WHAT IS SOLAR GAIN?

SUMMARY

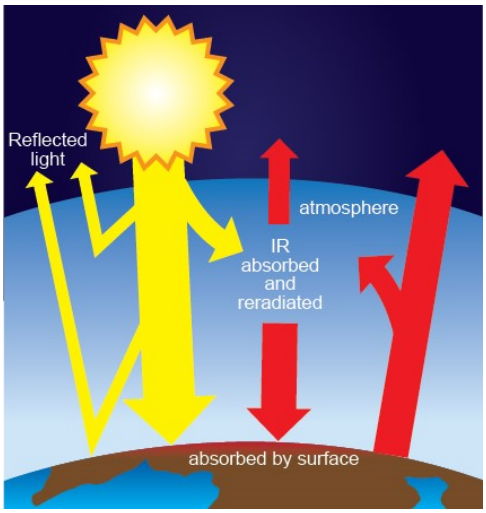
- ✓ Solar radiation levels around us are constantly changing but building occupants need a consistent and narrow band indoor temperature for their comfort and well-being.
- ✓ Solar radiation enters a building through glass which causes its wavelength to change. It is then trapped indoors creating the Greenhouse Effect.
- ✓ Solar radiation and solar gain can be effectively controlled by blinds and shutters.

1.0 INTRODUCTION

To understand the need for shading and the positive effect it can have on our indoor environment, we need to understand how the Sun's rays work. The Sun is constantly flooding the Earth with its energy. The amount of energy reaching the Earth's surface varies due to the amount of cloud coverage and the level of absorption by the atmosphere.

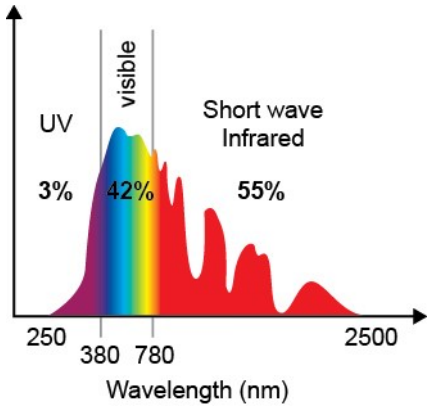
Even though the amount of solar radiation constantly varies, we require a consistent temperature inside our buildings, ideally between 19°C – 24°C to be comfortable and productive. This can be achieved through mechanical heating and cooling, insulation of the roof and the walls and also through shading. This will result in lower heating and cooling energy costs.

2.0 THE SUN AND SOLAR RADIATION



This is what happens when Sun's rays reach the Earth:

1. The Sun's rays enter the Earth's atmosphere as shortwave radiation.
2. Some of the radiation is reflected by the atmosphere and by the Earth's surface.
3. At the same time the Earth's surface absorbs some of the radiation and re-radiates it as heat.
4. Greenhouse gases in the atmosphere such as carbon dioxide absorb additional radiation and it becomes trapped within the Earth's atmosphere. The Earth becomes hotter as a result.



UV radiation = 320nm - 380nm

Visible light = 380nm - 780nm

Near Infrared (Shortwave IR) = 780nm - 2,500nm

Thermal Infrared (Longwave IR) = 2,500nm - 25,000nm

Incoming solar radiation consists of three main types:

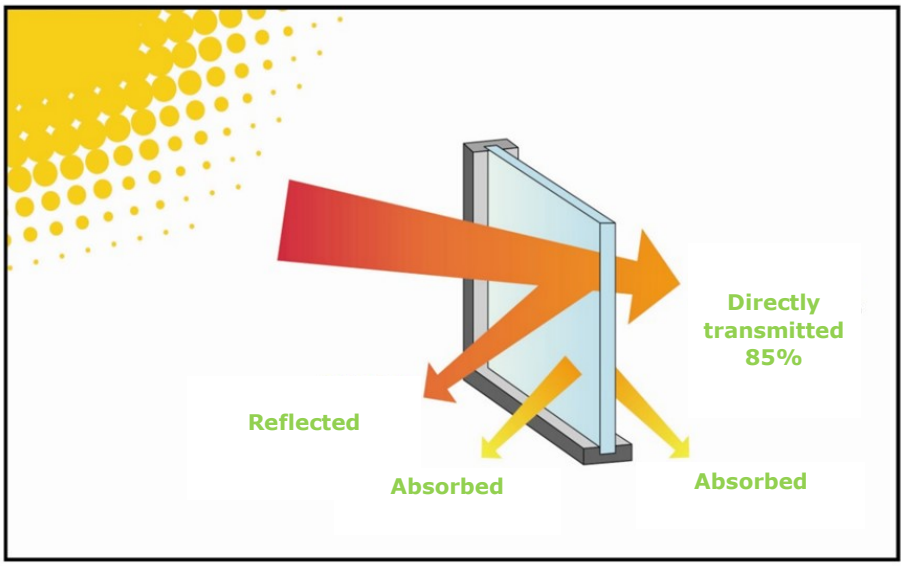
- ultraviolet radiation (UV),
- visible light, and
- infrared radiation (IR).

The Earth's atmosphere absorbs a large proportion of the incoming UV and IR radiation before it even reaches the surface. The radiation that reaches the Earth's surface is predominantly visible light with only 5% being UV.

3.0 SOLAR RADIATION ENTERING BUILDINGS

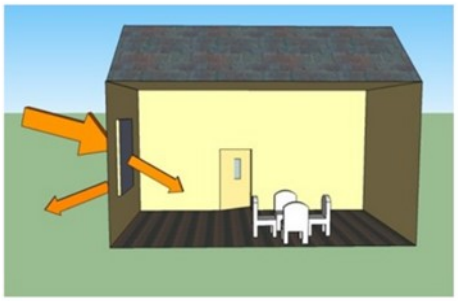
Glass allows shortwave visible light and shortwave infrared radiation to pass through into a building. The glass reflects some of the shortwave radiation back to the atmosphere however a large percentage is transmitted into the building.

For single glazing 85% of the Sun's energy hitting the window is transmitted to the inside.

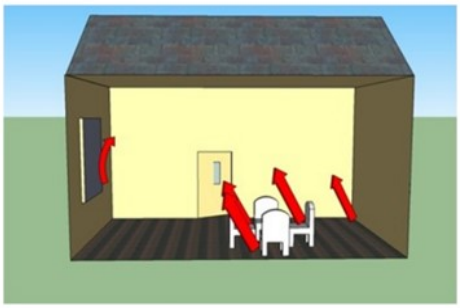


Once the solar radiation is in the building it is then absorbed by objects such as walls, floors, chairs, desks and people. These are constantly absorbing and radiating energy.

The absorbed shortwave radiation subsequently changes to heat (longwave radiation). This occurs when the shortwave hits an object and is then re-radiated at a longer wavelength.



Radiation enters as shortwave.



It converts to longwave when it hits an object.

The radiation that is transmitted through the window is at wavelengths of 780nm – 2,500nm. When it is re-radiated, it is between 5,000nm – 25,000nm. These longer wavelengths are infrared radiation which are perceived as heat. This heat is not able to pass back through the glass and so the building or room begins to increase in temperature. This phenomenon is recognised as The Greenhouse Effect.

4.0 HOW SOLAR SHADING CAN PREVENT BUILDINGS FROM OVERHEATING

Blinds and shutters can prevent excessive solar gain by helping to block most of the incoming shortwave solar radiation.

External blinds are particularly effective at this as they can prevent most of the radiation from even reaching the window.

Internal blinds can also reduce solar gain, especially where fabrics with a reflective coating facing the window are used. This will reject some of the incoming shortwave radiation therefore preventing it from being absorbed and turned into heat.

5.0 FURTHER INFORMATION

For more information including scientific reports, guidance notes and videos, visit the resources section of the BBSA's Shade IT website - www.shadeit.org.uk.