CARBON TRUST
Making business sense of climate change

How to implement solar shading

Air conditioning is an expensive way of keeping buildings cool, especially as fuel prices rise. Solar shading can be a very cost-effective alternative.

Solar shading can be integrated during the construction of almost any new building, and many existing buildings can also be fitted with some form of solar shading. In some cases, a combination of shading and natural ventilation can completely stop the overheating caused by sunshine on a building – known as solar gain.

The business case

The cost of solar shading depends on the type and complexity of the installation. Given a choice between installing air conditioning and solar shading on a new-build, it's worth noting, though, that shading will usually be cheaper.

On a building with existing air conditioning, the amount you save on energy bills could pay back the cost of installing shading within 10 years. This is quite a conservative estimate and easily achievable. It's based on installing fixed solar shading on a 25m by 10m single storey, open-plan office building, which would cost around £6,000. We've assumed an electricity tariff of 10p/kWh (including Climate Change Levy) and a 25% reduction in use of the air conditioning (around 6,000kWh/year).

The technology

Solar shading reduces heat from the sun during the summer, while allowing low-angled winter sun to provide some passive heating.

Types of solar shading

This guide focuses on fitting solar shading to an existing building, using overhangs and awnings, external blinds or internal blinds. Shading on new-builds could also include coated glazing and mid-pane blinds.

Overhangs, awnings and light shelves

Overhangs are a simple, yet effective way of blocking out the high summer sun and are usually installed on south-facing facades.

Also known as 'brise soleil', this type of shading can be integrated with new-builds or fitted to an existing building. They don't stop windows from opening and no visibility is lost.

This style is popular with contemporary architects and is often installed for the look as much as for its effectiveness.

Awnings are a more simple form of overhang that are cheap to install and can be retracted if required.

Light shelves are similar to overhangs and awnings, but are installed part-way up a window, typically just above head height. The top of the shelf reflects extra daylight into the building without glare and without compromising shading.

The amount of shading depends on the degree of overhang compared to the window height. A ratio of 1:1 is usually ideal for south-facing facades.

External blinds

Various types of external blinds are available and can be used over a fixed overhang or awning for more control of shading. Blinds tend to be better on existing buildings because they have lightweight frames, whereas overhangs or awnings are often heavy and need chemical fixing. You can opt for manual control of the blinds from inside the building.

Figure 1 *A typical 'brise soleil' installation*

Internal blinds

Internal blinds tend to be less effective than external shading at controlling heat gain.

- Reflective roller blinds look like reflective window film when closed and stop solar gain very effectively. They can also be opened when solar radiation and daylight are required.
- Opaque blinds reduce solar glare, but daylight levels will be poor and artificial lighting will usually be needed.
- Light-coloured blinds allow some natural light in and absorb less heat than opaque blinds. They do cut solar glare, but don't give much privacy at night.
- Transparent blinds maximise daylight, but don't completely stop solar glare.

Controlling how shades operate

Manual control

Manual controls can be wall switches, hand-held transmitters or systems linked to a building's telephone or computer network. This method of control is best for 'owned' or shared spaces, such as cellular and open-plan offices, because an automatic system is unlikely to satisfy everyone.

Manual control with automatic reset

This method is best for areas that are unused for long periods. Reset is often used to:

- return to optimum position – closed during sunny periods and fully open during dull periods, for example
- control overheating at critical times – closing before the sun hits a west-facing facade in late afternoon, for example
- to reduce heat-loss at night – when the solar shading provides a better U-value than the glazing alone.

Automatic control

Automatic control is best in 'un-owned' or managed areas, such as circulation areas and shops. People move in and out of these spaces and wouldn't expect to have control over the conditions.

Automatic control can be based on the following factors – and these should be used in combination for optimum performance:

- time
- sunlight
- sun direction
- temperature
- wind
- rain
- occupancy.

Applications

In most buildings, the need for solar shading changes throughout the year. It can vary depending on:

- the season – overheating may be a problem during the summer, but solar gains in winter can reduce the need for other heating
- weather – on dull or overcast days there's often no need for shading
- use – some activities require privacy, others need less solar glare, for example.

Adjustable shading is usually preferred for most applications, but it's more expensive and needs more maintenance because of its moving parts.

If the changing seasons are the only factor, then fixed shading may be enough. Its geometry is designed to block out high-angled summer sun, but allow low-angled winter sun.

External shading may be impractical where there are planning constraints (on listed buildings, for example), or where there are structural limitations (such as glass curtain walling).

Whether you choose manual or automatic control depends on how your building is used. In offices, for example, people expect to be able to control the level of shading themselves, and tend to resent automatic shading. In circulation spaces, swimming pools, sports halls, airport buildings and shopping centres, users don't generally expect to control shading, and automatic controls are often the most appropriate.

If you do have manual controls, they should be easy to find and operate; complicated controls may be used incorrectly or not at all. Some automatic reset control is a good idea alongside manual control.

Table 1 *Performance data for shading types*

System	Best for window types	% reflective total solar transmittance (south-facing)		% reflective daylight transmittance		Adjustability	Privacy	Glare control
		Summer	Winter	Diffuse	Back of room			
Clear double glazing, no shading	–	100	100	100	100	X	X	X
Overhang	S	55	84	61	72	1	X	2
Light shelf	S	51	78	52	90	1	X	2
External louvre						1*	3	2?
Shut	HSEW	4	4	3	3			
Open	HSEW	26	45	32	50			
Curtains	Any	50	49	6	6	3	3	3?
Venetian blind						3	3	3?
Shut	Any	57	58	3	3			
Open	Any	100	100	32	50			
Roller blind	Any	43	43	6	6	3	3	3?
Reflective roller blind	Any	34	33	4	4	3	2+	1*

Key:

Window types

N = north
S = south
E = east
W = west
H = horizontal

Adjustability

X = performance generally remains the same
1 = seasonal variation in performance
2 = some user adjustability
3 = completely adjustable
* = some types completely adjustable

Privacy

X = no improvement in privacy
1 = some improvement in privacy
2 = good privacy by day, not at night
3 = good privacy all the time
+ = opaque types give good privacy all the time

Glare control

X = no improvement in glare
1 = reduces sky glare but not reduce sun glare
2 = reduces sky glare and eliminates sun glare at certain times
3 = eliminates sky and sun glare
* = opaque types eliminate sky and sun glare
? = some types don't eliminate sun glare

Table 2 *Specification checklist*

Considerations	Comments
Most appropriate type of solar shading, based on requirements and budget	See the Applications section.
Will you need planning permission?	Check this as early as possible to avoid delays on site. There are various models, designs and colours of solar shading, and an installation can often improve the appearance of a building. This means that most projects are signed off fairly easily.
Which elevations need solar shading? Is it just south-facing, for example?	The manufacturer should advise you. Typical design data is available in CIBSE Guide C – Environmental Design. Solar shading shouldn't be used for aesthetic purposes only, as unnecessary shading can lead to higher energy bills.
Is fixing of an overhang possible?	The manufacturer should advise you. Chemical fixing may be required.
Building use	This should inform your choice of control. See the Application section for more detail.
Level of privacy required	Some kinds of shading don't give any privacy.
Acceptable level of glare	Transparent blinds won't keep out glare.

Specification checklist

Table 2 outlines the factors to consider when discussing solar shading with your supplier.

Commissioning checklist

- When installing automatic or semi-automatic controls, solar shading should change position no more than twice in a 24-hour period. A visible change of structure can actually be distressing to building occupants.
- Controls should be accessible and easy to operate. The manufacturer should give you a full demonstration.
- Building occupants should be trained in how to operate the shading.
- For best control of glare, blinds should have no gaps.
- Ensure all operating and maintenance documentation has been provided by the manufacturer or installer.

Common problems

The most common problems with solar shading stem from the system being poorly designed. This can lead to overheating, glare, lack of privacy and constant automatic movement of the louvres or blinds. For example, it's a common misconception that light and temperature sensors should be installed inside. In fact, this can lead to over-frequent operation of the solar shading.

Good design, liaison between with the manufacturer and careful commissioning should avoid these problems.

Finding a supplier

Solar shading systems should always be fitted by a reputable manufacturer or contractor. You may already know a suitable contractor. If not, contact a recognised trade association for advice.

The Heating and Ventilating Contractors' Association (HVCA)
0207 313 4900
www.hvca.org.uk

Chartered Institution of Building Service Engineers (CIBSE)
0208 675 5211
www.cibse.org