3 Everybody wants to be comfortable

Everybody dreams of a winter holiday on a tropical island, and a summer holiday under shady trees at the beach or beside a lake. We can bring our tropical paradise closer to home by taking notice of the micro-climate of our chosen location and learning about good climatic design.

THE SECRET OF RESIDENTIAL COMFORT

Nobody wants to be too hot, too cold, sit in a draft, sweat it out in high humidity, or live in a damp musty environment. When it comes to residential comfort you have to take notice of more than just the design of the house. Not all places on earth are equally comfortable, and even in the same town or suburb, some localities are blessed with a better micro-climate.

There are three major factors that combine to determine your residential comfort. They are:

- The climatic zone in which you live.
- The micro-climate surrounding your immediate residence.
- Whether the design of your house or unit makes climatic sense.

To achieve a high degree of bodily comfort your home, or unit, must be well-adapted to the basic climate, and to the locality's specific micro-climate. Unfortunately many Australian houses, town-houses, and units, have not been designed with these factors in mind. The result, in some cases, is a climatic disaster, with overheated rooms in summer having large, unshaded windows facing west, houses that receive little or no sun in winter, and others that are wind traps for every chilling breeze. There is often little the residents can do to improve things.

It is both frustrating, and unnecessary. With a little observation of local micro-climate, a knowledge of the basic conditions of your climatic zone, and application of some simple design rules, you can avoid the mistakes our ancestors made. You can even go one better, by building or choosing for yourself, housing which enhances your body's comfort and makes your friends envious of how cool your house is in summer, how warm in winter, all without air conditioning or overly expensive heating.

The secret of residential comfort is sound climatic design, and attention to your local micro-climate.

RESIDENTIAL CLIMATIC ZONES

Your neighbourhood's micro-climate is governed by the larger forces of your climatic zone. For most Australians there are only four zones: coastal tropics, coastal south, highlands and interior.

That doesn't really cover all the climatic variations in this continent, but it does cover the zones where most of us live, or want to live. Not many opt permanently for the desert or Snowy Mountains.

Coastal tropics have the special problem of having too much humidity and too much sun in summer. The basic air temperature is often quite pleasant, if only we can keep the direct sun out, and have sufficient air movement flowing across our bodies to carry off our excess body heat.

Coastal south covers a surprising geographic range from Brisbane down the coast to Sydney and Melbourne, west to Adelaide and Perth, and south to Hobart. The major characteristic is the tempering effect of proximity to the sea.

Air temperatures are generally pleasant in summer though it can often get hot in the afternoon sun. Winters are mild by other people's standards elsewhere in the world. But we must design for winter as well. The challenge is to defeat the afternoon summer heat, the winter chills and the storms.

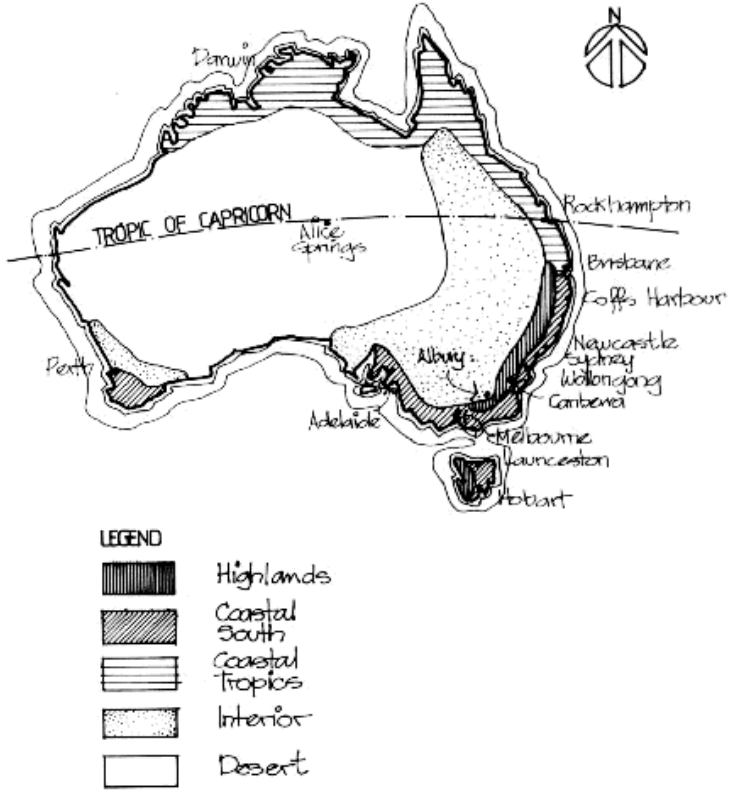
Highlands, any areas above 500 metres and south of Toowoornba, are known for their winter frosts, occasional snow, and cold winter winds. All of which means we should be designing houses as glass-walled caves. Glass to the north for the winter sun, and well insulated walls to the south protecting us from the prevailing winter winds.

Interior is a loose term for inland towns, generally at less than 500 metres altitude, well away from coastal influences but not directly affected by desert conditions. These areas are subject to a month or two of frosty winter nights, chill winter winds, low winter humidity, and warm to hot summers. It excludes the desert and tropical inland towns. The typical interior city climate is Albury, where a milder version of the glassed-in cave is still appropriate.

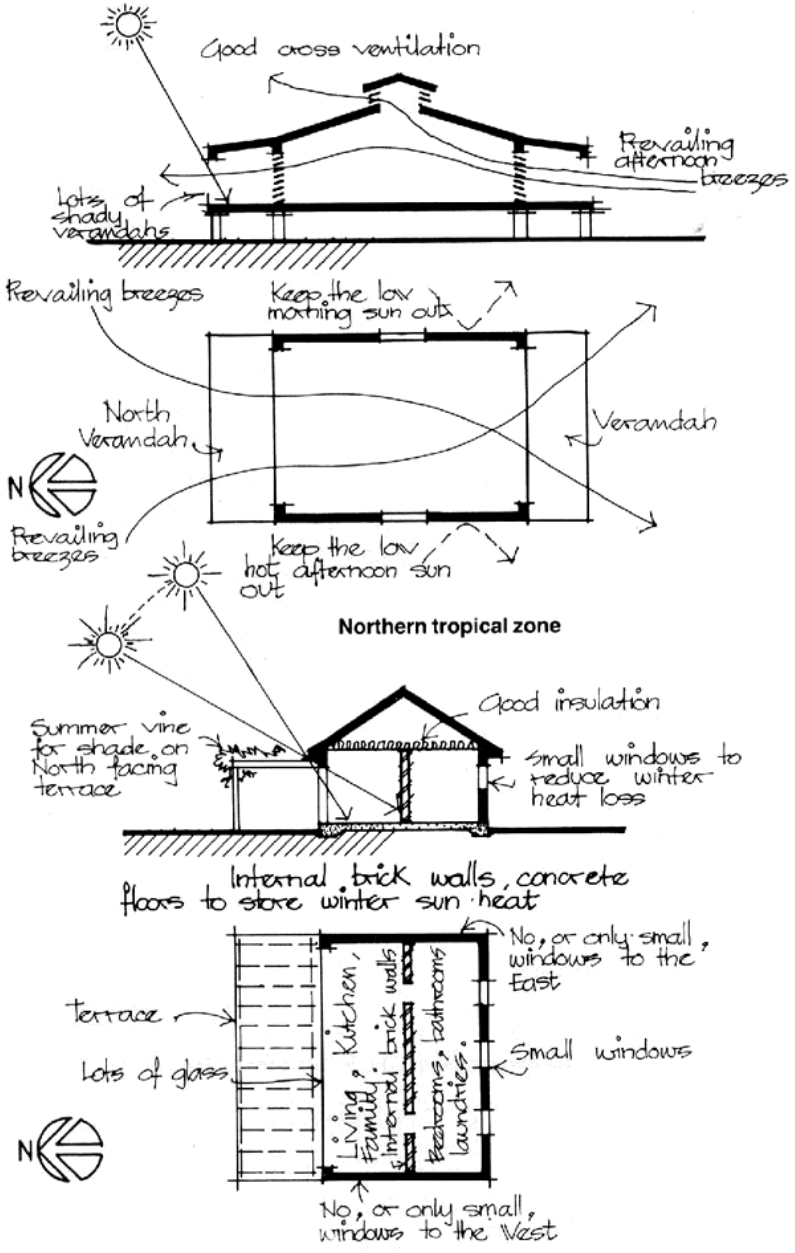
CLIMATIC ZONES AND GOOD BUILDING DESIGN

Learning to recognise building forms that make good climatic sense is really quite simple.

In the northern tropic coastal zone it means lots of wide eaves, wide verandahs, sun shades over windows, few windows facing east or west to keep the low-angle hot morning and afternoon sun from



Australian residential climatic zones


Good cross ventilation
Prevailing afternoon breezes
Lots of shady verandahs
Prevailing breezes
Keep the low morning sun out
North Verandah
Verandah
N
Prevailing breezes
Keep the low hot afternoon sun out
Northern tropical zone
Summer vine for shade on North facing terrace
Good insulation
Small windows to reduce winter heat loss
Internal brick walls, concrete floors to store winter sun heat
No, or only small, windows to the East
Terrace
Lots of glass
Living, Family, Kitchen, Internal brick walls
Bedrooms, bathrooms, laundries.
Small windows
N
No, or only small, windows to the West
South coastal, highland and interior zones
(not desert or tropical interior)

penetrating deep into rooms, and of course, lots of ways of getting cross-ventilation that takes advantage of the afternoon breezes in summer to blow the heat out of the house.

In the southern coastal highland and interior zones it means having the living room, kitchen and family rooms facing as close to true north as possible, virtually no windows in the east or west walls to keep out hot low-angle sun, and small windows on the south side, so that the chill winter winds can't suck heat out. It also means having lots of glass facing north for the living, kitchen and family rooms, with eaves of about 900 mm or so, to let in lots of winter sun, and keep out the summer sun. Cross-ventilation is important in summer, but absolutely lousy in winter if it produces cold drafts. Heavy pelmeted curtains are needed for the winter.

These rules apply in general to all types of housing, including apartment towers, home units, terraces, townhouses, villa homes and suburban houses.

THERMAL MASS—NATURE'S WAY OF HEATING AND COOLING

Thermal mass is the name given to the means of providing natural heating and airconditioning. Dense materials such as brick, concrete, ceramic tiles and slate, have a delightful capacity to store lots of heat.

Build the interior walls and floors of these materials, and they will happily store the winter sun's heat coming through those large north-facing windows in the living, kitchen and family rooms. Close the thick curtains at night after a sunny winter day, and you have a natural radiator giving you free heat for several hours into the night.

In the summer they act like a refrigerator, storing the heat of the summer air and keeping the house cool during the day. However, at night, get the breezes blowing through the house, or turn on a big exhaust fan to draw air over the floor and walls to extract the heat. Otherwise you will sweat it out in bed as the brick walls and concrete floors radiate their stored heat.

Thermal mass, all those good old interior brick walls and tiled concrete floors are exactly what you want in the southern coastal, highland and interior zones, but the exact opposite of what is right for the northern coastal zone.

In the north, bricks and concrete have a hard time ever cooling off. They tend to go on storing and radiating all the heat exactly when you want to get rid of it. So look for lightweight timber or steel construction.

In the hot interior deserts you need a mixture of construction. Thick walls and floors to keep it cool during the day, and lightweight construction in the bedroom areas to stay cooler while sleeping.

A CHECKLIST FOR SPOTTING GOOD CLIMATIC RESIDENTIAL DESIGN

NORTHERN COASTAL ZONE

- Lightweight building materials
- Wide eaves and verandahs
- Few windows that get northeast mid-morning and northwest mid-afternoon sun
- Lots of good cross-ventilation for afternoon breezes

SOUTHERN COASTAL, HIGHLAND AND INTERIOR ZONES

- Interior brick walls, concrete floors with ceramic or slate covering in living, kitchen and family room
- All living, kitchen and family rooms facing north with lots of windows to let in deep winter sun
- North-facing eaves should be no wider in the following locations than:

Coffs Harbour, Brisbane	700 mm
Newcastle, Perth, Sydney	900 mm
Canberra, Wollongong, Adelaide	900 mm
Melbourne	1100 mm
Launceston, Hobart	1400 mm

- Small or no windows facing east or west
- Small windows facing south
- A wide terrace or deck on the north
- Good cross-ventilation for summer, and no drafts for winter

UNDERSTANDING MICRO-CLIMATE

Micro-climate is shaped by:

- Latitude
- Distance from the sea
- Altitude
- Prevailing winds
- Hills, winds and solar orientation
- Trees, gullies, dampness and shade

These combine to produce the weather that over the four seasons becomes your residential micro-climate. Sometimes a distance of 500 or 1000 metres can change residential micro-climate and comfort dramatically.

Living on top of a hill exposes you to the summer breezes as well as the full force of the winter gales. Living on the north side of a hill can be very different to living on the south side, especially in winter. Living under shady trees in summer is great, but unless they lose their leaves in autumn, they also block the winter sun. Living in a gully lets you grow great ferns and also makes good conditions for mould and damp.

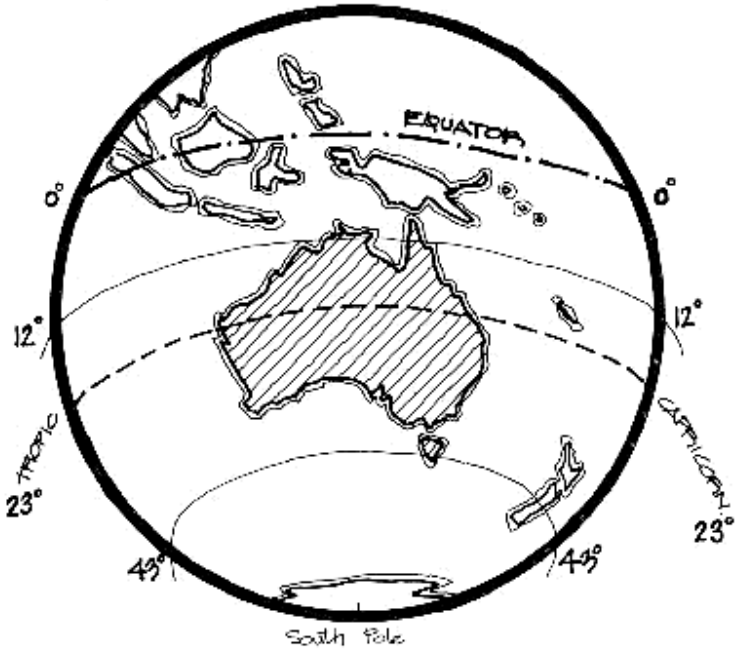
To understand your chosen location's micro-climate you need to observe the effects of:

Latitude which measures the distance of your spot on earth from the equator is the first indicator of how hot or cold it will become, and how low the sun drops in the sky in winter. This last fact is important for it determines the depth of sun penetration into your house, and the length of shadows cast by trees and other buildings.

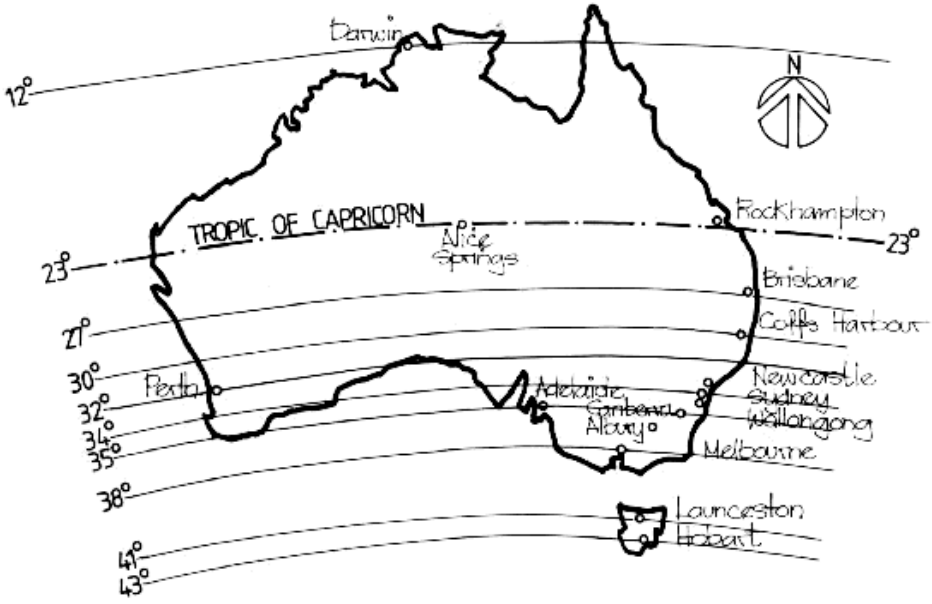
Typical latitudes, temperatures and sun angles

Location	Latitude	Temperature		Midday angle of sun above horizon	
		Summer Mean Max °C	*Winter* Mean Min °C	Mid-Summer	Mid-Winter
Darwin	12° 27’	31.8	20.9	79°	54°
Rockhampton	23° 22’	31.3	10.0	90°	43°
Alice Springs	23° 42’	35.6	5.1	90°	43°
Brisbane	27° 28’	29.1	10.2	86°	39°
Coffs Harbour	30° 18’	26.5	7.8	83°	36°
Perth	31° 57’	29.7	9.8	81°	35°
Newcastle	32° 56’	27.3	8.2	81°	34°
Sydney	33° 53’	25.5	8.6	80°	33°
Wollongong	34° 26’	25.5	8.8	79°	32°
Adelaide	34° 56’	28.8	7.7	79°	32°
Canberra	35° 17’	26.9	-0.5	78°	31°
Albury	36° 05’	30.8	2.7	77°	30°
Melbourne	37° 49’	25.4	6.9	76°	29°
Launceston	41° 27’	22.5	2.7	72°	25°
Hobart	42° 53’	21.2	5.0	71°	24°

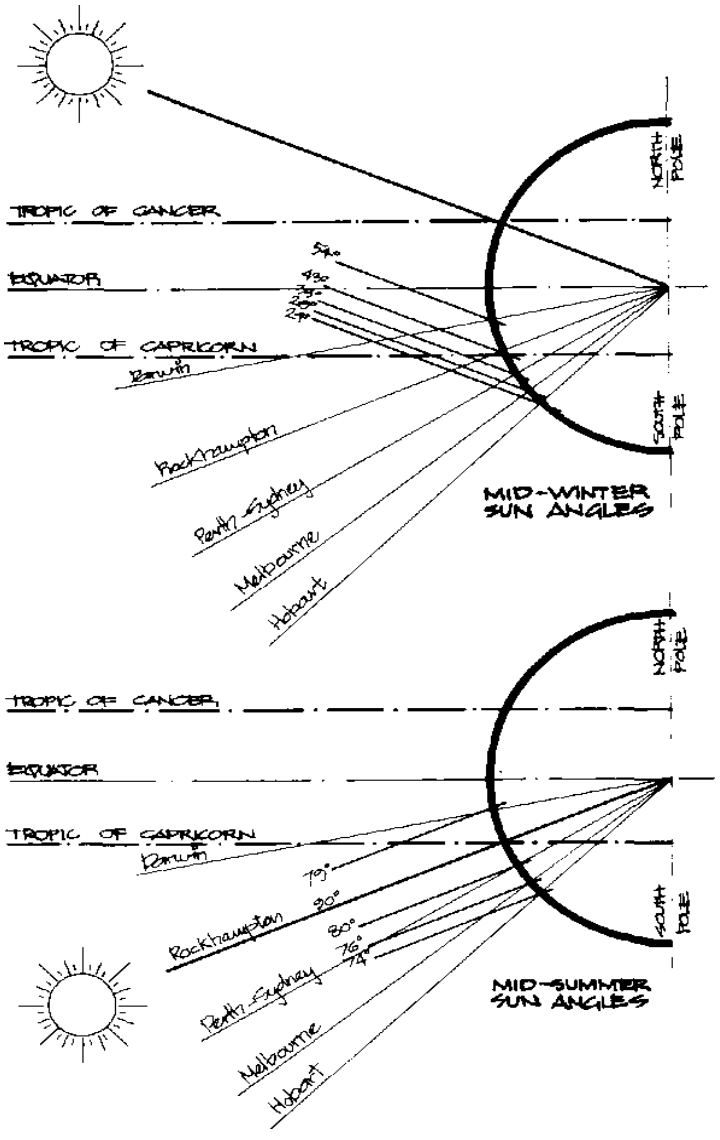
Distance from the sea is important because of the moderating effect the ocean has on highs and lows of temperature, and for the effect of cooling sea breezes in summer. It is no accident that most Australians have chosen to live in coastal towns and cities. The local climate is always milder by the sea. Of course, right by the sea it is also more humid. This may be a factor to take into account if humidity is a health problem.



Australia and world latitudes



Latitudes of Australian cities



Changes in the midday angle of the sun above the horizon
— mid-winter to mid-summer

Within the local region, distances of 10 or 20 km from the coast can mean temperatures 2-7°C higher in summer or lower in winter.

Altitude for most Australians is simply a local factor. Only Canberra, Tarmworth, Armidale, Bathurst, Orange, Alice Springs, the towns of the Blue Mountains, Bendigo and smaller towns on the highlands of the Great Dividing Range, are affected by altitude to the extent that height above sea level reduces the temperature significantly.

However, local altitude is important. Living at the top or bottom of a hill, can affect temperatures by exposing or sheltering you from cooling summer breezes and chilling winter winds. Where frosts occur they can be more severe at the bottom of valleys.

Prevailing winds are often the single most noticeable factor which changes the temperature in a region or locality. Local knowledge is often necessary to be sure of their direction and effect.

All of us like a cooling breeze on a hot summer day and want to stay out of the wind in winter. Sometimes the differences between the residential comfort of one locality when compared to another, can be explained simply by the differences in wind patterns.

Hills, winds and solar orientation combine to shape the prevailing temperatures set by latitude, altitude and distance from the sea. The shape, slope and orientation of hills not only directs the flow of the wind into streams of channelled air, but also make for hotter or cooler ground.

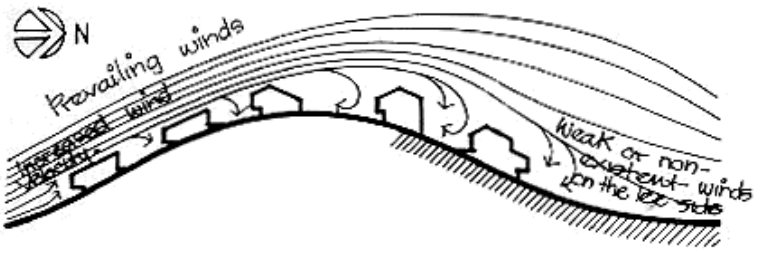
A hill running at right angles to the direction of a prevailing wind will intensify its effects on the windward side especially near the crest, and decrease, if not eliminate, its effects on the lee.

A hill which is located in the south of Australia, which runs east and west and has a slope of 25°, will receive almost maximum solar winter radiation on its north face, and nearly no solar radiation on its south face. Frost on the south slope will last long into the morning.

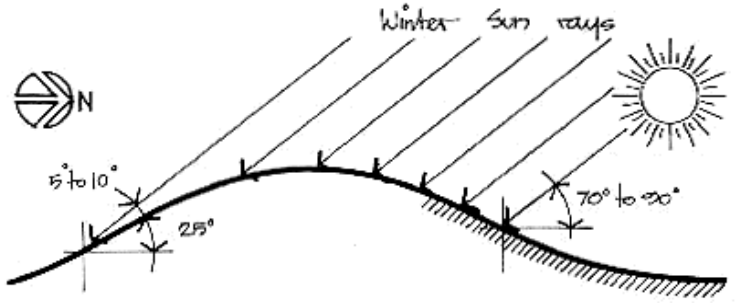
Combine these south-side effects and the result can be frigid winters and delightfully cool summers. It suits some while others would hate it.

Trees, gullies, dampness and shade Trees can often modify temperatures by up to 5-6°C and can noticeably reduce the velocity of winds, changing a gale at treetop level to a breeze around the roots.

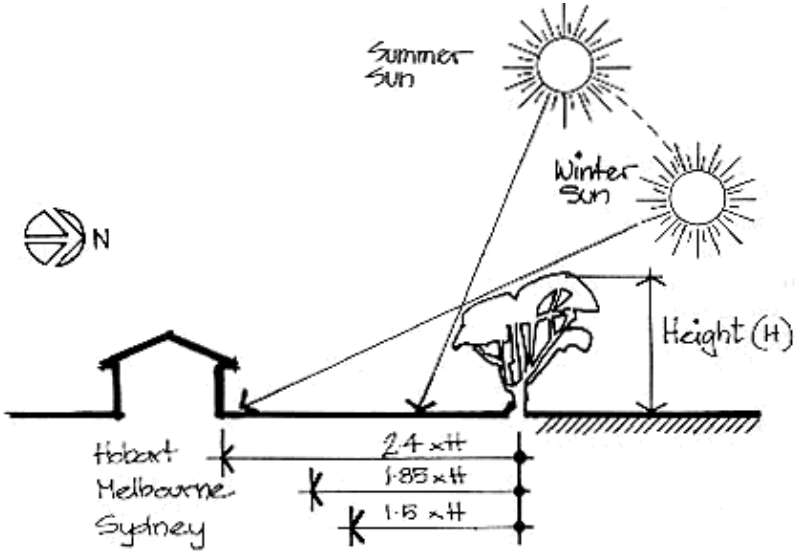
Trees in the south of Australia also cast long winter shadows. These may have a length up to $1^1/2$-2 times their height. It can have a critical affect on penetration of



Hills and Wind Effects



Hills and Solar Radiation



Trees and Winter Shadows

winter sun into your house or flat.

Gullies are great for growing ferns, but can also be a cause of local spots of humidity, especially if surrounding hills are steep. Add some large trees and it becomes a great summer spot and chill winter home, with excellent conditions for growing mould, mosses, lichen, snails and slugs.

HOW TO CHECK IT OUT

SUMMER-WINTER TEMPERATURES AND WINDS

Contact the local office of the Weather Bureau, and ask them to send you the seasonal temperature ranges, and wind directions and velocities for the weather station nearest to where you want to live.

LOCAL KNOWLEDGE

Talk with local people who have lived in the area for a long time, or people who have a special interest in the weather, such as fishermen, sailors, managers of marinas, forestry people, surf-lifesaving clubs, farmers, graziers, gliding clubs, flying clubs, even lighthouse keepers.

Ask them about temperature extremes, how often they occur, frosts, unusual weather, occasional snow, directions and strengths of cold winds or gales, where the cool summer breezes come from, when the heavy torrential rain arrives, and anything else that's unusual or special about the local weather in any season. Check how temperatures vary across the neighbourhood, and which areas get the worst winds or most flooding.

Take lots of notes, so you can make comparisons when you drive around.

Talk to more than one person. Local knowledge is often subjective. Compare local reports with the weather bureau's information. Do they agree, if not, check out why.

GET A COMPASS

Surprisingly, a simple child's compass can revolutionise your choice of where to live, and the choice or design of your house.

Knowing in which direction to find north, east, west and south is one of the most important skills anyone can have in choosing where to live. Why? Simply because the sun shines from the north and except in the tropics, we always want sun in our living rooms, kitchen and family rooms in spring, winter and autumn. Also, we need to know where the cool summer breezes and cold winter winds come from. If they blow from the north-east and south-west, we need to know those directions as we look around a neighbourhood.

Buy a compass and check direction as you drive around. Regularly check where north is, where the winds are blowing from and in which direction the streets

run. Is it east-west, north-south or some other angle? In which direction do the ridges of hills run? Will they deflect the wind, or channel it?

All of these can only be really understood when you can quickly find north, east, south and west. A compass does it for you.

SHADOWS

They help on hot summer days and hinder in winter. Will the trees cast long shadows from the western or eastern sun, or short shadows from the northern sun?

Latitude, as we have seen, is the key to solar shadow angles. Latitude is simply the distance from the equator. At the equator, latitude equals zero, at Darwin, it is about 12.5, Sydney nearly 34, and at Hobart, just about 43. The further south you go, the higher the latitude number and the lower the angle of the sun in the sky in both winter and summer. It matters most in winter.

The sun's movement makes it a bit difficult to understand how shadows change length. The sun's path is a curve across the sky. Rising in the east in the morning, it immediately heads north in a curve, hits a midday high in the sky in summer or lower in winter, and then settles into a soft curve to set low in the west.

This curved path across the sky results in longer shadows in the midmorning and midafternoon than at midday regardless of the season. If there are trees or buildings to the north-east or north-west they will cast longer shadows than if located towards the north. This is especially so in winter when the sun is lowest in the sky.

If your windows face north-east or north-west, you will also receive deeper sun penetration into those rooms than if they face north. This is great in winter and not so good in summer. Of course, if your windows face south, you'll be in shade almost all the time.

TO SUM UP, FOUR EASY STEPS

1 Find out the latitude of your town or city, it decides your basic temperature and sets your sun angles.
2 Get the Weather Bureau's nearest report and compare it with what the local's say.
3 Buy a compass and learn the direction of the sun, winds and hills.
4 Take note of trees, gullies and ridges. Will they shade or protect you?

The best housing adapts the basic designs that are right for your climatic zone to the specific needs of the micro-climate on your land.

If the land is in a gully, missing the cooling summer breezes, the house should he built to encourage natural drafts.

If you live on the south slope of the hill, with views to the south, the design must balance glass to the north for winter sun, against glass to the southerly view avoiding excessive heat loss in winter.

Should you find yourself on a wide plain, exposed to strong hot, and cold westerly winds, the house should wrap itself around a north-facing, wind-sheltering, courtyard.

By combining knowledge of your chosen location's micro-climate with understanding of designs that make good climatic sense you will be better able to choose comfortable housing.

SPECIAL PROBLEMS OF TOWNHOUSES AND UNITS

If you intend to buy a townhouse, villa unit, home unit, apartment or retirement unit there is often very little you can do to improve poor climatic design except aircondition the unit. Such buildings are usually owned corporately, with restrictions on external alterations, and their construction and design makes them difficult to change. It is especially important to take care when choosing such housing, as your chances of significantly improving a poor design are low.

Unless you start from scratch and build a new house, you're probably always going to end up with a compromise on good climatic design. Fortunately, the human body is fairly efficient at adapting, and we can always put on a sweater or switch on the fan, though it would be nice if our townhouses and units were better designed climatically.

When we build for ourselves we will only have ourselves to blame if we build into our designs baking hot summer living rooms and frigid winter family rooms. Starting from scratch, the choice is ours to avoid designing a climatic disaster.