ARCHITECTURE STUDENT CONTEST

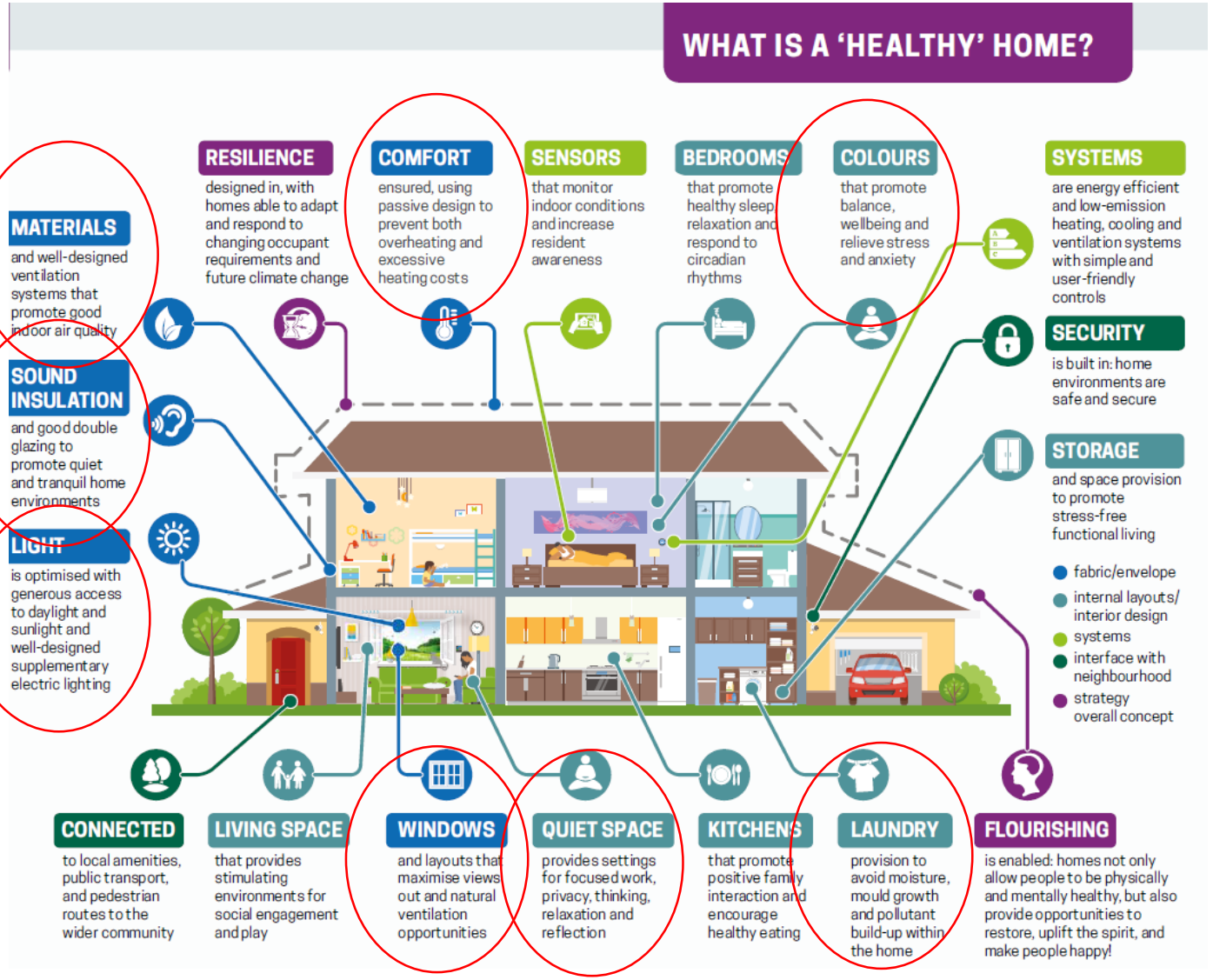
Warsaw 2022

SAINT-GOBAIN

Comfort

Speaking about Comfort

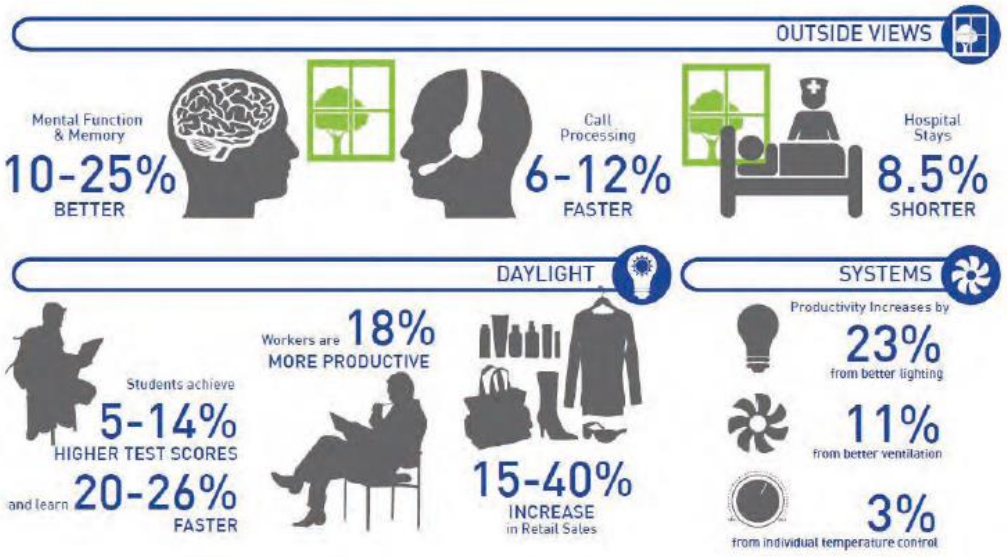
Speaking about Comfort



Source:
https://www.worldgbc.org/sites/default/files/160705_Healthy_Homes_UK_full_report.pdf

Speaking about Comfort

There is a growing body of evidence from around the world showing the strong link between better buildings and increased wellbeing among occupants. Saint-Gobain is a worldwide sponsor of campaigns driving the dissemination of this evidence, such as the World Green Building Council's Better Places for People campaign.



For further information visit www.worldgbc.org and www.betterplacesforpeople.org

Net present value analysis of the operational cost and productivity and health benefits of LEED certified buildings. Illustration taken from 'Health, Wellbeing & Productivity in Offices', World Green Building Council, 2014.

Speaking about Comfort

Comfort is a state of physical ease and wellbeing in a given environment. Within a building, various conditions are required to enable people to feel comfortable, and to perform their tasks effectively. There are four main considerations that affect people's senses and therefore their perception of comfort inside buildings. These are core to the Multi Comfort standard.

Feel
THERMAL **COMFORT**

See
VISUAL **COMFORT**

Hear
ACOUSTIC **COMFORT**

Breathe
INDOOR AIR **COMFORT**

Thermal Comfort

Thermal Comfort

Effects on work performance

The perceived thermal comfort has a direct effect over the human body performances

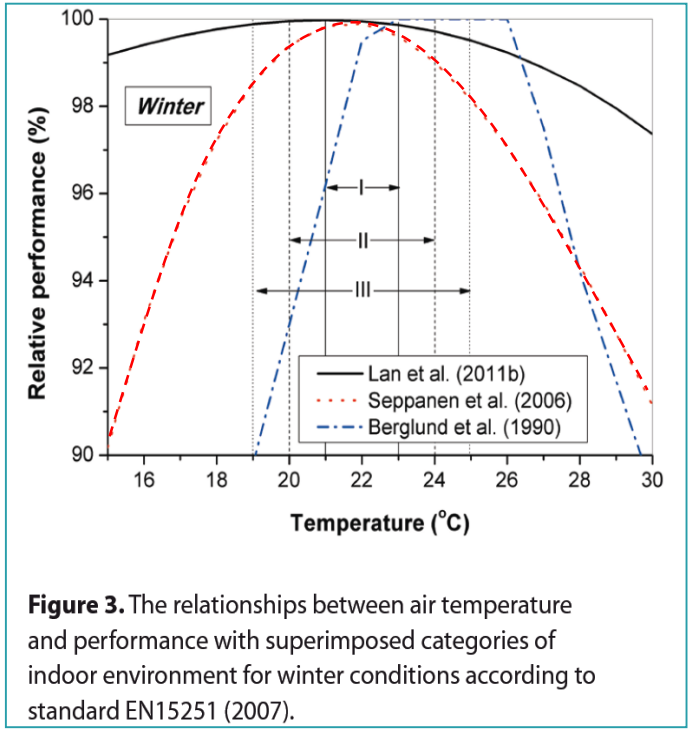


Figure 3. The relationships between air temperature and performance with superimposed categories of indoor environment for winter conditions according to standard EN15251 (2007).

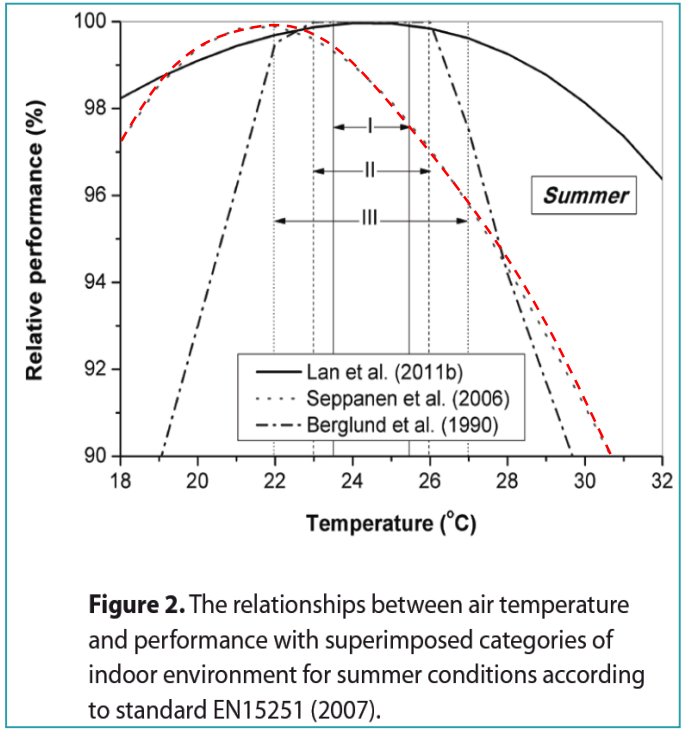


Figure 2. The relationships between air temperature and performance with superimposed categories of indoor environment for summer conditions according to standard EN15251 (2007).

Source :REHVA Journal – January 2012/ Optimal thermal environment improves performance of office work, Wargocki/Lan/Lian

Thermal Comfort

Determined by:

- Air temperature
- Surface temperatures
- Humidity
- Absence of draughts

Your Projects

- Keep your ideal indoor temperature all year round using very little energy
- Have walls that are nice to touch or lean on regardless of the weather outside
- Have no draughts, even on the floor

Saint-Gobain solutions:

- **Glazing to let sun in or block it out**
- **Insulation to reduce heat loss or summer heat gains**
- **Plasters and plasterboards to improve Thermal Comfort**
- **Smart membranes to improve airtightness and manage moisture**
- **Renders that insulate and provide weather defence**

Feel
THERMAL
COMFORT

Visual Comfort

Visual Comfort

Effects on human well-being and comfort in case of good level of natural light

- generates higher level of concentration and better short-term memory recall.
- up to 20% better performances in standardized test (1)1
- faster progress on math tests by 20% (2)
- faster progress on reading tests by 25% (2)

Source :1 : CEC study 1999, 2 : Study San Juan Capistrano, California

Visual Comfort

Determined by:

- Views of outside space and connected to nature
- Light quality
- Luminosity
- Absence of glare

Your Projects

- Are full of natural light without glare
- Have rich colors, making close-up work easy from even light distribution
- Bring the outdoors inside, connecting you with nature and improving your mood

Saint-Gobain solutions:

- Transparent products, such as glass, films or architectural membranes, which allow access to daylight and views through windows, doors and partitions
- Translucent products that allow daylight whilst preserving privacy
- Opaque interior products, such as wall coverings, ceiling or flooring products, which can contribute to the distribution of daylight and to the aesthetics of the space

See

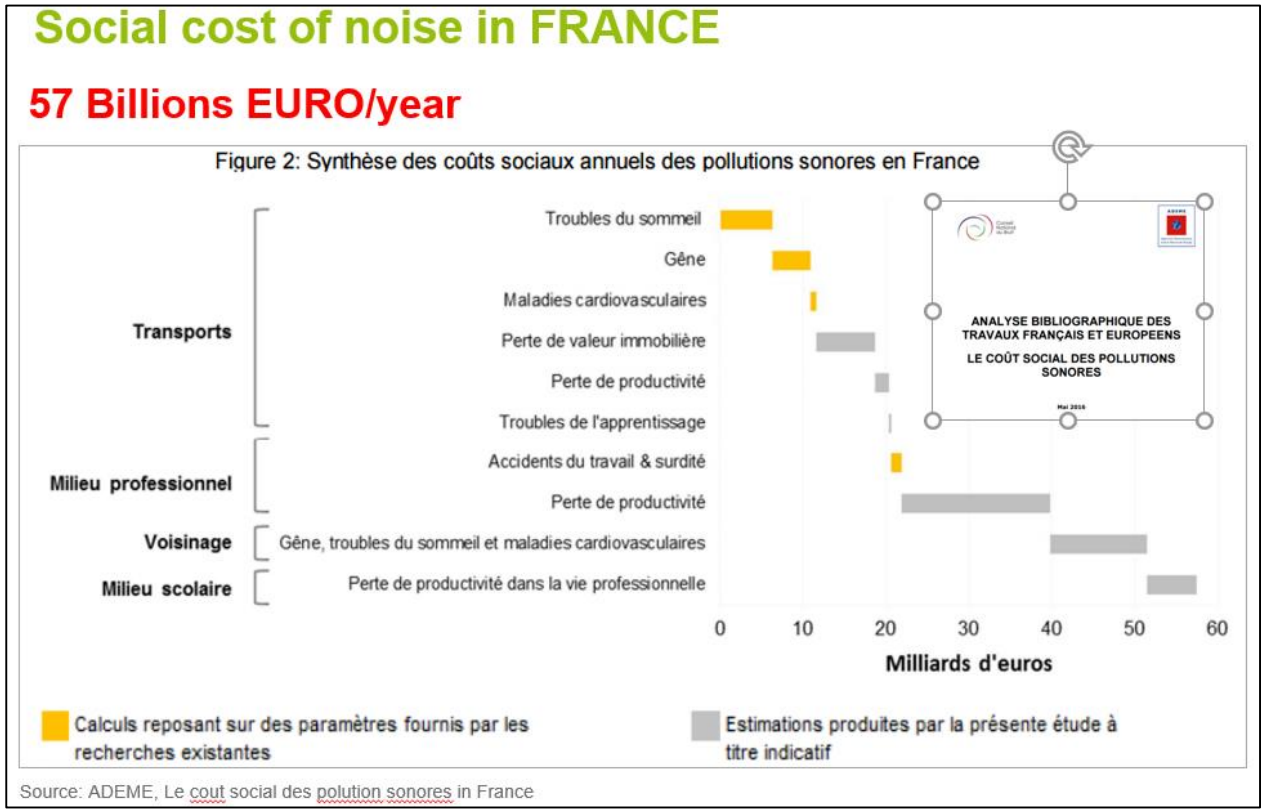
VISUAL COMFORT

Acoustic Comfort

Acoustic Comfort

Noise has several adverse effects on human like:

- high blood pressure,
- mental stress,
- heart attacks,
- hearing damages



Source : ADEME, Le cout social des polution sonores in France

Acoustic Comfort

Determined by:

- Noise from outdoors and/or neighbors
- Sound vibrations through the structure
- Clarity of hearing, speech intelligibility

Your Projects

- Protect you from noise – coming from outside or inside
- Mean you can make noise without disturbing others
- Enjoy an improved level of ambient noise
- Control noise reverberation and increase speech intelligibility making sound places to work and learn

Saint-Gobain solutions:

- **Provide ideal room acoustics for any living, learning or working environment**
- **Plasterboard linings to reduce airborne noise**
- **Insulation solutions to reduce impact noise from above and below**
- **Absorbing acoustic ceilings and panels to control room noise**
- **Sound insulating glazing**

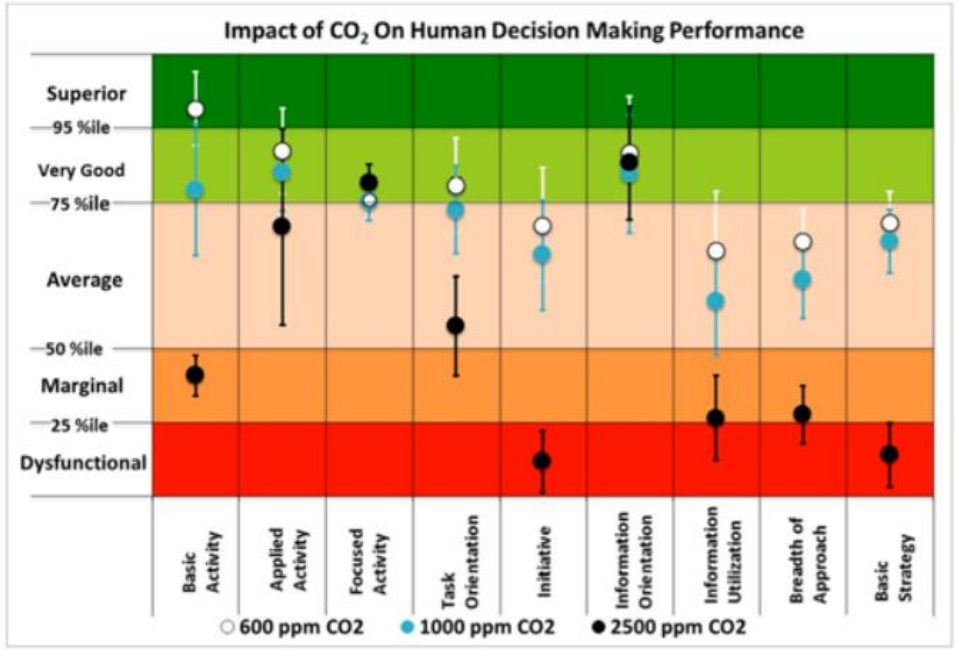
Hear
ACOUSTIC COMFORT

Indoor Air Comfort

IAQ

Indoor Concentrations of CO2 Can Impair Decision-Making Performance

- Study from scientists at the Berkeley Lab, in collaboration with researchers at SUNY Upstate Medical University, found that moderately high indoor concentrations of CO2 can significantly impair people's decision-making performance.



Berkeley Lab researchers found that even moderately elevated levels of indoor carbon dioxide resulted in lower scores on six of nine scales of human decision-making performance.

Source : https://scitechdaily.com/indoor-concentrations-of-co2-can-impair-decision-making-performance/

IAQ

Determined by:

- Indoor air quality
- Fresh air supply
- Absence of internal pollutants
- Control of odors

Your Projects

- Keep outdoor pollution outside
- Have a constant supply of clean, fresh air
- Never feel stuffy nor damp
- Actively break-down impurities in indoor air

Saint-Gobain solutions:

- **Insulation, drylining, membranes and high performance windows and doors providing superior airtightness**
- **Low emission solutions to improve indoor air quality**
- **Products to purify indoor air by scavenging certain (VOCs) Volatile Organic Compounds such as formaldehyde**
- **Low-dust screeds and adhesives improving user-comfort during installation**

Breathe
INDOOR AIR COMFORT

Speaking about Comfort

Feel
THERMAL **COMFORT**

See
VISUAL **COMFORT**

Hear
ACOUSTIC **COMFORT**

Breathe
INDOOR AIR **COMFORT**

Comfort Interactions

Insulation material

Airtightness & ventilation

Windows reveal/ Glazing surface

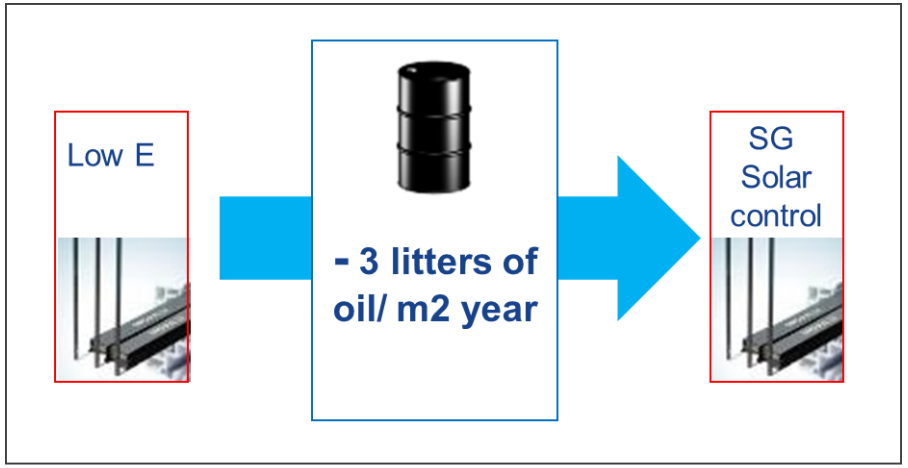
Natural & mechanical ventilation

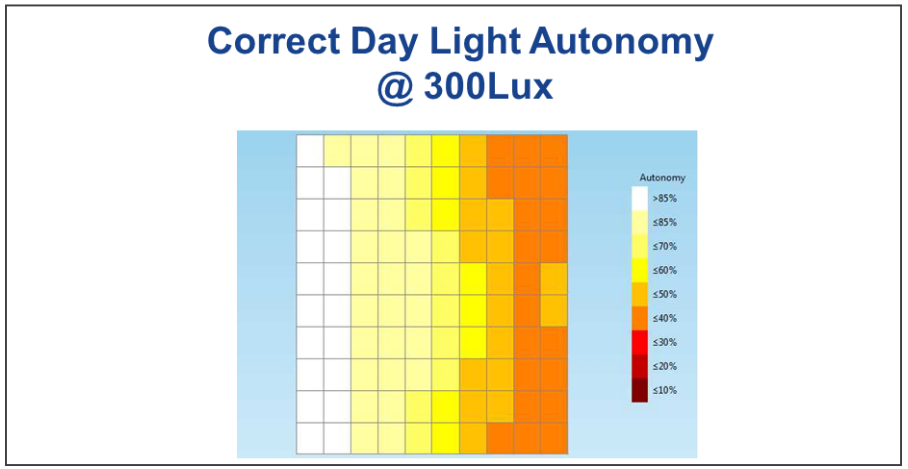
Glazing surface

EPD VERIFIED

Comfort Interactions

Visual comfort & Thermal comfort



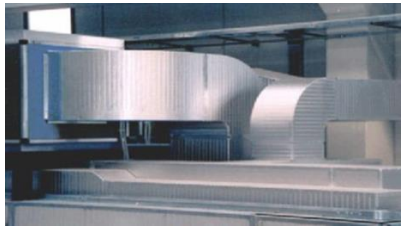


Comfort Interactions

Acoustic Comfort & Thermal comfort

Metallic duct

Rigid foams



CLIMAVER®

Comfort Interactions

IAQ + Acoustic comfort

Comfort Interactions

Four sensory comforts

Sustainability Considerations

ENERGY AND CARBON
Towards zero carbon

Ultimately...

Keep the need for heating, cooling and lighting to the unavoidable minimum. Fulfil any remaining energy needs from renewable and decarbonized sources. Be prepared to produce more energy than needed.

MATERIALS AND RESOURCES
Towards a circular economy

Ultimately...

Close the loop by reducing waste generation to the absolute minimum. Divert residual waste from landfill, and where possible use it as a secondary raw material, while ensuring all materials have zero hazardous content.

HEALTH AND SAFETY
Towards nuturing buildings

Ultimately...

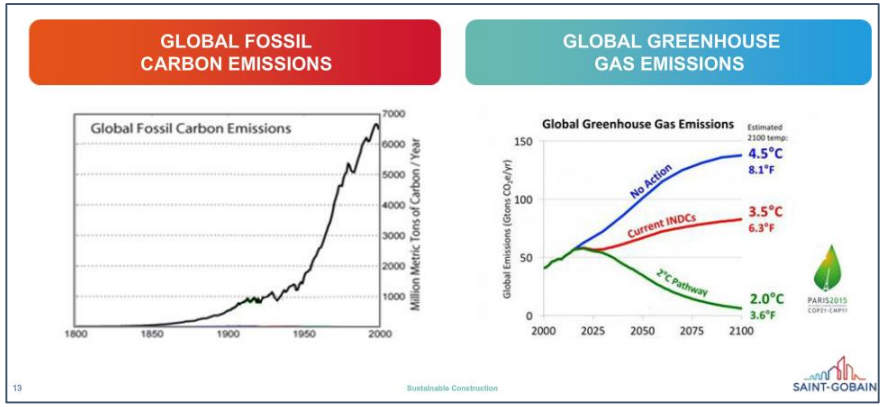
Remove harmful ingredients and releases in the indoor environment and contribute to buildings that are protective of their occupants and their health.

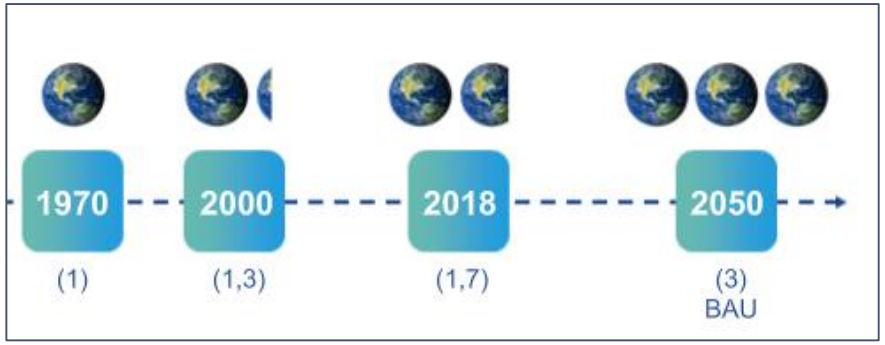
Thermal Comfort

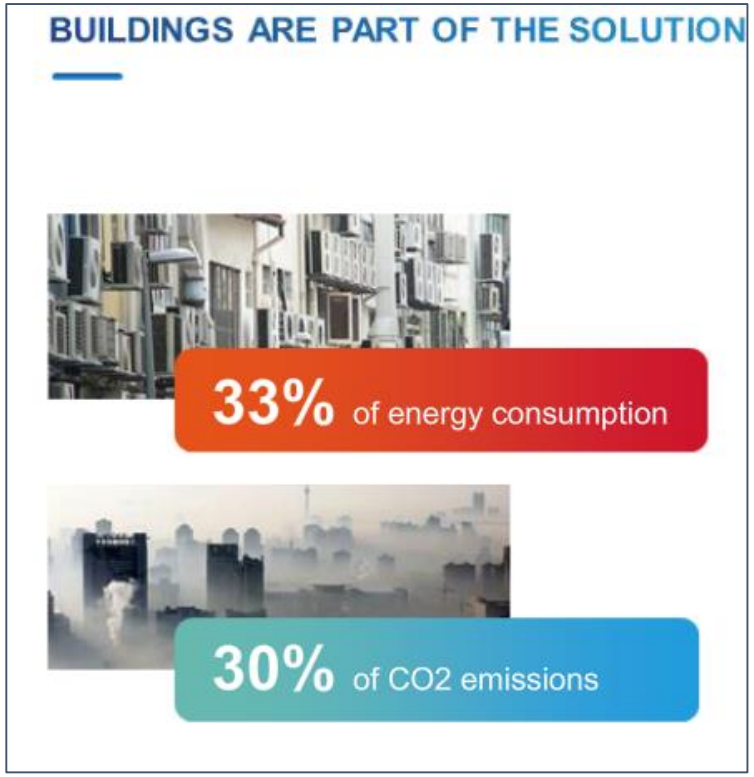
Thermal Comfort

Carbon and resources challenge

Buildings as part of the solution



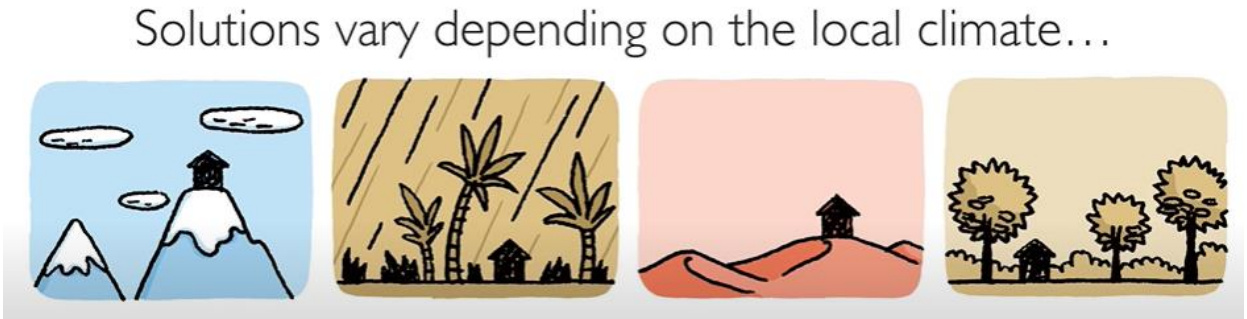




Designing for thermal comfort

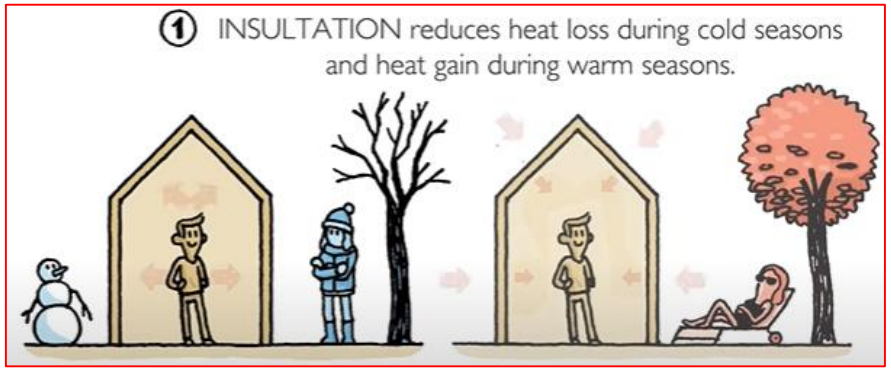
"No universal solution"

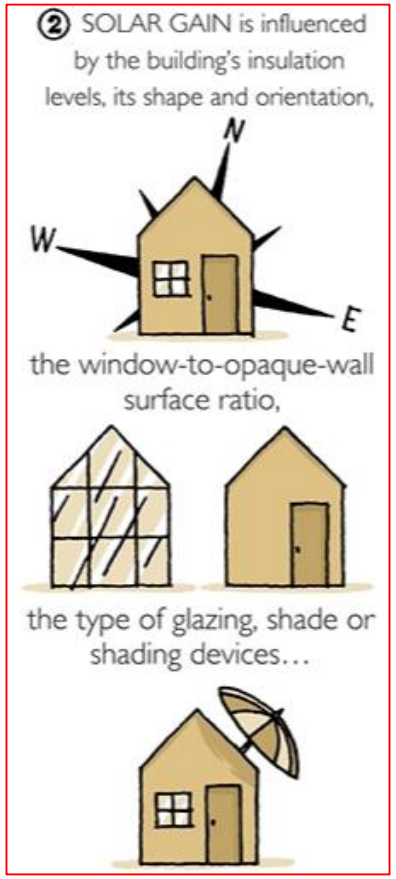
https://www.youtube.com/watch?v=BTdiimklSqo

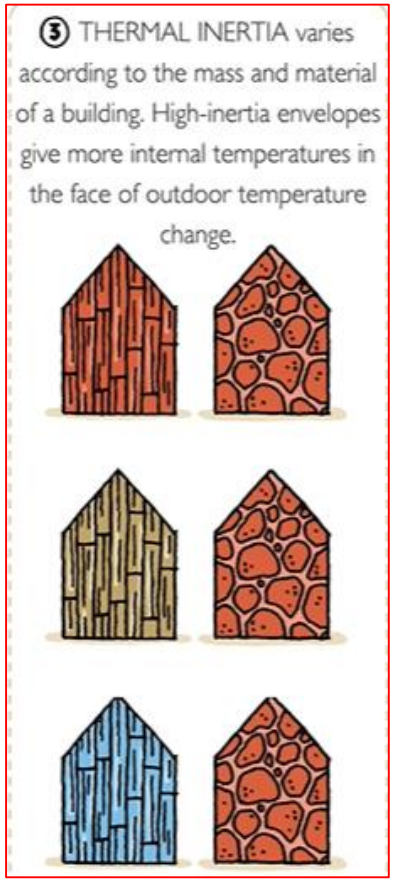


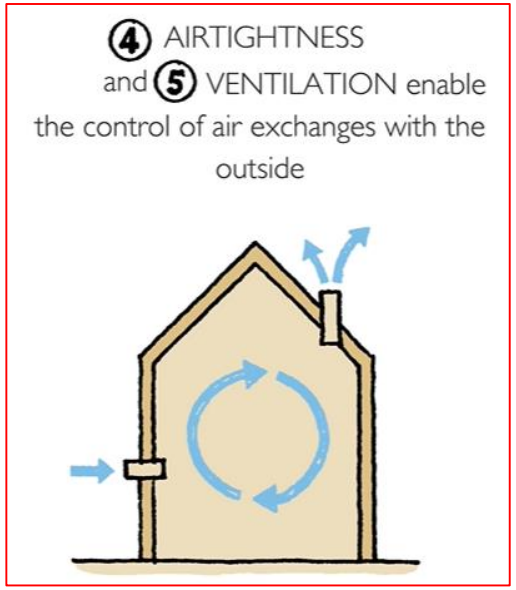
Designing for thermal comfort

Main Steps









Designing for thermal comfort

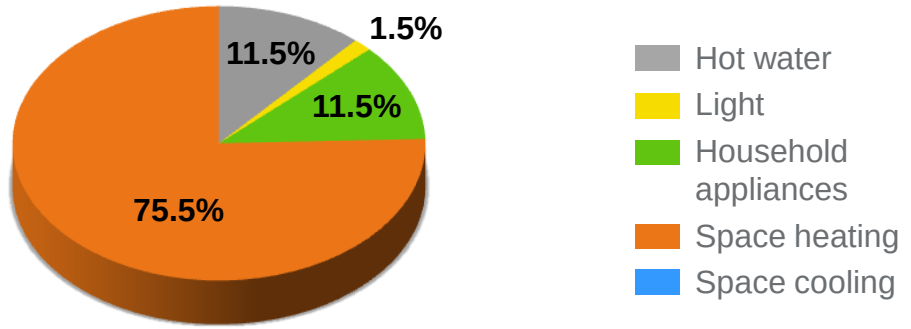
A well designed building envelope can dramatically reduce the need for mechanical systems required to provide thermal comfort, so reducing the environmental impact.

Designing for thermal comfort

Space heating & cooling

Main „energy consumer“ in (residential) buildings

Energy usage in residential buildings



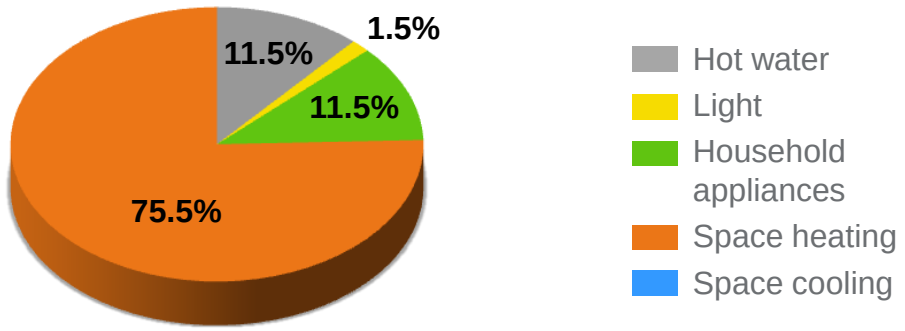
European moderate climate

Designing for thermal comfort

Space heating & cooling

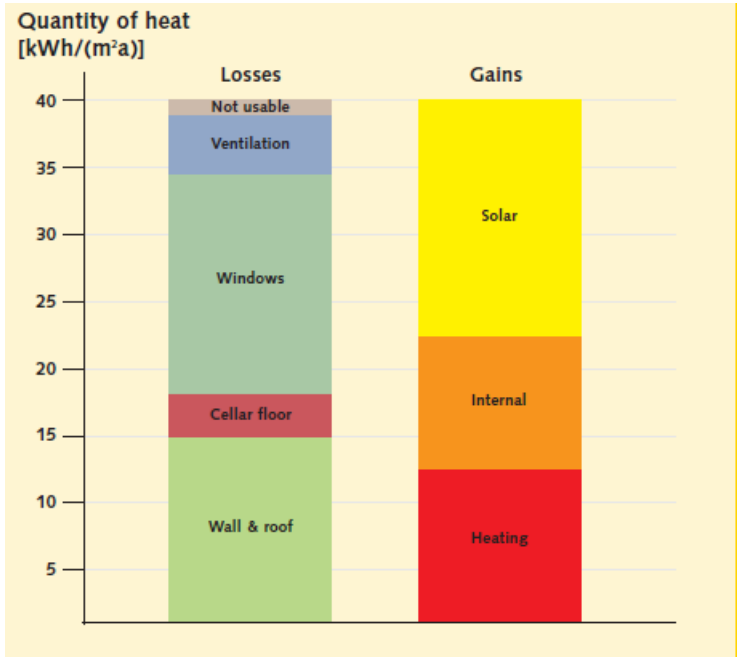
How to balance them

Energy usage in residential buildings



European moderate climate

Thermal balance



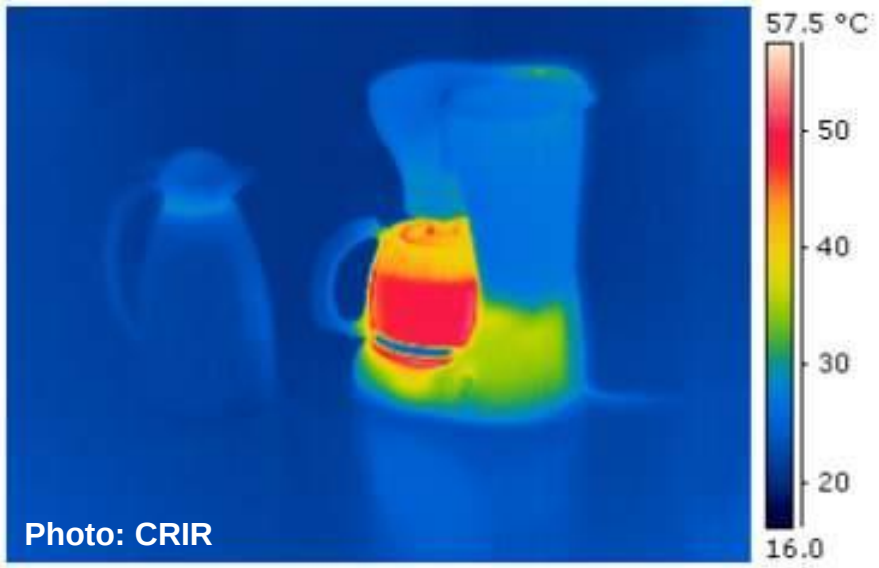
Designing for thermal comfort

From active heating to preserving energy while coffee is still hot

Preserving:
Keep it warm through insulation

Active:
Keep it warm by heating with energy

Low tech – low maintenance



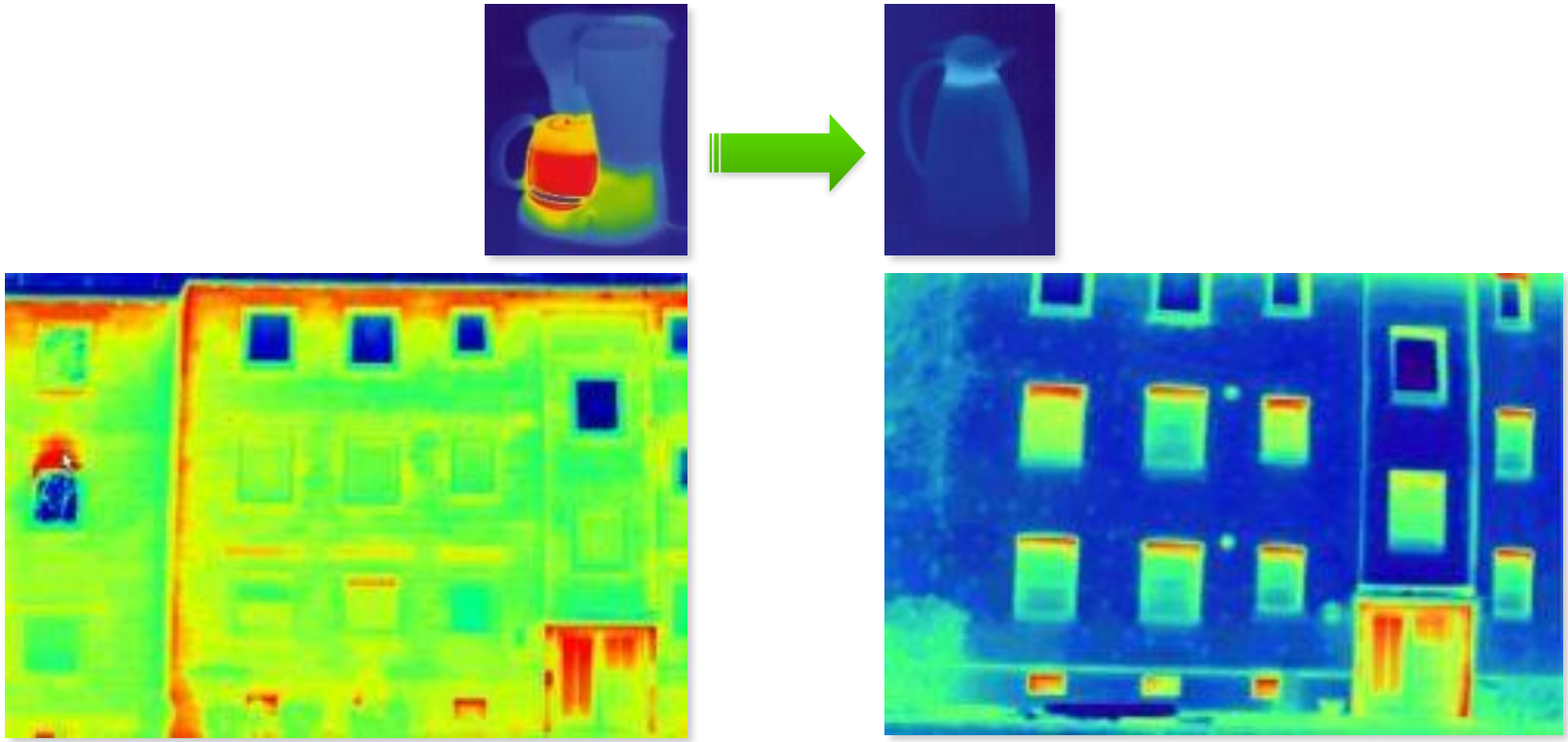
preserving:
Keep it warm through insulation

Active:
Keep it warm by heating with energy

A well insulated house is not visible

Designing for thermal comfort

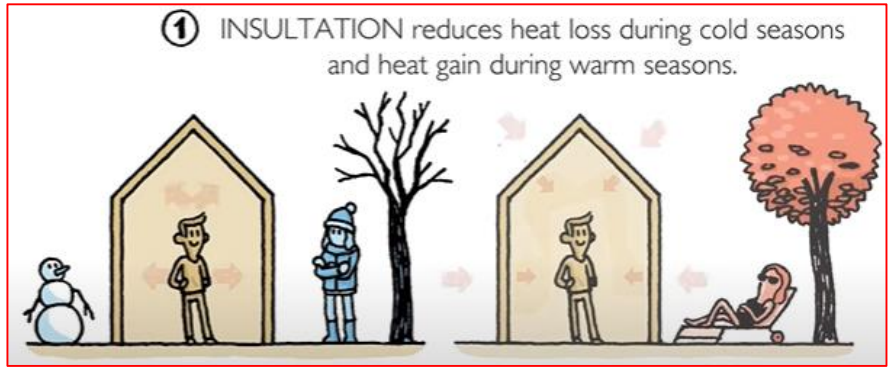
From active heating to preserving energy

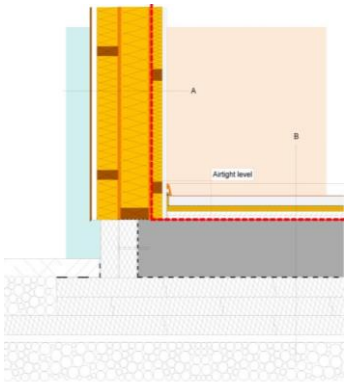


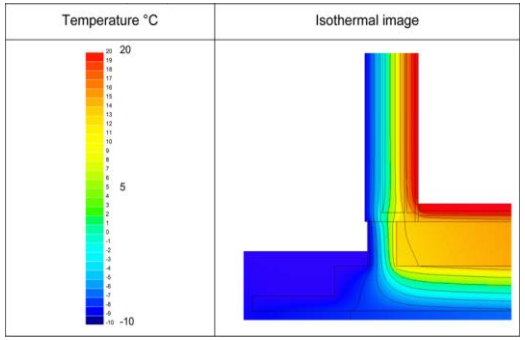
Designing for thermal comfort

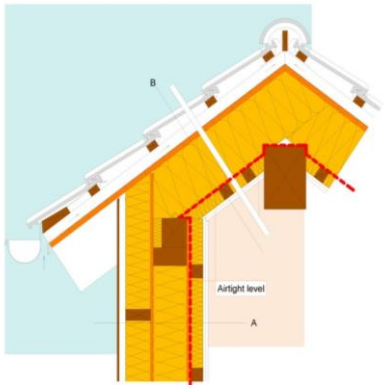
Criteria

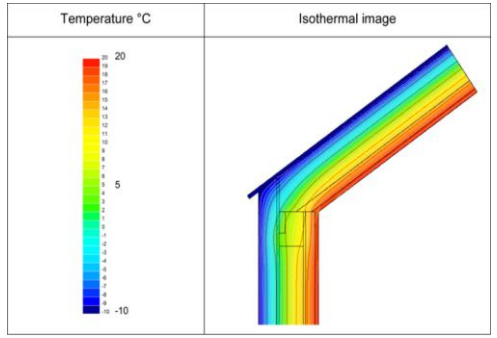
- U value for roof < 0,15 W/m2K
- U value for external wall < 0,20 W/m2K
- U value for floors on the ground < 0,30 W/m2K
- U value for windows < 0,90 W/m2K











Designing for thermal comfort

Roof

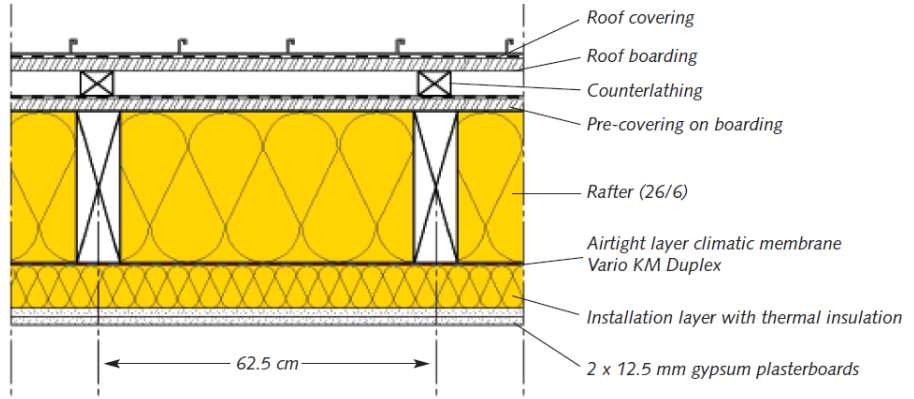
A. Roof (structure from the inside out)

Component layer	d in m	λ in W/(mK)	R in m²K/W
1. Gypsum plasterboard, 2-layered	0.0250	0.250	0.100
2. Glass wool under rafter insulation	0.0500	0.035	1.438
3. Climatic membrane Vario KM Duplex	–	–	–
4. Glass wool clamping felt	0.260	0.035	7.428
5. Roof boarding	0.024	0.130	0.185
6. Underlay, diffusible	–	–	–
7. Roofing, ventilated	–	–	–
Total sum of thermal resistances			9.151
Thermal surface resistances			0.140
U-value without wooden parts			U = 0.11 W/(m²K)
U-value with wooden parts			U = 0.13 W/(m²K)

ψ-value[1] = -0.03 W/(mK); f-value[2] = 0.952; minimal surface temperature ϑsi = 18.79 °C; at 20°C indoors and -5°C outdoors.

[1] The ψ-value describes the additional heat loss of a construction caused by thermal bridges. The values indicated above are based on the building's external dimensions. The psi values have been calculated in keeping with EN ISO 10211, based on the boundary conditions laid down in Supplement 2 of DIN 4108.

[2] The f-value is a dimensionless temperature factor. It is a measure for the minimal surface temperature of a construction when the outdoor and indoor temperatures have been predefined. It describes the risk of condensation and mould formation.



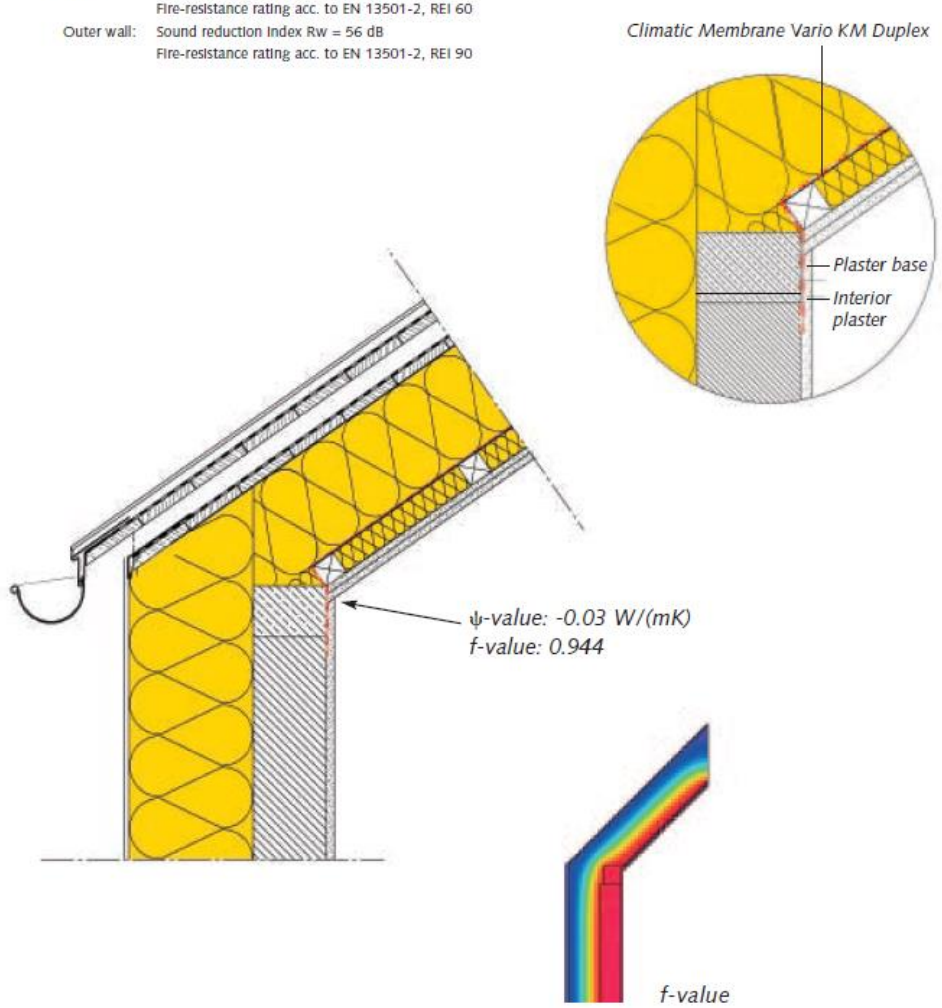
Designing for thermal comfort

Wall

B. Outer wall (structure from the inside out)

Component layer	d in m	λ in W/(mK)	R in m²K/W
1. Interior plaster	0.015	0.700	0.021
2. Sand-lime wall 1600	0.175	0.790	0.221
3. Mineral wool plaster baseboard	0.280	0.035	8.000
4. Exterior plaster	0.025	1.000	0.025
Total sum of thermal resistances			8.267
Thermal surface resistances			0.170
U-value of the construction			U = 0.120 W/(m²K)

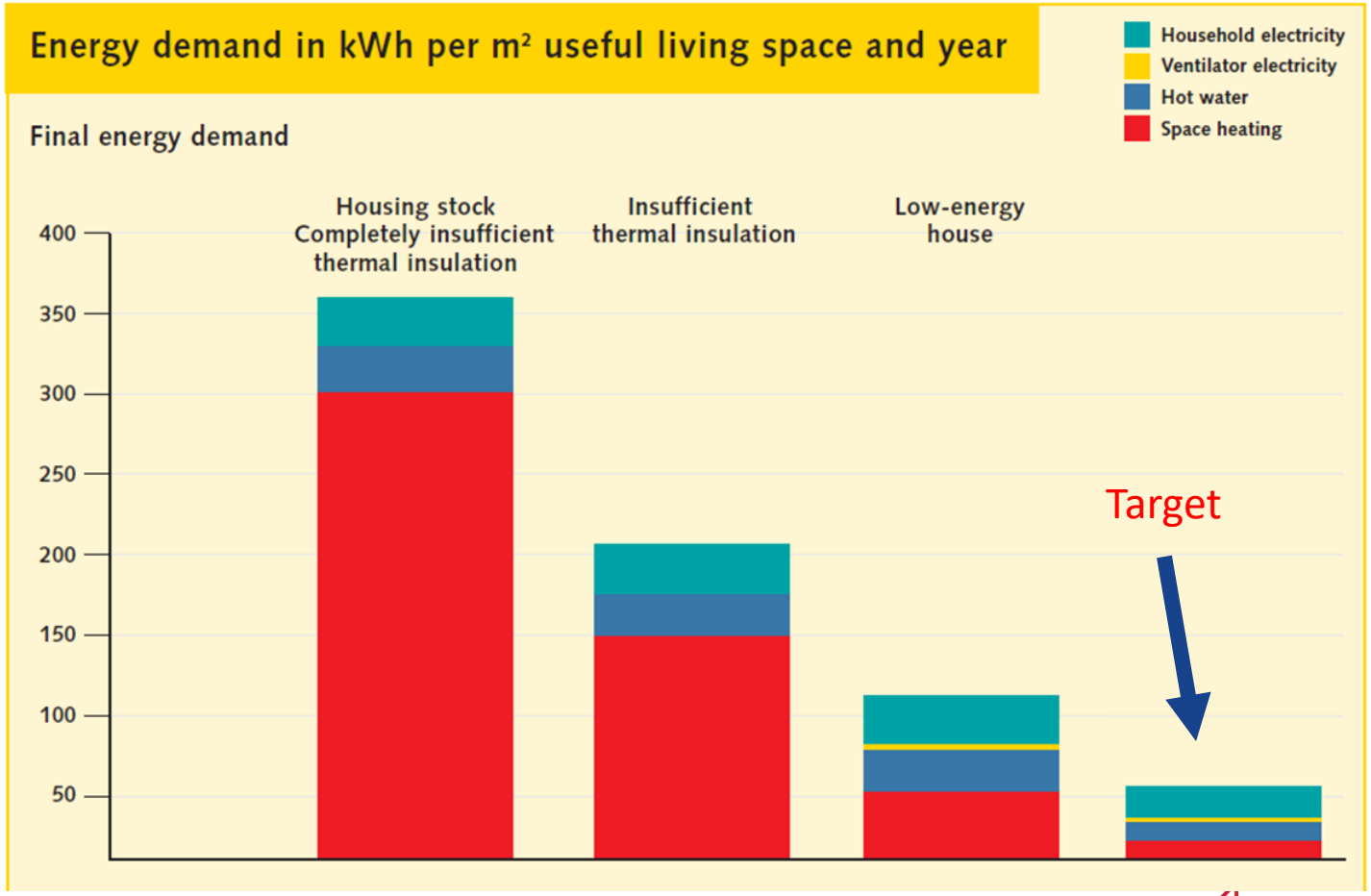
Roof: Sound reduction index Rw = 52 dB
Fire-resistance rating acc. to EN 13501-2, REI 60
Outer wall: Sound reduction index Rw = 56 dB
Fire-resistance rating acc. to EN 13501-2, REI 90



Designing for thermal comfort

Criteria

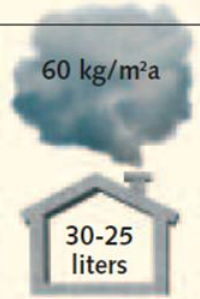
- Annual energy demand for heating < 15 kWh/m2



Designing for thermal comfort

Criteria

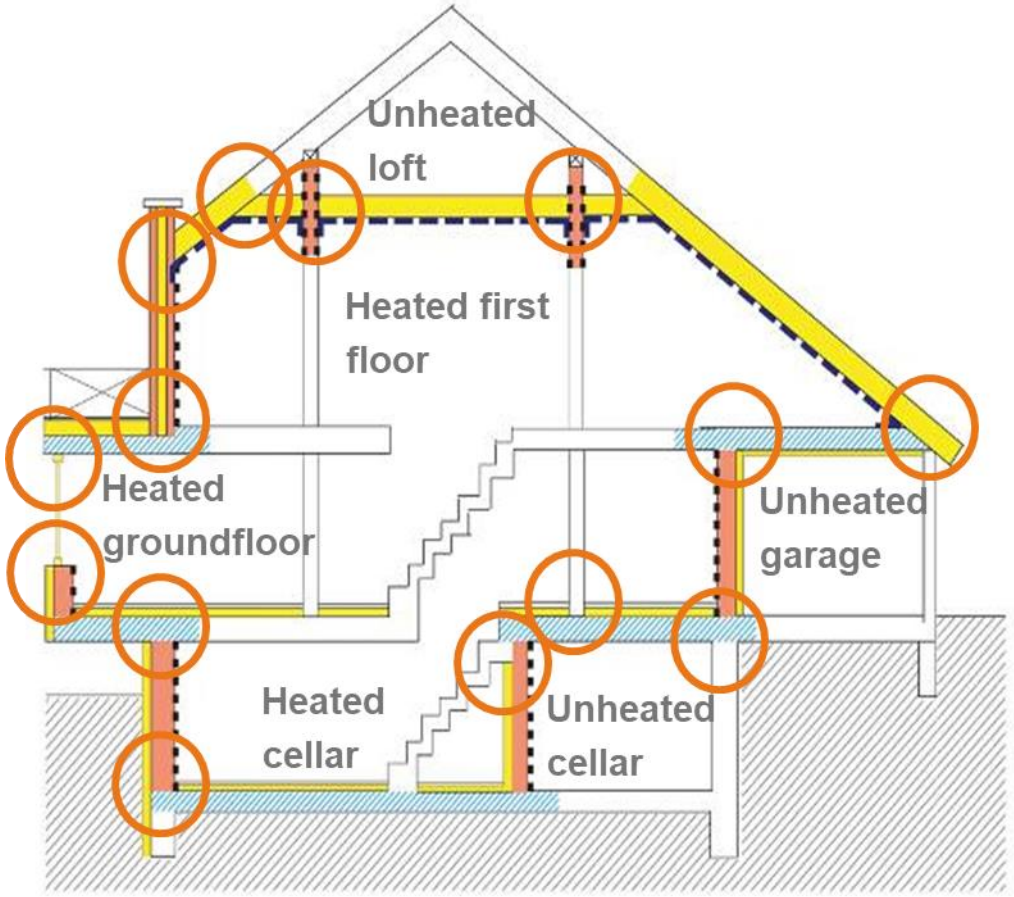
- Annual energy demand for heating < 15 kWh/m2

Heating energy demand of a typical one-family house	kWh/m²a 300-250	kWh/m²a 150-100	kWh/m²a 50-40	kWh/m²a ≤ 15
BUILDING STANDARD	**Completely insufficient thermal insulation** Structurally questionable, cost of heating no longer economical (typical of rural buildings, non-modernized old buildings).	**Insufficient thermal insulation** Thermal renovation is clearly worth the trouble (typical of residential houses built in the 50s to 70s of the last century).	Low-energy houses	Very low energy houses
BUILDING ELEMENT	Typical U-values and insulation thicknesses			
External walls (massive wall of 25 cm) Insulation thickness	1.30 W/(m²K) 0 cm	0.40 W/(m²K) 6 cm	0.20 W/(m²K) 16 cm	0.13 W/(m²K) approx. 30 cm
Roof Insulation thickness	0.90 W/(m²K) 4 cm	0.22 W/(m²K) 22 cm	0.15 W/(m²K) 30 cm	0.10 W/(m²K) 40 cm
Floors to ground Insulation thickness	1.0 W/(m²K) 0 cm	0.40 W/(m²K) 6 cm	0.25 W/(m²K) 10 cm	0.15 W/(m²K) 26 cm
Windows	5.10 W/(m²K) Single glazing	2.80 W/(m²K) Double glazing, insulation glass (air-filled)	1.10 W/(m²K) Double glazing, thermal insulation glazing	0.80 W/(m²K) Triple glazing, thermal insulation glass, special frame
Ventilation	Leaky joints	Open the windows	Exhaust air unit	Comfort ventilation with heat recovery
CO_2 emission	60 kg/m²a	30 kg/m²a	10 kg/m²a	2 kg/m²a
Energy consumption in liters heating oil per m² living space and year				

Designing for thermal comfort

Avoid or minimize thermal bridges

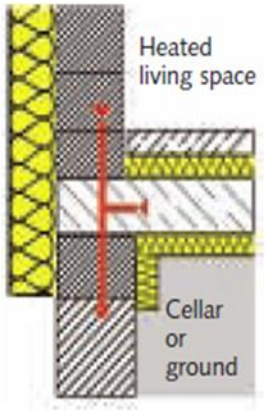
- foundation slabs
- basement ceilings
- upper edges of walls (roof area)
- wall penetrations between heated and unheated areas
- balconies, landings and other cantilevered elements
- windows and roller shutter boxes
- rafters and support posts
- stairs



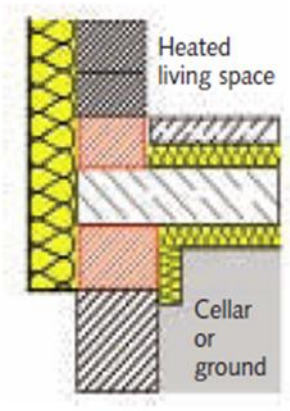
Designing for thermal comfort

Avoid or minimize thermal bridges

With a single-leaf external wall and a cellar floor or sole plate insulated on its upper or under side

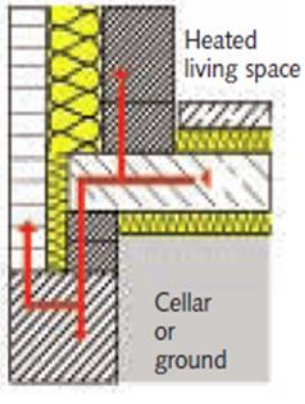


Insufficient if support of ceiling on cellar outer wall resp. strip footing and the support of warm internal wall ground floor has been installed without thermal separation using a material with lambda > approx. 0.12 W/mK.

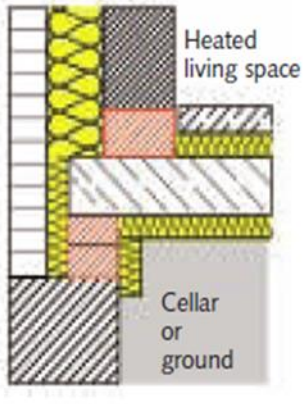


Good if both supports have been produced from a material with lambda < approx. 0.12 W/mK.

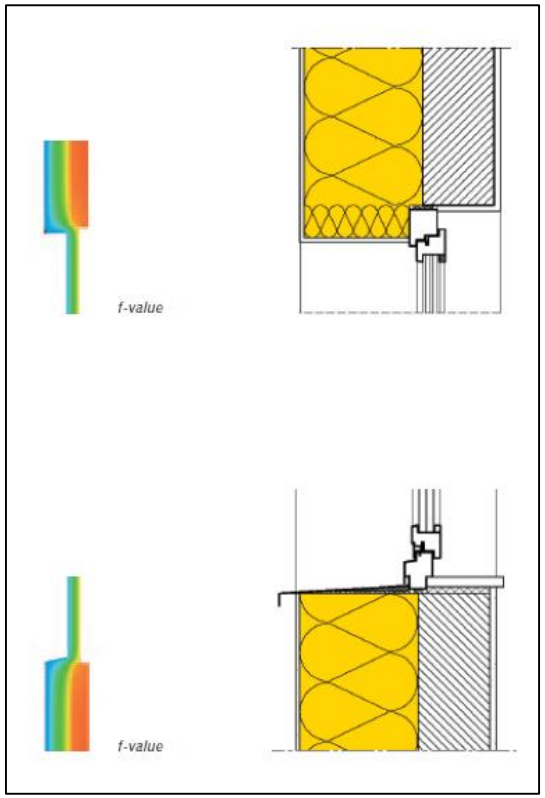
With an external cavity wall and a cellar floor or sole plate insulated both on its upper and under side



Insufficient if support of ceiling on cellar outer wall resp. strip footing and the support of warm internal wall ground floor has been installed without thermal separation using a material with lambda > approx. 0.12 W/mK.

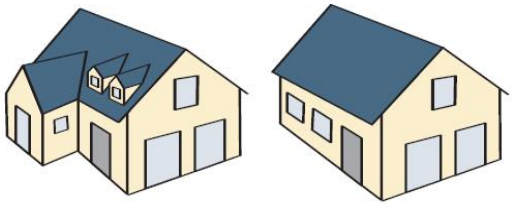


Good if both supports have been produced from a material with lambda < approx. 0.12 W/mK.

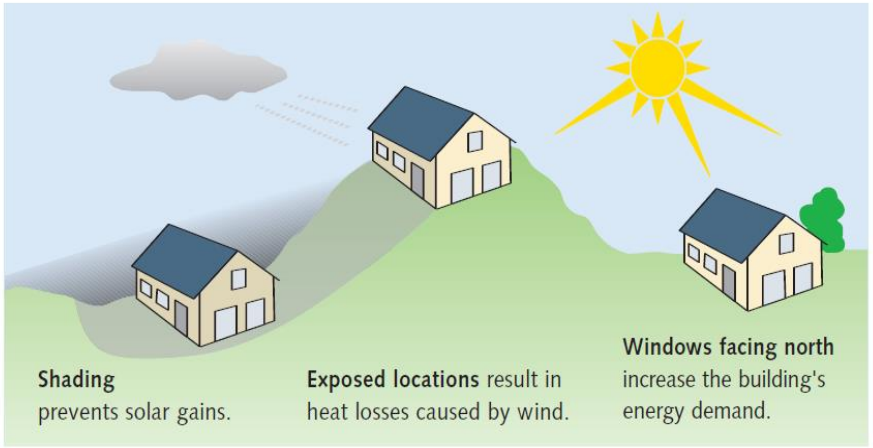


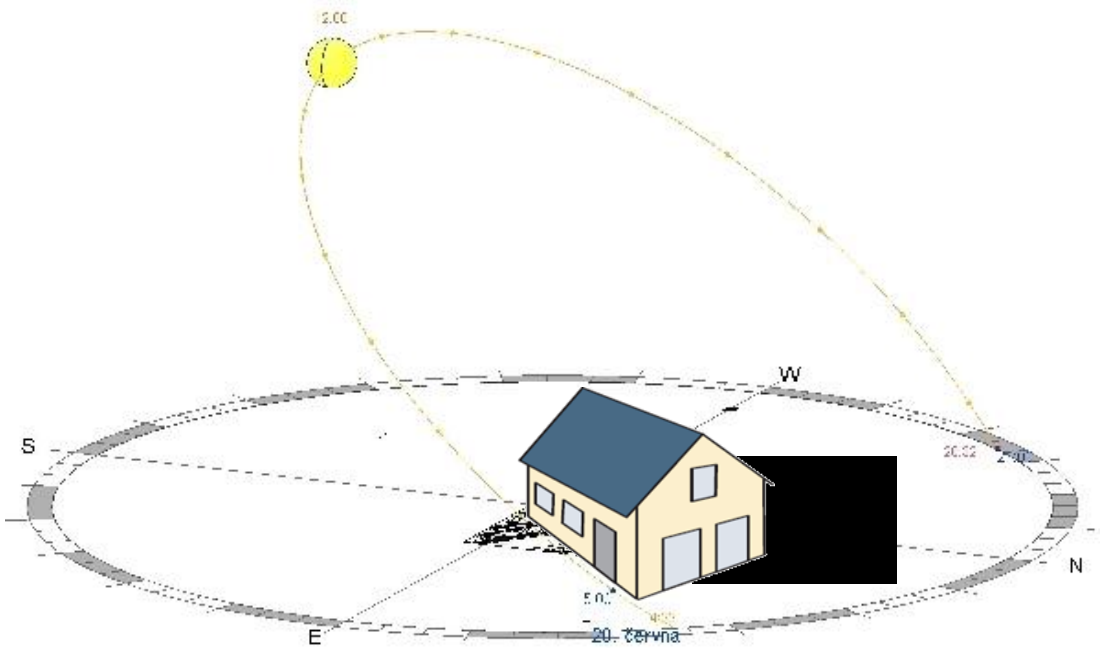
Designing for thermal comfort

Building shape and orientation



Complicated designs increase the energy demand compared to plain, compact building styles.

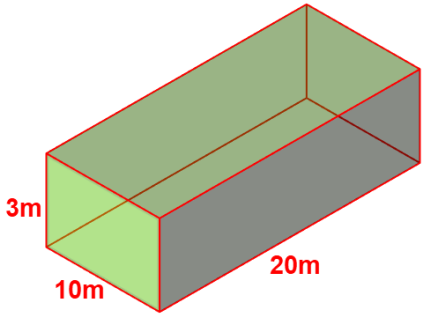




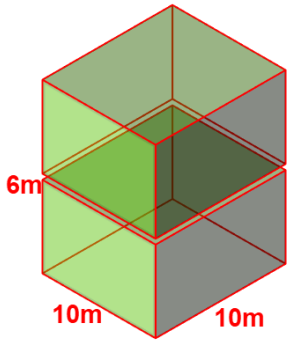
Designing for thermal comfort

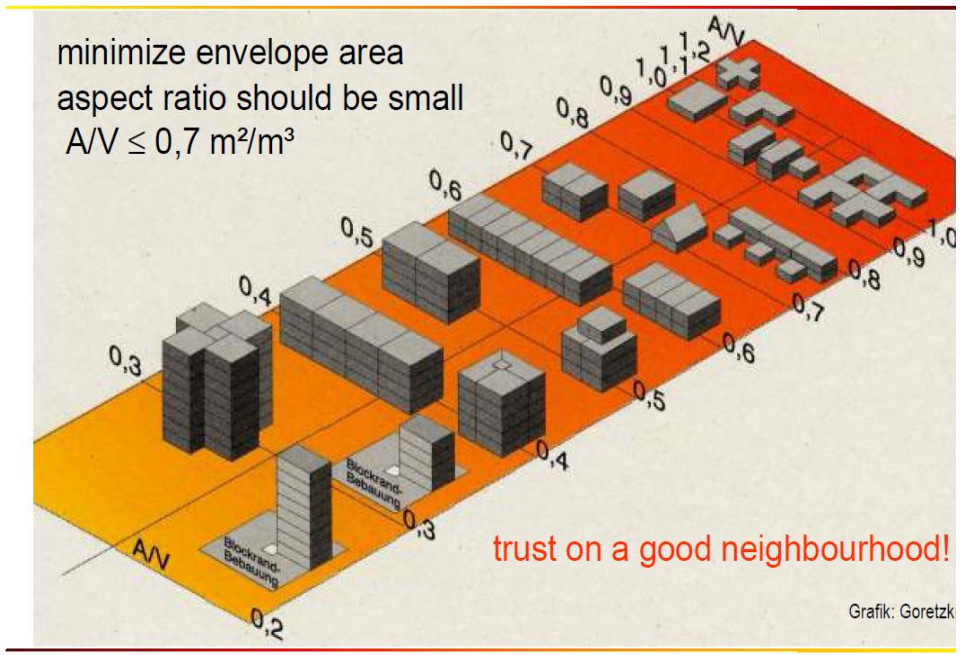
Building shape and orientation

- Variant 1
  - Foot print: 200mp
  - Envelope surface:580m2



- Variant 2
  - Foot print: 200mp
  - Envelope surface:440m2



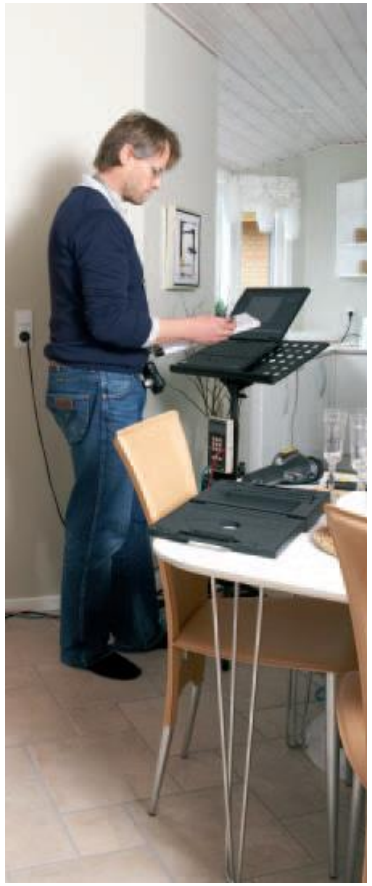


Passive House Seminar, Saint-Gobain, Paris 2010

Designing for thermal comfort

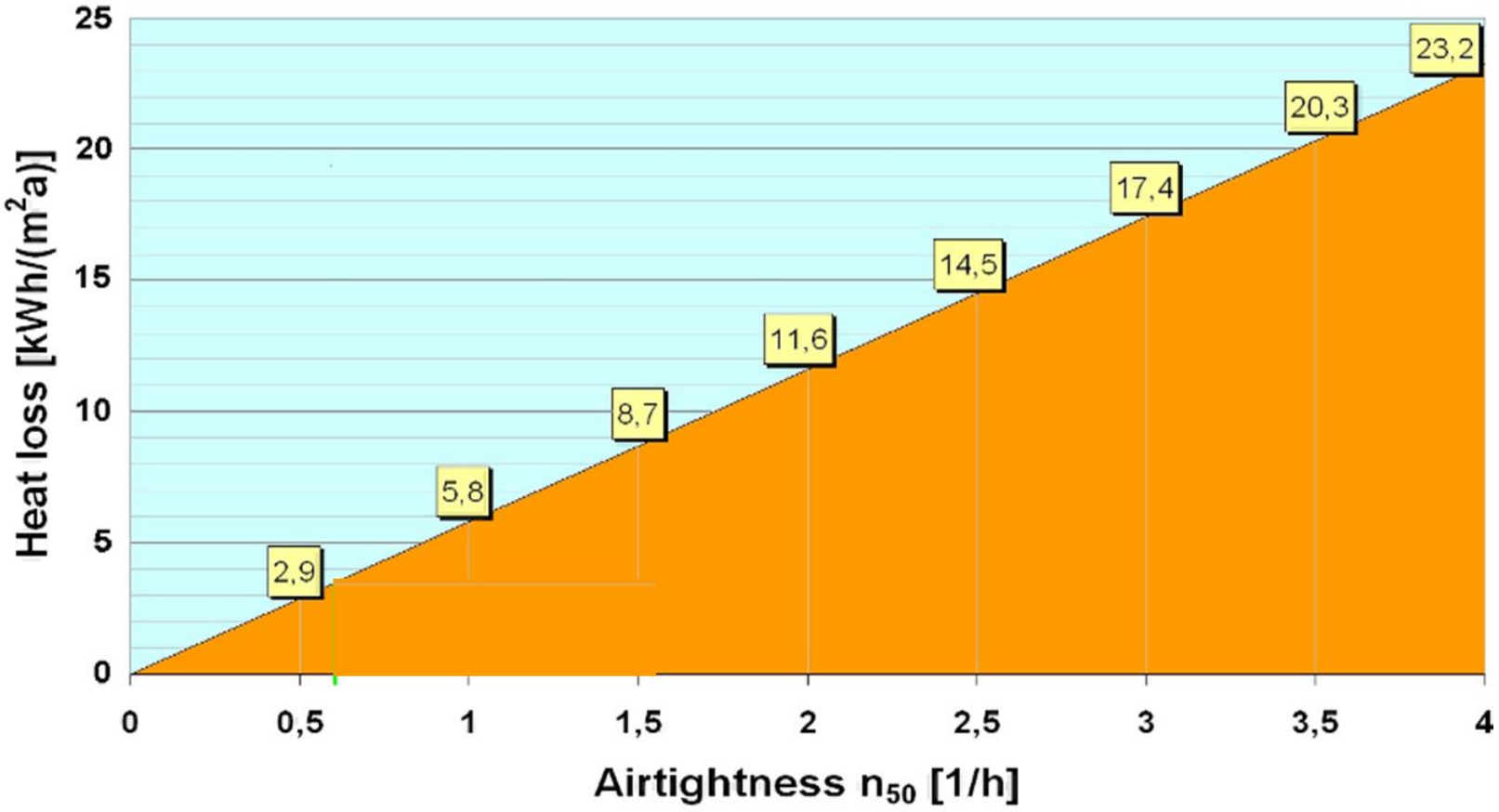
Airtightness

ISOVER Vario® Blower Door Test
https://www.youtube.com/watch?v=hVSEWgFOx6o



Designing for thermal comfort

Airtightness



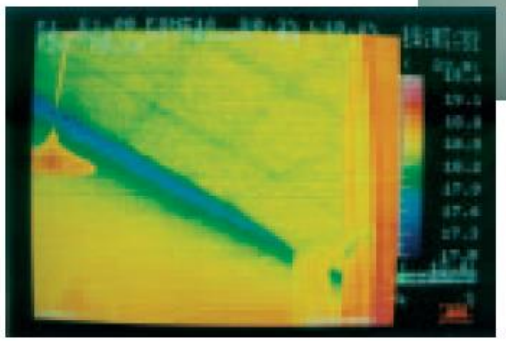
Designing for thermal comfort

Airtightness

One example says more than 1000 words. Survey of frequent structural defects.

An important security factor is the quality of the bond. An airtight bond between two strips of a sealing membrane cannot be produced by riveting. The seam area must therefore be sealed with a suitable adhesive tape.

Carefully tape overlapping areas.

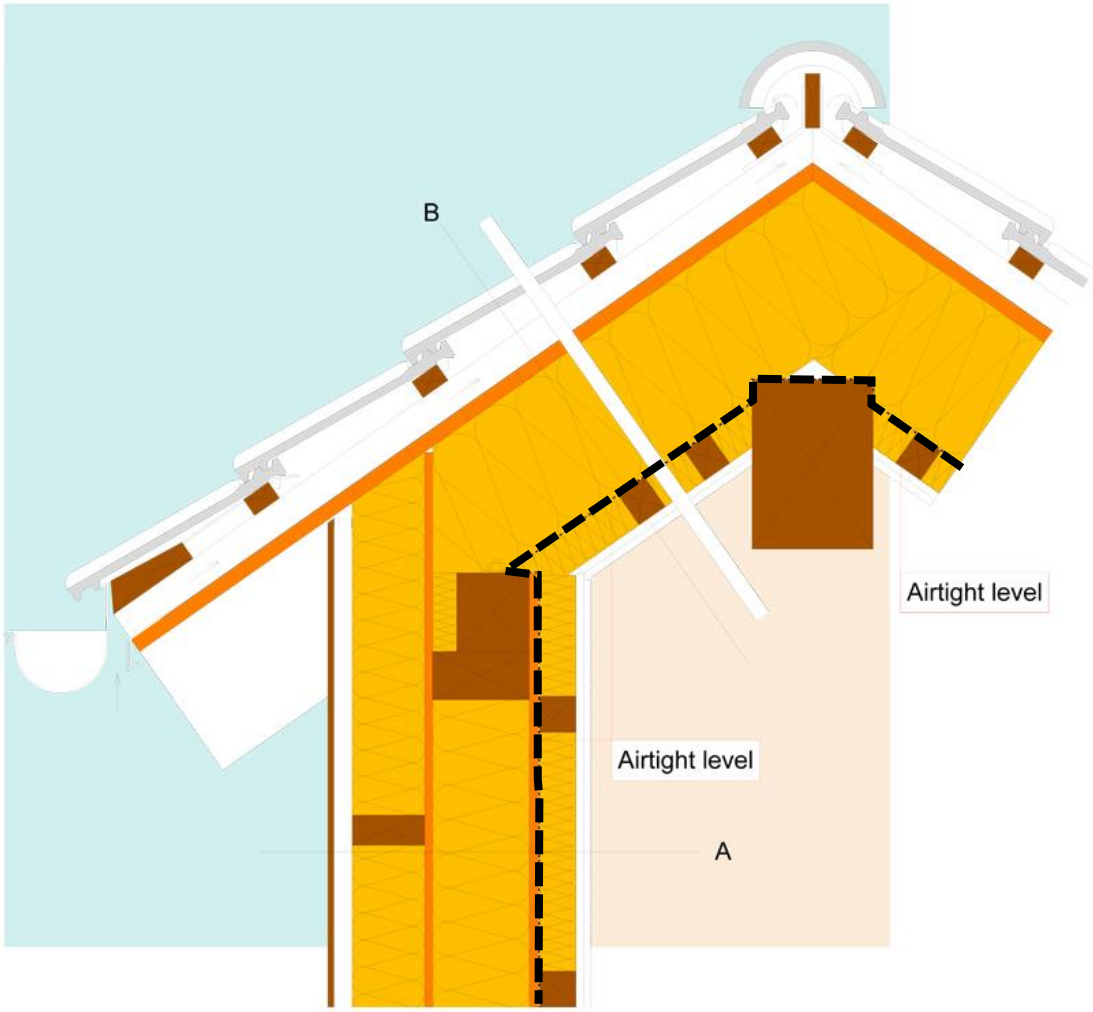


The lack of airtightness between ceiling and wall results in clearly visible heat losses.

Source: Niedrig Energie Institut (Low-Energy Institute), Germany

Designing for thermal comfort

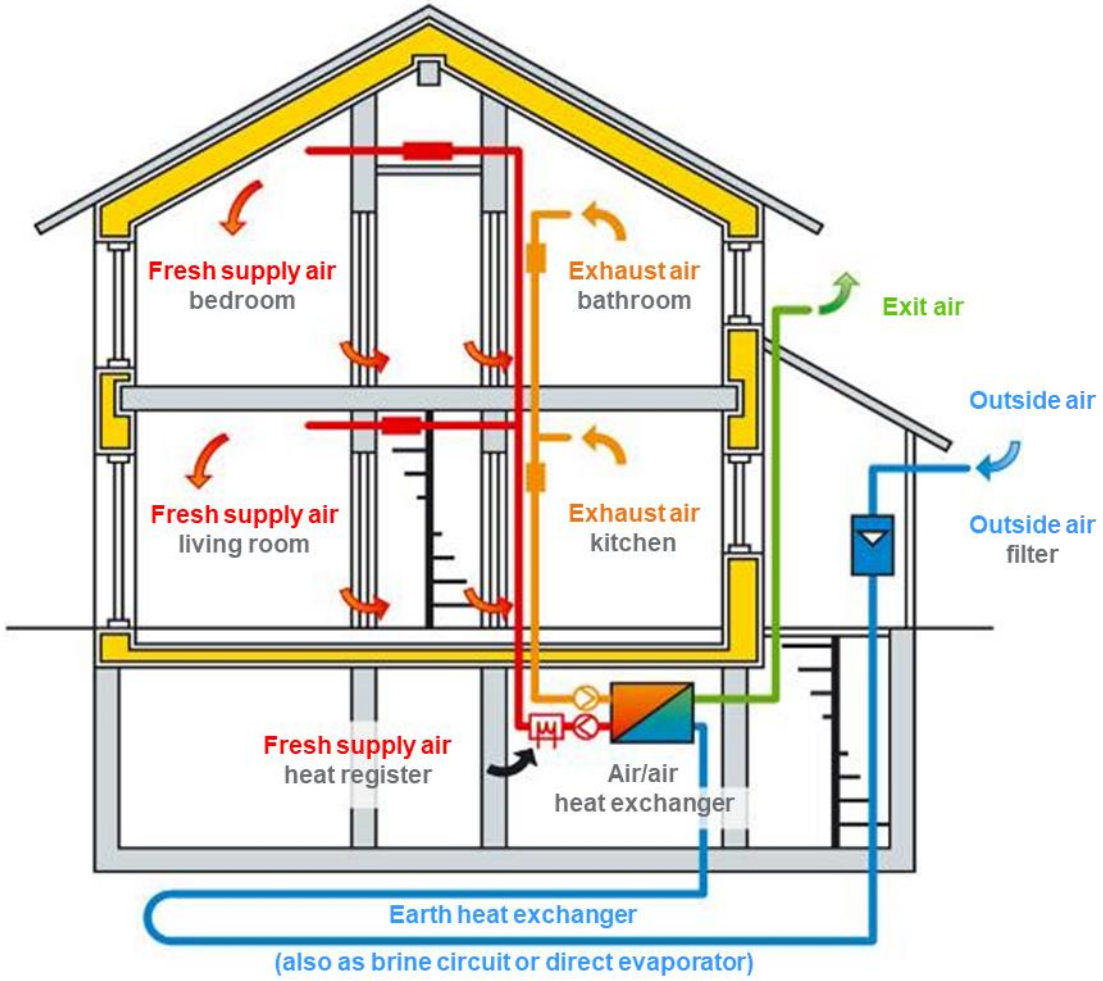
Airtightness



Designing for thermal comfort

Controlled ventilation …

is going hand-in-hand with air tightness



Designing for thermal comfort

1. Thermal insulation
2. Airtightness
3. Good windows and doors
4. Solar gain + internal gain
5. Ventilation system with heat recovery

Designing for thermal comfort

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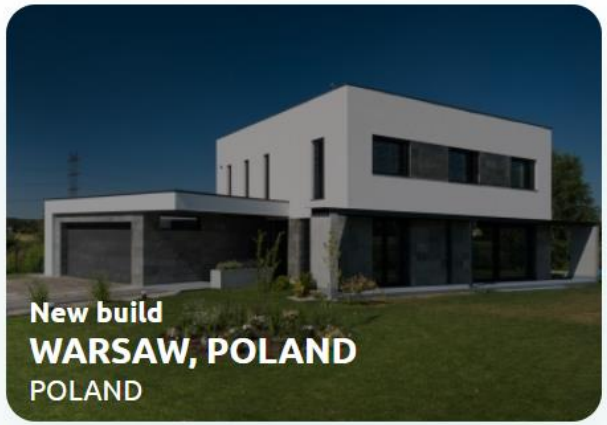

Designing for thermal comfort

THANK YOU