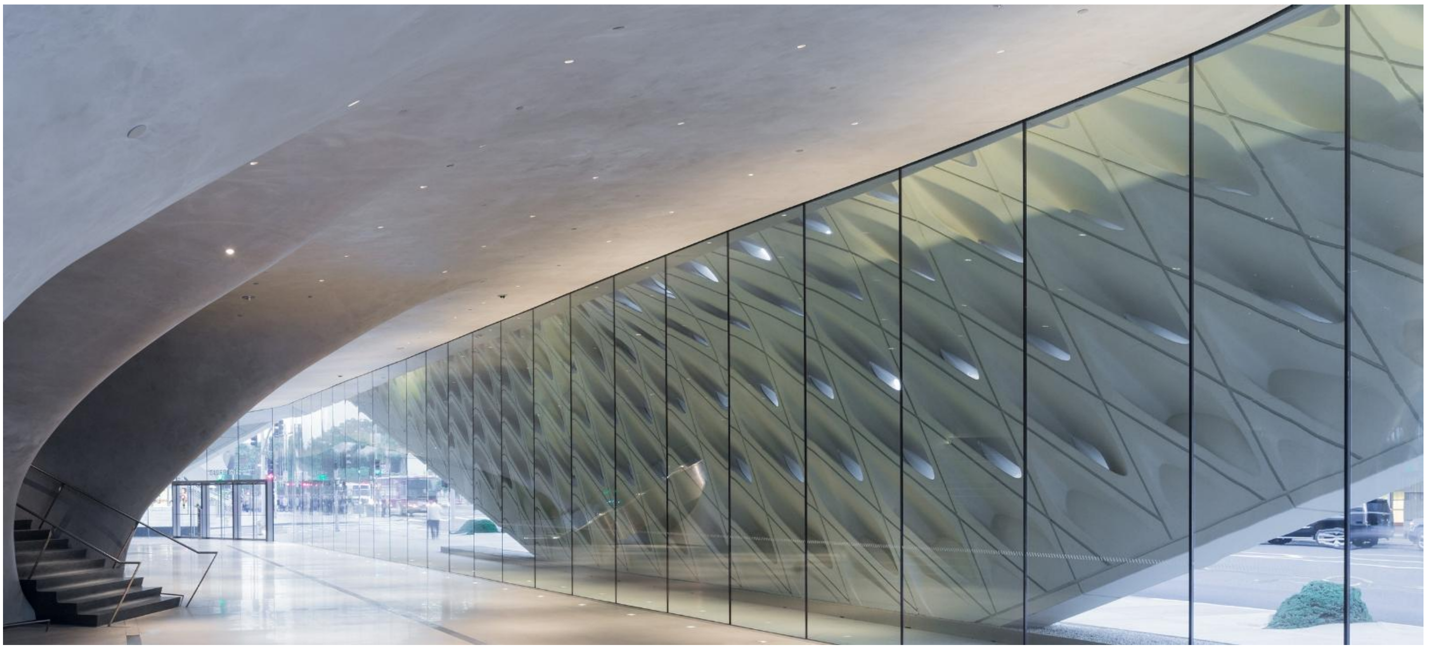
Glass and thermal insulation



Technical Information about Glass

Glass and thermal insulation

Thermal exchanges

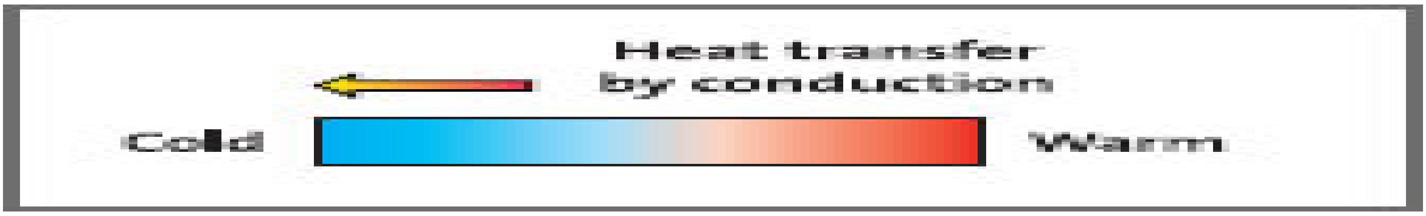
Whenever differences in temperature exist between surfaces, heat will migrate from the warmer area to the cooler area.
This is true of all surfaces. However, a glazed surface is special in that it is also transparent to solar radiation, which results in free heat gain.

Heat exchanges through a surface

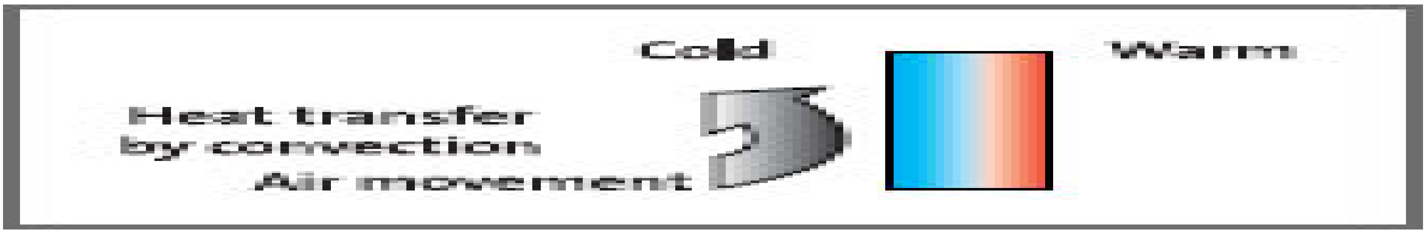
Heat is exchanged through a surface and hence lost in any of 3 different ways:

- **conduction** is the transfer of heat within a body or between two bodies in direct contact. No material is physically moved during this type of transfer.
The heat flow between the two faces of a sheet of glass depends on the temperature difference between the faces and the thermal conductivity of the material.

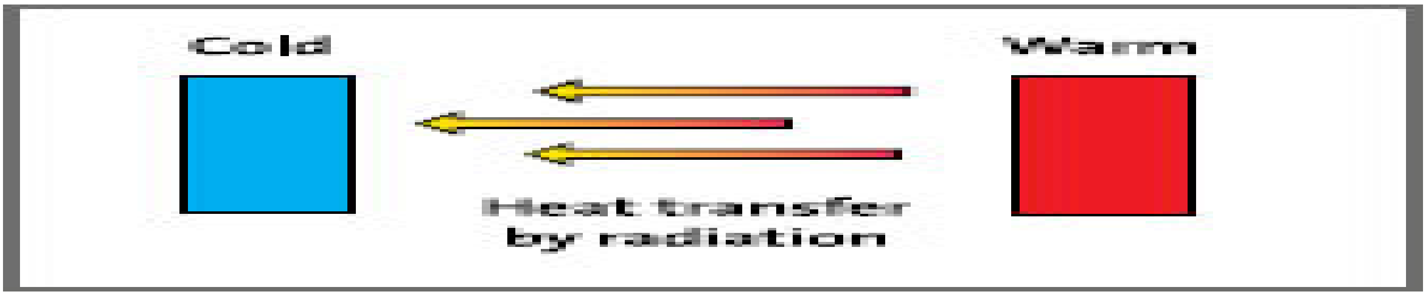
The thermal conductivity of glass is : Ï = 1.0 W/(m.K)



- **convection** is the transfer of heat between the surface of a solid and a liquid or a gas. This type of transfer involves movement via circulation.



- **radiation** is the transfer of heat by radiation between two bodies at different temperatures.



At ambient temperature, this radiation takes place in the infra-red band of the spectrum, at wavelengths above 5 µm. It is proportional to the emissivity of these bodies.
- emissivity is related to the surface characteristic of a body. The lower the emissivity, the weaker the heat transfer.
The normal emissivity ?n of glass is 0.89. Certain types of glass can be modified by means of a low-emissivity coating, in which case ?n can be as low as 0.02.

Surface exchange coefficients

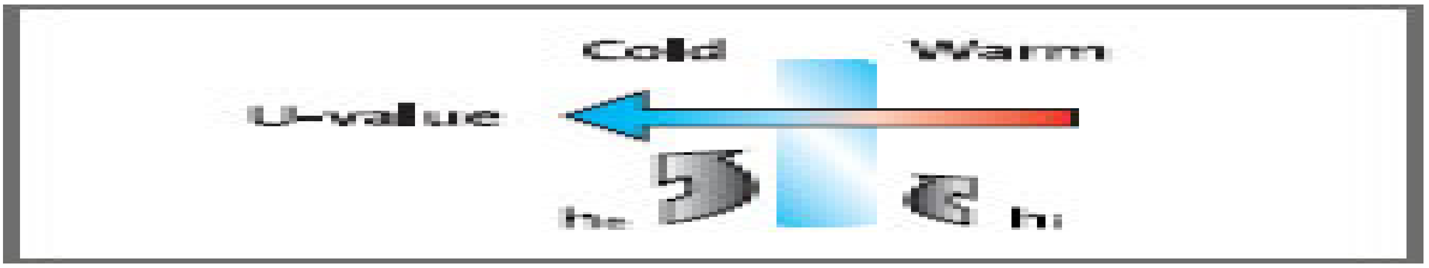
A surface will exchange heat with the air it is in contact with by conduction and convection. It will also exchange heat to its surroundings by radiation.
Normally, these heat transfers in the field of building and construction are related to wind speeds, temperatures and levels of emissivity. They are characterised by he for external exchanges and hi for internal exchanges.
The standard values for these coefficients are : he = 23 W/(m2.K) hi = 8 W/(m2.K)

Thermal transmission of a surface

U-value

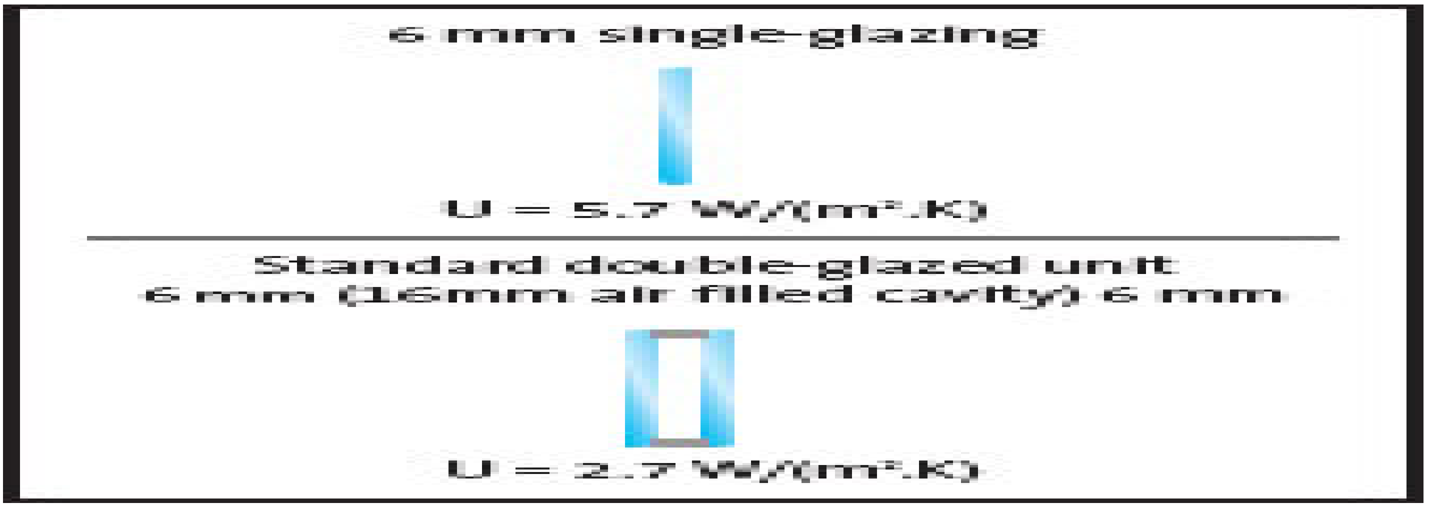
Heat transmittance through a surface by conduction, convection and radiation is expressed by its U-value*. This is the rate of heat loss per square metre for a temperature difference of 1 degree Kelvin, or Celsius, between the interior and exterior.
It is calculated using the surface exchange coefficients he and hi defined above and in accordance with BS EN

673.
It is possible to calculate a specific U-value* by using design values of the surface exchange coefficients, which will take into account environmental variants, such as wind speed.
The lower the U-value, the lower the heat loss.



The U-value* of glazing

Double-glazing affords better thermal insulation than single glazing. The principle behind double-glazing is that by enclosing a cavity of dry, still air between two sheets of glass, heat exchange by convection is reduced and the low thermal conductivity of the air limits heat loss by conduction.
* U-value according to European standards, formerly known as the K coefficient in some countries.



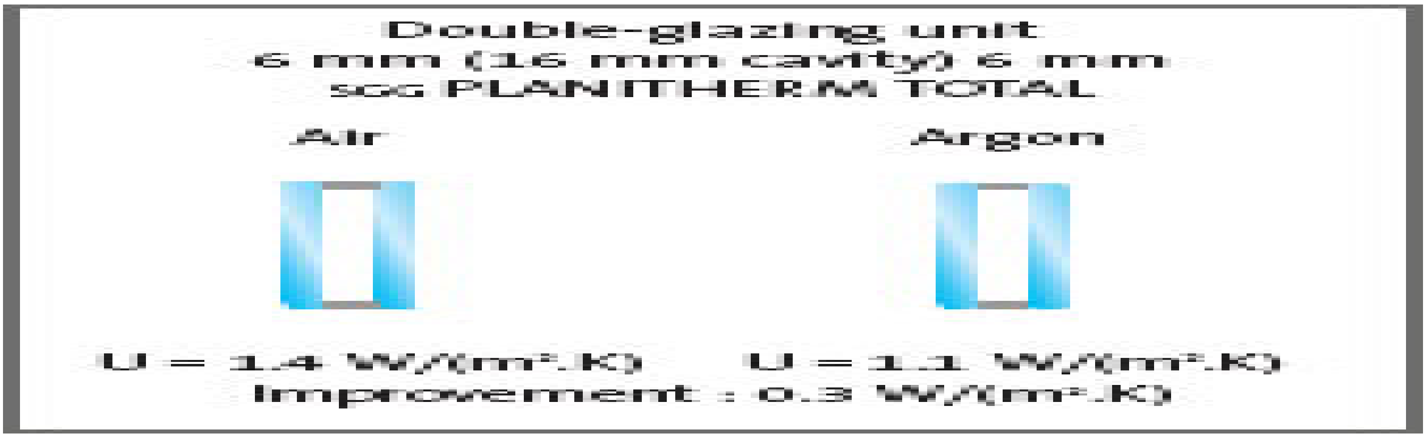
Improving the U-value of windows

Improving the U-value means reducing the transfer of heat by conduction, convection and radiation.
Since it is impossible to alter the internal and external heat transfer coefficients, any enhancements are brought about by reducing heat exchange between the two glass components of the double-glazed unit:
• Radiated heat transfer can be reduced by using glass with a low-emissivity or low-E coating.

Capitalising on this concept, SAINT-GOBAIN GLASS has developed a range of low-emissivity coated glasses which provide enhanced thermal insulation :
• Glass with sputtered coatings applied under vacuum conditions: SGG PLANITHERM range and SGG

COOL-LITE SKN range

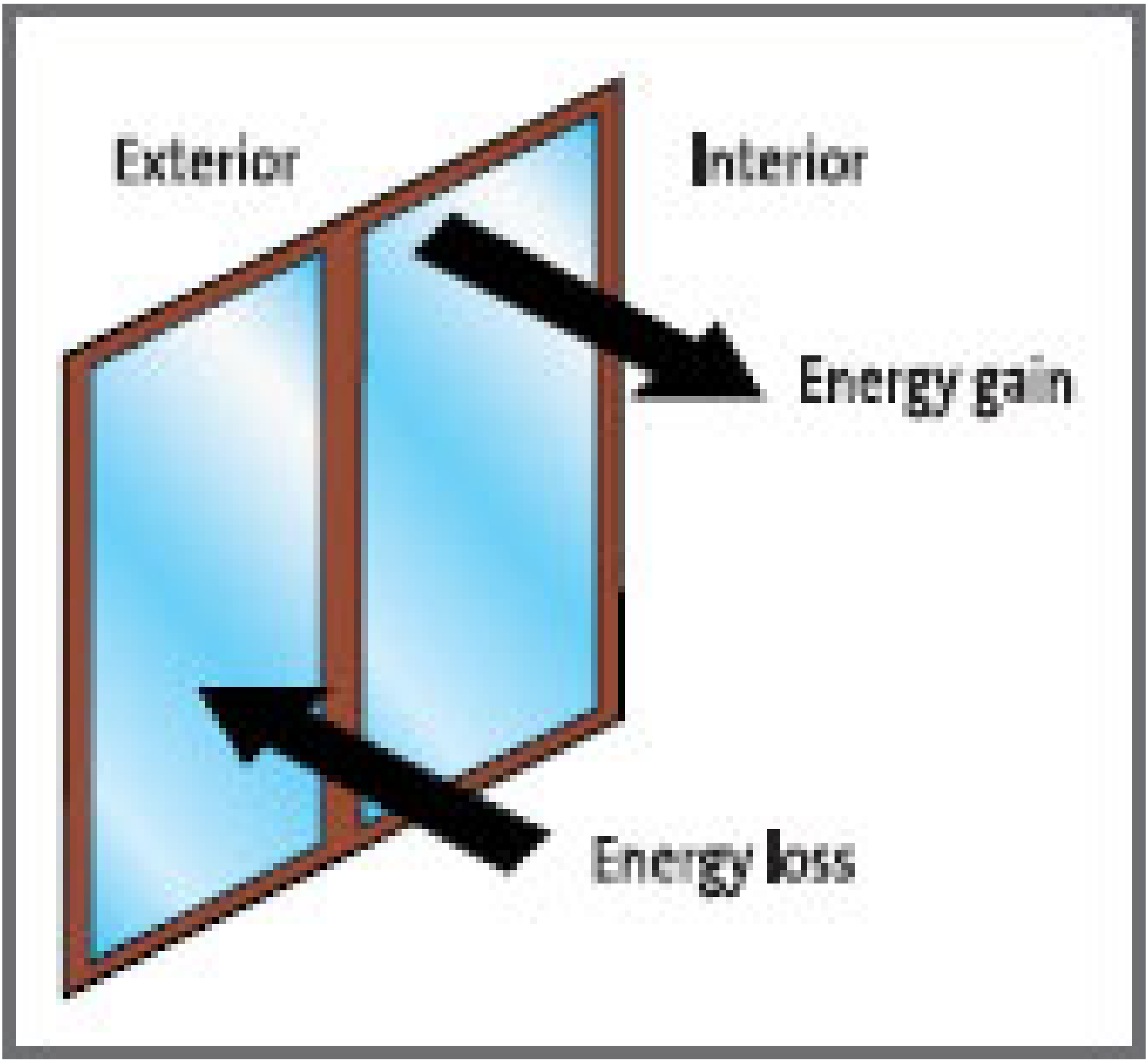
• Heat loss by conduction and convection can be reduced by replacing the air in the unit cavity with a gas with lower thermal conductivity (generally argon).



Energy balance

Windows are a source of both heat loss, measured by the U-value, and solar energy heat gain, represented by the solar factor.
The overall energy balance of a window equals the solar energy heat gain minus the heat loss.
In heating dominant environments, the most energy efficient windows reduce thermal losses to a point at which they are exceeded by solar heat gain, thus becoming a net contributor of energy. The energy efficiency

of windows in temperate climates is further discussed under “Window Energy Ratings”.



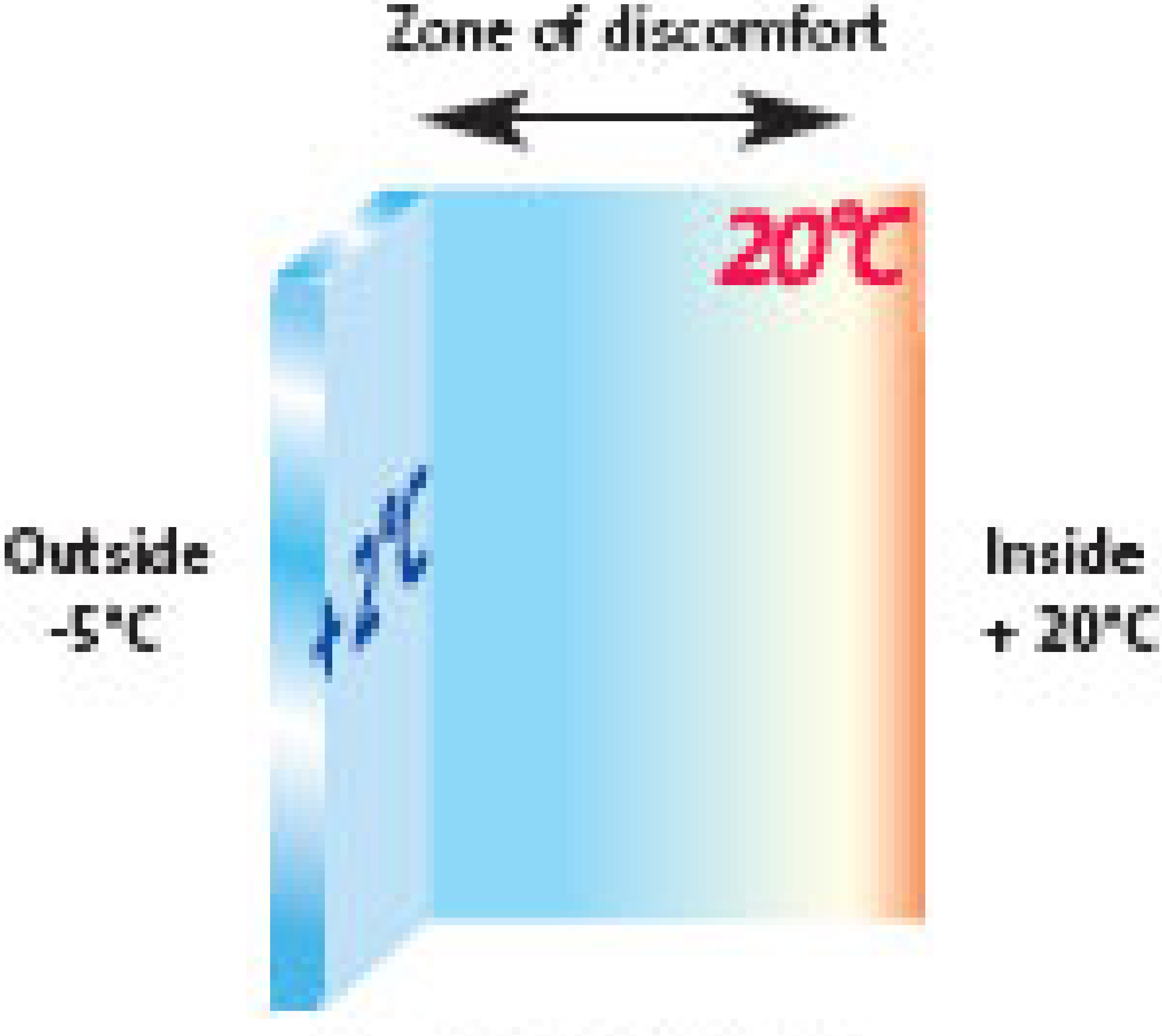
Thermal comfort

Increased wall temperatures

The human body exchanges heat with its surroundings by radiation. When standing near a cold wall, even if the room temperature is comfortable, we sometimes have the sensation of standing in a draught.
In winter, the temperature of the interior face of a window with a low U-value is likely to be higher, thus reducing what is termed as the “cold zone effect" around the window.
Therefore:

- we can stay closer to windows without feeling uncomfortable
- there is less risk of condensation.

4 mm single-glazing



$U = 5.8\ W/(m^2K)$

Standard double-glazing

4 mm (16 mm air filled cavity) 4 mm

Zone of discomfort

Find out more

Glass and solar radiation


Determining the thickness of glass


Safety & Protection

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