PRINCIPLES OF ENERGY EFFICIENT HOUSE DESIGN

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Post & Beam Corporate Charter

1. To be a responsible corporate citizen
2. To make the building experience for our clients joyous, satisfying and fulfilling
3. To be profitable with integrity
4. To design homes which "tread lightly" on the planet
5. To incorporate energy efficient design principles into every home design
6. Where possible to provide materials which have low embodied energy
7. Where possible to provide materials with low "cradle to grave" costs
8. Where possible to provide materials that are reclaimed, renewable or are sourced from sustainable production methods
9. To support our employees, subcontractors and the local community

Introduction

Why is it important to design and build energy efficient homes?

1. About 40% of energy used in Australian homes is for heating and cooling.

2. Australian homes produce about twice as much greenhouse gases as all the cars on our roads.

3. Homes are more comfortable.

4. Homes are cheaper to run and maintain because less energy used to keep them cool or warm.

1. Siting & Orientation

1.1 Siting

Maximise distance between house and any buildings to North to reduce possible overshadowing (especially if they are 2-stories high).

Houses to east and west can help block summer sun.

Evergreen trees to east, west or north need to be taken into account to prevent blocking winter sun.

Refer Fig 1. This diagram illustrates how in summer and winter shadows from adjacent trees and buildings can positively or negatively impact on the efficiency of a new building.

If the trees were evergreen then they could have a positive impact by providing protection from Summer sun. But they might also have a negative impact by excluding much needed Winter sun when it is necessary to help warm the interior.

Conversely if the trees were deciduous then they might provide the positive effect of cooling shade during Summer as well as allowing Winter sun into the house when they have no leaves from Autumn to Spring.

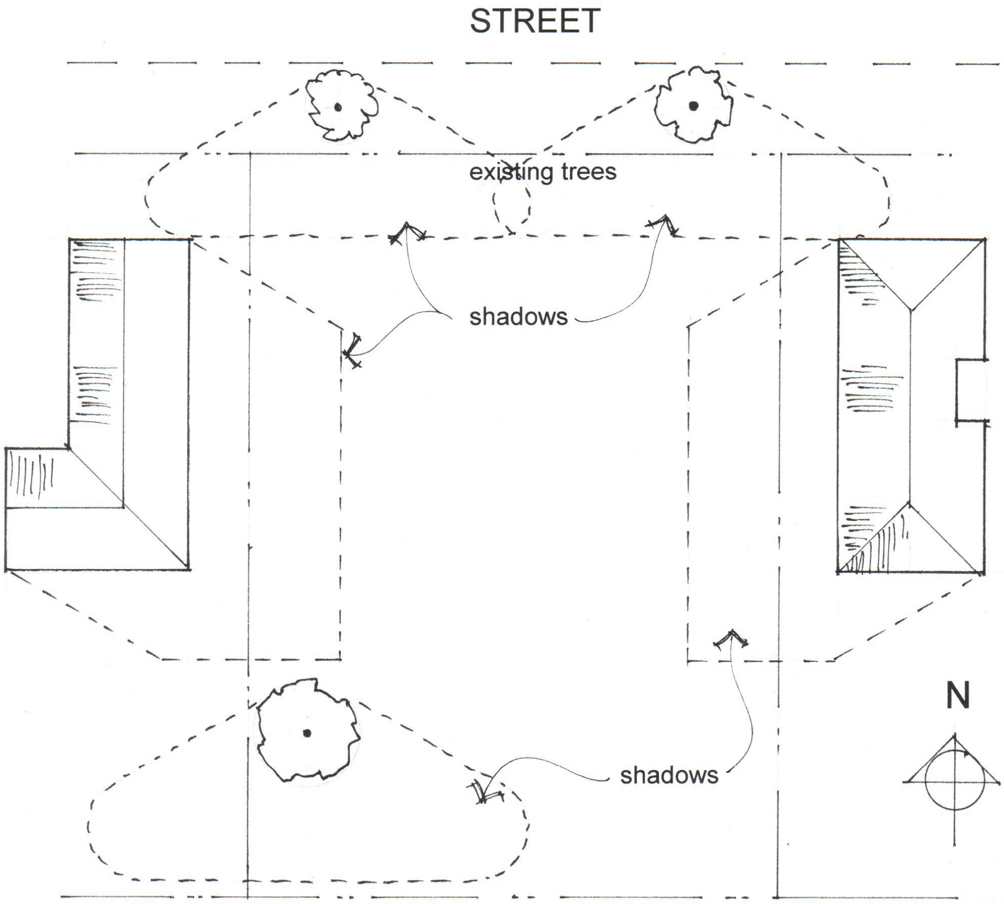


Fig 1 Shadows From Adjacent Trees & Buildings

1.2 Orientation

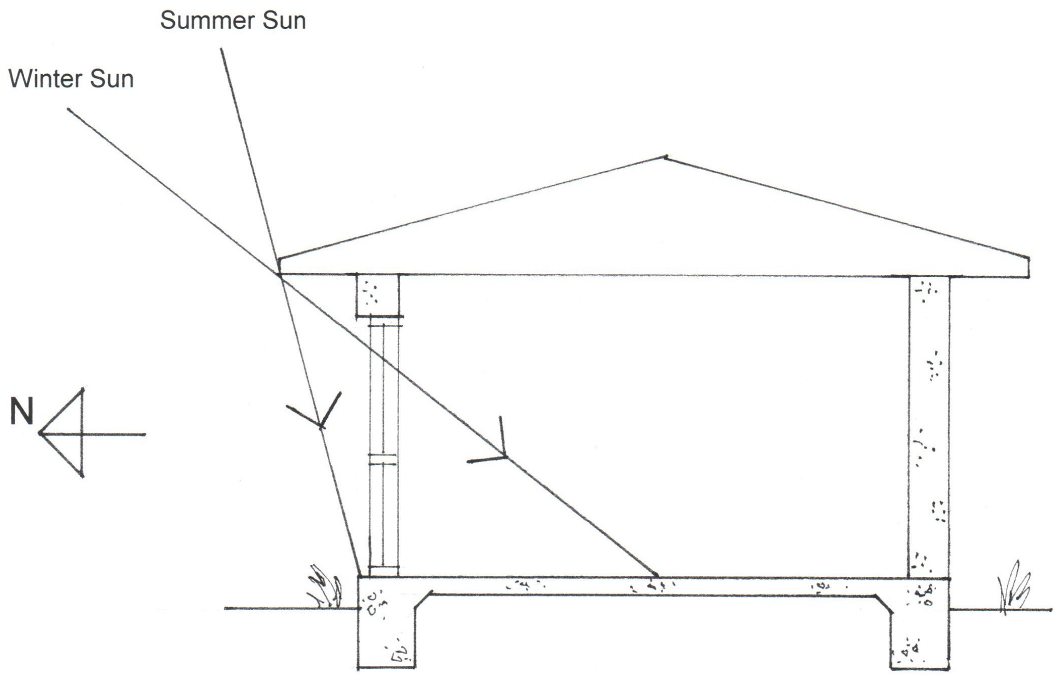
Note difference between "magnetic north" and "true (or solar) north". In Melbourne and Sydney true north is about 11^{o} west of magnetic north.

In southern states of Australia orient living areas to north. Utility and bedroom areas to south.

Most glass area to the north with correctly designed shading to control entry of sun in winter and exclude sun in summer.

Reduce amount of east, south and especially west facing windows to reduce negative effects of uncontrolled sun entry. This is especially a problem in summer.

Refer to Fig 2 for details. This diagram shows how glass areas facing north with a correct eave overhang can control entry of sun into the house. In winter sun can enter to warm the interior and excluded in summer to keep the hoe cool. This principle relies on the fact that the angle of the sun changes between summer and winter.



<u>**Fig 2 House Orientation for Solar Control**</u>

2. Passive Solar Heating

2.1 Basic Principles

Basic passive solar heating design principles are:

(a) Daytime living areas to North

(b) Bedrooms & utility rooms to South

(c) Most glass to north (10-25% of room's floor area should be glazed)

(d) Least glazing to South

(e) Optimal shading of glass and double glazing

(f) Keep suitable distance between house and any buildings or evergreen trees to North to avoid overshadowing

(g) Thermal mass for storing heat (solar and internal heaters)

(h) Good insulation of walls, floors (if suspended timber) and ceiling

(i) Draft sealing

(j) Keep areas to be heated together

Heat entering through proper designed and oriented windows is absorbed and stored by materials with high density (eg. masonry, concrete).

Heat is released at night when cooler.

Shading by deciduous trees helps control solar gain in Summer

2.2 Control of Solar Access

Fixed shading devices (eg. correctly designed eaves) can maximise solar access to north facing glass.

Pergolas with deciduous vines to north, east & west can help to control summer solar gain.

Shade battens to north can also help to control summer solar gain.

Refer Fig 3. This diagram shows the relationship between the height of North facing glazing and the optimum eave overhang dimension for control of sun access to the inside rooms of a dwelling.

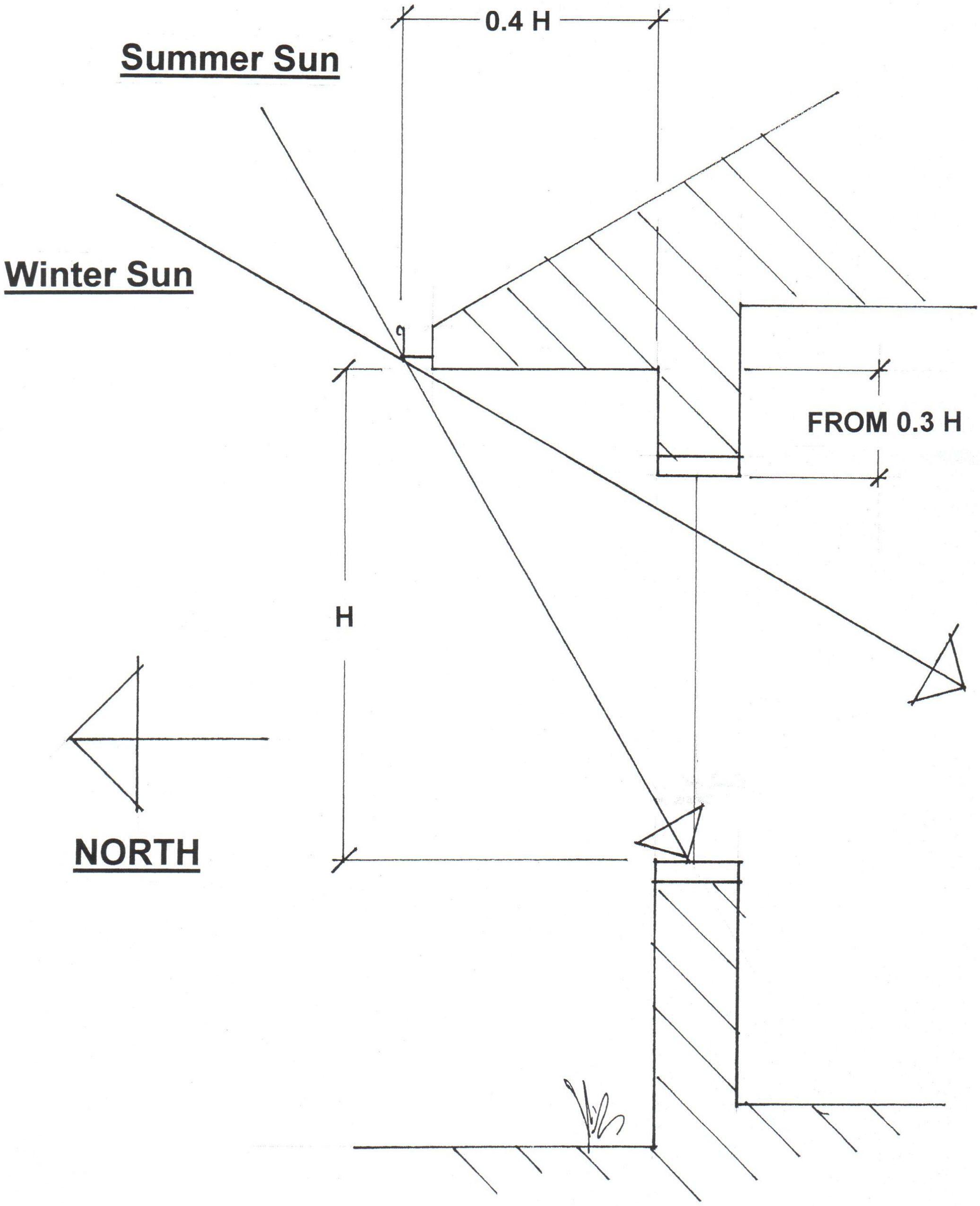


Fig 3 Optimum Eave Dimensions

3. **Passive Cooling**

Passive cooling minimises heat gain from outside and uses natural sources to remove excess heat.

- Inexpensive to incorporate
- Low environmental impact
- Appropriate in all Australian climates

Main Design Elements

- Orientation for exposure to cooling breezes
- Internal design to maximise cross-flow ventilation (least obstacles)
- Zoning design to maximise daytime living and night-time sleeping comfort
- Appropriate window ventilation
- Shading to keep house and surrounds cool in winter, deciduous trees are best
- Landscaping to direct cooling breezes to house to assist ventilation, deciduous trees are best (Refer Figs 4 & 5)
- Light coloured building materials for greater reflection of heat
- High mass or low mass building materials (which type depends on climate – light mass in tropical, high mass in temperate and cool)

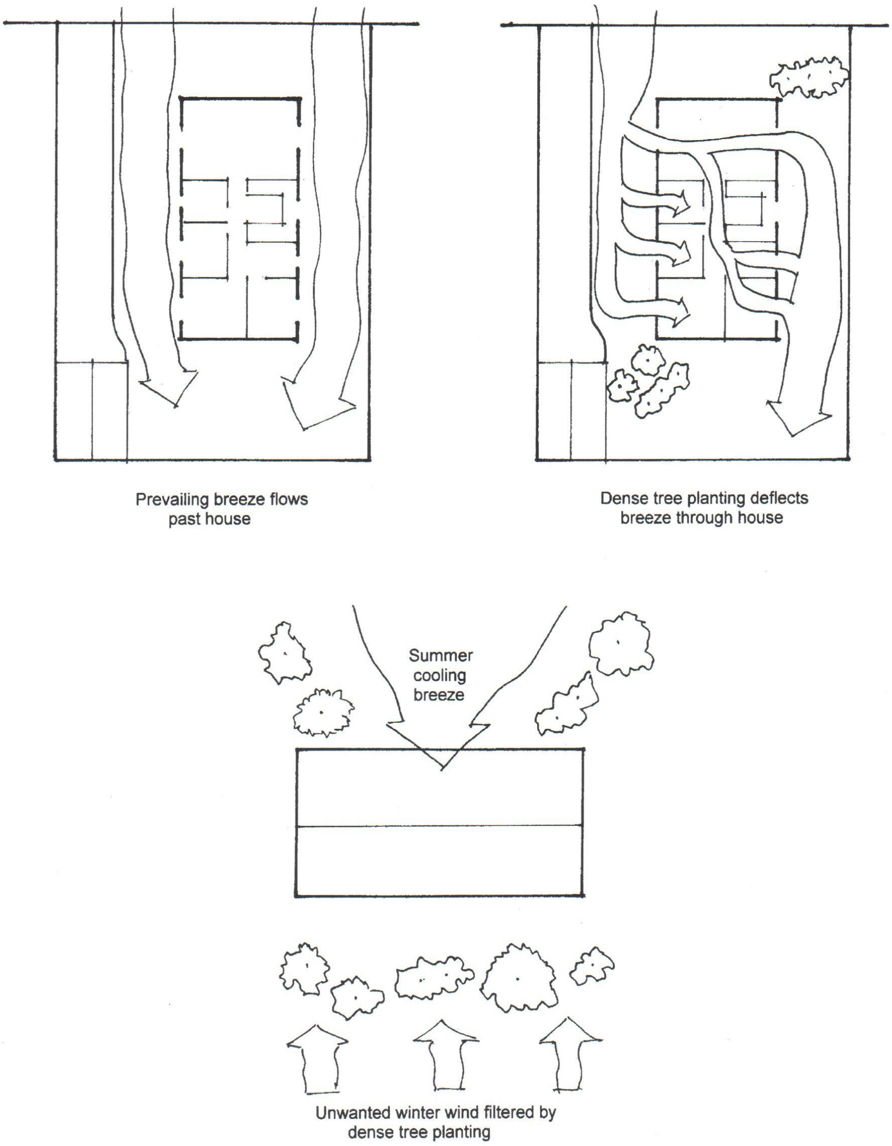


Fig 4 Landscaping to Assist Ventilation

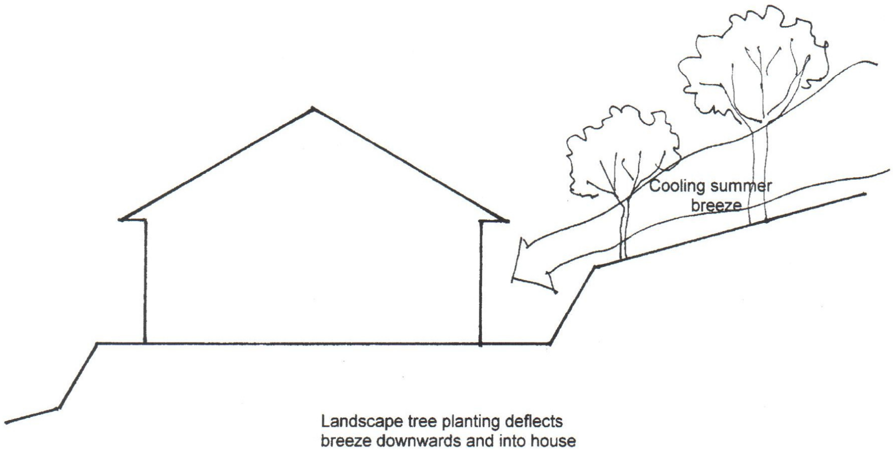


Fig 5 Landscaping to Assist Ventilation

4. <u>Insulation</u>

Insulation acts as a barrier to heat flow.

Keeps home warmer in winter and cooler in summer.

Insulation must be used in conjunction with good passive design techniques otherwise it may have detrimental effect (eg. home becomes oven if not shaded).

Performance of any insulation is measured by its "R value". The higher the value the better insulator the material is.

Two general types of insulation:

(a) Reflective

- silver reflective surface (one or both sides)
- requires 25mm air gap to work properly
- may be designed to provide differing insulation performance in either direction

(b) Bulk

- Fibreglass, Styrofoam, cellulose fibre (shredded paper)
- Generally have same insulation value in both directions
- Does not require adjacent air gap as reflective insulation does

Type and amount of insulation depend upon climate zone.

Where it is appropriate to insulate:

- Roof
- Ceilings
- External walls
- Floors
- Underside of suspended timber floors
- Slab edges in cool climates

5. Thermal Mass

This is the ability of a material to absorb and transmit energy. It is closely linked to density.

Refer Fig 6 to see how thermal mass moderates the house temperature in summer and winter.

Using thermal mass correctly moderates internal temperatures by averaging day/night extremes by absorbing excess heat during hot periods and giving this stored heat up during cooler periods.

Thermal mass must be used in conjunction with good passive design techniques otherwise it may have detrimental effect (eg. inadequate north eave overhang would allow too much heat to be stored).

Thermal mass materials are not generally good insulators.

Thermal mass external walls are generally best insulated on the outside (eg. reverse brick veneer)

Thermal mass internal walls are best located where there is direct sunlight or radiant heat from heaters in winter.

Internal thermal mass walls must be protected from sun in summer and should be exposed to cooling breezes.

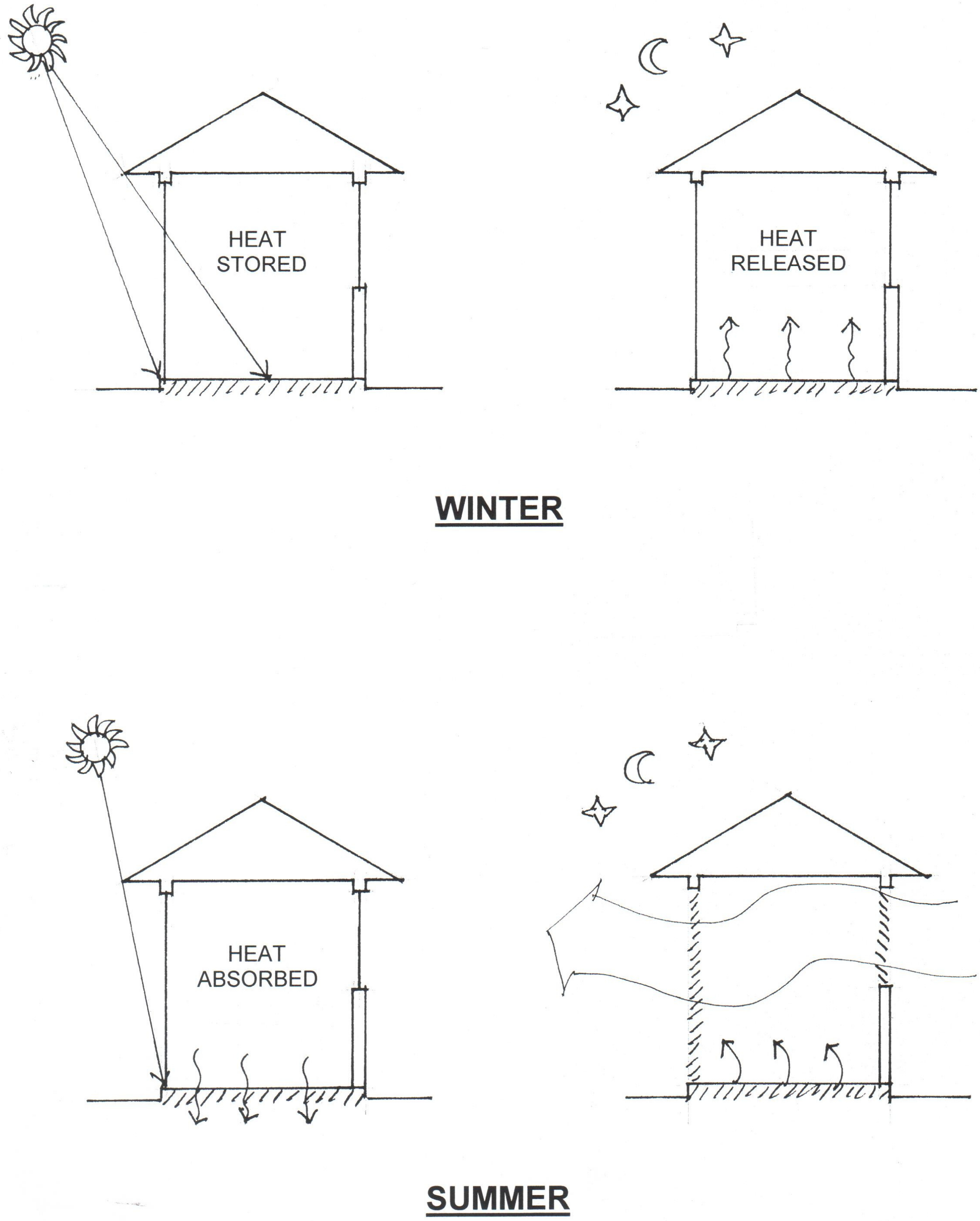


Fig 6 How Thermal Mass Works

6. Glazing

Glazing can have a major impact on the energy efficiency of a house.

If **NOT** designed correctly glazing can allow significant heating and cooling at the wrong times.

If designed correctly glazing can help maintain comfort levels throughout the year.

Heat gain in summer of 1 square metre of glass can be equivalent to a single bar radiator.

Heat loss in winter of glazing can be up to 10 times more than an insulated wall.

There is a range of different glazing surfaces – reflective, Low-E.

Double glazing – offers much better insulation than single glazing.

Window frames also have a significant effect on performance of windows

- Timber and PVC window frames are more efficient than aluminium
- Aluminium frames conduct heat out and into the house more readily (can decrease performance by up to 30% compared with timber or PVC)

Curtains:

- Close fitting curtains with pelmets can substantially improve winter performance of windows.
- Reflective backing can further improve summer performance of windows

7. Designing for Even Greater Energy Efficiency

During more than 35 years that Post & Beam have been designing and building unique homes we have always been committed to sustainability and energy efficiency both in building materials and design concepts.

Post & Beam has always attempted to embody best current practice into its design methodology to ensure clients' homes require minimal energy cost to keep in the "comfort zone" during summer and winter climatic extremes.

Over the last few years Sustainability Victoria has developed a computer software program called FirstRate. All Post & Beam custom designed homes are now assessed by an accredited Thermal Performance Assessor using this software.

Post & Beam offer a range of energy efficiency options which enable each client to achieve the highest cost effective efficiency rating.

Some of the energy efficiency options available are:

- Enhanced ceiling insulation (up to R4.0)
- Timbercrete, stone, earth brick or timber walls with enhanced insulation values
- Double glazing
- Low-E glass
- Timber doors & windows (already included as Post & Beam standard item)
- Under-slab insulation
- Timber floor insulation
- Passive solar eave overhangs (already included as Post & Beam standard item)

These enhanced energy efficiency options may cost a little more initially but their cost is more than offset by the reduction in heating and cooling bills. These energy cost savings more than pay for any additional building costs.

And remember – less energy used means less greenhouse gas emissions and that is a benefit to the whole planet.

Please feel free to ring at any time on (03) 9486 7100 to discuss your particular home building project energy efficiency requirements or to get a fuller understanding of Post & Beam's "6 Star" energy saving options.