WHAT IS SOLAR GAIN? A Specifier's guide

SUMMARY

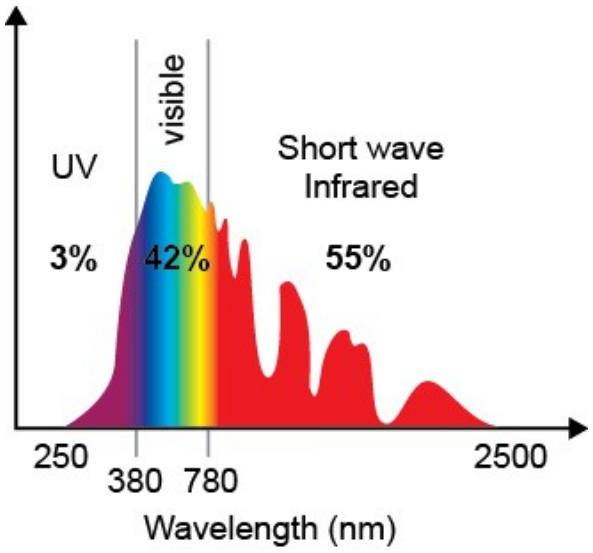
- ✓ Solar energy is a powerful source of energy that can be harnessed for winter heating.
- ✓ The Sun emits its energy in different wavelengths.
- ✓ The short wavelength radiation can pass through glass, unlike long infrared radiation which gets trapped indoors and is felt as heat.
- ✓ Shading is the insulation of the transparent parts of a building.
- ✓ Solar shading can efficiently prevent overheating of buildings by blocking the incoming solar radiation.

1.0 INTRODUCTION

Our Sun produces an enormous amount of energy. To put this into perspective, the Earth receives the same amount of solar energy in about 45 minutes as it globally consumes in one year. Harnessing this powerful energy source can provide valuable energy for winter heating but without shading in the summer, it can also mean that energy costs will be required for cooling.

2.0 THE SOLAR SPECTRUM

The sun emits UV waves, visible waves and infrared waves at different wavelengths. These are expressed in nanometres.



UV radiation = 320nm - 380nm

Visible light = 380nm - 780nm

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

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

2.1 SHORT WAVELENGTH

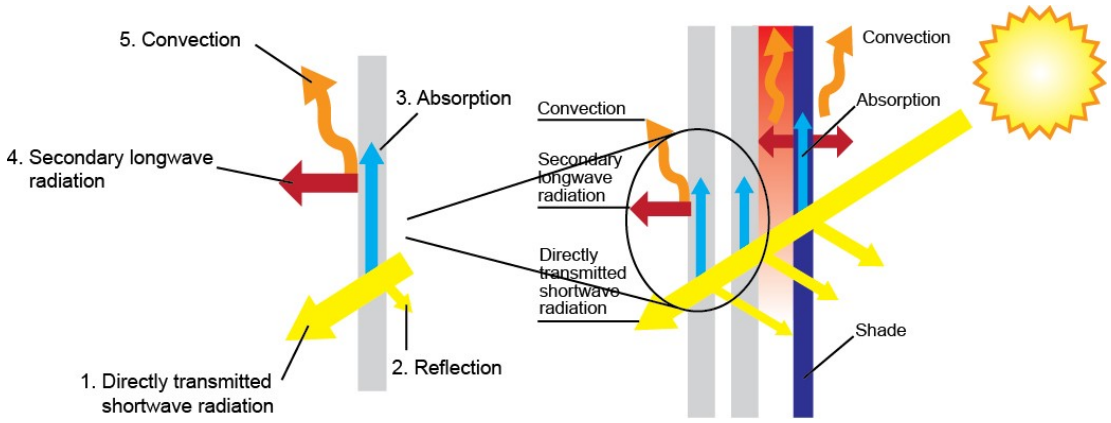
Shortwave visible light and shortwave infrared radiation pass through glass into a building. Glass reflects some of the shortwave radiation back to the atmosphere however a large percentage is transmitted into the building. For single glazing 85% of the solar energy is transmitted to the inside. The radiation enters at wavelengths of 780nm - 2,500nm and once inside, the short wavelength changes into the infrared long wavelength.

2.2 LONG WAVELENGTH

The infrared radiation (long wavelength) is unable to pass back through the glass to the outside. It gets trapped inside and is perceived as heat. Once the radiation is in the building it is then absorbed by objects such as walls, floors, desks and people. These are all constantly absorbing and radiating energy. The radiation when first transmitted through the window is at wavelengths of 780nm – 2,500nm. When re-radiated it is between 5,000nm – 25,000nm. This change in wavelength is responsible for the increase in the indoor temperature.

3.0 SOLAR RADIATION AND GLASS

This diagram shows how solar radiation travels through a window system and interacts with its different layers.



For well insulated buildings the main way that solar radiation enters a building is by passing through the glass in the windows. Glass is transparent to the shortwave visible light emitted by the Sun.

3.1 WHAT HAPPENS WHEN SUN RAYS REACH THE WINDOW?

1. **Shortwave radiation (directly transmitted) -** Glass is transparent to visible light and shortwave infrared radiation. Some of this radiation passes straight through the glazing and shading.

2. **Reflection -** Some of the incoming shortwave solar radiation is reflected at each layer in the window system. This may then be absorbed by other layers or further reflected.

3. **Absorption -** Each layer of the window system absorbs some of the incoming solar radiation. Some colours and materials absorb more radiation than others (e.g. dark colours are more absorbent).

4. **Secondary longwave radiation -** Objects hit by radiation are constantly absorbing and re-radiating energy. This is at longer wavelengths (thermal infrared) and is perceived as heat. As glass is opaque to these wavelengths, the heat is unable to escape and the temperature inside increases.

5. **Convection -** This refers to the movement of warm air across the pane of glass as the temperature changes due to solar gain.

4.0 SOLAR SHADING AS AN OVERHEATING PREVENTION AID

Blinds and shutters can prevent excessive solar gain by blocking some of the incoming shortwave solar radiation. External blinds are very effective as they prevent the radiation from even reaching the window. The absorbed and re-radiated energy is longwave and does not pass through the glass so is trapped between the blind and the outer pane of glass. By natural convection the hot air rises and the heat is dissipated.

Internal blinds can also reduce solar gain especially if the fabric has a reflective coating facing the window. This will reject some of the incoming shortwave radiation therefore not allowing it to be 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.