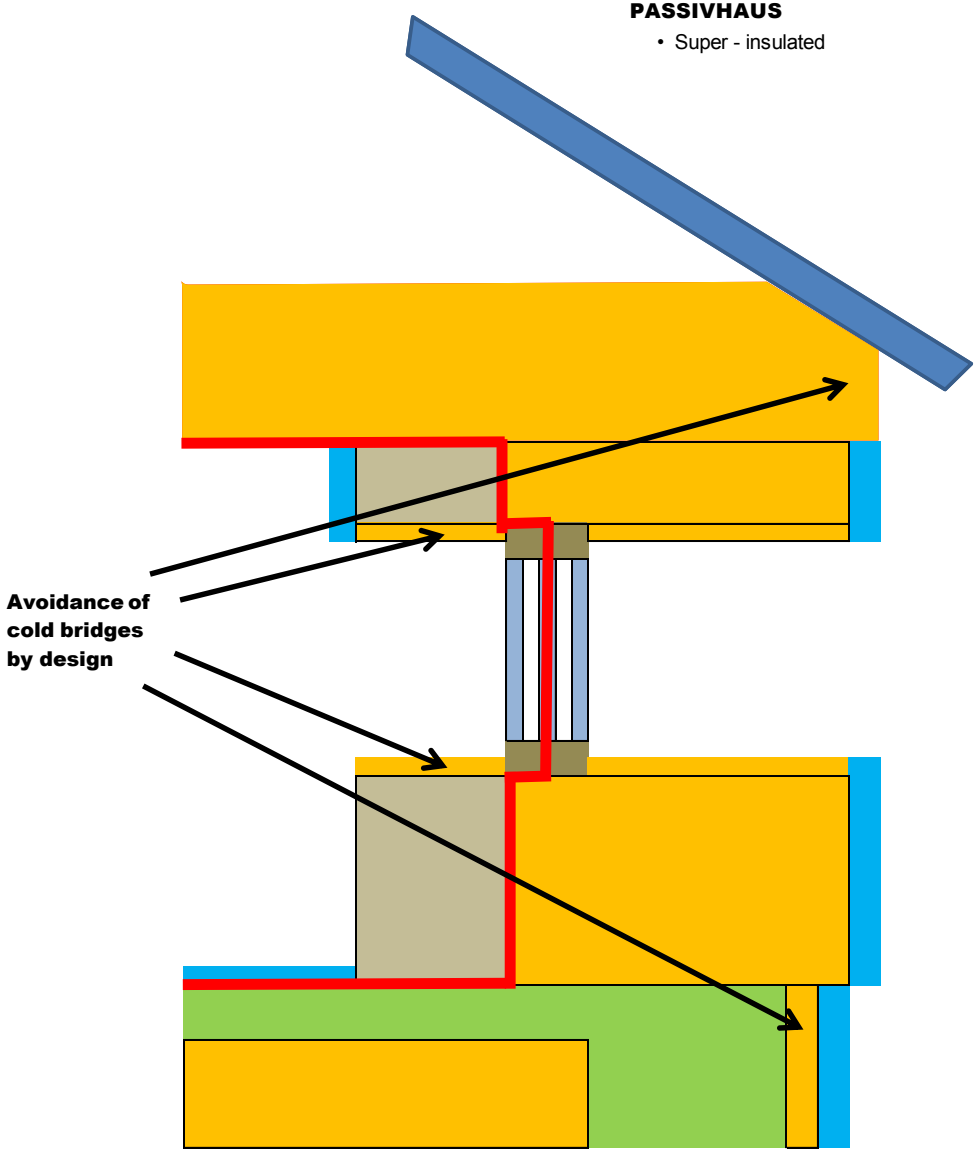
CONVENTIONAL HOUSE

- Poor insulation



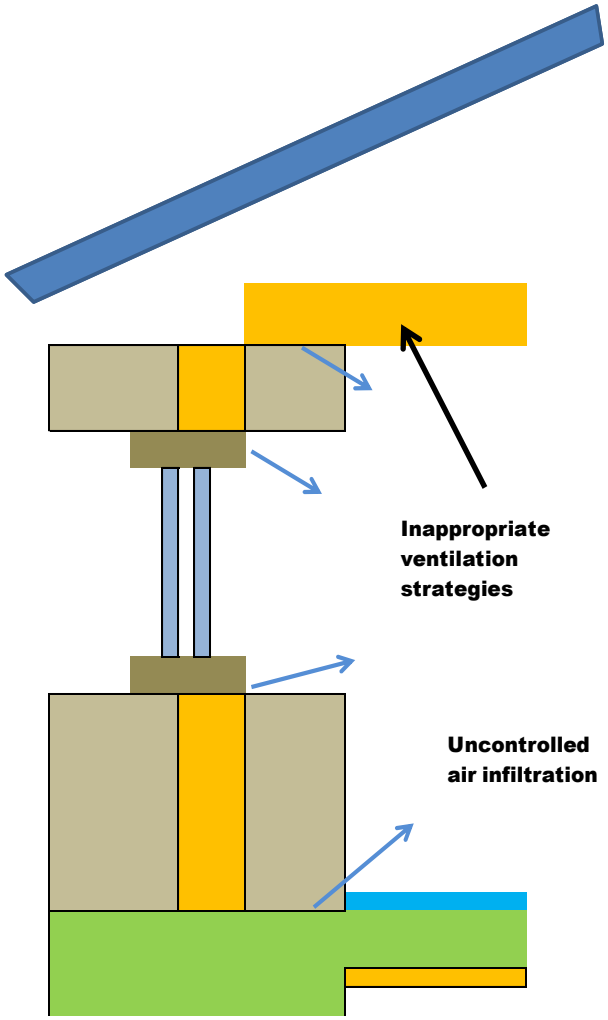
PASSIVHAUS

- Super - insulated



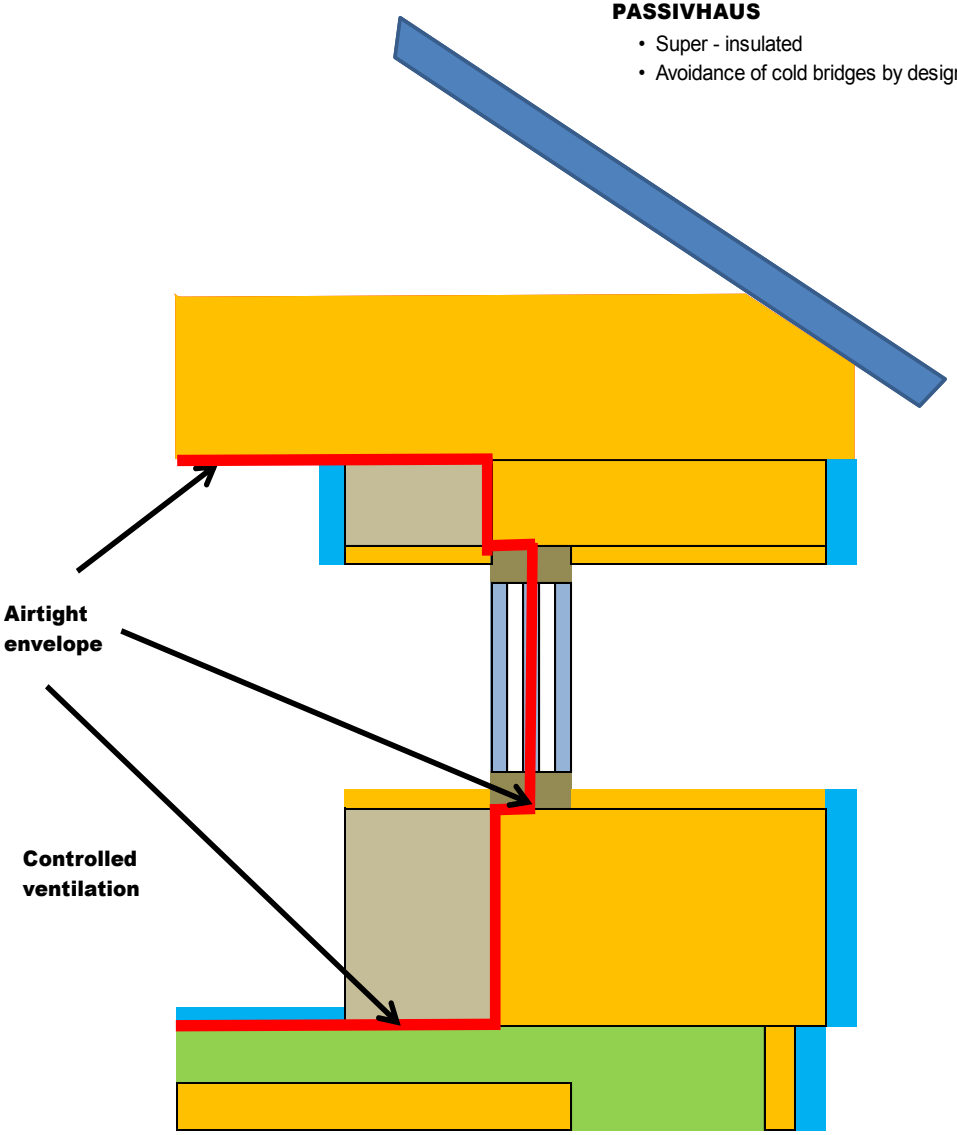
CONVENTIONAL HOUSE

- Poor insulation
- Frequent cold bridges



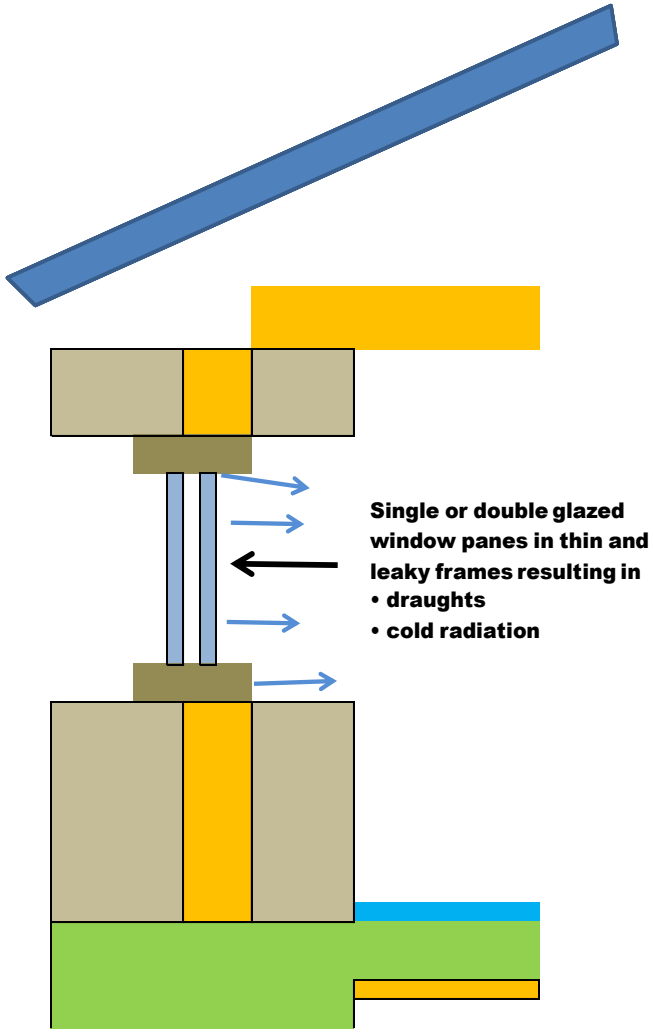
PASSIVHAUS

- Super - insulated
- Avoidance of cold bridges by design



CONVENTIONAL HOUSE

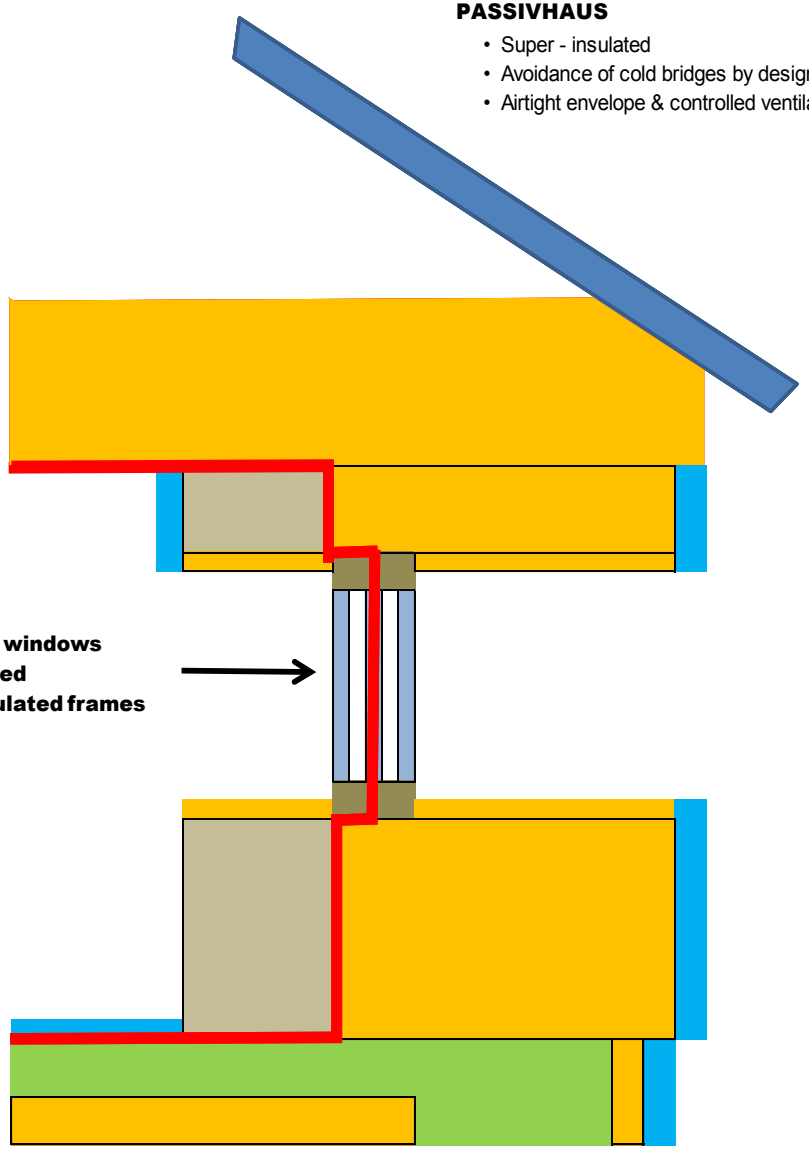
- Poor insulation
- Frequent cold bridges
- Inappropriate ventilation strategy



Single or double glazed window panes in thin and leaky frames resulting in
- **draughts**
- **cold radiation**

PASSIVHAUS

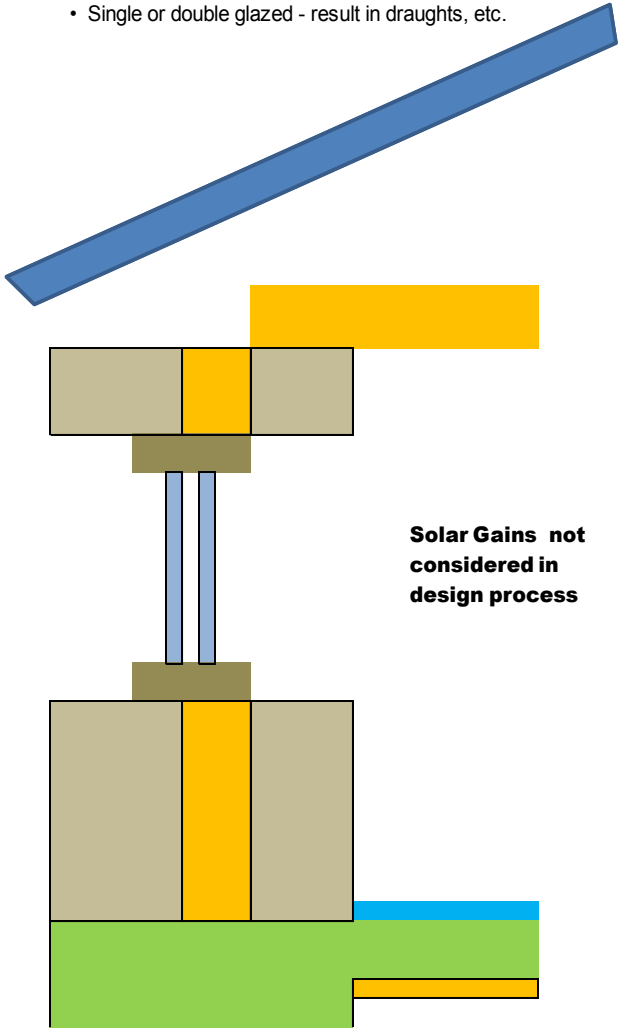
- Super - insulated
- Avoidance of cold bridges by design
- Airtight envelope & controlled ventilation



Passivhaus windows
- **triple glazed**
- **super-insulated frames**

CONVENTIONAL HOUSE

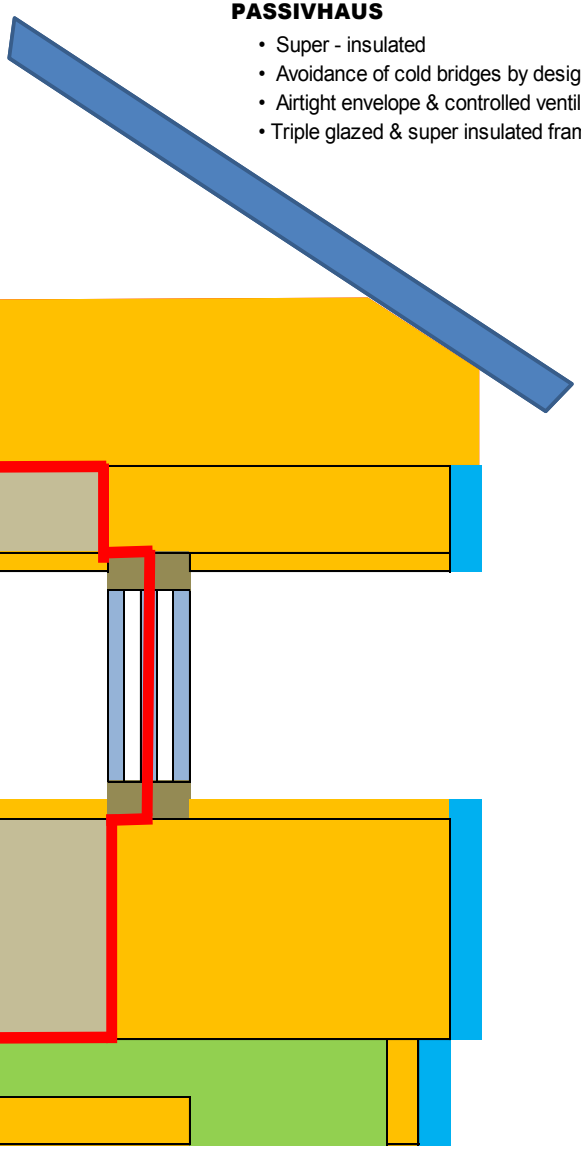
- Poor insulation
- Frequent cold bridges
- Inappropriate ventilation strategy
- Single or double glazed - result in draughts, etc.



Solar Gains not considered in design process

PASSIVHAUS

- Super - insulated
- Avoidance of cold bridges by design
- Airtight envelope & controlled ventilation
- Triple glazed & super insulated frames



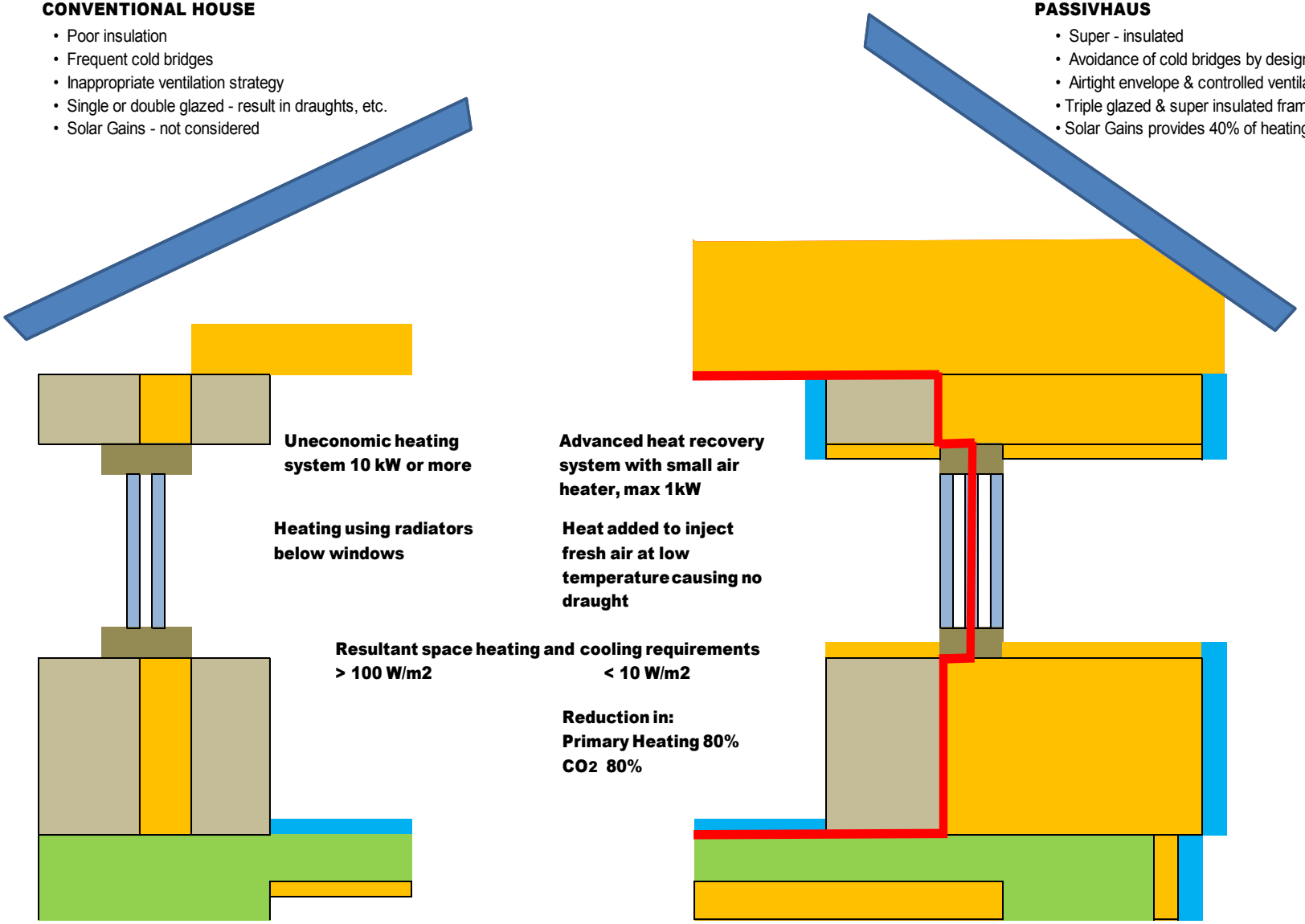
Orientation on plot and glazing designed to provide approximately 40% of heating requirements from passiv solar gains

CONVENTIONAL HOUSE

- Poor insulation
- Frequent cold bridges
- Inappropriate ventilation strategy
- Single or double glazed - result in draughts, etc.
- Solar Gains - not considered

PASSIVHAUS

- Super - insulated
- Avoidance of cold bridges by design
- Airtight envelope & controlled ventilation
- Triple glazed & super insulated frames
- Solar Gains provides 40% of heating



Uneconomic heating system 10 kW or more

Heating using radiators below windows

Advanced heat recovery system with small air heater, max 1kW

Heat added to inject fresh air at low temperature causing no draught

Resultant space heating and cooling requirements
> 100 W/m2 **< 10 W/m2**

Reduction in:
Primary Heating 80%
CO_2 80%

Outline Specification for a Passivhaus in the UK

Outline Specification	Passivhaus Standard	UK new-build best Practice
Compact form and good insulation:	All components of the exterior shell of a Passivhaus are insulated to achieve a U-value that does not exceed 0.15 W/m2/K	U-values of approximately 0.25 to 0.35 W/m2/K
Southern orientation and shade considerations:	Passive use of solar energy is a significant factor in Passivhaus design	Some consideration is given with regard to north/south orientation, but the improved energy savings resulting from passive site design are often overlooked
Energy-efficient window glazing and frames:	Windows should have U-values not exceeding 0.80 W/m2//K for both glazing and frames - this requires the window frame to incorporate insulation and to be triple glazed. Solar Heat Gain Co-efficient through the glazing should be at least 50%	Double glazed units, U-value that typically does not exceed 1.80 to 2.20 W/m2/K
Building envelope air-tightness:	Air leakage through gaps and cracks in the building envelope must be less than 0.60 times the house volume per hour. Air permeability of less than 1m2/hr/m3@50Pa - Camden House achieved 0.35 times the house volume per hour.	Design air permeability of 7 to 10m2/hr/m3 @50Pa approx. 10 times poorer and frequently in practice exceeds design
Highly efficient heat recovery from exhaust air using air to air heat exchanger:	Most of the perceptible heat in the exhaust air is transferred to the incoming filtered fresh air (heat recovery rate over 80%)	The majority of new-builds do not achieve good enough air permeability values to warrant the incorporation of a whole house ventilation system -
Passive preheating of filtered fresh air:	Filtered fresh air may be brought into the house through underground ducts that exchange heat with the soil. This preheats fresh air to a temperature above 5°C, even on cold winter days	thus trickle vents, extract fans, or passive stack ventilation is commonly used.
Energy-saving household appliances	Low energy refrigerators, lamps, washers, dryers, etc. are important in a Passivhaus	Dedicated low-energy lights are provided in a number of rooms in a new dwelling
Total energy demand for space heating and cooling	Less than 15kWh/m2/yr	Typically more than 55kWh/m2/yr

The Code for Sustainable Homes (CSH)

To push forward the efficiency of new build houses in the UK the government introduced the Code for Sustainable Homes which became a mandatory rating for new homes from May 1st 2008.

With greater demand for homes that offer reduced environmental impact, lower running costs and features that enhance health and well-being, there is a need for home builders to demonstrate their capacity in sustainable home building. The Code offers such a tool.

The code measures the sustainability of a new home using 9 categories, rating the whole house as a complete package. The design categories are:

- **Category 1** — **Energy and CO2 Emissions**
- **Category 2** — **Water**
- **Category 3** — **Materials**
- **Category 4** — **Surface Water Run-off**
- **Category 5** — **Waste**
- **Category 6** — **Pollution**
- **Category 7** — **Health and Wellbeing**
- **Category 8** — **Management**
- **Category 9** — **Ecology**

The Code uses a sustainability rating system – indicated by 'stars', to communicate the overall sustainability performance of a home. A home can achieve a sustainability rating from one (★)[entry level] to six (★★★★★★)[highest level].

Each category includes a number of environment issues, these are assessed against a performance target and awarded one or more credits.

The Code signals the future direction of Building Regulations in relation to carbon emissions from, and energy use in homes.

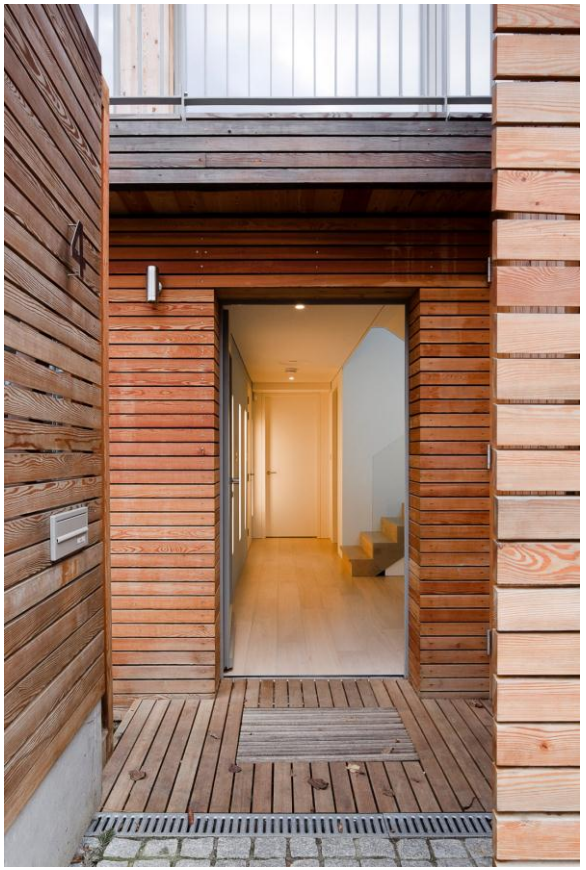
Achieving a high performance in one category of environmental impact can sometimes result in a lower level of performance for another. It is therefore impossible to achieve a Total percentage points score of 100.
For every category, the number of credits achieved is divided by the total available and multiplied by the category weighting factor to give a percentage point score for the category.
The rounded percentage point scores for each category are then summed to arrive at the Total percentage points score for the dwelling.

Relationship between Total percentage points score and Code Level	
Total percentage points score (equal to or greater than)	Code Levels
36 Points	**Level 1 (★)**
48 Points	**Level 2 (★★)**
57 Points	**Level 3 (★★★)**
68 Points	**Level 4 (★★★★)**
84 Points	**Level 5 (★★★★★)**
90 Points	**Level 6 (★★★★★★)**

The Passivhaus approach is fundamentally about minimizing energy losses within the building fabric through insulation and air-tight construction. The CSH is wider ranging, covered water usage, and renewable energy devices such as wind turbines and PV. Ultimately the priority is to make the building consume as little energy as possible (by building to Passivhaus principles), then PVs and wind turbines can be added to produce the small amount of energy required on site. Simply bolting renewable energy products onto a poor building is the wrong approach. The AECB carbonlite standard is based around the Passivhaus principles.

Passivhaus standards, therefore emphasises energy demand and building fabric, not water, materials, etc. A Passivhaus achieves Code Level 4; a Passivhaus fabric is required to achieve Code Level 6

INTEGRITY BUILDINGS
MAIN CONTRACTOR ON 1ST CERTIFIED PASSIVHAUS IN LONDON



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