







Site Layout and Building Design



Good Practice

-  **The layout of new development should maximise the potential for passive solar gain**
-  **Site layout should use landform and landscape to benefit from shelter to minimise heat losses in winter and avoid over-shadowing of the solar orientation of buildings**
-  **Design principles should be applied to new buildings, that maximise the capture and use of passive solar energy while avoiding excessive solar gain in summer**
-  **Site layout and landscape should provide adequate shade in summer**

Background

Passive solar energy (the energy provided by sunlight entering buildings through windows) can make a significant saving in energy needed for heating and lighting, and so reduce the CO₂ emitted by burning fossil carbon fuels. The greatest energy savings arise when site layout that optimises passive solar gain is combined with building designs that take advantage of solar energy.

However, it is important to balance the benefits of reduced energy consumption in winter offered by passive solar gain, with the risk of excessive solar gain during summer which can cause discomfort or heat stress, and increase the demand for energy for cooling.

Above

Brise soleil (sun louvers) can provide an attractive way of preventing excess solar gain for residential and commercial developments (The Point, Woking)

CLIMATE NEUTRAL DEVELOPMENT

A good practice guide



The Benefits of Passive Solar Energy

Designing new developments to maximise passive solar energy can provide a number of benefits:

- Good layout and design results in warm and sunny houses that are attractive to buyers
- Passive solar developments need cost no more than 'conventional' developments
- Passive solar design is not dependent on technology, and has no ongoing cost implications
- Providing thermal massing in the construction helps to maximise the benefits of passive solar energy, and also helps to buffer against high internal temperatures in the summer

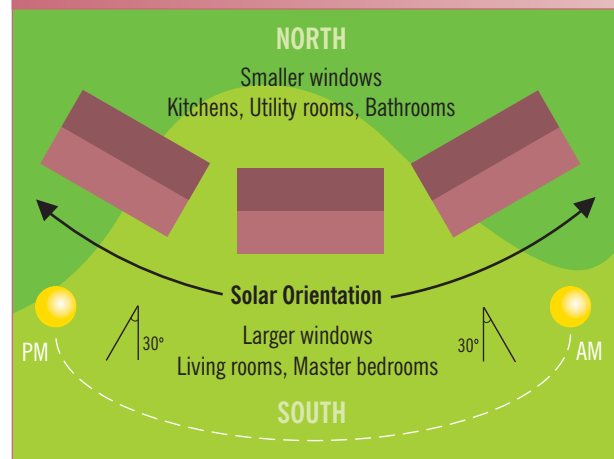
By applying simple layout and building design principles, savings of up to 10% on fuel costs can be made

Site Layout Principles for Passive Solar Energy

Careful orientation of buildings is vital for passive solar energy gains. The main glazed elevation should be orientated within 30° of south ('solar orientation') with a correspondingly small proportion of glazing on the north elevation.

Inevitably, road layout will largely dictate the arrangement of buildings on a new development, with east-west alignment enabling the optimal orientation of houses for passive solar gain. However, it is not essential for all buildings to be orientated due south and variations of up to 30° can be accommodated whilst still benefiting from passive solar gains. On north-south roads, detached units provide greater flexibility for maximising solar gain. Plots should be set at an angle to diagonal (e.g. northeast-southwest) roads for maximum passive solar gain.

Solar Orientation



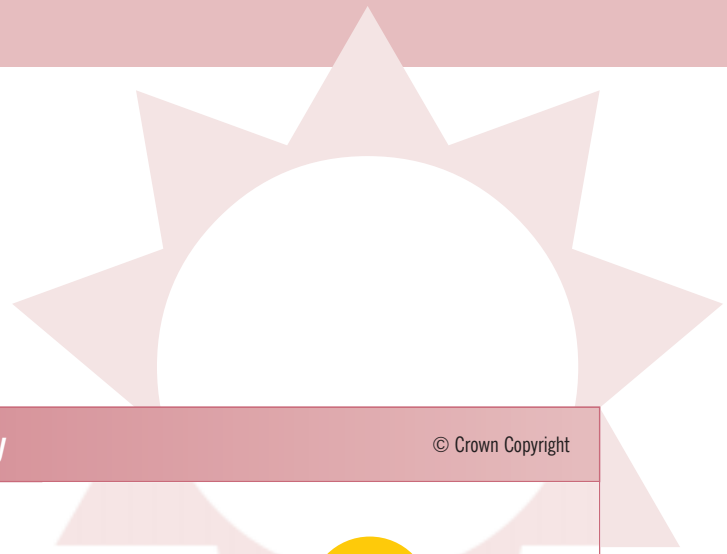
Below

Brise soleil can help prevent excess solar gain, and reduce energy costs in office buildings by up to 10% (Victoria Gate, Woking).



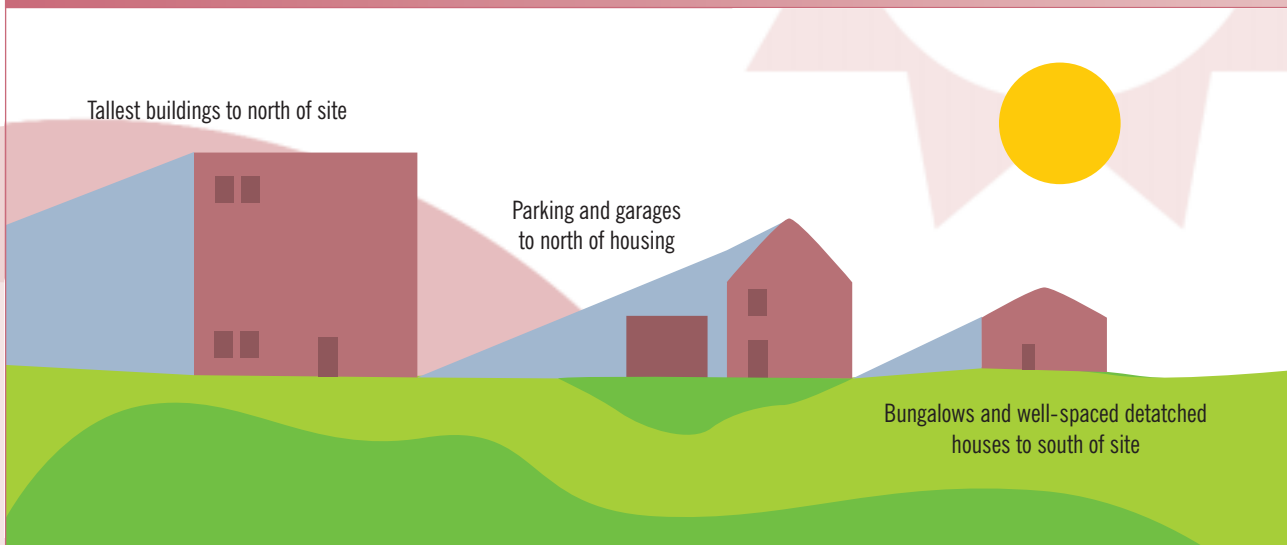
Step-by-step changes from 'conventional' to passive solar design © Crown Copyright

Estate Layout	% Energy Saving
'Conventionally' planned houses orientated north/south	1-3
Estate layout designed to minimise shading from obstructions to solar gain	2-4
Typical energy savings from solar estate layout	3-5
House design	
Glazing biased towards south (for the conventionally planned houses)	3-4
Houses replanned internally so that most principal rooms face south	1-2
Typical energy savings from passive solar houses on passive solar estates	8-10



Site Layout Principles for Passive Solar Energy

© Crown Copyright



Further site layout considerations include:

- ☼ Minimising over shading by locating taller buildings to the north of the site, or to the south of road junctions, open spaces or car parks.
- ☼ Locating car parking and garages to the north of housing.
- ☼ Using land over-shadowed by tall trees for parking (where the shading may be beneficial in summer).

Houses located to the north of access roads will have south-facing front gardens and main living rooms. These are likely to need privacy and screening, and in shallow gardens this is likely to reduce the solar gain reaching the house. Furthermore, the rear garden space will be over-shadowed by the building and consequently less attractive for private garden use. Therefore, it may be more appropriate to locate apartments in these locations where living accommodation can be located off the ground floor and communal gardens maintained as open plan, or with low hedges.

A good practice guide



Landscape

Existing trees and new landscape planting should be taken into account when site planning for passive solar energy. Vegetation and landform can complement passive solar design, reducing heat loss by providing shelter. However, if poorly positioned in relation to buildings, tall vegetation will reduce solar gain by overshadowing, and obstructing sunlight.

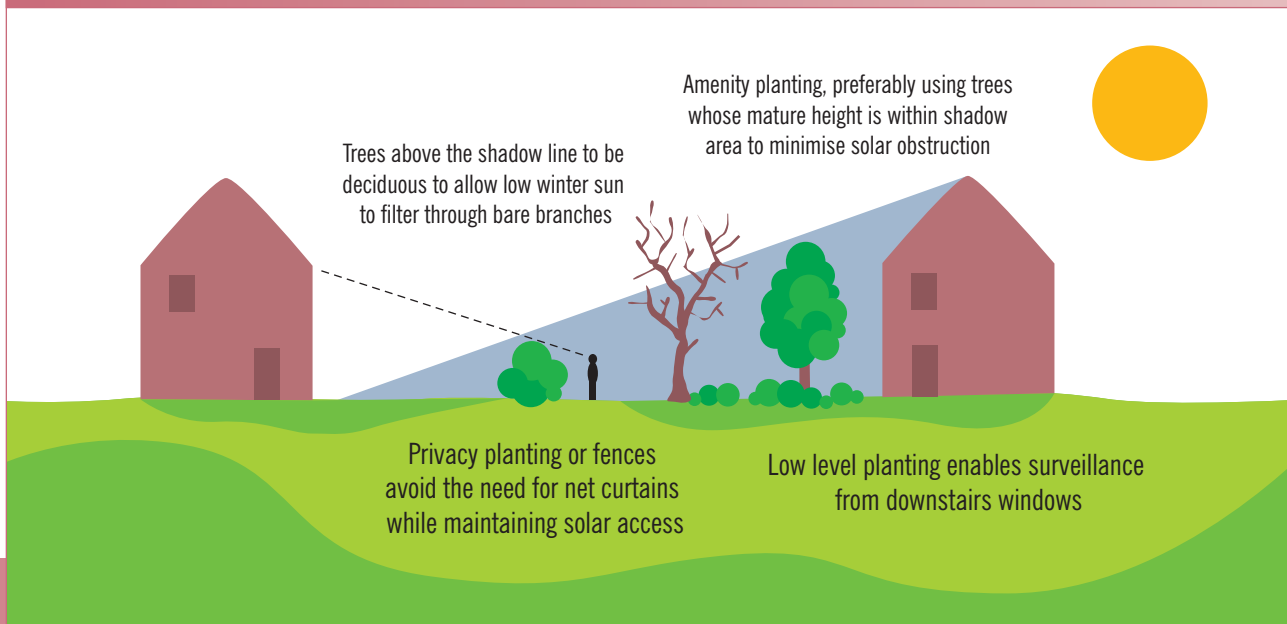
The key principles are:

- ☼ Shelterbelts should be orientated to the south-west of development and distanced 3-4 times their mature height from south-facing elevations.
- ☼ Trees that will grow above the shadow line should be deciduous as they allow sunlight to pass through when at a low angle in winter and provide beneficial shading in summer.
- ☼ Small scale tree and shrub planting should be used to provide privacy for ground floor south-facing living room windows.

Urban green space (trees, grass and shrubs) has a number of beneficial impacts on the micro-climate of our towns and cities where the consequences of climate change will be most severe. By creating daytime shade and evaporative cooling at night, green space can moderate the urban heat island. Green space also reduces storm water run off, and helps to lower the risk of urban flooding.

Landscape for Passive Solar Energy

© Crown Copyright





Building Design Principles

Passive solar energy houses need not be significantly different in construction or appearance to conventional housing. The key principles are:

- ⚙️ Avoid the use of high pitched roofs which overshadow neighbouring buildings.
- ⚙️ Avoid over shading of living rooms by projections from the south elevation or staggered house plans.
- ⚙️ Provide thermal mass and storage by using solid walls to buffer against heat fluctuations and provide cooler conditions in summer.
- ⚙️ Locate the main glazed elements on the south elevation.
- ⚙️ Design the internal layout to ensure the main living room and other frequently used rooms are on the south side and rooms that benefit less from sunlight (bathrooms, utility rooms) on the north side. Kitchens are better positioned on the north side to avoid excessive heat gain.
- ⚙️ Arrange internal layout to distribute solar energy gains using through-rooms.

Passive solar energy houses do not require especially large south-facing windows - if windows are too large, heat loss may outweigh solar gain, and occupants' desire for privacy is likely to lead to the installation of net curtains or blinds which significantly reduce passive solar gain. Likewise, if the windows on the north, east and west facing elevations are too small to achieve reasonable internal light, occupants will resort to daytime use of artificial lighting, eroding the energy savings from passive solar energy. Windows on these elevations should be approximately 15% of the room's floor area.

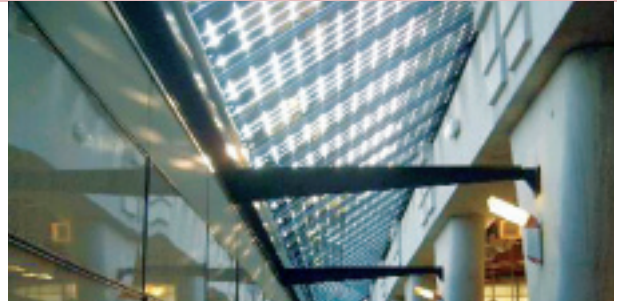
Conservatories can help to harness passive solar energy and provide shelter to external walls. However, they should be carefully incorporated into a design to ensure effective distribution of heat around the home, avoid heat loss in winter through large glazed areas, and prevent over-heating in summer. It is important to be able to thermally isolate a conservatory from the rest of the house to prevent excessive heat loss. Sunspaces (glazed elevations within conventional walls) can create warm and light spaces within buildings. They are particularly useful in flats and apartments where they can throw light further back into deep plans and can provide an attractive internal space where no private garden space is available. Low-e glazing is essential in these cases where the sunspace forms an integral part of the building, and heat losses can be further reduced by the installation of thermal blinds or curtains to prevent heat loss at night.

Remember - if it is not possible to achieve good solar orientation, there is little benefit in energy saving to be made in using a passive solar energy design for housing.



Right

Sun spaces on the solar elevation of apartments create warm internal environments as an attractive alternative to private gardens (BedZed, Sutton)



Cooling and Preventing Excessive Solar Gain

With predicted increases in summer temperatures, building design will need to ensure there is adequate cooling to prevent uncomfortable internal temperatures. As a first priority, measures (such as shutters or brise-soleil) are simple and effective in preventing excessive solar gain, especially on large glazed solar-orientated elevations.

The World Health Organisation estimates over 25,000 people in Europe died during summer 2003 due to the heat-wave in July and August

However, reduction in solar gain alone may not be sufficient to control internal temperatures in summer, and additional cooling may be required. Natural ventilation should be used in preference to conventional mechanical air cooling systems which generate high energy demands and in some cases rely on refrigerants that are far more harmful to climate change than CO₂. But, as external temperatures rise, natural ventilation may become inadequate and demand for additional air cooling is also set to rise. Furthermore, in large buildings adequate natural ventilation may be hard to achieve. Gas and heat-fired absorption cooling are significantly more energy efficient than grid electricity powered air cooling systems. If heat-fired absorption cooling is combined with CHP (Combined Heat and Power) 'green electricity' can be generated as a by product.

As our climate is predicted to become more southern European in character, a number of exciting opportunities exist for gardeners who will be able to cultivate many of the fruits and flowers that we associate with popular holiday destinations. In the same way, we need to consider applying some of the building principles that have been used for centuries in warmer regions, and recognise the opportunities that are available to us.

Top

Photovoltaics can provide attractive solar shading (spectator's gallery, Pool in the Park, Woking)

Photovoltaic cells have been installed on the southerly elevation of the flumes tower at Woking's Pool in the Park to provide solar shading

Cost implications

Applying the principles of solar layout and design need not add to the cost of development. Passive solar houses cost no more to build than conventional houses, and there are no additional running costs.

Marketing opportunities exist for passive solar houses, promoting the warmth and quality of the internal environment along with reduced heating bills, which may provide a competitive sales advantage over conventional properties. The incorporation of sun spaces can add to 'kerb appeal'.



Further information

For detailed design guidance and examples of best good practice: Passive Solar Estate Layout General Information Report 27 (BRE/Energy Efficiency Best Practice Programme). Copies of this guide and other good practice information on energy efficiency in housing is available from the Energy Saving Trust at: www.est.org.uk/bestpractice

Information on energy efficiency in non-domestic developments is available at: www.actionenergy.org.uk

WOKING BOROUGH COUNCIL

Civic Offices, Gloucester Square, Woking, Surrey, GU21 6YL

Endorsed by:

www.woking.gov.uk

Endorsed by:

