

# Sustainable Building and Design

10 things you must get right  
(or try to do well!!!)

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# What is environmentally sustainable building???

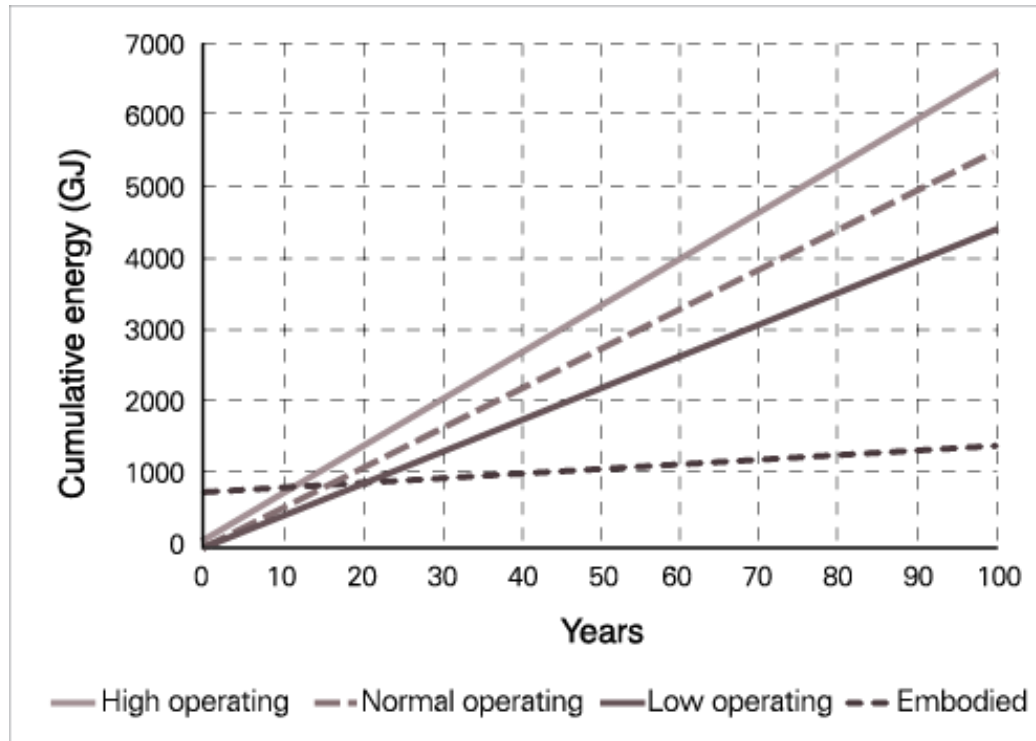
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- Consumer confusion. 'Green washing'
- A building whose manufacture, operation, and demolition has no net deficit of non-renewable natural resources. Very difficult to do!!!
- Building lifecycle:
  - Construction
  - Operation
  - Demolition

# Embodied energy

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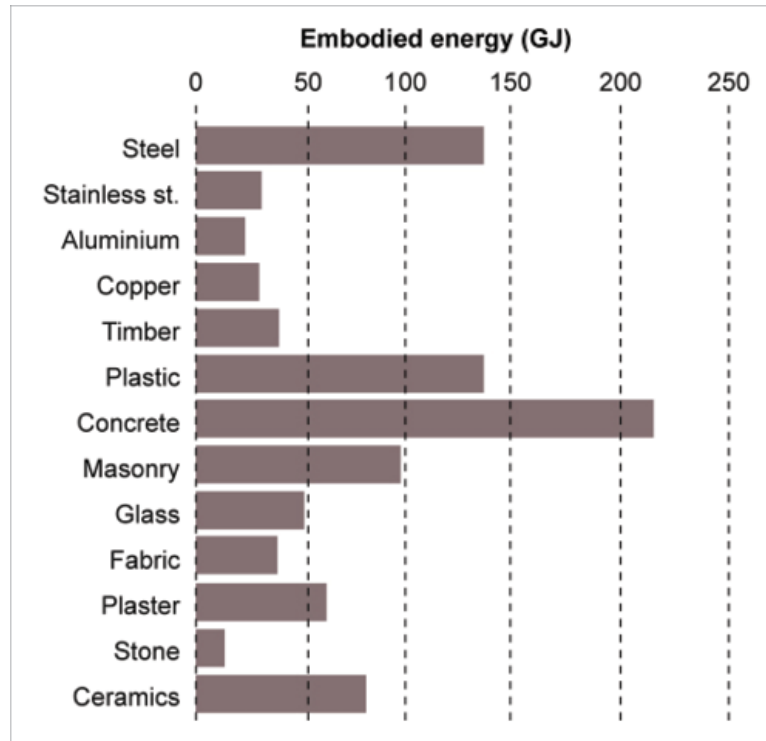


Source Adams, Conner, Ochsendorf 2006

- Consider lifecycle energy costs of the home. A sustainable home may have a certain amount of energy consumed in the manufacture and transport of materials, but ideally will then be able to function on a minimal amount of energy throughout its life span.
- A non-sustainable home will continue to drain non-renewable energy throughout the lifespan of the building, and then maybe demolished at further energy cost and yet another building built in its place.

# Energy consumption

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Source CSIRO

- Some high embodied energy building components may be justified because of their longevity and contribution to an energy efficient home.
- Energy consumption in operation. 40% of household energy consumption goes into heating and cooling in the average home.
- Energy consumption also depends on the user habits. Our homes are filled with more energy consuming technology than ever before. The house alone cannot do all the work!!

# Why build sustainably?

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- Human Health. Poor building practices can cause mould and rot, condensation, which lead to serious respiratory issues, illness and death to vulnerable Australians during winter
- Saving money on heating and cooling bills
- Tackling climate change

# At least 10 things to get right (or at least consider)

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## Physical attributes (quantifiable)

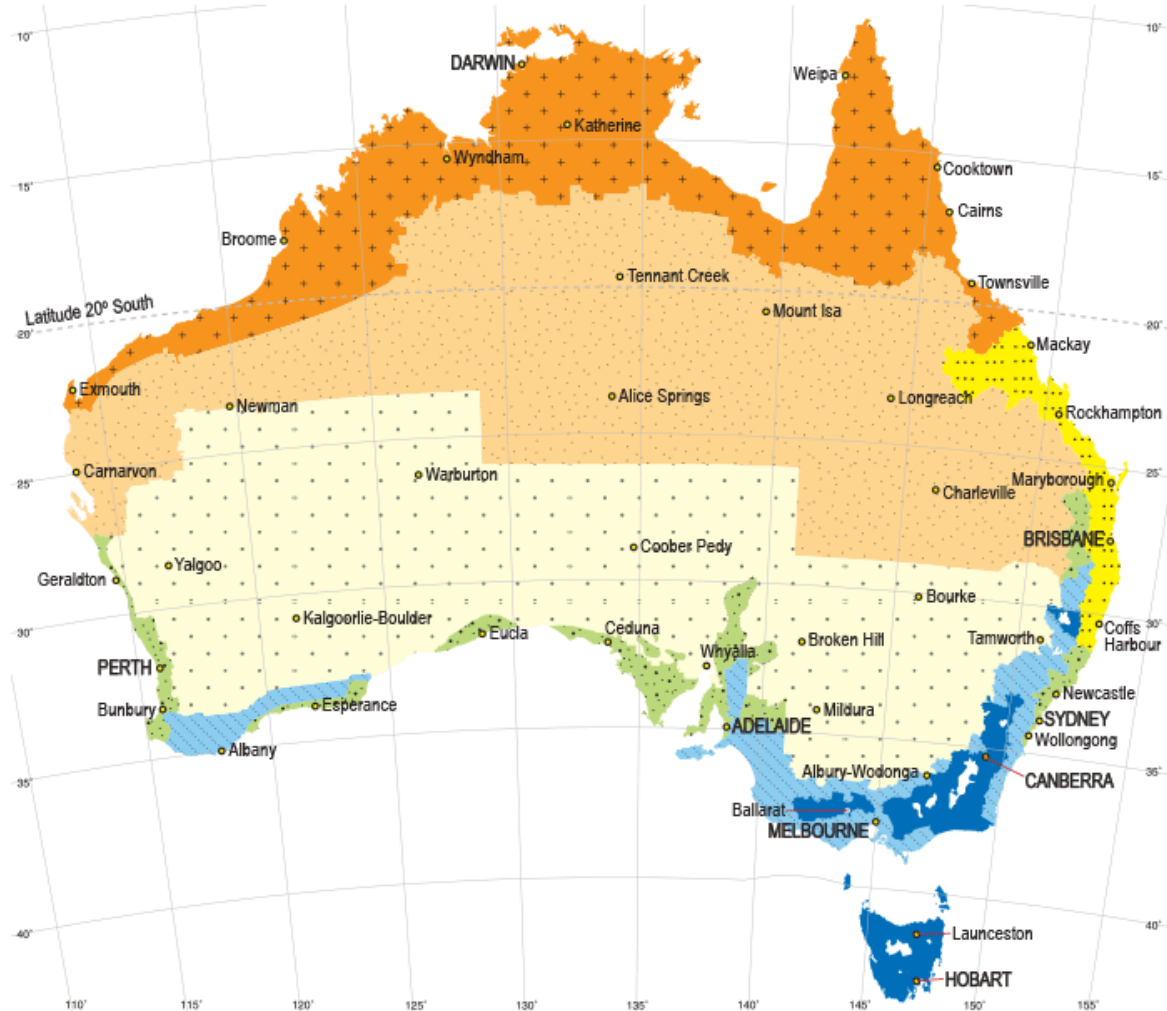
- Understanding your climate
- Orientation
- Solar gain
- Shading
- Thermal mass
- Insulation
- Glazing
- Moisture control

## Design attributes (non-quantifiable)

- Size
- Zoning
- Visual sustainability
- Vernacular inspiration
- Future heritage

# Understanding your climate

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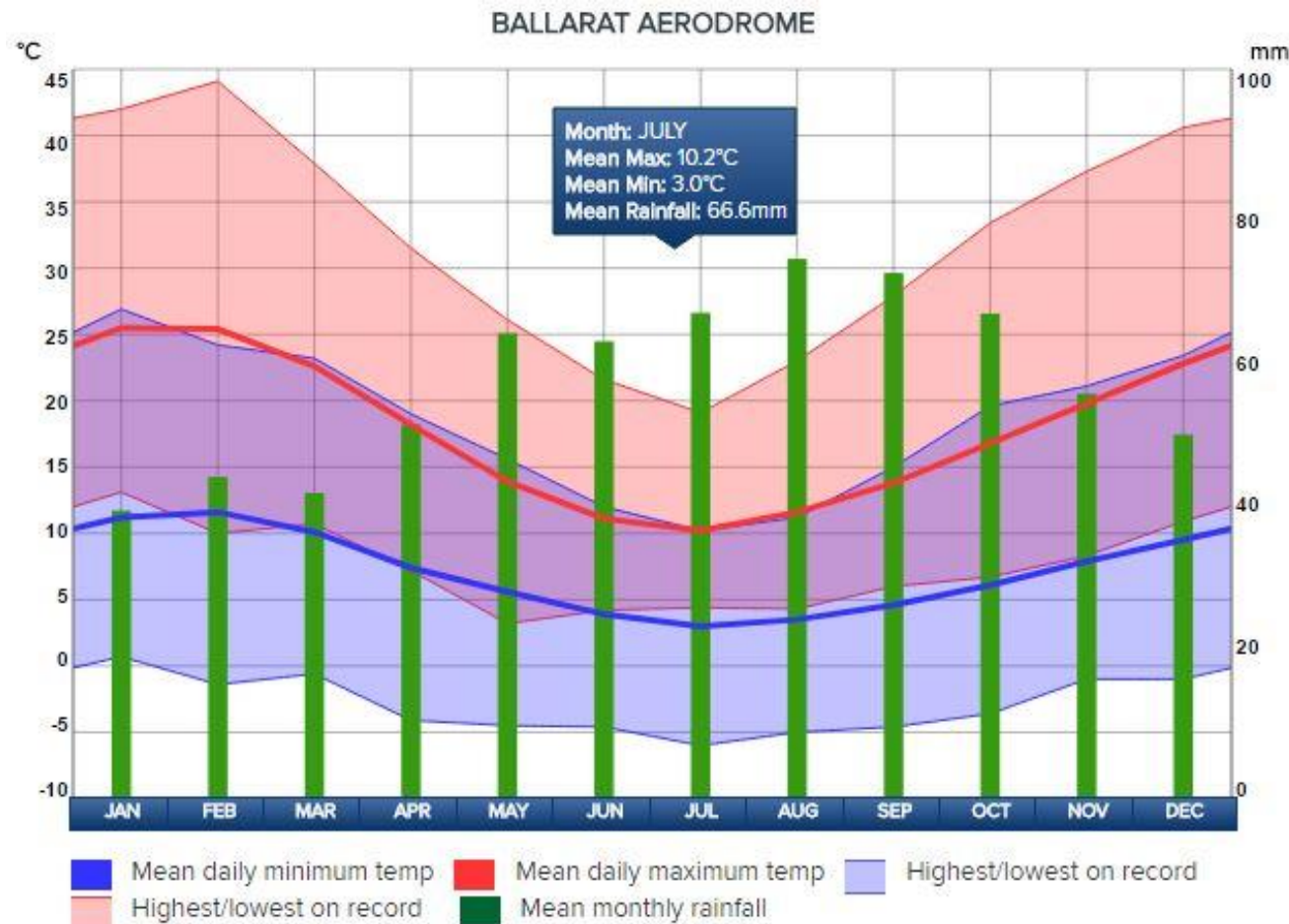


## Ballarat Zone 7 – Cool temperate

### Main characteristics

- Low humidity, high diurnal (day–night) temperature range
- Four distinct seasons: summer and winter exceed human comfort range; highly variable spring and autumn conditions

# Understanding your climate

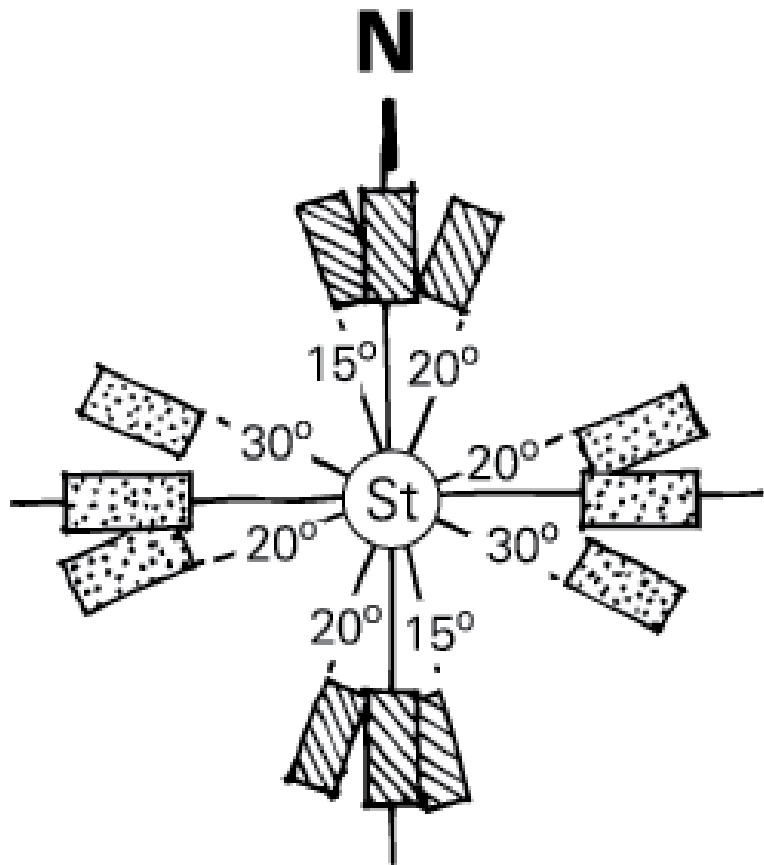


## Ballarat Zone 7 – Cool temperate

- Consider wildly varying temperature fluctuations.
- Large range in temperature between day and night, throughout the year.
- Location of sun varies throughout the year.
- Consider predominant wind direction.
- Consider 'micro-climate' characteristics unique to your site.

# Orientation

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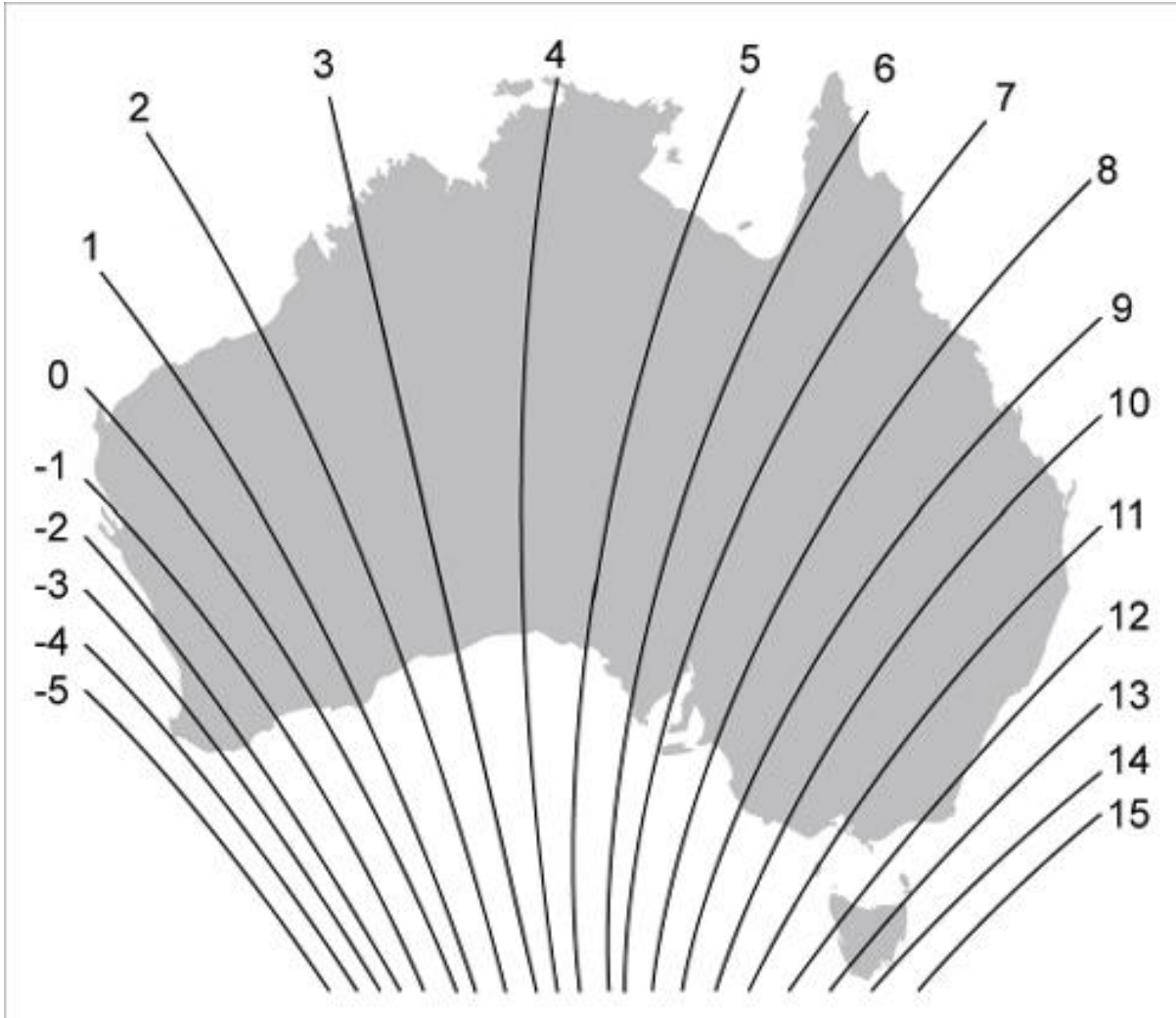


- Doesn't HAVE to face north exactly for passive solar design to still work effectively

 Good site orientation  
 Ideal site orientation  
 Street

# Orientation

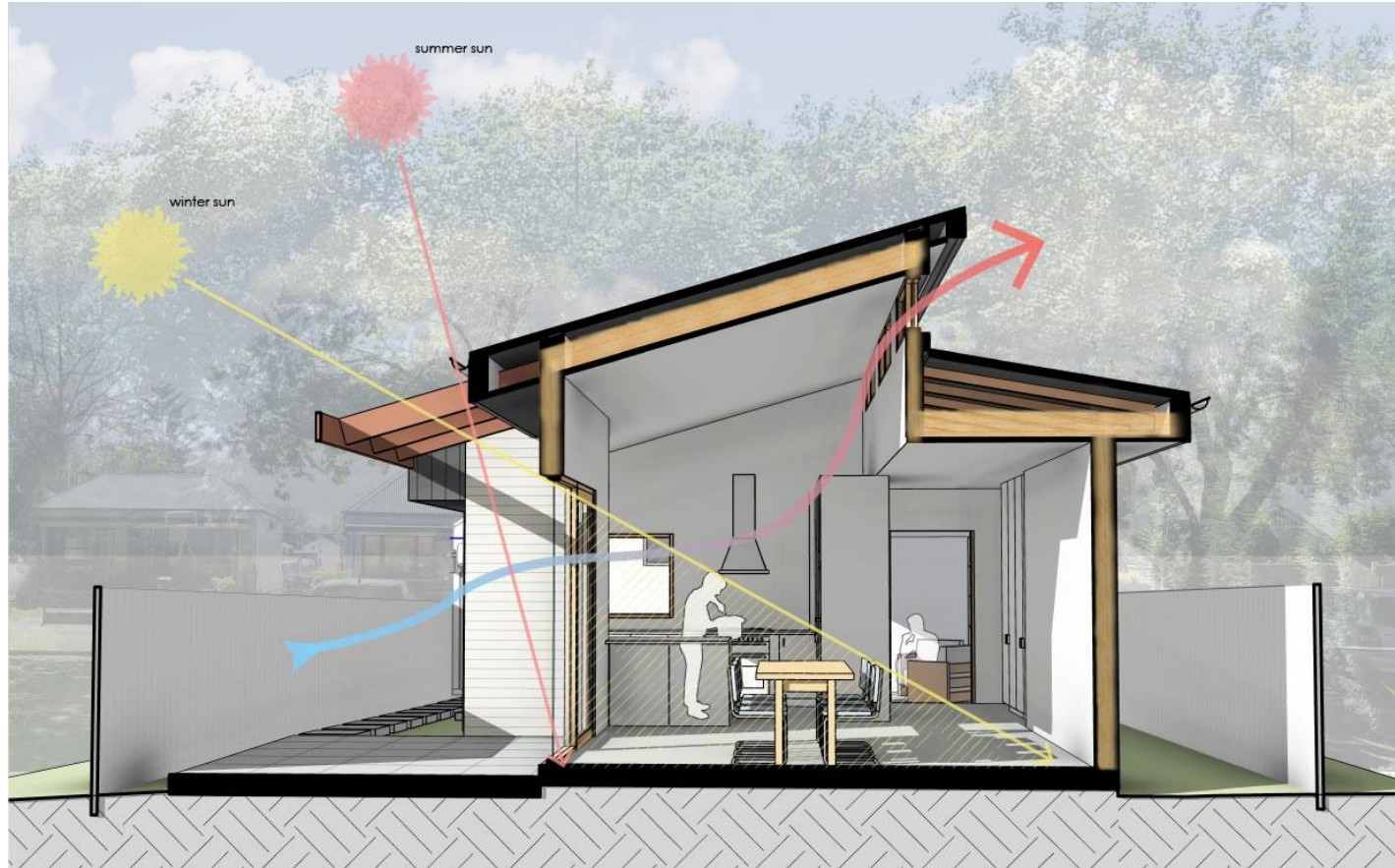
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- Solar north is different from magnetic north
- Solar north is the ideal orientation and is specific to your geographic location
- Zoning is important. Living areas to the north, utilities to the south. Consider which spaces you want to get morning and afternoon sun.

# Solar gain

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- Short-wave radiation from the sun passes through unshaded glass
- Light hits thermal mass within the building and stores energy as heat
- Think of how a greenhouse works
- Benefit of natural light – reduced need for artificial lighting, health benefits – serotonin levels affect our mood and mental wellbeing and help us feel energized

# Solar gain

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- You want to have direct sunlight penetrating deep into your rooms and striking a thermal mass surface.

# Shading

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- Let the low angle winter sun in, and most of the Autumn and Spring sun for that matter.
- Try to exclude direct sunlight hitting your glass in the hotter months, and even the walls.
- Heat can transfer through a solid insulated wall
- Radiant heat in the air can still pass through your well shaded building envelope

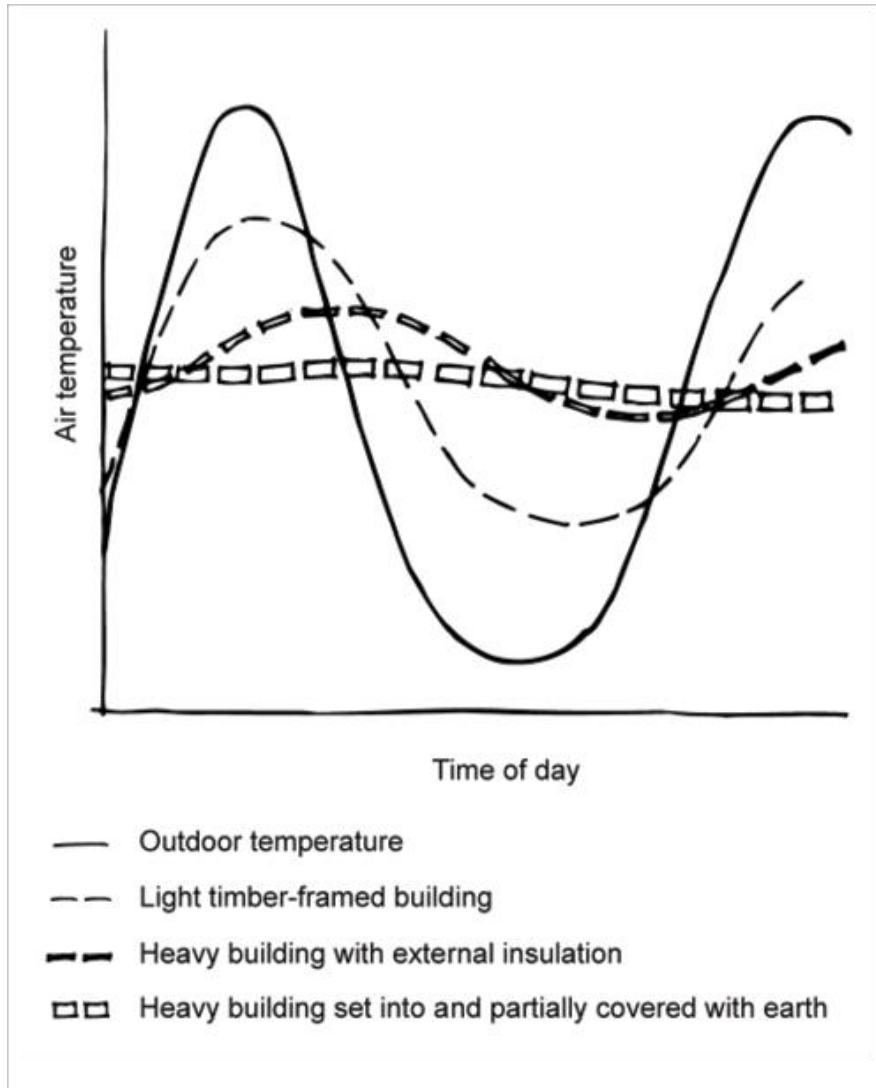
# Shading

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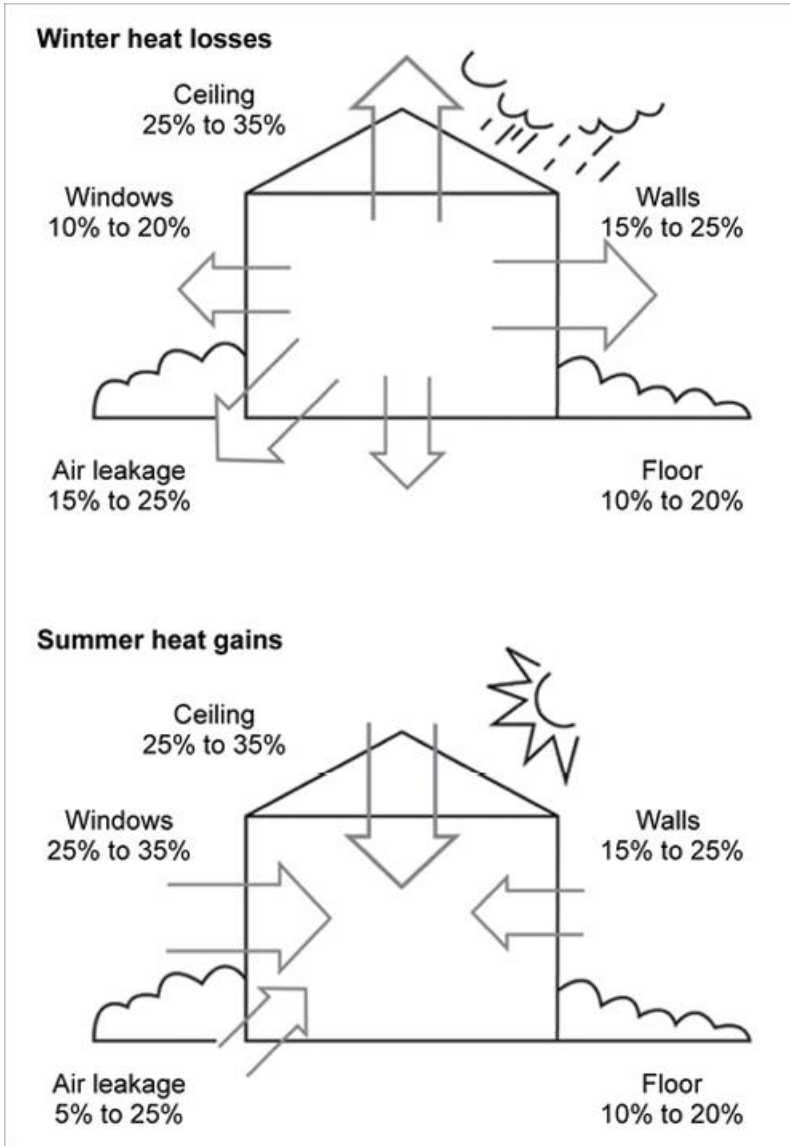
Shading low angle afternoon sun

# Thermal mass



- Helps to sustain comfortable internal air temperature
- Must be located within an insulated building envelope. Solid masonry walls or brick veneer does nothing to help the thermal performance
- Use an appropriate amount of thermal mass for your climate. Too much mass can make the building feel cold, too little and the building will be more susceptible to outside temperature fluctuations
- Underslab insulation is not required unless the ground temperature down to 3 metres falls below 16°C

# Insulation



National Construction Code  
minimum insulation requirements

Element	Total R-value
Suspended floor	2.75
Roof	4.6
External Walls	2.8

Complex floor plans with a large proportion of external wall area will incur greater heat loss.

# Glazing

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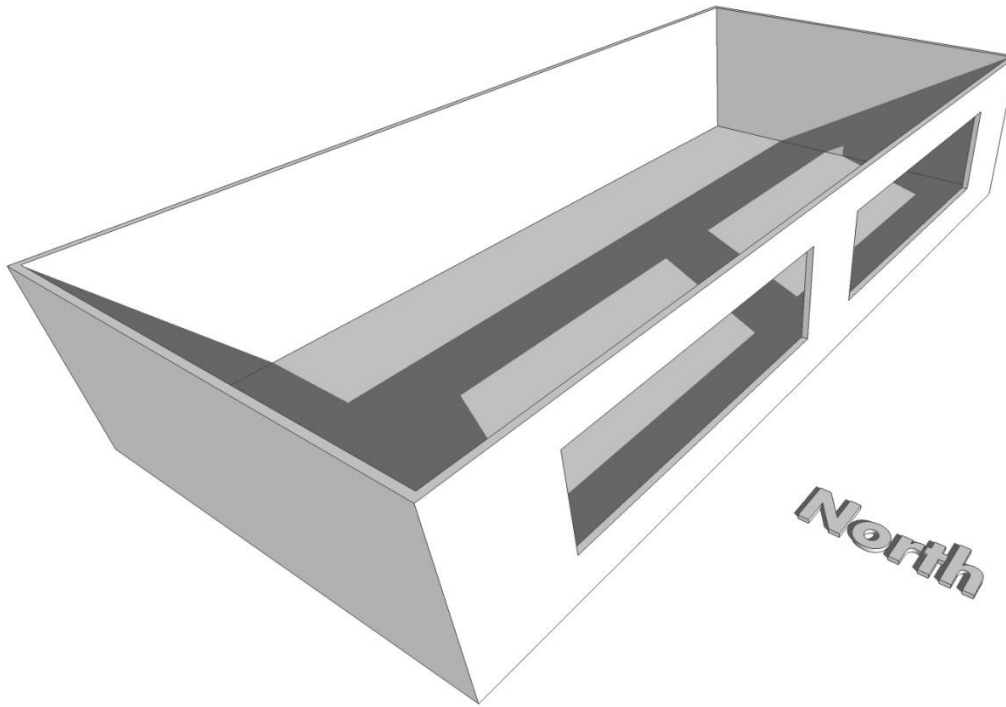


- Heat conduction expressed as U-value. The lower the U value the better.
- More heat radiation is transmitted through glass when the sun is lower in the sky.
- Proportion of glass to floor area, and amount of thermal mass is vital. 15 – 20% solar exposed glass area.
- In Winter up to 20 hours of heat loss with only 4 hours useful solar gain.
- Orientation of glass is vital. Of course not everyone has a view to the north!

# Glazing

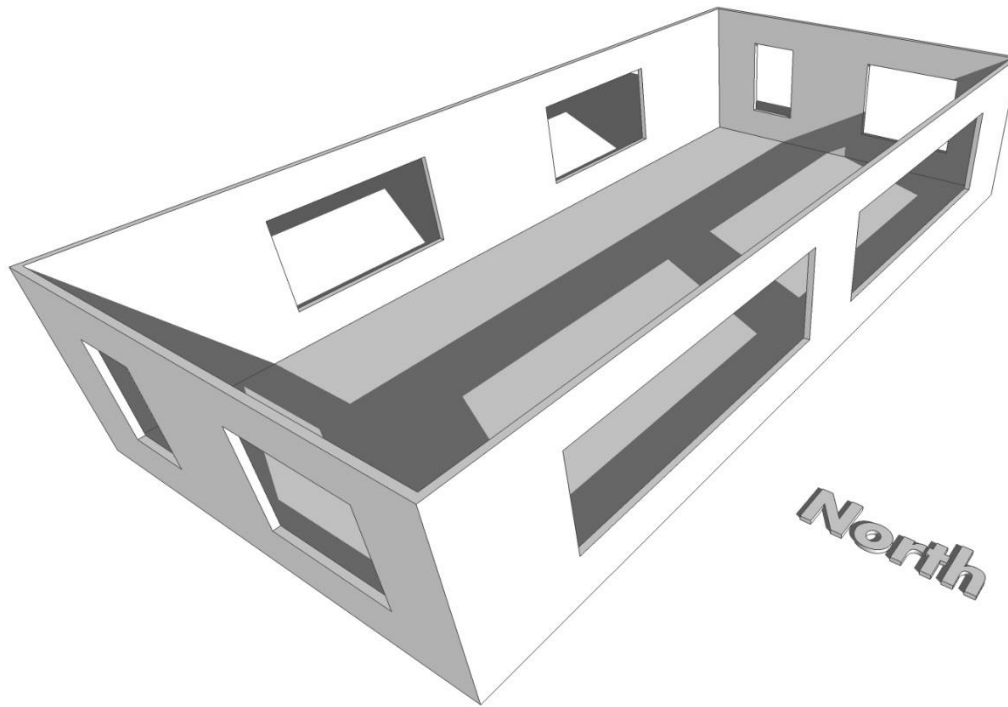
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- 15% north facing glass area to exposed thermal mass floor



# Glazing

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- 15% north facing glass area to exposed thermal mass floor
- Additional glazing on east, west and south offer little to no usable solar gain, and contribute to winter heat loss and summer radiant heat gain

# Glazing

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- Floor to ceiling glass creates a convective loop.
- Be conservative with the amount of glass you use. Sometimes Less is More.
- Position your openable windows to allow for cross ventilation.

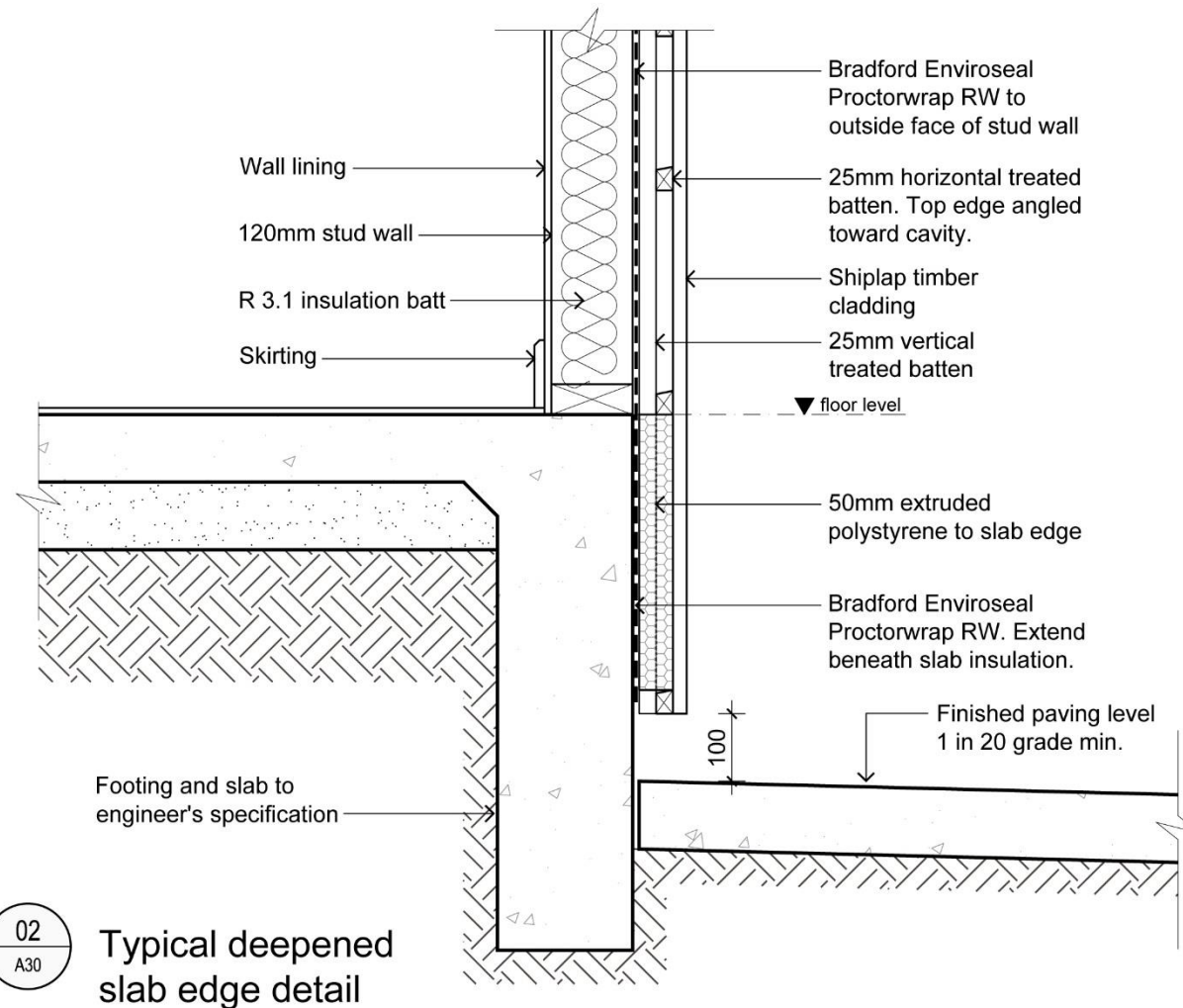
# Moisture control

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- These days we are using breathable building membranes. Foil wraps trap moisture between the frame and cladding and causes undetected rot.
- Provide an air gap between your building wrap and the cladding.
- Membranes must be carefully installed sealing all joins, gaps and cracks around the building.

# Moisture control



# Moisture control

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- Use eaves vents and whirlybird roof ventilators to expel excess heat and moisture
- Exhaust fans should be ducted to the outside
- Don't forget to open your windows and air your house out. This is a free design feature in almost every house!

# Size

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- News Flash. Bigger houses use more energy to heat and cool, and more materials to construct!!!
- (also more cleaning)
- Build what you need, not what the next people might want.
- Good floor planning can reduce overall floor area without reducing usable space.

# Visual sustainability

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- Use a palette of materials sympathetic to the location you are building in.
- In an open setting with space around you, remember a building has four sides. Treat them all as though they were the front.
- Ground the building on its site with a sense of permanence. 'Touching the earth lightly' is only a metaphor.

# Visual sustainability

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Work with the natural features  
of the land, not fight against it.

# Vernacular inspiration

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Respect the buildings of the area that have come before. Take inspiration from the vernacular forms that fit in with the locale.

# Vernacular inspiration

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Appropriate materials and well built elements will endure the ravages of time and provide a perpetual link between the past, present and future.

# Future Heritage

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- Creating Future Heritage
- Modern vernacular

If we create buildings that function well AND are built to a high level of quality and care AND imbue the virtues of appropriate design, we transcend fleeting trends and we will own something worthy to care for, maintain and hand down to future generations.