

# Sponsor's Update and Passivhaus Awareness

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Leicester 09.12.11**

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# Summary

**Climate Energy update**

**Passivhaus Principles**

**Passivhaus design**

**PHPP**

**Elements**

**Airtightness**

**MVHR**

**Comfort**

# Climate Energy Update

- CESP/CERT
- Green Deal
- CES & CEH

“I was working as a physicist. I read that the construction industry had experimented with adding insulation to new buildings and that energy consumption had failed to reduce. **This offended me** – it was counter to the basic laws of physics. I knew that they must be doing something wrong. So I made it my mission to find out what, and to establish what was needed to do it right.”



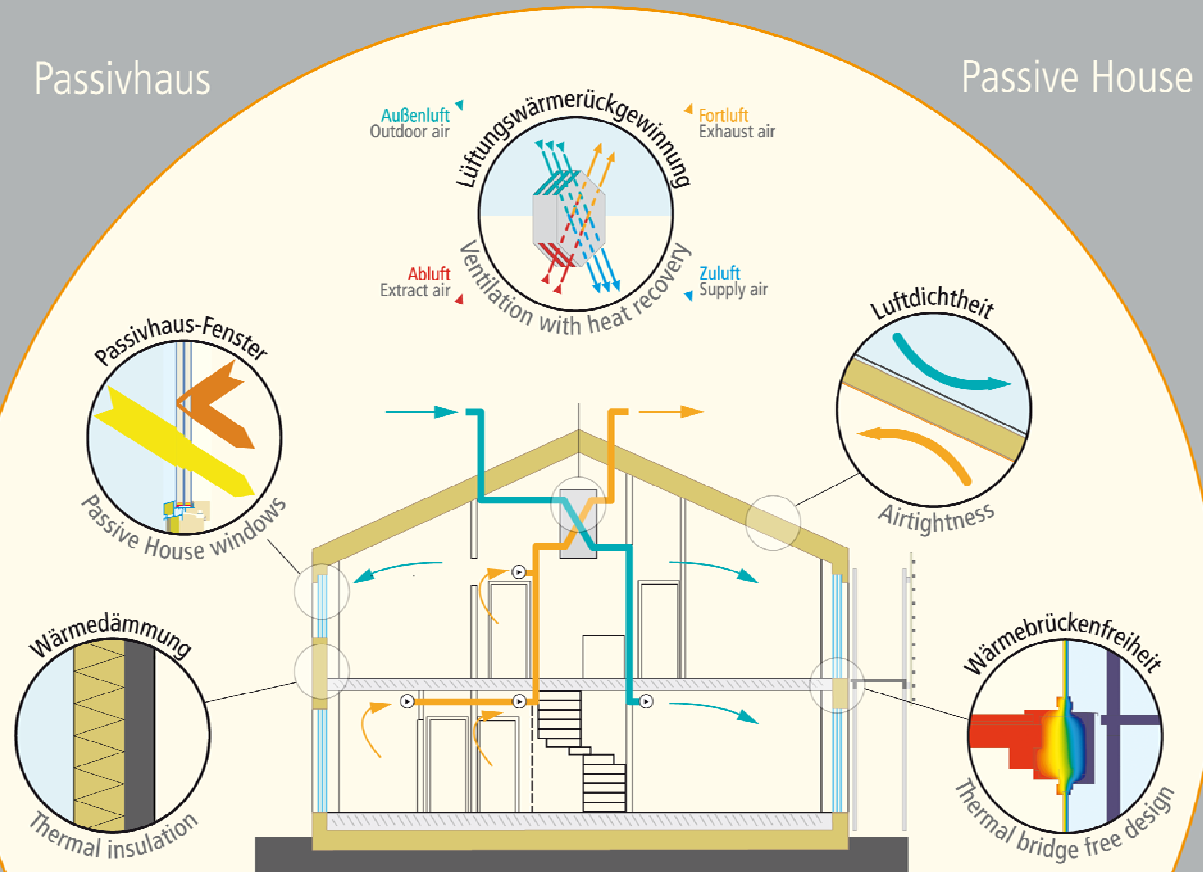
Professor Wolfgang Feist  
Founder Passivhaus Institut, Germany



PASSIV  
HAUS  
INSTITUT  
*Dr Wolfgang  
Feist*

Passivhaus

Passive House



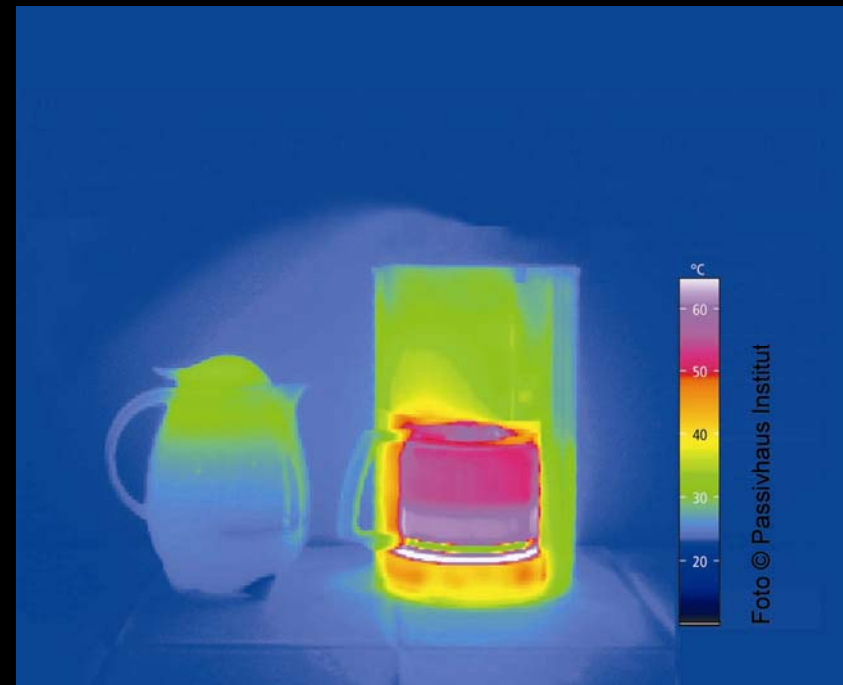
# 5

Die fünf Grundprinzipien  
The five basic principles

Passive – maintaining the heat using an insulated flask



Active – maintaining the heat by energy input



# Fridtjof Nansen's polar ship, the "Fram", was a Passive House (1883)



# Key design criteria

- Annual heating requirement is no more than 15KWh/m<sup>2</sup>/a

*or*

- Heating load is no more than 10W/m<sup>2</sup>
- Total combined primary energy consumption does not exceed 120KWh/m<sup>2</sup>/a
- Airtight envelope: no more than 0.6ac/h @ 50Pa (generally means air permeability <1m<sup>3</sup>/h/m<sup>2</sup>@50Pa).



1 candle  $\approx$  30 W

1 incandescent lamp  $\approx$   
100 W

1 person  $\approx$  100 W

10 W/m<sup>2</sup> from fresh air:  
heating with the  
ventilation  
system.

using wood, gas,  
heatpumps, a compact  
unit.





**Would you like to have less?**

# How to achieve a Passivhaus

- Wall and roof U values c. 0.1 – 0.15W/m<sup>2</sup>K
- Window and door U values < 0.85W/m<sup>2</sup>K installed
- Mechanical ventilation with heat recovery with efficiency above c.80% (tested to PH standard)
- Compact form (surface to volume ratio)
- Excellent design and onsite practice to ensure very high levels of airtightness
- Very low thermal bridging 0.01W/mK
- Care with orientation of window openings.

# How to achieve a Passivhaus

Compact form



# How to achieve a Passivhaus

Excellent design and onsite practice



# How to achieve a Passivhaus

Care with orientation and size of windows



# How to achieve a Passivhaus

Superinsulation – wall,  
floor and roof U values  
c.  $0.1\text{W/m}^2\text{K}$



# How to achieve a Passivhaus





# How to achieve a Passivhaus



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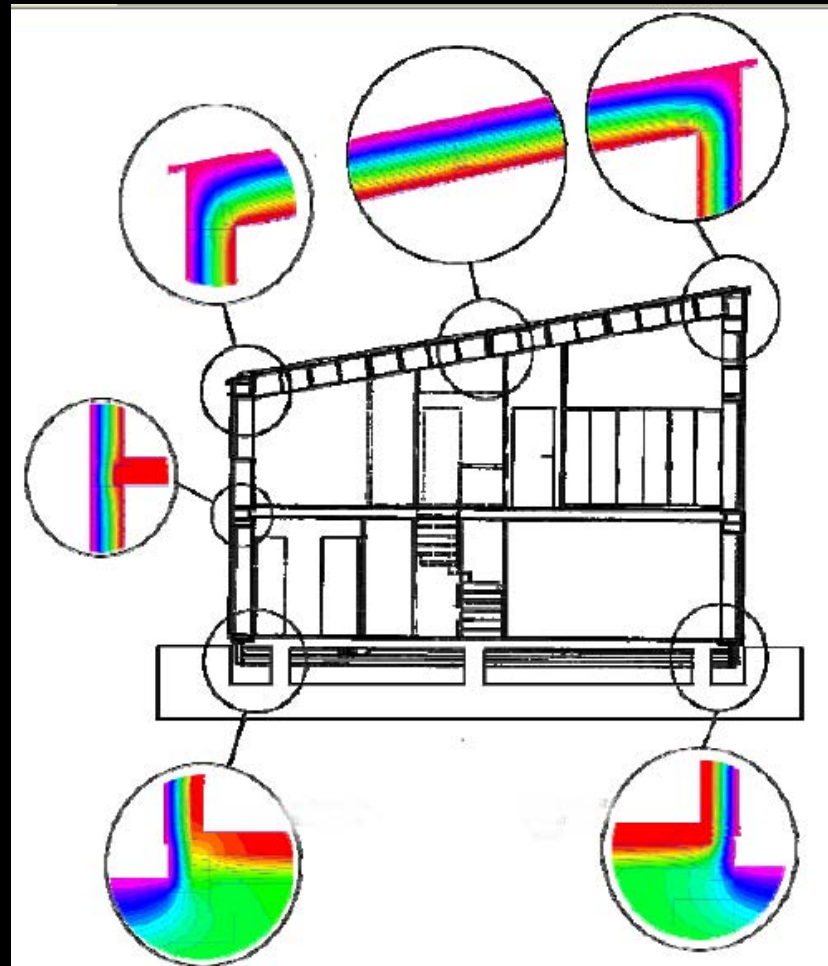


# How to achieve a Passivhaus



# How to achieve a Passivhaus

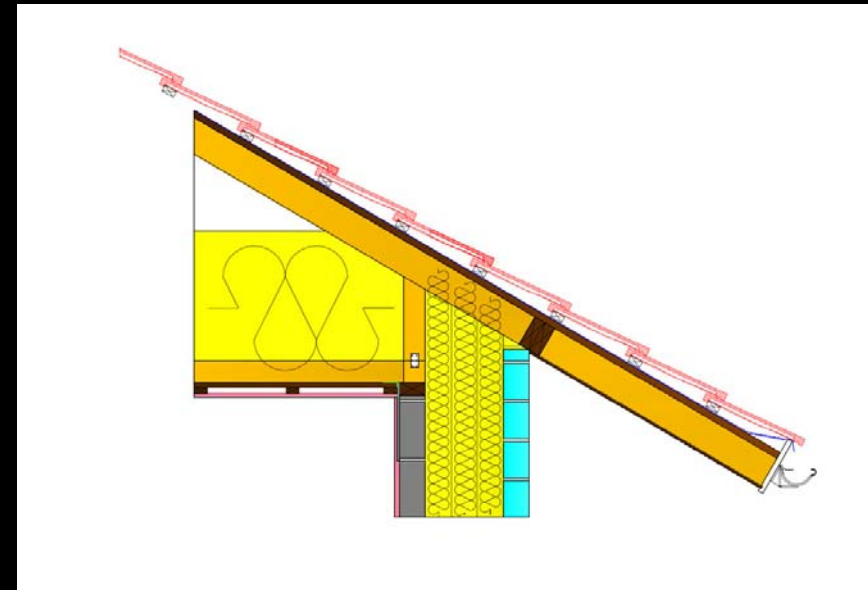
Very low thermal bridging  $\psi < 0.01\text{W/mK}$



# How to achieve a Passivhaus



# How to achieve a Passivhaus

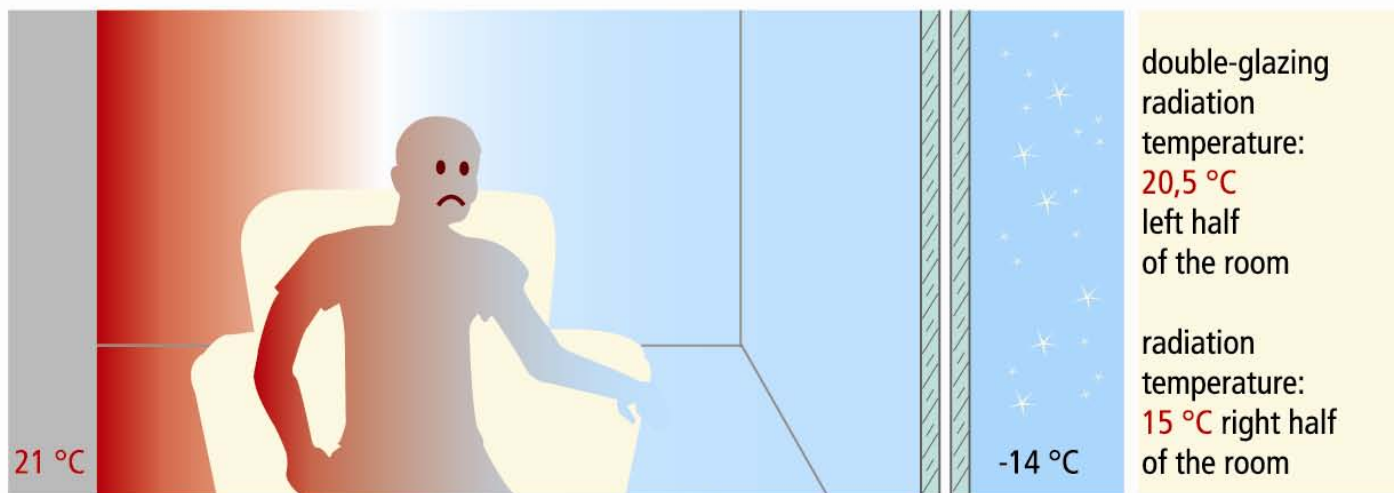
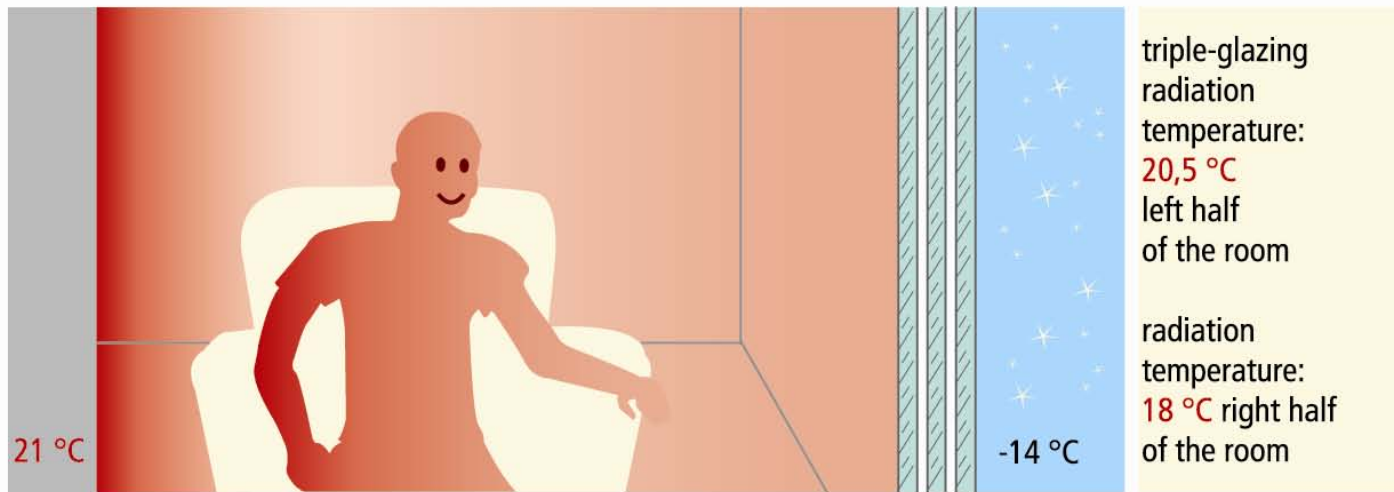




# How to achieve a Passivhaus

Super windows - window and door U values  $\leq 0.8\text{W/m}^2\text{K}$



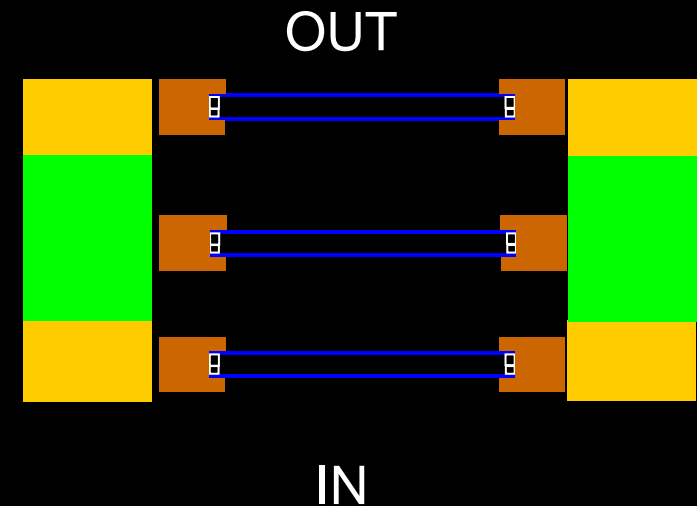
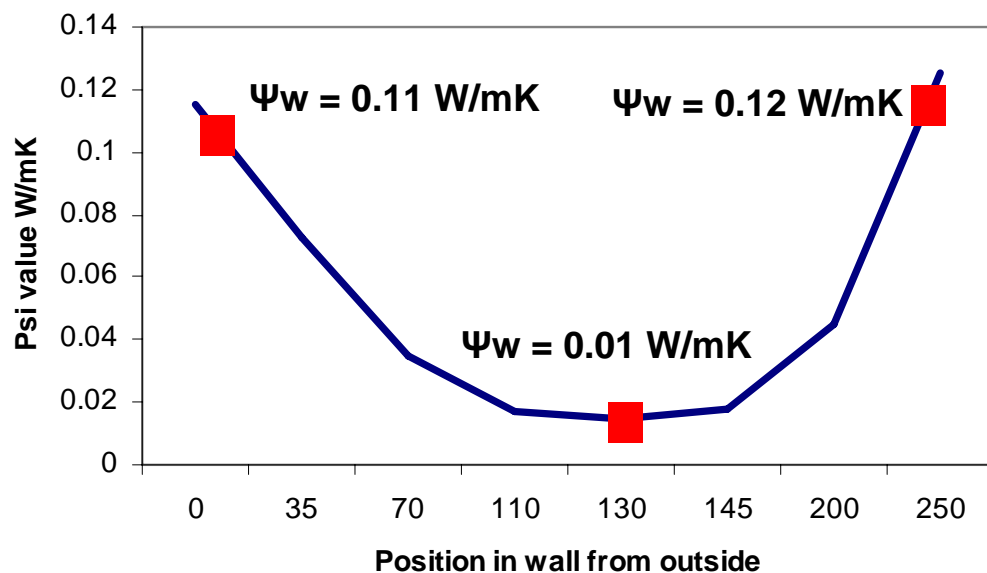


21 °C

-14 °C

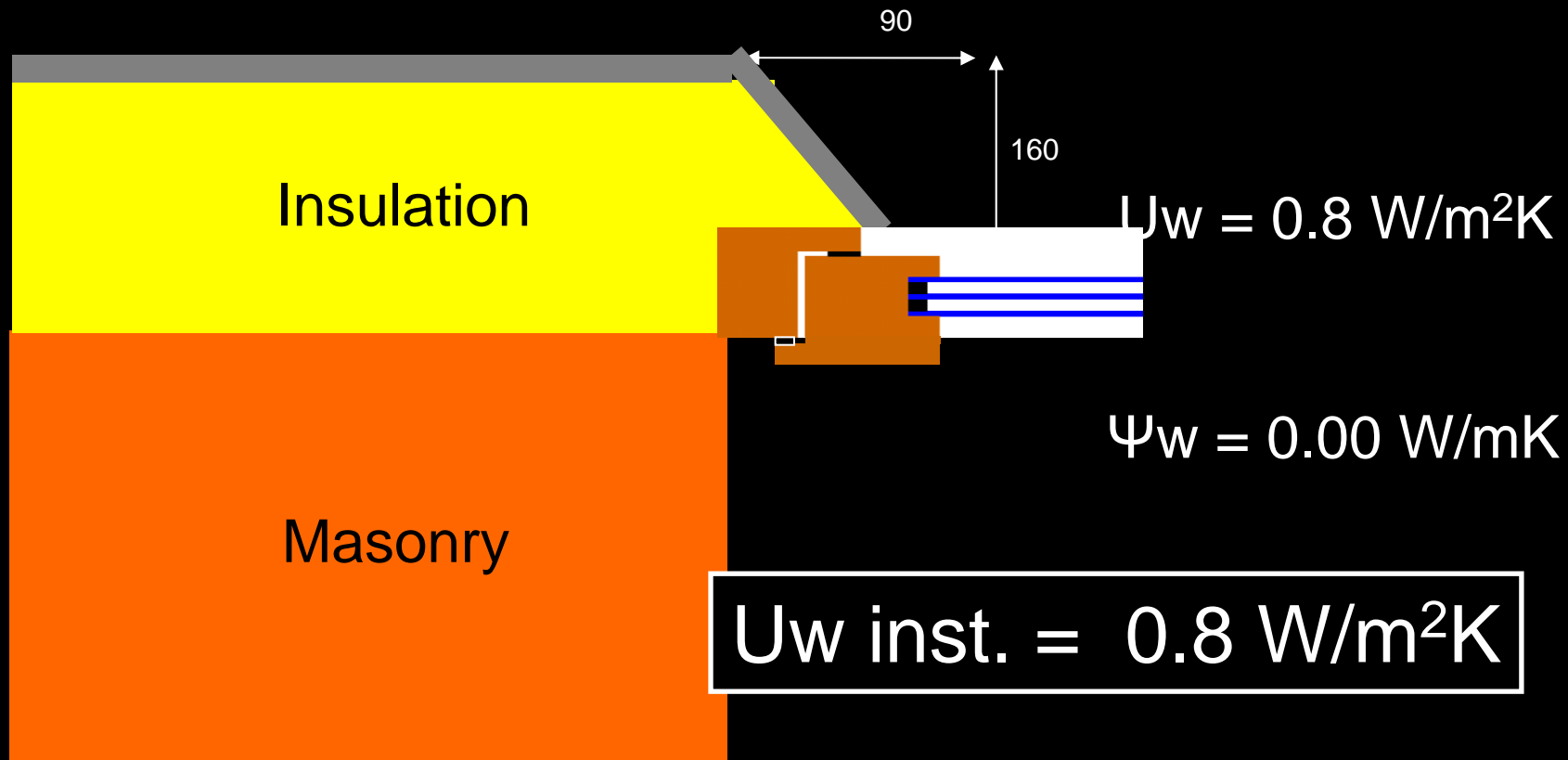


# The effect of installing window in different positions in the wall



Schematic for illustration purposes based on installation positions for a high performance double glazed window into advanced specification cavity wall construction  
From "Stamford Brook – making sustainability work" Lowe et al

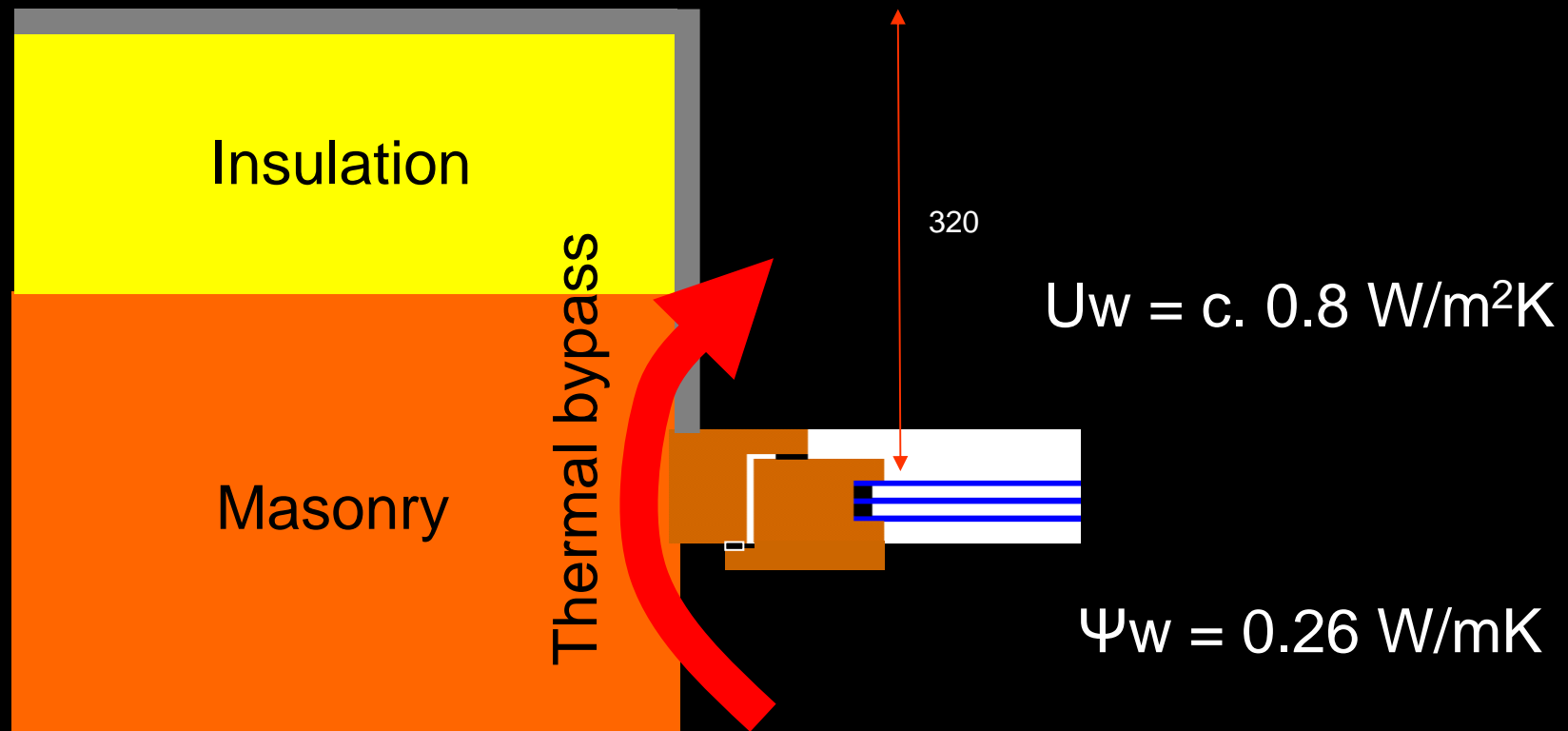
# The effect of window position and insulation wrapping



Schematic drawing based on an example from proceedings of the Passive House Conference 2006 for renovation of typical German construction using PH standard window. Freundorfer, Kaufmann and Krause

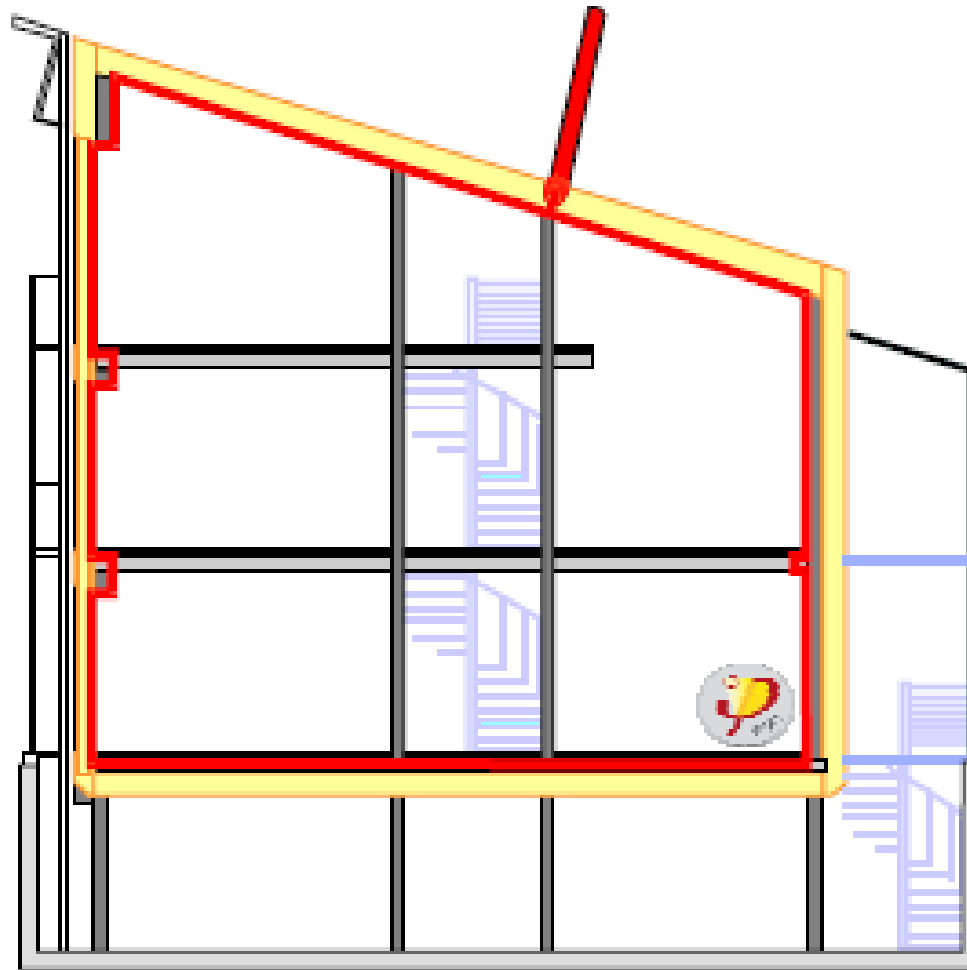
# The effect of window position and insulation wrapping

$$U_w \text{ inst.}^* = 1.84 \text{ W/m}^2\text{K}$$



Schematic drawing based on an example from proceedings of the Passive House Conference 2006 for renovation of typical German construction using PH standard window. Freundorfer, Kaufmann and Krause

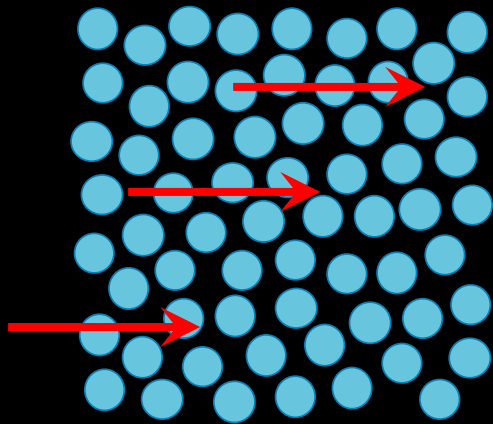
\*1m x 1m window



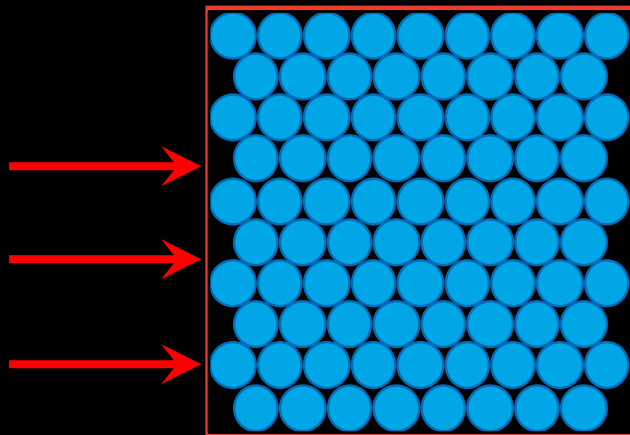
$n_{50}$  max.  $0.60 \text{ h}^{-1}$

design **ONE** airtight layer  
all around the building

# Airtightness and insulation values



**Air movement = heat transfer**



**Only encapsulated air,  
protected against air  
movement, insulates!**

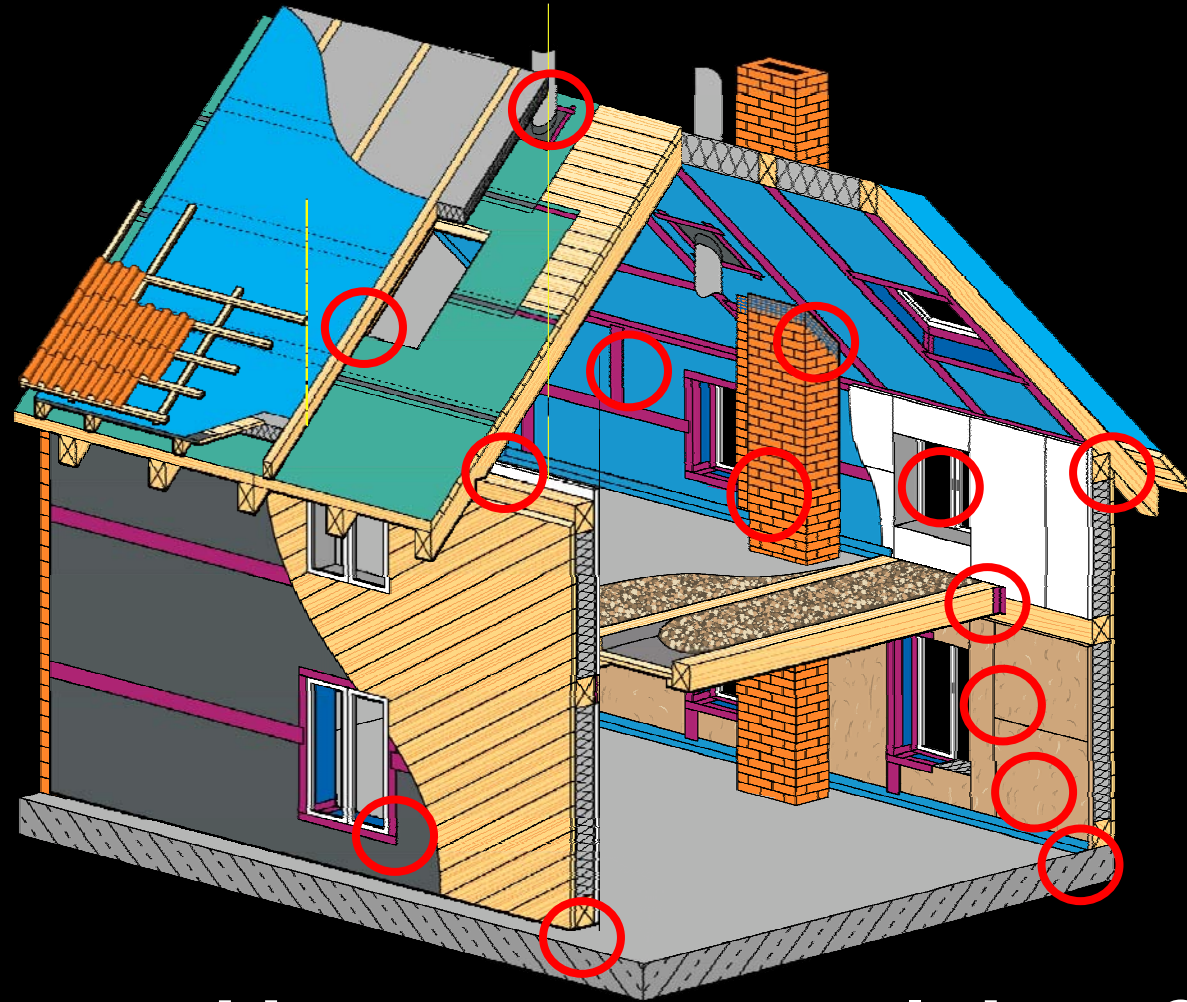
# How to achieve a Passivhaus

Highly airtight  $\leq 0.6$  ac/h @ 50 Pa





# So where are all of the gaps?



...and how can we seal them?

Tapes ■ Membranes ■ Grommets

# How to achieve a Passivhaus

Tapes

Window box and wall

Sealing of overlaps



# How to achieve a Passivhaus

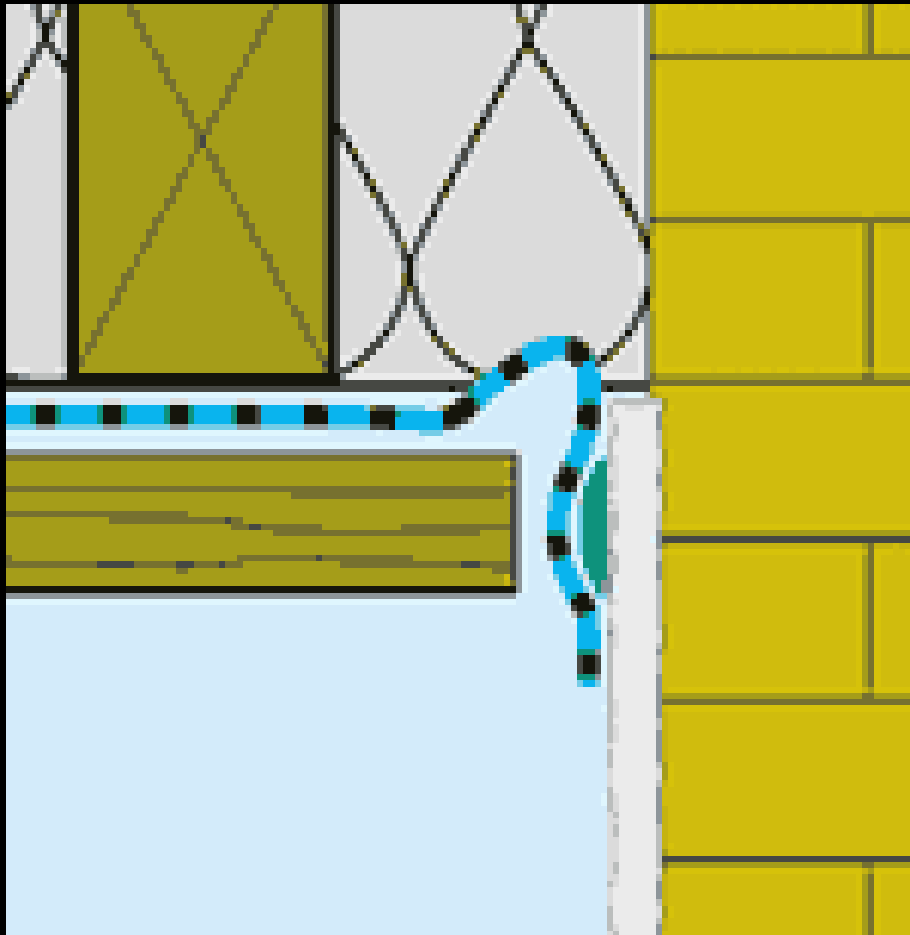
Connections of corners and edges in timber construction



Connections to plastered walls



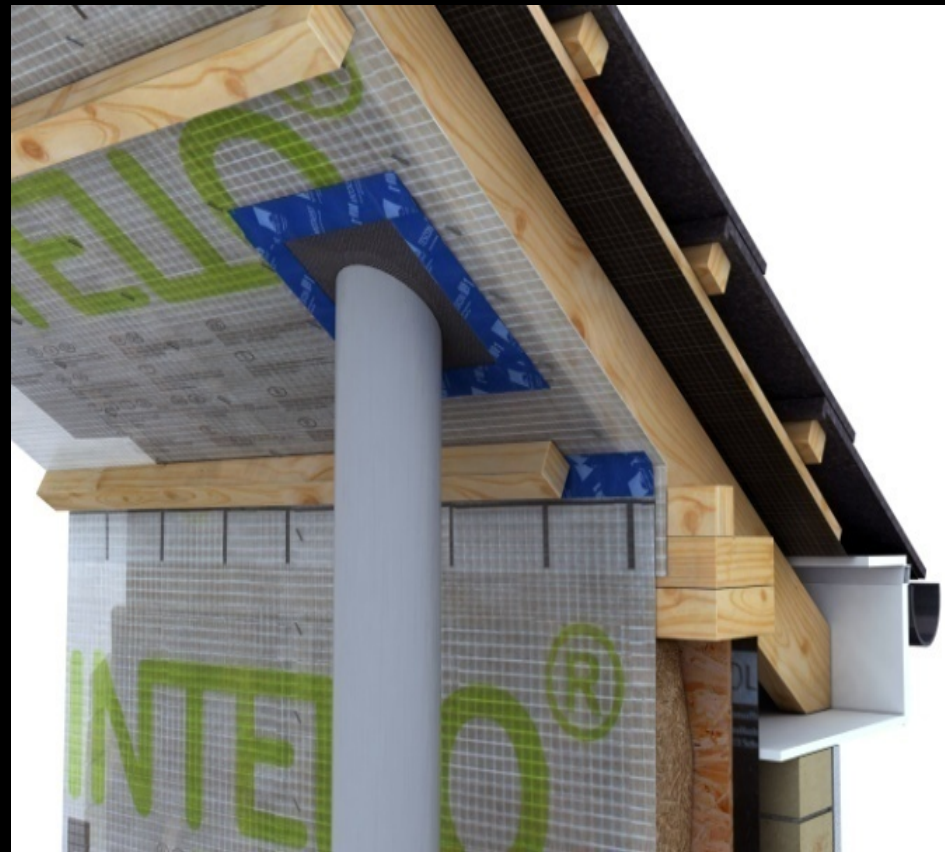
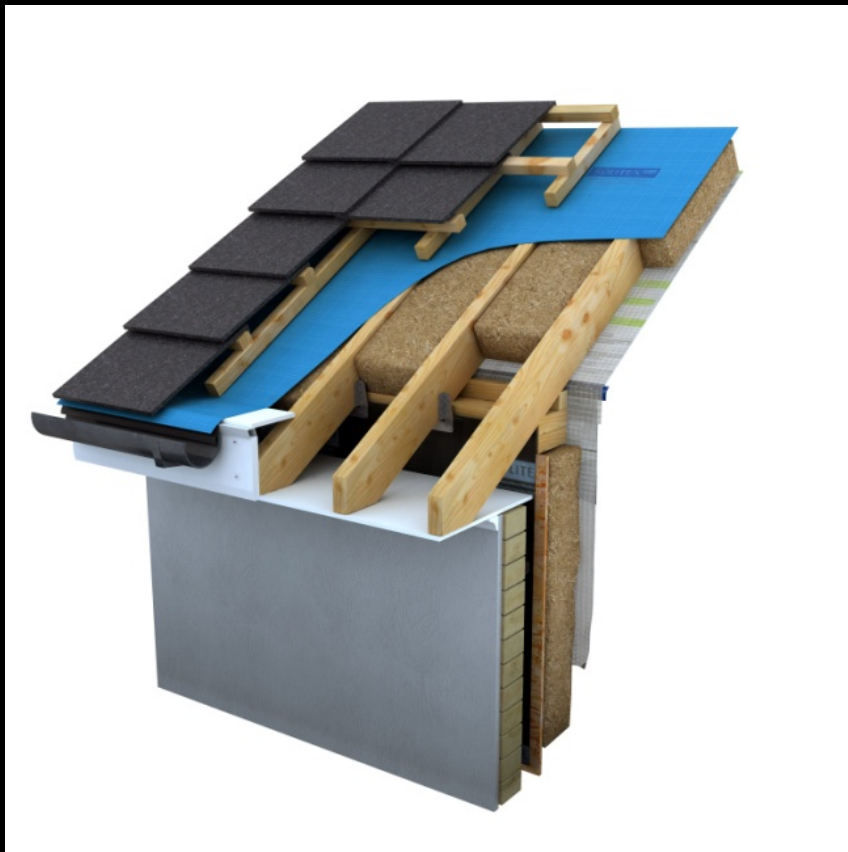
# How to achieve a Passivhaus



Connections to walls –  
airtight connection adhesive

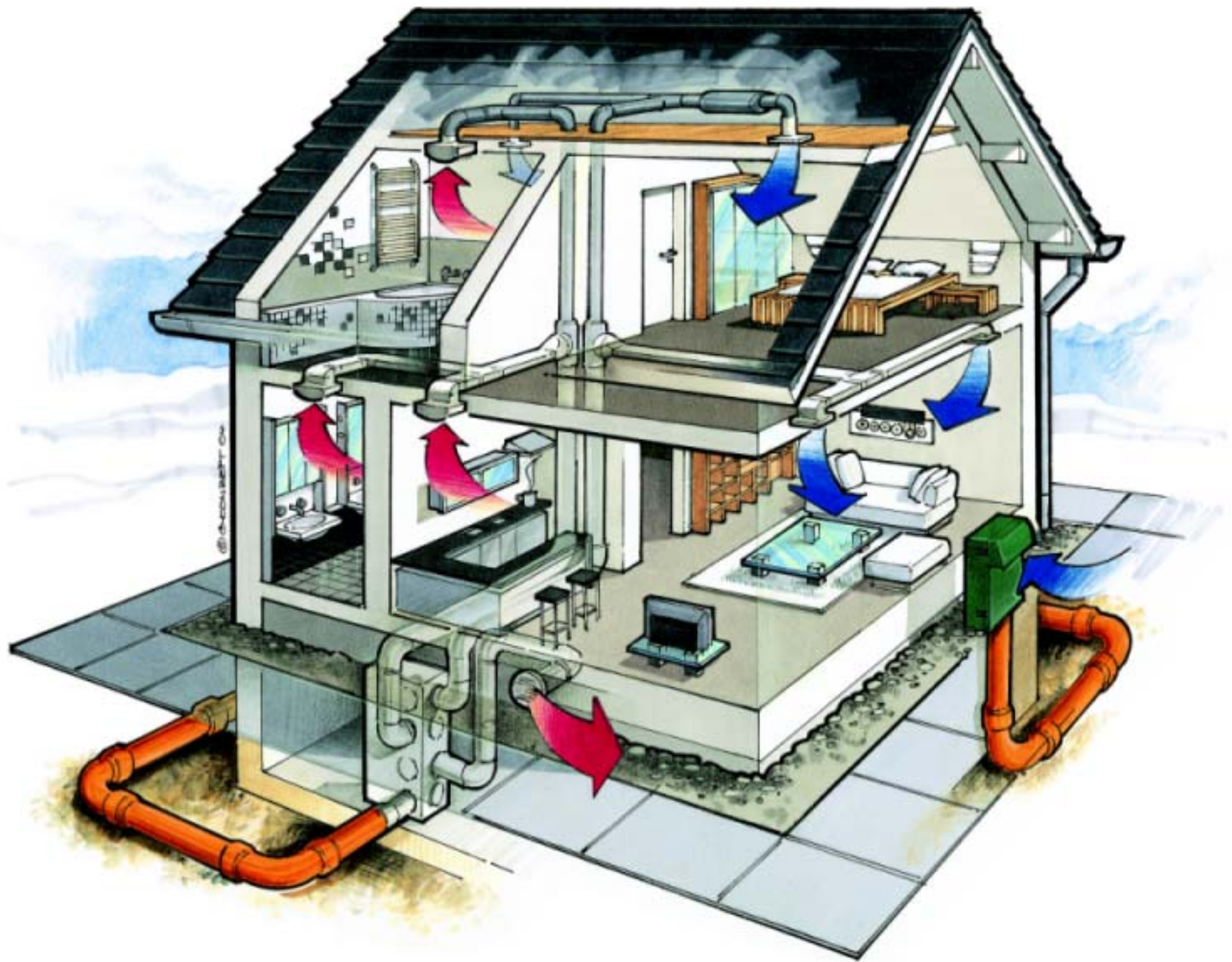


# Membranes

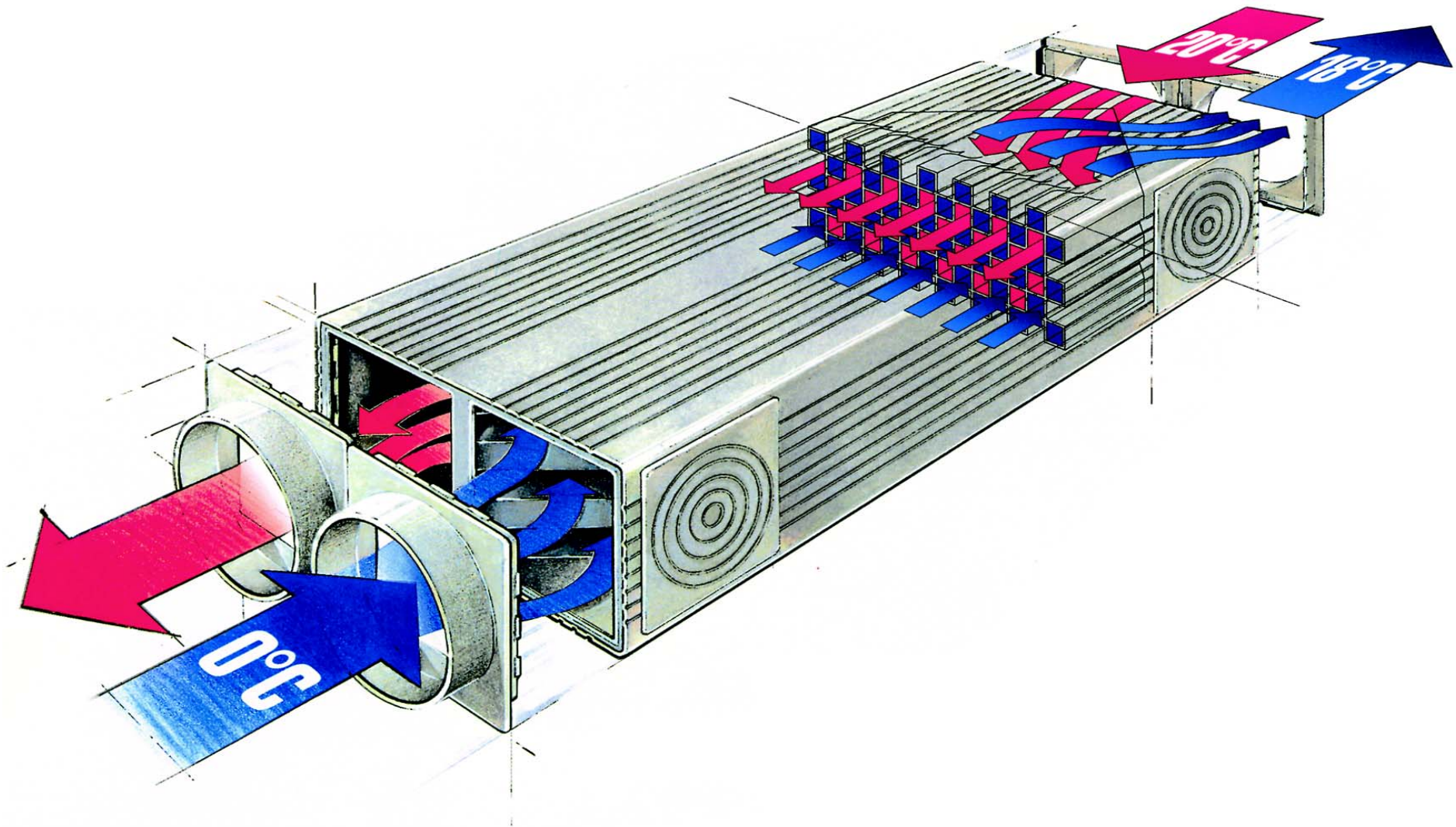


# Grommets





# PAUL counterflow heat exchanger







# Passivhaus ventilation



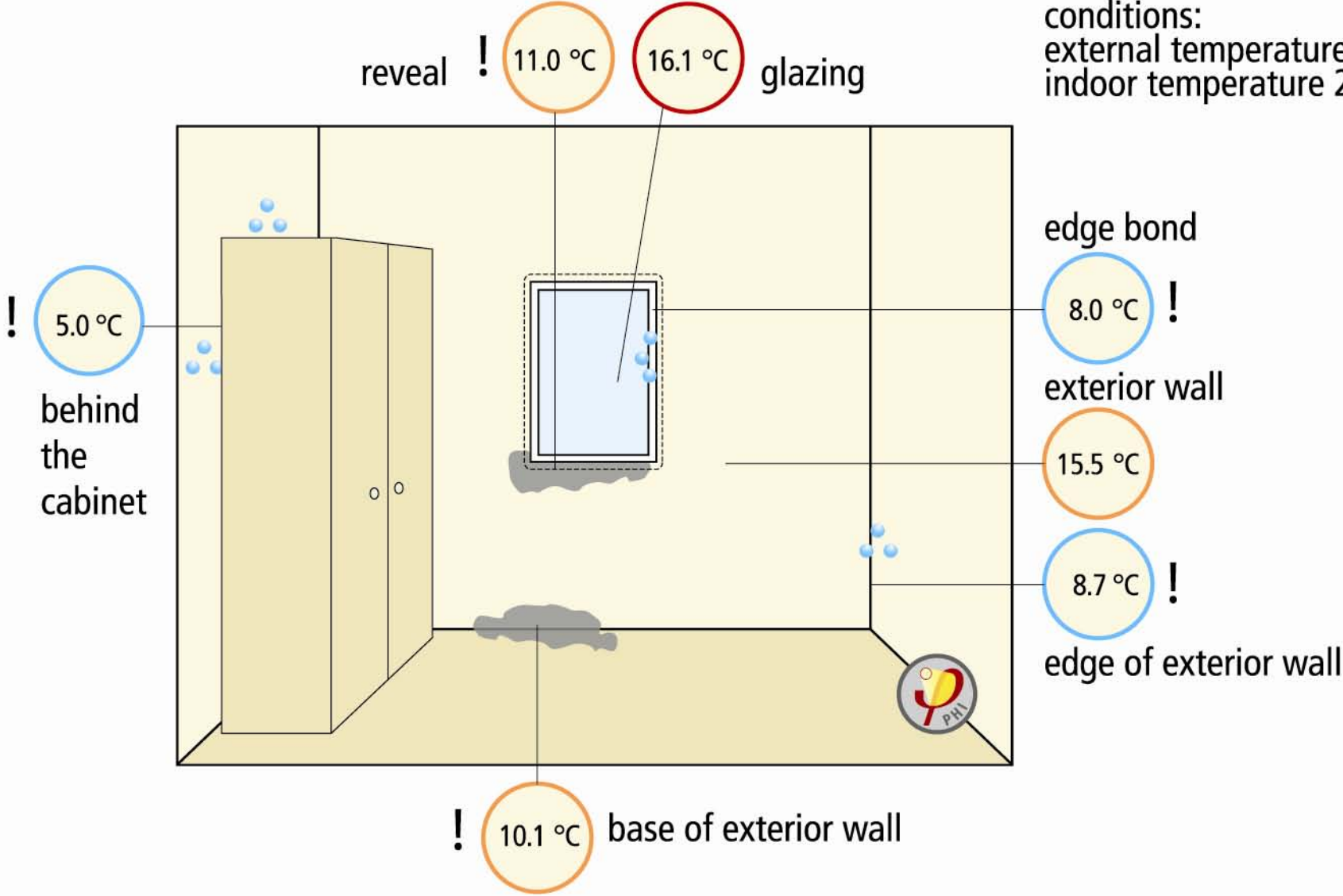
# Passivhaus – a comfort standard

- No draughts
  - No cold radiant
  - No summer overheating
  - Fresh air always
  - Whole house warm - no hypothermia
  - Fuel Poverty eliminated
- all by simply improving the build quality



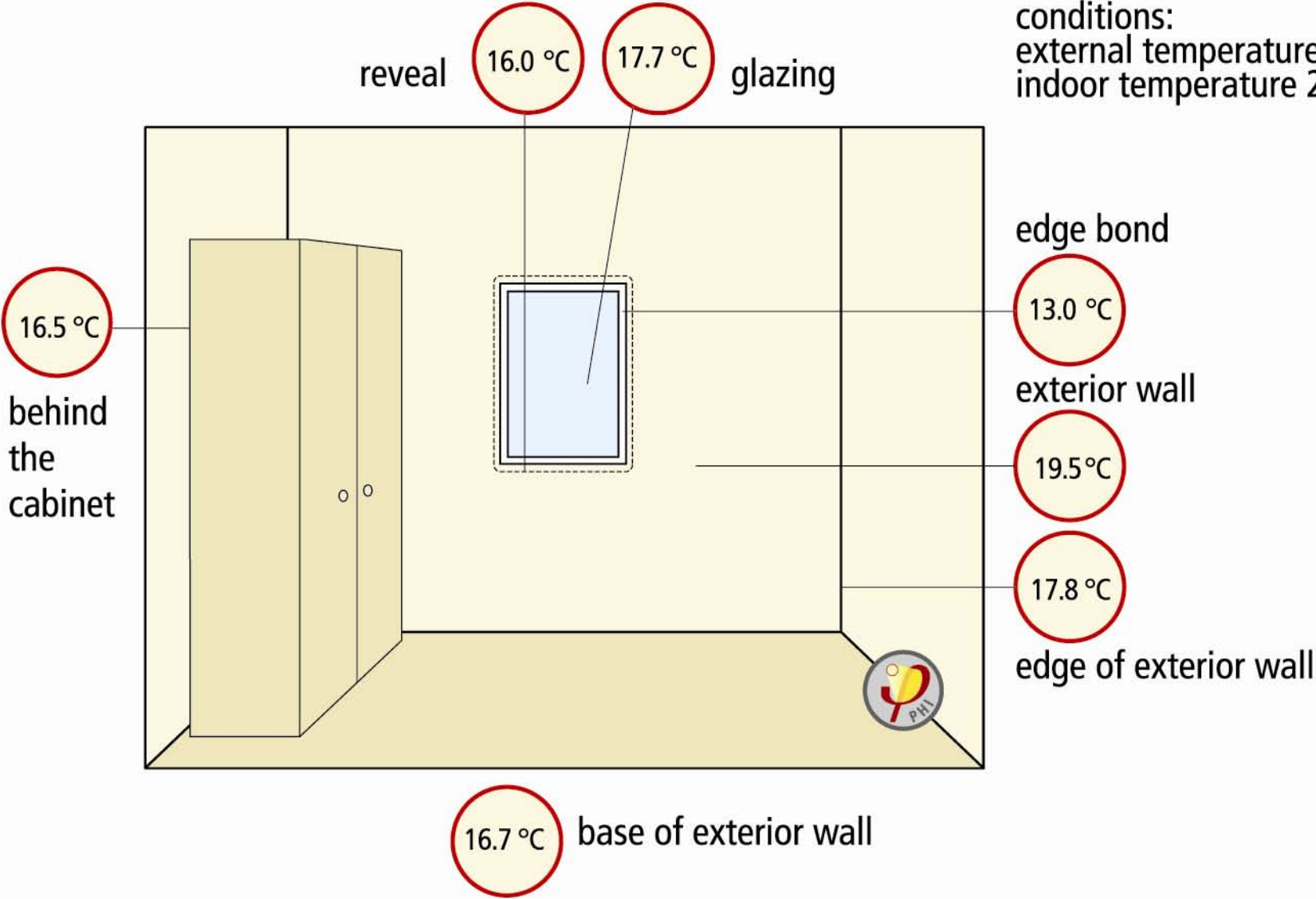
**Previous condition:** cold surfaces can lead to moisture damage

conditions:  
external temperature -5 °C  
indoor temperature 20 °C



**Present condition:** modernised using Passive House components

conditions:  
external temperature -5 °C  
indoor temperature 20 °C
















# Passivhaus standard

Air-tightness	0.6ach @ 50Pa
Surface temp (windows)	>17degC
Summer overheating	Max 10% >25degC
Vent	~30m <sup>3</sup> /hr.person
Heating	15kWh/m <sup>2</sup> a
Primary Energy	120kWh/m <sup>2</sup> a

# Passivhaus: a robust approach

- High thermal comfort and air quality
- User friendly
- Easy to maintain
- Simple and efficient technology
- Cost effective

# Comparisons

ZCH issues	UK	PH
Accurate prediction of performance	?	
Complex combination of systems which perform	?	
Accurate prediction of overheating		
Good air quality ensured	?	
Performance assurance scheme (QA)		
Monitoring recent low energy buildings		
Regional variations in climate data		
High degree of urgency	Lots to do	Ready



# Acknowledgements

- PHI
- IPHA
- Passivhaus Trust
- BRE
- Green Building Store
- Disability Essex

**Questions?**

# Thanks for listening

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