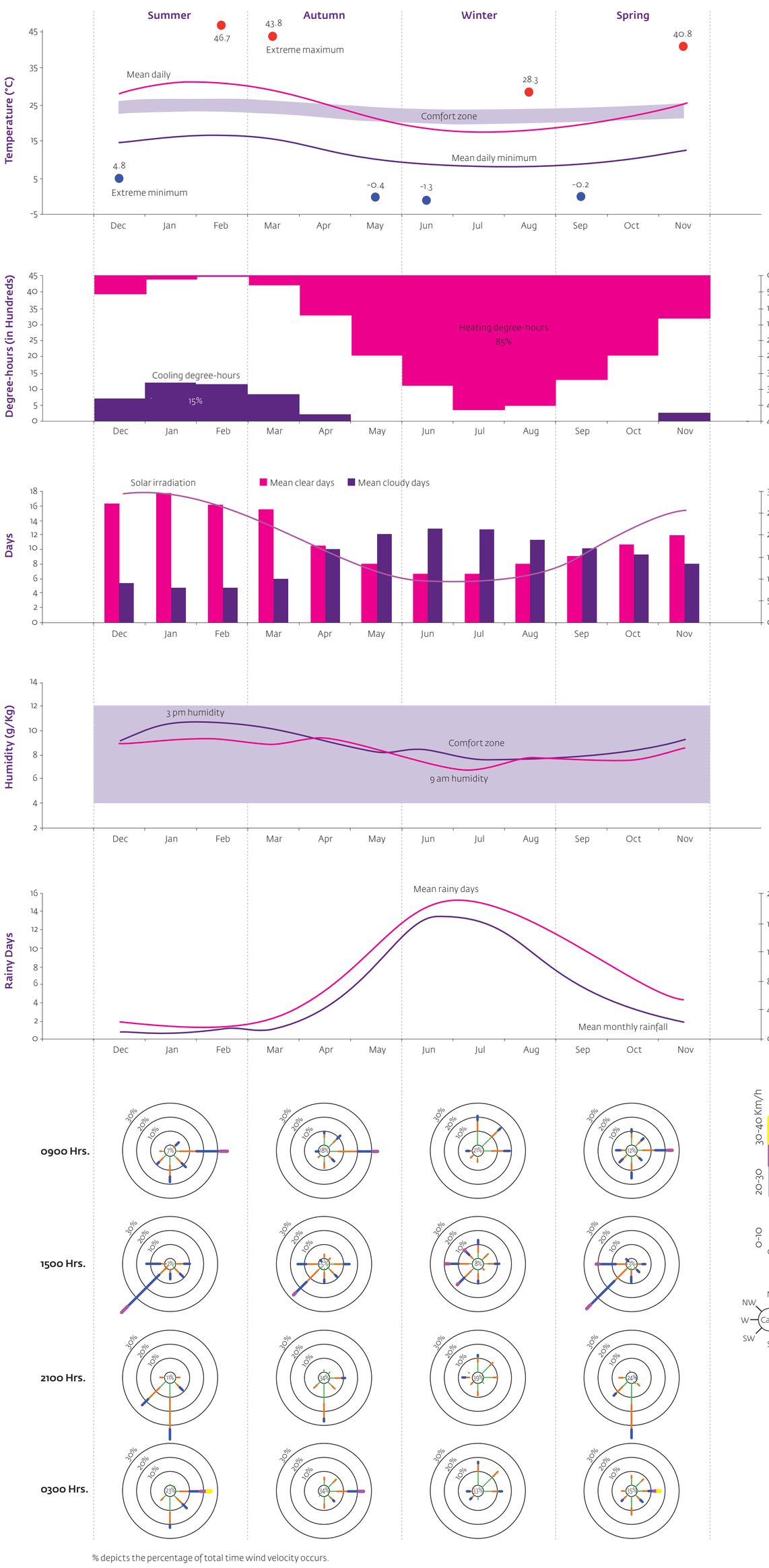
Sustainable design strategies for Perth

Now, more than ever, climate design is a critical element in modern building design. Climate data to date has been poorly presented, too technical or simply not accessible.

To demonstrate industry leadership Think Brick Australia developed the following guide for architects and building designers as an adjunct to an eight year research program of thermal performance of Australian housing, conducted in collaboration with The University of Newcastle. To date the research has demonstrated the critical role clay brick plays as a thermal mass material in sustainable building design.

Clay brick's thermal mass properties, its design versatility, its natural beauty, and lack of VOC's makes it the perfect building material for the future.

In order to formulate practical design strategies for Perth, we analysed 60 years of climate data from the Bureau of Meteorology using tools such as bioclimatic charts and Mahoney tables. Growing recognition and need for this valuable information has resulted in the production of a fully dedicated website where you can access information for 22 locations around Australia. Be sure to register on **www.thinkbrick.com.au** to be kept up to date.

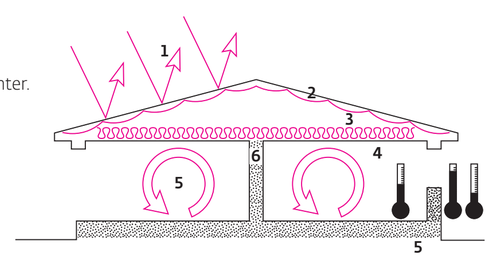


% depicts the percentage of total time wind velocity occurs.

Air temperature

Daily temperature range in Perth is significant. Houses should be well insulated in the walls and roof to promote a stable temperature against heat in summer and cold in winter. Thermal mass on the interior can store "warmth" in winter and "coolth" in summer.

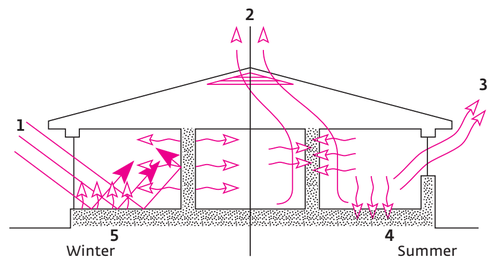
1. Reflective insulation in the roof repels summer heat and sun
2. Roof can be almost any colour and any material if good insulation is used
3. Ceiling insulation keeps winter heat in
4. Roof and wall insulation helps keep a constant internal temperature when air temp is above or below comfort
5. Thermal mass in floors provide warmth and helps stabilise internal temperature at night when air temperature drops down from comfort range.
6. Clay brick as thermal mass in walls provide "coolth"



Heating and cooling degree-hours

This shows the sum of every hour, multiplied by the number of degrees, the outside temperature is above or below the comfort temperature. The house can use design strategies for night time cooling in summer and heat gain in the winter.

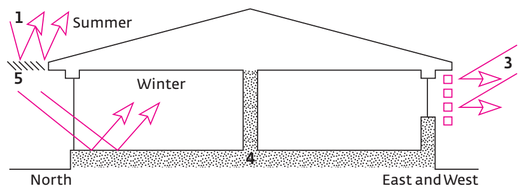
1. Winter sun through north glass absorbed into thermal mass of walls and floor
2. Cross and stack ventilation removes the heat from the thermal mass thus creating "coolth"
3. Night sky radiation removes heat on summer nights creating "coolth"
4. Thermal mass absorbs summer heat during the day
5. Stored heat in thermal mass releases at night



Solar irradiation and sky condition

Summer solar irradiation is high with long clear days requiring good shade to the interior. Hard surfaces around buildings should be limited to reduce reflected radiation in summer months. Clear days in winter offer excellent opportunities for passive heating in north facing living areas.

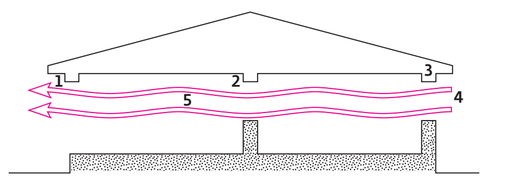
1. High angle summer sun is excluded by wide eaves and properly designed shading devices in north facade
2. Vertical screening is needed on the west and east to combat the intense low angle summer sun
3. Low angle winter sun enters the house to be stored in the thermal mass
4. "Solar pergola" will create more shade and prevent reflected heat off the ground
5. Shaded outdoor living areas are useful in summer months



Humidity

Humidity expressed in g/Kg is known as absolute humidity or humidity ratio. By combining temperature comfort zone with the humidity comfort zone, we will get a complete picture of comfort condition. Humidity levels are well within comfort zone across all seasons. Summer high temperature can be alleviated by house designs with cross ventilation in living and sleeping areas.

1. Larger openings on Leeward side
2. Openings needed in internal walls to allow cross-flow
3. Smaller openings on the Windward side of the house
4. Summer afternoon cooling breezes from the south and south-west
5. Provide clear paths for cross ventilation on opposite (or adjacent) walls of every habitable room



Rainfall

High rainfall for 3 months in winter, but low in summer. Tank sizes should be increased to allow for storage of water during the dry months of summer.

1. Water tanks come in all shapes and sizes and can be above or below ground
2. Gutters need leaf guards and pipes need screens to prevent debris entering the tank
3. Provide pump to use rainwater directly on the garden (or in WC's)
4. Above ground tank
5. Pump with filters can provide potable water (where no tank water is available)
6. Below ground tank

Wind

Diagrams show direction and strength of the wind at 6 hourly intervals for a typical day, for each season. Houses can be cooled by the cooler south west winds on summer afternoons (the "Fremantle Doctor").

1. "Night flushing" removes heat from thermal mass leaving "coolth" for the next day
2. Stack cooling – hot air rises (up stairs, in "cooling chimneys" or in roof vents) to be replaced by cooler night breezes that absorb heat from the thermal mass
3. Thermal mass loses heat to the cross ventilation or stack ventilation, known as "night flushing"
4. Night-time cooling breezes come from south and south east in summer, autumn and spring

Role of thermal mass – when integrated with sound design principles, this form of construction produces thermally comfortable properties – even in temperate climates as the findings above demonstrate. To learn more about our ground-breaking thermal performance research please visit **www.thinkbrick.com.au** or **www.designingforclimate.com.au**

How the house works over the year

The House in Summer

- The house should be well insulated with living areas oriented well and shaded to prevent solar heat gain.
- Orientation of building should aim to provide best possible ventilation in summer months.
- Openings on the east to south west capture breezes throughout summer and should be carefully shaded to avoid unnecessary heating at daytime.
- Provide thermal mass for "coolth" in the house to offset hot summer days with extreme diurnal temperature variation.
- Daytime high temperatures are accompanied by an acceptable level of humidity. Use cross ventilation to cool the house with the afternoon south westerly breezes.
- Thermal mass in the walls (or ceilings) of the house will soak up the daytime heat so it can be "flushed" by the south and east breezes at night, leaving "coolth" for the next day.

The House in Autumn

- Autumn daytime temperatures are above and within the thermal comfort range but the temperature drops late at night so additional heating may be required.
- Daytime comfort can be achieved through effective cross ventilation and openings should be located on the east to south-west to ensure breezes move across the buildings.
- Good shading is needed over north-east and west windows for long periods of the year.
- Good insulation in roof and walls, together with thermal mass, helps stabilise house temperatures and also offset the heating necessity at night time.

The House in Winter

- Living areas should be oriented towards the north east and north. Large openings with overhangs to ensure winter sun can penetrate onto thermal mass inside the house for passive solar gain.
- This ensures the clear sky, sunny conditions of the day can be used to heat the house at night. The large requirement for heating shown in the heating degree hours can be offset in a passive, non-mechanical manner to provide "free" heating for the house.
- Winter months receive highest rainfall so chances of humid conditions are usually high as temperature is low in the mornings. Vapour barrier on warm sides is essential to prevent condensation in winter months.
- Plants and vegetation to the north and west will provide protection from cold winter wind.

The House in Spring

- Mornings are usually cold but afternoon temperatures are within or very close to comfort range.
- Large heating requirements can be met with passive heating techniques by having large openings towards north and thermal mass in walls and roofs.
- Good insulation in roof and walls, together with thermal mass, helps stabilise house temperatures.

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Jade Projects 8 Star House