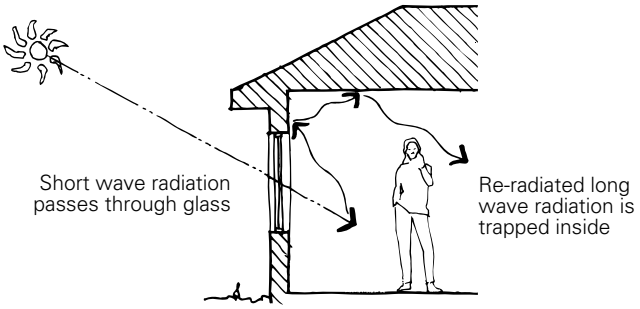
Shading of the building and outdoor spaces reduces summer temperatures, improves comfort and saves energy. Direct sun can generate the same heat as a single bar radiator over each square metre of a surface. Shading can block up to 90 percent of this heat.

Shading of glass to reduce unwanted heat gain is critical. Unprotected glass is often the greatest source of unwanted heat gain in a home.



Radiant heat from the sun passes through glass and is absorbed by building elements and furnishings, which then re-radiate it. Re-radiated heat has a different wavelength and cannot pass back out through the glass as easily. In most climates, 'trapping' radiant heat is desirable for winter heating but must be avoided in summer.

Shading of wall and roof surfaces is important to reduce summer heat gain, particularly if they are dark coloured and/or heavyweight.

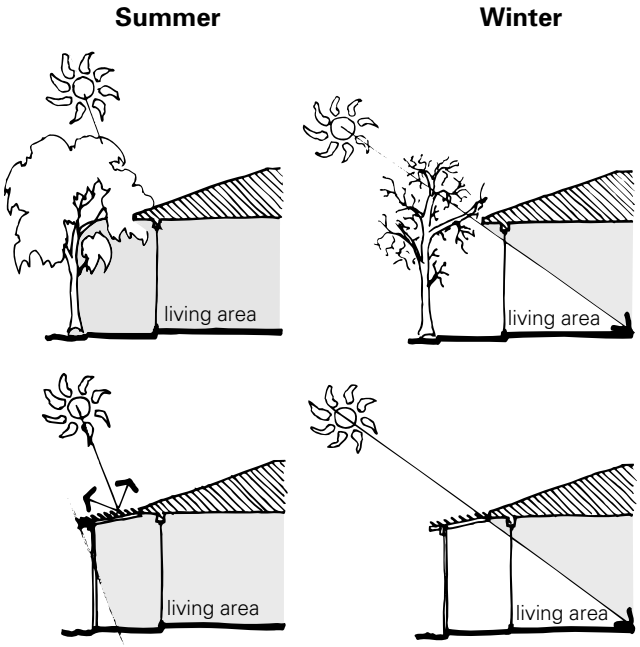
Shading requirements vary according to climate and house orientation. A general rule of thumb is:

ORIENTATION	SUGGESTED SHADING TYPE
NORTH	fixed or adjustable shading placed horizontally above window
EAST & WEST	adjustable vertical screens outside window
NE & NW	adjustable shading
SE & SW	planting

GENERAL GUIDELINES FOR ALL CLIMATES

Use external shading devices over openings. Lighter-coloured shading devices reflect more heat. Internal shading will not prevent heat gain unless it is reflective.

Use plants to shade the building, particularly windows, to reduce unwanted glare and heat gain. Evergreen plants are recommended for hot humid and some hot dry climates. For all other climates use deciduous vines or trees to the north, and deciduous or evergreen trees to the east and west.



With ideal north orientation sun can be excluded in summer and admitted in winter using simple horizontal devices, including eaves. For situations where ideal orientation cannot be achieved (eg existing house, challenging site) it is still possible to find effective shading solutions. [See: Passive Solar Heating; Orientation]

North facing openings (and south facing ones above the tropic of Capricorn) receive higher angle sun and therefore require narrower overhead shading devices than east or west facing openings. Fixed horizontal shading is often adequate above north facing glazing. Examples include eaves, awnings, and pergolas with louvres set to the correct angle. See Fixed Shading

East and west facing openings require a different approach, as low morning and afternoon sun from these directions is more difficult to shade. Keep the area of glazing on east and west elevations to a minimum where possible, or use appropriate shading devices. Adjustable shading is the optimum solution for these elevations. See Adjustable Shading.


Courtesy of QMBA / Your New Home Magazine

Deep verandahs, balconies or pergolas can be used to shade east and west elevations, but may still admit very low angle summer sun. Use in combination with planting to filter unwanted sun.


Sunpower Design

Pergolas covered with deciduous vines provide self adjusting seasonal shading. A 500mm gap between the wall and planted screens should be left for ventilation and cooling. Vines on walls (where appropriate) can also provide summer insulation to all orientations. Evergreen vines block winter sun and should only be used in tropical climates.

Use drought tolerant ground-cover plants instead of paving where possible, to keep the temperature of the ground and surrounding surfaces lower in summer.

Protect skylights and roof glazing with external blinds or louvres. This is crucial as roof glazing receives almost twice as much heat as an unprotected west facing window.

Position openable clerestory windows to face north with overhanging eaves to exclude summer sun.

Double glaze clerestory windows and skylights in cooler climates to prevent excessive heat loss.

Advanced glazing solutions such as solar films and tinted glass may be appropriate as a secondary measure on east and west elevations. They can exclude up to 60 percent of the heat compared to plain glass.

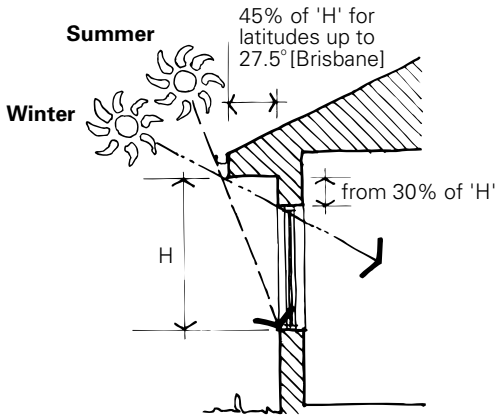
Avoid using tinted glass on north facing windows designed to let in winter sun. [See: Glazing Overview]

FIXED SHADING FOR PASSIVE SOLAR ACCESS

Fixed shading devices can regulate solar access on northern elevations throughout the year, without requiring any user effort.

Summer sun from the north is at a high angle and is easily excluded by fixed horizontal devices over openings. Winter sun from the north is at a lower angle and will penetrate beneath correctly designed fixed horizontal devices.

Correctly designed eaves are generally the simplest and least expensive shading method for northern elevations, and are all that is required on most single storey houses.



The general 'rule of thumb' for calculating eaves width is given above. This rule applies to all latitudes south of and including 27.5°S (Brisbane, Geraldton). Within this range the rule is self adjusting - going south winter sun angles decrease, but at the same time the need for solar access increases as climates becomes cooler.

For latitudes north of 27.5°S the response varies with climate. For hot humid climates and hot dry climates with no passive heating requirements, shade the whole building at all times. For hot dry climates with passive heating requirements allow some low angle winter sun to reach walls, concrete floors and especially windows. See Climate-specific responses. [See: Passive Solar Heating; Passive Cooling]

Permanently shaded glass at the top of the window is a significant source of heat loss, especially in cool and cold climates. To avoid this, distances between the top of glazing and the eave underside should be at least 30 percent of H. See illustration above.

This is not always achievable with standard eave detailing which is flush with the 2100 head. The top 20 percent of this window is in permanent shade.

Above, standard 2100 high doors are shaded by a 1000 eave (including gutter) set 300 above the head. Note the sun angle at midday in mid winter is above the glass line. This configuration provides full shading to glass from late October to late February at latitude 35°S (near Canberra) and is appropriate for a higher altitude cool climate winter.

Above, north facing upward raked eaves allow full exposure of glass to winter sun and shade larger areas in summer, without compromising the solar access of neighbours to the south. This inner city terrace in Sydney uses an upward raked eave to passively shade highlight windows. A separate horizontal projection of louvres shades lower glazing. This allows 100 percent winter solar access and excludes all sun between the spring and autumn equinoxes.

Varying the rule of thumb may be beneficial:

> At high altitudes.

> Where cold winds or ocean currents are prevalent.

> In hot dry inland areas.

> In cold, high latitude areas [eg Tasmania].

In colder higher latitudes such as Canberra, Armidale, Coonawarra, Mt Gambier, Albany, Ballarat, Colac, and all of Tasmania.

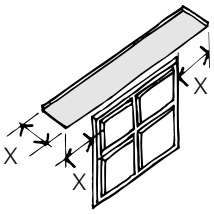
> Reduce eaves width to 42-43 percent of H to extend the heating season past the equinox.

> Increase window head to eave distance.

In lower latitudes such as Alice Springs, Toowoomba, and Kingaroy, where the need for winter heating is significant but hot summers are common, varying eaves width may not be beneficial.

> Increase window head to eave distance.

See Climate-specific responses for more information.



Awnings and pergolas need to extend beyond the width of the north facing opening by the same distance as their outward projection.

For locations north of the Tropic of Capricorn (23.5°S) in hot humid climates or hot dry climates with warm winters, the building and outdoor living spaces should generally be shaded throughout the year.

Fixed horizontal louvres set to the noon midwinter sun angle and spaced correctly allow winter heating and summer shading in locations with cooler winters.

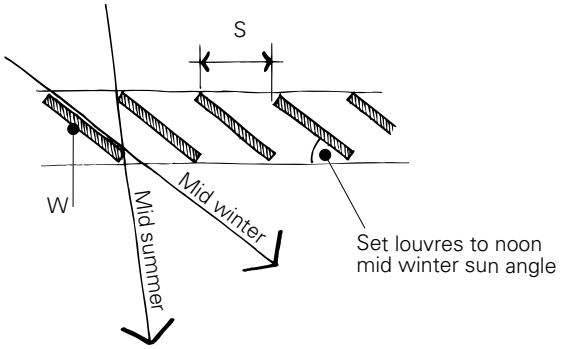
Midwinter and midsummer noon sun angles for locations can be calculated using the formulas below, where L is the latitude of your home.

Midwinter noon sun angle	= 90 – (L+23.5)
Midsummer noon sun angle	= 90 – (L–23.5)
Equinox noon sun angle	= 90 – L

The latitude of a number of cities and towns is shown on the climate map below. The Geoscience Australia website (http://www.agso.gov.au/nmd/geodesy/astro/) allows you to find the latitude of more than 250,000 place names in Australia, and will calculate the sun angle at any time of the day, on any day of the year.

As a rule of thumb, the spacing (S) between fixed horizontal louvres should be 75% of their width (W).

The louvres should be as thin as possible to avoid blocking out the winter sun.



ANGLES OF LOUVRES TO THE HORIZONTAL	
Hobart	24°
Melbourne	29°
Sydney, Canberra, Adelaide	31°
Perth, Broken Hill, Port Augusta	34°
Brisbane, Geraldton	38°

ADJUSTABLE SHADING

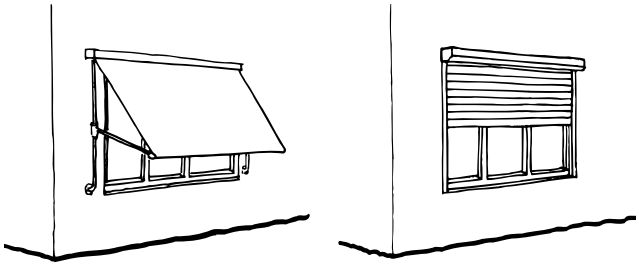
Adjustable shading allows the user to choose the desired level of shade. This is particularly useful in spring and autumn when heating & cooling needs are variable. Note: active systems require active users.

NORTHERN ELEVATIONS

Adjustable shading appropriate for northern elevations includes adjustable awnings or horizontal louvre systems above glazing, and removable shadecloth over pergolas or sails. Shadecloth is a particularly flexible and low cost solution.

EASTERN & WESTERN ELEVATIONS

Adjustable shading is particularly useful for eastern and western elevations, as the low angle of the sun makes it difficult to get adequate protection from fixed shading. Adjustable shading gives greater control while enabling daylight levels and views to be manipulated. Appropriate adjustable systems include sliding screens, louvre screens, shutters, retractable awnings and adjustable external blinds.



Awning blind **Roller shutter**

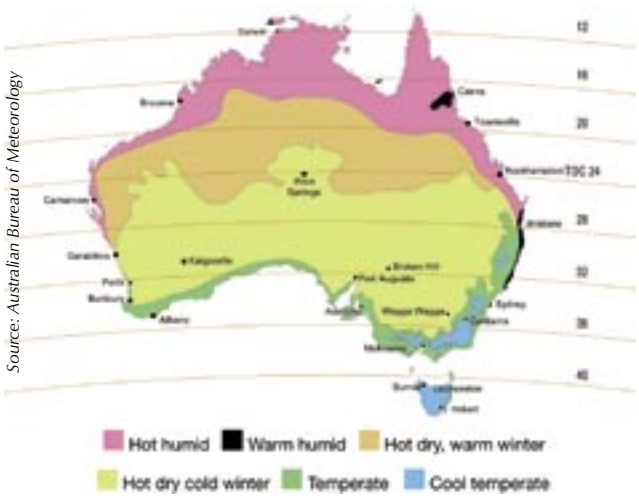
NORTH-EAST & NORTH-WEST ELEVATIONS

Adjustable shading is recommended for these elevations as they receive a combination of high and low angle sun throughout the day. Typical responses for northern and eastern or western elevations need to be integrated. Select systems which allow the user to exclude all sun in summer, choose full sun in winter, and manipulate sun levels at other times.

CLIMATE SPECIFIC RESPONSES

Hot humid climates and Hot dry climates with warm winters: Shade the building and outdoor living spaces throughout the year.

All other climates: Use appropriate passive solar design principles. [See: Passive Design Introduction; Passive Solar Heating; Passive Cooling]

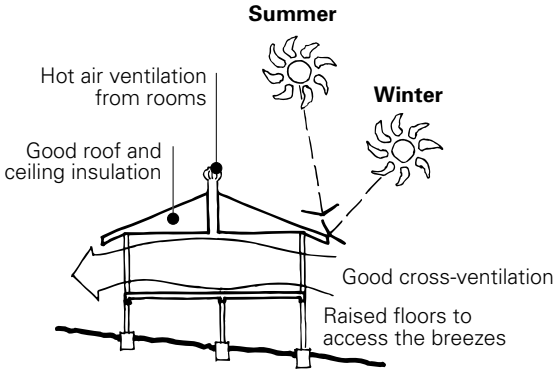


HOT HUMID CLIMATES

Shade all external openings and walls including those facing south.

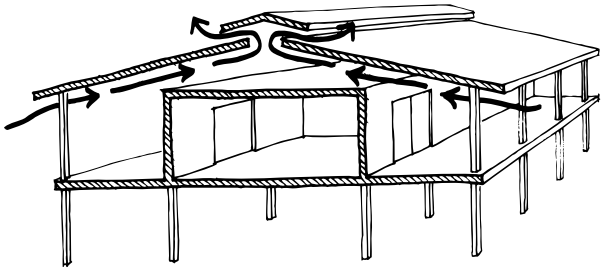
Use covered outdoor living areas such as verandahs and deep balconies to shade and cool incoming air.

Use shaded skylights to compensate for any resultant loss of natural daylight.



Choose and position landscape to provide adequate shade without blocking access to cooling breezes.

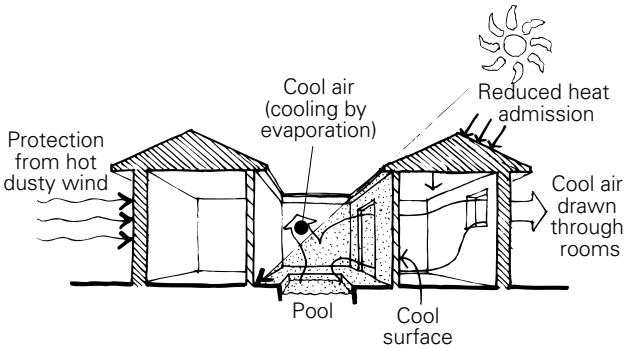
Use planting instead of paving, to reduce ground temperature and the amount of reflected heat.



A 'fly roof' can be used to shade the entire building. It protects the core building from radiant heat and allows cooling breezes to flow beneath it

HOT DRY CLIMATES

Shade all external openings in regions where no winter heating is required.



Provide passive solar shading to north facing openings in regions where winter heating is required. Avoid shading any portion of the glass in winter- use upward raked eaves to allow full winter solar access, or increase the distance between the window head and the underside of the eave.

Use adjustable shade screens or deep overhangs (or a combination of both) to the east and west. Deep covered balconies or verandahs shade and cool incoming air and provide pleasant outdoor living space.

Place a shaded courtyard next to the main living areas to act as a cool air well. Tall, narrow, generously planted courtyards are the most effective when positioned so that they are shaded by the house.

Use planting instead of paving, to reduce ground temperature and the amount of reflected heat.

WARM HUMID AND TEMPERATE CLIMATES

Provide passive solar shading to all north facing openings, using shade structures or correctly sized eaves

Use adjustable shade screens or deep overhangs to the east and west. Adjustable shade screens are the most effective at excluding low angle sun.

COOL TEMPERATE CLIMATES

Do not place deep covered balconies to the north as they will obstruct winter sun. Balconies to the east or west can also obstruct winter sun to a lesser extent

Avoid shading any portion of the north facing glass in winter - use upward raked eaves to allow full winter solar access, or increase the distance between the window head and the underside of the eave.

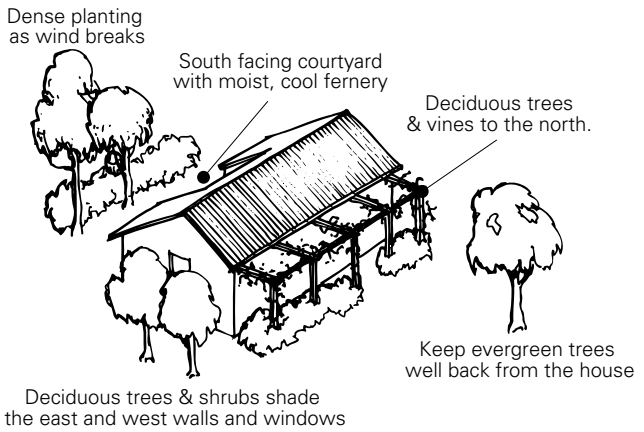
Use deciduous planting to the east and west. Avoid planting to the north which obstructs solar access.

shading

USING PLANTS FOR SHADING

Match plant characteristics (such as foliage density, canopy height and spread) to shading requirements. Choose local native species with low water requirements wherever possible.

In addition to providing shade, plants can assist cooling by transpiration. Plants also enhance the visual environment and create pleasant filtered light. [See: Sustainable Landscape]



Deciduous plants allow winter sun through and exclude summer sun.

Trees with high canopies are useful for shading roofs and large portions of the building structure.

Shrubs are appropriate for more localised shading of windows.

Wall vines and ground cover insulate against summer heat and reduce reflected radiation.

SHADING AND DAYLIGHT

Choose shading methods that allow adequate amounts of daylight into the building while preventing unwanted heat gain.

Select plants that allow filtered light into the building. [See: Sustainable Landscape]

Design glazing to admit maximum light for minimum heat gain. Clear sections in verandah roofs can be useful. [See: Glazing Overview]

Light coloured external surfaces or shading devices reflect more light into the building. Depending on the situation this can be beneficial, or it can create unwanted glare.

SHADING FOR A HEALTHIER ENVIRONMENT

Appropriate shading practices reduce the chance of exposure to harmful UV rays. Planting is a low cost, low energy provider of shade that improves air quality by filtering pollutants.

ADDITIONAL KEY REFERENCES

Energy Efficient Building Design Resource Book
Brisbane Institute of TAFE Unit 5 Windows & Shading

Energy Efficient Housing Manual, Energy Victoria
Plant selection guidelines for shading (vic) p106-111
Calculating the size of north facing shading devices (vic) p34-36

BDP Environment Design Guide, RAIA
Space Cooling GEN 18-19 p4
Landscape for Shade and Cooling DES 9 p3
The Shade Audit DES 32
Retrofitting residential buildings to reduce greenhouse gas emissions, DES 38 parts 2 & 4

AMCORD, Commonwealth Department of Housing & Regional Development
Site planning & building design, parts 5.4, 5.7, 5.10

Warm House, Cool House, Hollo, N
Shading of glazing p.24-27

Geoscience Australia Website
www.agso.gov.au/nmd/geodesy/astro

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