

# Solar Shading and Energy Saving

## *2009 the most important year yet*

Energy saving is now at the top of many agendas and our industry is beginning to make a significant contribution. On the following pages Dick Dolmans Secretary General of ES-SO (European Solar Shading Organisation – [www.es-so.eu](http://www.es-so.eu)) discusses this particularly in relation to savings in air conditioning costs.



Commonsense also says that external shading can be more effective in the control of solar energy entering a building. This type of shading has not been as prevalent in the UK as in many other countries but maybe its time has come. Three companies involved in external shading put the case. An update of the BBSA's own key initiative Shade Project is also presented.

## Synergies between solar shading and HVAC technologies



Dick Dolmans

Saving energy in buildings is usually and spontaneously identified with at least these three measures: insulate more, use high-performance double glazing and use energy-efficient installations for HVAC. The insulation industry in particular has been very active in showing the benefits of better and more intensive use of its products and has published serious and convincing studies on its effect on energy use and on the reduction of greenhouse gas emissions. Insulation of walls and



Dome over the Reichstag Building in Berlin

roofs, among other things, helps keep the cold out. But the problem is often to

keep the heat out in summer conditions, especially in buildings with lots of glass, as the architects now love to build them. Glass brings in natural light and shows openness. Sometimes there is a message behind the use of fully glazed buildings: transparency and democracy, as in Norman Foster's dome over the Reichstag building in Berlin. But even the best type of glass is basically static. Solar control glass will keep a good part of the sun's energy out in summer time, but unprotected, it will still allow a sizeable part into the building. As we become more demanding for our comfort conditions, air conditioning moves from luxury to standard equipment in offices and, depending on the climate, also in residences. This creates a considerable extra need for electric power and often causes peak demand problems that our electricity grids are not equipped for. On the other hand, solar control glass will also prevent that the sun's energy enters the buildings when it's welcome, in winter time. That's where mobile solar shading comes in. To make glass dynamic and to make buildings more comfortable at a lower energy cost.

### The greenhouse effect in a building

When a glazed surface is exposed to the sun, a sort of 'greenhouse effect' takes place: the sun's energy has a short wavelength and travels easily through the glass. Once inside the building, this energy is absorbed by walls and floors, by furniture and all sorts of objects, and transformed into higher wavelength, infrared radiation. It becomes heat and these heat waves do not travel as easily through the glass. Therefore, heat will accumulate and a greenhouse effect happens. That's why inside a car, parked in the glaring sun, the temperature will rapidly rise beyond the outside temperature.

The capacity of a glass quality to manage energy is measured by its U-value and g-value. What is usually seen as the main characteristic is the U-value, or thermal transmittance, the capacity to insulate from conduction. But U-value is not about radiation, it's about what happens when there is a temperature differential between outside and inside. For the sun's radiation, however, the g-value is representative, a dimensionless figure that indicates

continued on page 36

Three important parameters for glass and solar shading devices:

**U-value:** in  $W/m^2K$  is the heat transfer coefficient, or thermal transmittance: a measure of how well the glass or shade insulates

**g-value:** the solar heat gain factor: the measure of how much solar energy is let in. Expressed as a fraction or %

**T<sub>v</sub>** : the visual light transmittance: the measure of how much visual light is let in. Expressed as a fraction or %

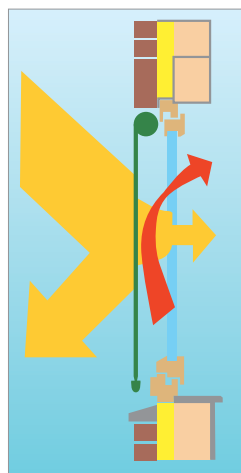
how much of the solar radiation will travel through the glass towards the inside of the building. The databases of the frequently used high performance glazings show U-values like 1.1  $W/m^2K$  or 1,3  $W/m^2K$ , while 'ordinary' double clear glass is still abundantly available at 2.9  $W/m^2K$ . On the face of it, there has been a big progress from the typical 5.7  $W/m^2K$  for clear single glazing -- still current some 30 years ago. But at the same time, the g-value has only gone down from values like 0.83 to 0.73, or maybe 0.61 for the most popular types of glass. Yes, there are values in the low twenties for the most advanced solar control glazings, but these will cause a need for extra heat in the winter, as the glass will also stop up to 80% (and let in, say, only a bit more than 20%) of the solar energy, when this energy would be welcome and contribute to the heating of the building.

### Mobile solar shading adds a dynamic capacity to the glass

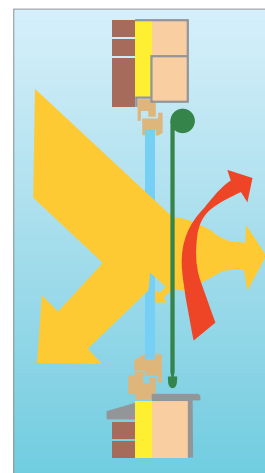
Solar shading (blinds, awnings, shutters etc.) comes in a variety of types, shapes and colors. Roughly speaking, there is the break-down between external and internal shading systems. In another logic, we can distinguish between fixed and mobile systems. Fixed, like canopies or louvers; mobile, like retractable awnings or motorized roller blinds, to name but a few. In this context, we'll only discuss mobile systems. That leaves us with mobile external and mobile internal systems. These constitute the vast majority of all applications. In double skin façades the shading is usually placed between the two panes, which somewhat combines the advantages of internal and external systems.

Common sense dictates that external systems will be more efficient for controlling the entrance of solar energy. The shading device (usually a fabric or a slatted venetian blind)

will stop the vast majority of the sun's energy, depending upon its coefficients of transmittance (how much is let through?) and reflectance (how much is reflected?), both of which are measured in a spectrophotometer according to EN410. The g-value then is calculated according to EN13363-1 (the simplified method) or EN13363-2 (the detailed method). These standards take into consideration the effect of both the glass and the solar shading device.<sup>1</sup> For a well-designed external solar shading system, the g-value is usually between 0.1 and 0.2, which means that 80 to 90% percent of the sun's energy will be stopped by the combination glazing-plus-blind. For internal blinds, the g-value covers a greater range and could be anywhere from 0.3 to 0.7, depending on type and



Typical representation of an external solar shading system



Typical representation of an internal solar shading device

color. In both cases – external or internal – the solar shading device should be mobile, ideally motorized and automated, so that the full benefits are reaped even if the building is not occupied.

### Influence of solar shading on HVAC: rightsizing cooling equipment

For the sake of argument, let's consider external shading and assume a g-value of 0.15. That means that 85% of the sun's energy will be stopped by the blind or awning and only 15% will penetrate the building and be converted into heat. If the system is automated, a solar sensor will bring the blind down as soon as the sun is present, even if the building's occupants are absent. A thermostat will keep the blind in the 'up'-position as long as the desired indoor temperature is not reached, bringing in some welcome, free and renewable solar energy as a contribution to the heating needs. Both these effects do influence the need for artificial cooling,

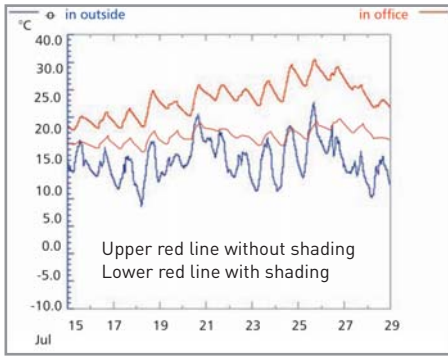
resp. heating and will therefore change the energy consumption of the building. To quantify this influence, the specifics must be known: the geographic location of the building façade, the applicable climate database, the orientation, the glass quality and quantity, the rate of ventilation, the internal heat gains, etc. Building simulation software programs are available to calculate the resulting indoor and outdoor temperatures, the energy needs for heating and cooling for the assumed indoor comfort conditions and the difference between the scenarios 'with' and 'without' solar shading. Often the energy demand for cooling will drop by 30% or more, while in some moderate climates, active cooling might not be necessary at all. The graphs above show the indoor (red) and outdoor (blue)

temperatures without (left) and with (right) external solar shading, in an unspecified example for a building in Brussels in July.

### Solar shading and natural night ventilation

Summer heat accumulates in the structure of the building. The greater the mass, the greater the thermal inertia. Combining automated external solar shading with natural night ventilation will avoid excessive heat build-up during the day while evacuating some of the heat during night time, which reduces the need for

artificial cooling during the next day. A study by the University of Delft in the Netherlands shows that the application of advanced solar shading systems combined with motorized windows for natural night ventilation can reduce the carbon emissions of a building by as much as 28%.<sup>2</sup> Some buildings are designed to intentionally create a natural draft at night, by construction methods that stimulate a stack effect which enhances the passive cooling, such as a wide central staircase or a natural draft chimney. The nightly flush carries away the heat that has settled in the building during the day and brings down the temperature by several degrees. The EU-sponsored Keep Cool research project features several case studies where this has been applied, such as the Best Practice Project on the Swiss Federal Statistical Office, a recently built computer center with an overall energy use of 56  $kWh/m^2a$ , including the power needed for the computers.<sup>3</sup> That's a



very low figure, compared to most of the existing building stock. Annual energy consumption figures are usually above 100 kWh/m<sup>2</sup> for recently constructed buildings and very often above 200 kWh/m<sup>2</sup> for older ones. Low energy buildings are associated with numbers in the area of 70 kWh/m<sup>2</sup>a, while the passive house label is applicable at 15 kWh/m<sup>2</sup>a.

### ESCORP study by ES-SO, the European Solar-Shading Organization

In 2004, the solar shading industry decided to establish an umbrella association in Brussels, representative for the European industry, with the objective of bringing the solar shading associations of the various countries together. Today, ES-SO counts members from 14 countries, representing thousands of companies, mostly small and medium-sized enterprises, and hundreds of thousands of jobs. ES-SO's major objective is to demonstrate the benefits of solar shading and to inform the European and national authorities so that the energy efficiency effects of solar shading are recognized and taken into consideration in the building regulations. To support this message,

numbers must be produced: how much energy can be saved by the proper use of solar shading and how does this affect the comfort level? ES-SO has commissioned a scientific study, called ESCORP-EU25.<sup>4</sup> Based on a reputable, ISO/FDIS 13791-validated building physics simulation program, this study concludes that up to almost 10% of the total energy used in buildings could be saved if only one window out of two had some form of shading. Plausible assumptions have been made for parameters such as building envelopes, building orientation, user profiles and climates, and a representative mix of internal and external solar shading, and of residential and commercial buildings, has been taken into account. The study concludes that intelligently controlled solar shading will save heating energy in winter conditions, by letting in welcome free solar energy during the heating season, while a substantial reduction is demonstrated in the energy needed for cooling purposes in the summer season. Related to the total surface of the built environment in the 25 countries of the EU (in 2006), the total potential energy savings have been calculated and converted into carbon dioxide emissions avoided. The study concludes that over 100 million tons of carbon dioxide could be saved per year and a total of 9.5% of all energy used in the building stock. With the fairly conservative basic assumptions of this study, this number is impressive. Assuming the use of more external solar shading – with a much higher efficiency in reducing the risk over overheating in summer – the results could even be higher.

### Conclusion

In the present context of energy scarcity and deep concern for our climate and environment, it is no longer an option to build 'the old way'. Constructing lightweight buildings with little or no thermal mass, then calling in the engineers to provide the comfort with a number of often oversized mechanical installation, is not a responsible way for today's environment. Buildings last for decades, sometimes centuries, and the way they are built today will determine their behavior for many, many years. Therefore energy efficiency and sustainable building practices are a must in the construction methods of the 21st century. Solar shading, internal or external, depending on the application, should be part of every energy-efficient building, newly built or renovated. To help create thermal comfort conditions, by avoiding overheating in summer conditions, and to enhance visual comfort, by filtering down the excessive light of the sun to acceptable levels, compatible with work safety rules and pleasant contrast conditions. This also helps 'rightsizing' the heating and cooling equipment.

1. EN13363-1: "Solar Protection Devices Combined With Glazing – Calculation of Solar & Light Transmittance – Part 1: Simplified Method"
2. A. van Paassen, Benefits of various types of shading and night cooling by vent windows, TU Delft, 2006, available from [www.es-so.eu](http://www.es-so.eu)
3. [www.energyagency.at/publ/pdf/keep-cool\\_switz2.pdf](http://www.energyagency.at/publ/pdf/keep-cool_switz2.pdf)
4. ESCORP: Energy Saving and CO<sub>2</sub> Reduction Potential from Solar Shading Systems in the EU-25, available from [www.es-so.eu](http://www.es-so.eu).

## The time is now.... for External Blind Solutions

External Blinds have far reaching but often overlooked capabilities for providing acceptable, yet economic, internal environments in all building types. Their usage can reduce the cost of air conditioning units; permitting the luxury of open windows whilst still allowing individuals to control the environment of their own work area. Considerable energy conservation benefits are also offered with External Blind products.

In many applications, it is recommended that Internal Blinds should

be used to complement External Blinds. Their purpose is two fold; they provide individuals with control over the ambient conditions in their immediate vicinity; and complement the effect of External Blinds by reducing glare.

External shading will not mitigate the entire cost of air conditioning in an existing building but will significantly reduce the cooling load. External Venetian Blinds (EVB's) are an ideal product for these needs. EVB's have many advantages including being the

continued on page 40

