Design for climate

This fact sheet provides a quick reference guide to the main climatic zones in Australia. Key passive design responses for each climate are given below.

This is a simplified overview only and should be used as an introduction to the more detailed and specific information presented in subsequent fact sheets.

An explanation of the conditions required for human thermal comfort and how our bodies achieve it is included at the end of the sheet.

This essential information will guide you in choosing the passive design features most appropriate for your needs, site and climate.

HOW TO USE THIS FACT SHEET

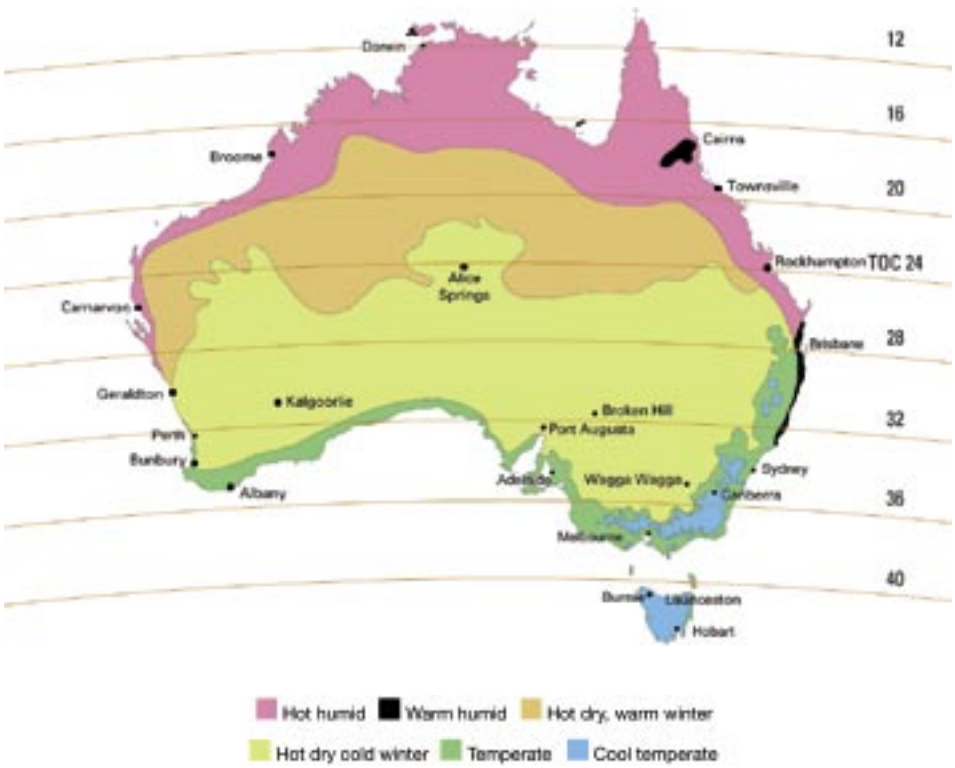
Choose the climate zone for your site from the map above and refer to the appropriate section below for an overview of the climate and how to respond to it in passive design terms.

There are many definitions of Australian climate zones. The zones used in this guide are defined by the Bureau of Meteorology. Common alternative names are listed in brackets.

Use this overview, and the highlighted references to other fact sheets to access more detailed information as you proceed through the various stages of designing, purchasing or altering your home.

AUSTRALIAN CLIMATIC ZONES

Australia's broad range of climatic conditions has been grouped into six categories, for simplicity. The main characteristics affecting envelope design for human comfort have been listed for each category along with key responses.



Australian Bureau of Meteorology

HOT HUMID (TROPICAL)

Main characteristics:

High humidity with a degree of "dry season".

High temperatures year round.

Minimum seasonal temperature variation.

Lowest diurnal (day/night) temperature range.

Key design responses:

Employ lightweight (low mass) construction.

Maximise external wall areas (plans with one room depth are ideal) to encourage movement of breezes through the building (cross ventilation). [See: Passive Cooling]

Site for exposure to breezes and shading all year. [See: Orientation]

Shade whole building summer & winter (consider using a fly roof). [See: Shading]

Use reflective insulation & vapour barriers. [See: Insulation]

Ventilate roof spaces.

Use bulk insulation if mechanically cooling. [See: Passive Cooling]

Choose light coloured roof and wall materials.

Elevate building to permit airflow beneath floors.

Consider high or raked ceilings.

Provide screened, shaded outdoor living areas.

Consider creating sleepout spaces.

Design and build for cyclonic conditions.

WARM HUMID (SUB TROPICAL)

Main characteristics:

High humidity with a definite “dry season”.

Hot to very hot summers with mild winters.

Distinct summer/winter seasons.

Moderate to low diurnal (day/night) temperature range. This can vary significantly between regions e.g. inland to coastal.

Key design responses:

Use lightweight construction where diurnal (day/night) temperature range is low and include thermal mass where diurnal range is significant. [See: Thermal Mass]

Maximise external wall areas (plans ideally one room deep) to encourage movement of breezes through the building (cross ventilation). [See: Passive Cooling]

Site for exposure to breezes. [See: Orientation]

Shade whole building where possible in summer. [See: Shading]

Allow passive solar access in winter months only.

Shade all east & west walls & glass year round.

Avoid auxiliary heating as it is unnecessary with good design.

Use reflective and bulk insulation (especially if the house is air-conditioned) and vapour barriers. [See: Insulation Overview]

Use Elevated construction with enclosed floor space, where exposed to breezes.

Choose light coloured roof and wall materials

Provide screened and shaded outdoor living.

HOT DRY, WARM WINTER

Main characteristics:

Distinct wet and dry seasons.

Low rainfall and low humidity.

No extreme cold but can be cool in winter.

Hot to very hot summers common.

Significant diurnal (day/night) range.

Key design responses:

Use passive solar design with insulated thermal mass. [See: Thermal Mass]

Maximise cross ventilation. [See: Passive Cooling]

Consider convective (stack) ventilation, which vents rising hot air while drawing in cooler air.

Site home for solar access and exposure to cooling breezes. [See: Orientation]

Shade all east & west glass in summer. [See: Shading]

Install reflective insulation to keep out heat in summer. [See: Insulation Overview]

Use bulk insulation in ceilings and walls.

Build screened, shaded summer outdoor living areas that allow winter sun penetration.

Use garden ponds and water features to provide evaporative cooling.

HOT DRY, COLD WINTER (HOT ARID)

Main characteristics:

Low humidity year round.

High diurnal (day/night) temperature range.

At least two (usually four) distinct seasons.

Low rainfall.

Very hot summers common.

Cold winters.

Hot, dry winds in summer.

Cool to cold dry winds in winter.

Key design responses:

Use passive solar principles with well insulated thermal mass. [See: Thermal Mass; Passive Solar Heating]

Maximise night time cooling in summer. [See: Passive Cooling]

Consider convective (stack) ventilation, which vents rising hot air while drawing in cooler air.

Build more compact shaped buildings with good cross ventilation for summer.

Maximise solar access, exposure to cooling breezes or cool air drainage, and protection from strong winter (cold) and summer (dusty) winds. [See: Orientation]

Shade all east & west glass in summer. [See: Shading]

Provide shaded outdoor living areas.

Consider adjustable shading to control solar access.

Auxiliary heating may be required in extreme climates. Use renewable energy sources. [See: Renewable Electricity Overview]

Use evaporative cooling if required.

Avoid air-conditioning. [See: Heating and Cooling]

Use reflective insulation for effective summer and winter application. [See: Insulation Overview]

Use bulk insulation for ceilings, walls and exposed floors.

Use garden ponds and water features in shaded outdoor courtyards to provide evaporative cooling.

Draught seal thoroughly. Use airlocks to entries.

TEMPERATE (WARM TEMPERATE)

Main characteristics:

Low diurnal (day/night) temperature range near coast to high diurnal range inland.

Four distinct seasons. Summer and winter can exceed human comfort range. Spring and autumn are ideal for human comfort.

Mild to cool winters with low humidity.

Hot to very hot summers with moderate humidity.

Key design responses:

Use passive solar principles. [See: Passive Solar Heating; Passive Cooling]

High thermal mass solutions are recommended. [See: Thermal Mass]

Use high insulation levels, especially to thermal mass. [See: Insulation Overview]

Maximise north facing walls & glazing, especially in living areas with passive solar access. [See: Orientation]

Minimise all east & west glazing.
Use adjustable shading. [See: Shading]

Use heavy drapes with sealed pelmets to insulate windows.

Minimise external wall areas (especially E & W).

Use cross ventilation & passive cooling in summer. [See: Passive Cooling]

Encourage convective ventilation and heat circulation.

Site new homes for solar access, exposure to cooling breezes and protection from cold winds.

Draught seal thoroughly and use entry airlocks.

No auxiliary heating or cooling is required in these climates with good design.

Use reflective insulation to keep out summer heat.

Use bulk insulation to keep heat in during winter. Bulk insulate walls, ceilings and exposed floors.

COOL TEMPERATE (INCLUDES COLD-ALPINE)

Main characteristics:

Low humidity.

High diurnal range.

Four distinct seasons. Summer and winter exceed human comfort range

Cold to very cold winters with majority of rainfall.

Hot dry summers.

Variable spring and autumn conditions.

Key Design Responses

Use passive solar principles. [See: Passive Solar Heating]

High thermal mass is strongly recommended. [See: Thermal Mass]

Insulate thermal mass including slab edges. [See: Insulation Overview]

Maximise north facing walls & glazing, especially in living areas with passive solar access.

Minimise east & west glazing.

Use adjustable shading. [See: Shading]

Minimise south facing glazing.

Use double glazing, insulating frames and/or heavy drapes with sealed pelmets to insulate glass in winter.

Minimise external wall areas (especially E & W).

Use cross ventilation & night time cooling in summer. [See: Passive Cooling]

Encourage convective ventilation & heat circulation.

Site new homes for solar access, exposure to cooling breezes and protection from cold winds. [See: Orientation]

Draught seal thoroughly and provide airlocks to entries

Install auxiliary heating in extreme climates. Use renewable energy sources. [See: Heating and Cooling; Renewable Electricity Overview]

Use reflective insulation to keep out heat in summer.

Use bulk insulation to keep heat in during winter. Bulk insulate walls, ceilings and exposed floors.

REMEMBER: transitions between climate zones are gradual. Every site will have specific micro-climate variations and these should have a significant impact on any design.

BUILDING ENVELOPE ENERGY RATING

Energy rating tools are computer programs that model the amount of heating and cooling energy required to maintain comfortable temperatures in a building. They take into account climate, season and envelope design. [See Rating Tools; First Rate].

A building envelope rating only reveals the energy performance of a building's design and fabric. It does not measure other areas of energy consumption (e.g. appliance efficiency transport and embodied energy.

In warmer climates, these variables can account for more energy consumption during the lifespan of your home than the performance of the envelope. [See: Transport; Energy Use; Embodied Energy]

CLIMATE SENSITIVE DESIGN

The importance of climate sensitive design can not be overrated.

All round shading is appropriate for tropical climates only. This style does not work in warm, cool or cold climates.

Eaveless cold climate designs (borrowed from Europe) do not work in Australia.

Many homes are built without eaves to save as little as $2,500. Builders may then add an air conditioner to counteract the overheating effects of the sun. This environmental burden can easily be avoided.

Homeowners pay hundreds of dollars more than they need to each year in heating and/or cooling bills because they are not taking advantage of free heating and cooling from passive design.

HUMAN THERMAL COMFORT

The main factors influencing human comfort are:

> Temperature.

> Humidity.

> Air movement (breeze or draught).

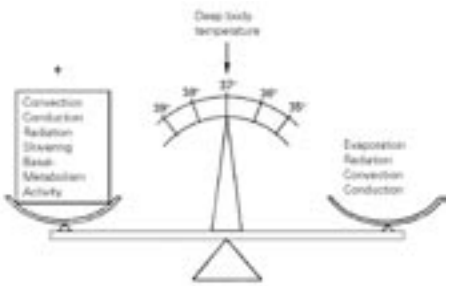
> Exposure to radiant heat sources.

> Cool surfaces to radiate to for cooling.

Sound building envelope design will moderate all of these factors except humidity.

To do this effectively, envelope design must be varied to suit the climate. It can significantly improve comfort levels whilst reducing heating and cooling bills.

Humans are comfortable only within a very narrow range of conditions. Human body temperature must remain at a constant 36.9ºC. The body generates heat – even while at rest. We must lose heat at the same rate as it is produced or gain heat at the same rate it is lost. The diagram below shows the various ways by which our bodies achieve this.



Steve Szokolay

Losing body heat

We mainly lose heat through the evaporation of perspiration. High humidity levels reduce evaporation rates. When relative humidity exceeds 60%, our ability to cool is greatly reduced.

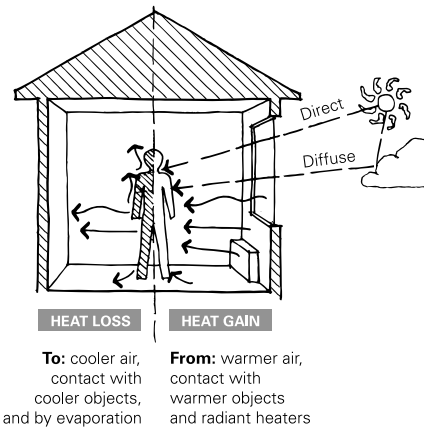
Evaporation rates are also influenced by air movement. Generally, a breeze of 0.5 metres per second provides a one off comfort benefit equivalent to a 3ºC temperature reduction.

We also lose heat by radiating to surfaces cooler than our body temperature. The greater the temperature difference, the more we radiate. Whilst not our main means of losing heat, radiation rates are very important to our perception of comfort.

Gaining body heat

When the heat produced by our bodies is insufficient to maintain body temperature, we insulate by putting on more clothes, shelter from wind and draughts, or shiver (increasing the production of body heat).

This is because we generate most of the heat required from within. A secondary source of heat gain is radiation. As with cooling, radiation is very important to our perception of comfort.



ADDITIONAL KEY REFERENCES

Manual of Tropical Housing and Building Design, Koenigsberger, O. 1974; Longman Group United Kingdom.

Principal Author:
Chris Reardon