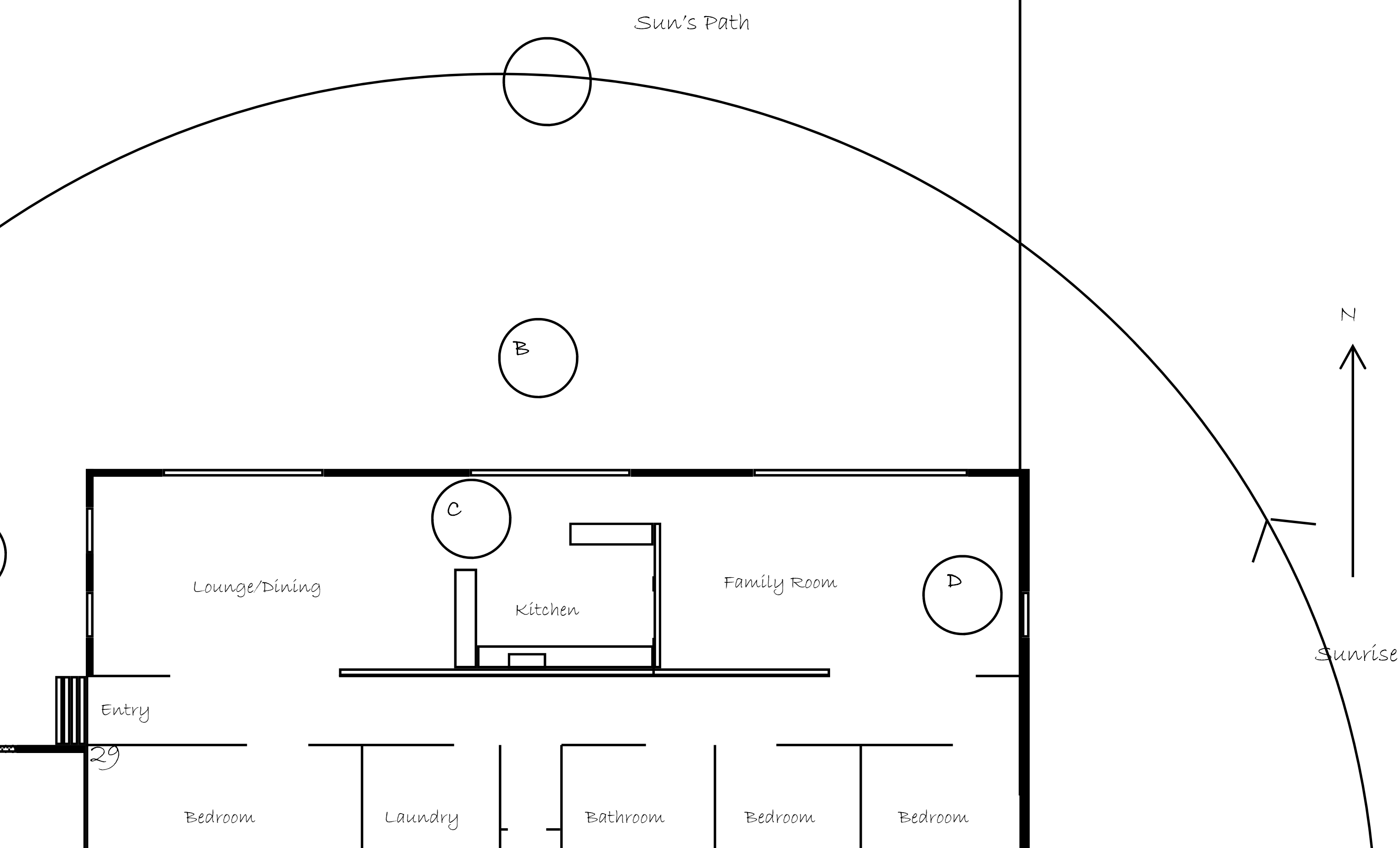
Energy Efficiency

Design Guidelines

HOBART
CITY COUNCIL



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Energy Efficiency

Introduction:

Energy efficient building design is all about the creation of homes that are comfortable for people to live in all year round. That is, naturally cool in summer and warm in winter without the need to use costly and time consuming energy sources. Temperature and light are maintained at comfortable levels with a minimum requirement for 'active systems' such as heaters, air conditioners, and daytime lighting.

Energy efficiency has many benefits for home owners:

Save money – if the sun heats and lights your home, your power bills are significantly reduced.

Less effort – if passive design features heat your home, tasks such as wood stacking and splitting are significantly reduced.

This brochure is intended to promote understanding of how to use the sun's energy during the building design stage to achieve energy efficiency. The practice of energy efficient design will help reduce demand on non-renewable energy resources consumed by the heating and cooling of buildings.

These guidelines seek to assist by identifying the key principles in utilising the suns energy.

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Note:

Ideal energy efficiency siting, design and landscaping is not always achievable for a number of reasons (see below.)

In most instances however, a compromise can be struck between achieving energy efficient goals and the range of issues pertinent to any given site, including;

- The location, orientation and size of a block may not allow a building to be ideally orientated or sited.
- Neighbouring properties may have structures which overshadow where property owners want to build.
- Bushfire protection, landscape protection, bushland and habitat conservation, cultural heritage conservation, streetscape, urban design, and amenity. These issues may need to take precedence, depending on their relative significance, under certain circumstance.

Analysis of a development site and its characteristics is a key element in the design process for maximising use of the sun's energy – heat and light.

Site analysis involves assessing a range of environmental factors that can affect the development of a site. The complexity of the analysis will vary depending on size, and potential impact, of the site being developed.

Usually for residential sites, a simple annotated plan or diagram which considers key site characteristics (such as aspect, slope, shaded areas from any surrounding buildings and trees) and relationships to adjacent properties and streets is sufficient.

Essentially it is important to determine and note any special characteristics of the site such as slope, drainage, views, relationship to the street, type, and size/condition of trees on, or affecting, the site.

Three steps for Site Analysis

1
Identify any areas of the site that may be shaded by existing buildings, structures, or vegetation on the site or adjacent to the site. The idea is to ensure that the northern side of the proposed house will not be shaded in winter. (See Principle 3, pages 4 - 8)
Note angle and direction of ground, as any slope will affect shadow length. (See Principle 3, pages 6 & 7)

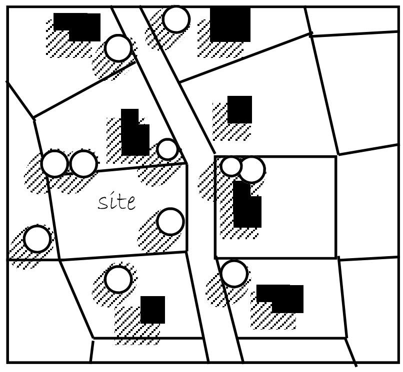
2
A) Identify direction of prevailing summer breezes which can be used for summer cooling – generally from South – East to South in Hobart. (See Principle 4f, page 19)

B)
Identify direction of prevailing winter winds from which the house needs to be protected – generally from North-West in Hobart.
(See Principle 5, page 23)

3
Determine angle of the house in regard to the sun.

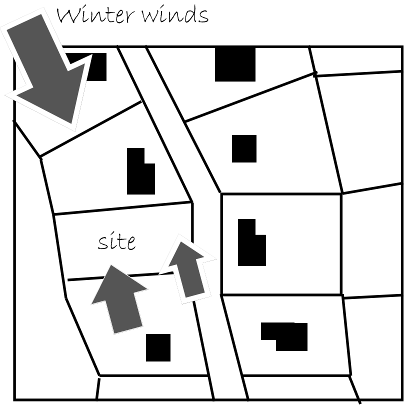
Aim to angle house within the range which takes as full advantage as possible of the sun's energy for heating and daylight (See Principle 2, page 3)

Site analysis



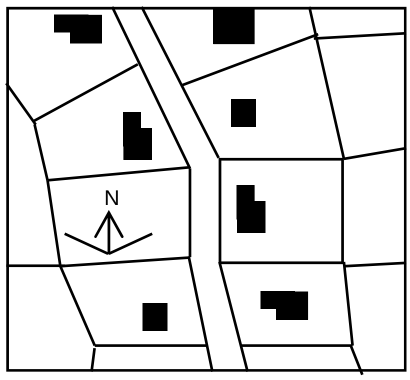
1

Identify areas that may be shaded by buildings or vegetation.



2 Summer breezes

Identify direction of prevailing winds.



3

Determine the angle of the house in regard to the sun.

Principle 2 Orientation of buildings

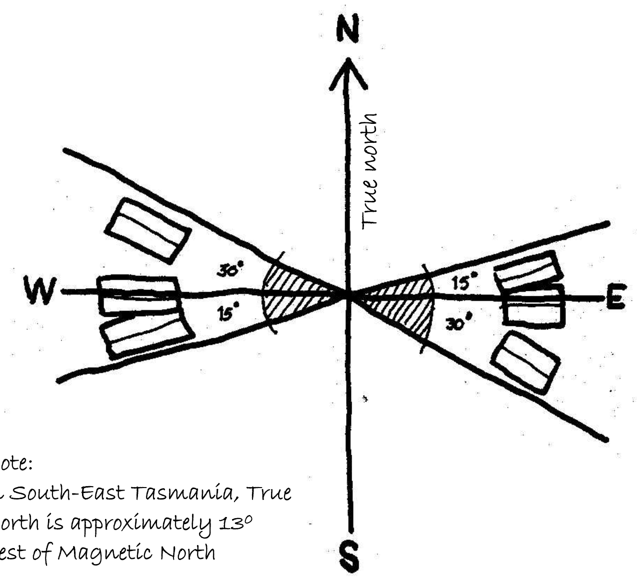
In order to take advantage of the sun's energy , it is best to orientate buildings so that one of the longer sides (with main daytime living areas) faces north.

In Hobart, buildings are best orientated within the range indicated on the diagram below to achieve early morning 'warm up' and minimise overheating from late afternoon sun.

Buildings orientated outside this range will not take full advantage of the sun's energy, and will receive light and warmth for a limited part of the day only.

A more westerly aspect is likely to result in overheating during summer afternoons.

A more easterly aspect is likely to result in need to install significant artificial heating systems for heating during winter.



Note:
In South-East Tasmania, True North is approximately 13° west of Magnetic North

The long edge of the building should face north.

Principle 3 Spacing of buildings

(to avoid overshadowing)

Careful siting and spacing of buildings can maximise potential gains of natural heat and light. Loss of heat and light is often the result if northern elevations of buildings are shaded (overshadowed).

It is important to ensure that new buildings, and useable private open space (I.e garden), are located so that they are not overshadowed by existing structures/ vegetation/raised ground.

Likewise, it is important that new structures/ vegetation do not overshadow buildings and private open space areas on adjacent properties.

3a) Shadow Lengths

In winter, buildings, vegetation and other features can cast shadows which are two to three times their height. As a guide, Table 1 indicates the length of shadow at various times of the year, assuming a 1 metre high feature on flat ground.

It is important to note, however, that shadow lengths can vary significantly depending on the time of the day, time of the year, slope of the land, and the height of the structure/vegetation.

(To measure the shadow length of higher features, multiply the height by the shadow length indicated in Table 1).

TABLE 1:

Shadow lengths of a 1m high feature on flat ground at various times of the year and day.

	9am/3pm	Noon	11am/1pm
21st June	4.35 metres	2.20 metres	2.30 metres
21st March & 23rd September	1.59 metres	0.90 metres	0.96 metres
22nd December	0.86 metres	0.34 metres	0.43 metres

Alternatively, the formula;

$$SL = H / Tan\theta$$

can be used in conjunction with Table 2 to measure shadow length.

Where:

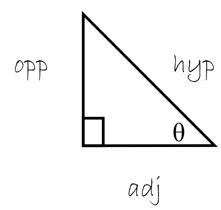
SL is the shadow length on flat land

H is the height of the structure or vegetation

Tanθ represents the values (actual degrees are shown in brackets) in the cells in Table 2.

Definition of Tan; in the instance of a right angled triangle;

$$Tan\theta = \frac{opp}{adj}$$



Principle 3 Spacing of buildings
(to avoid overshadowing)

3a) Shadow lengths continued......

TABLE 2: Vertical sun angle value (Tanθ) at various times of the year and day in Hobart. (Actual angle shown in brackets)

	TIME OF DAY							
Eastern Standard Time	12 Noon	11am & 1pm	10am & 2pm	9am & 3pm	8am & 4pm	7am & 5pm	6am & 6pm	5am & 7pm
Daylight Savings Time	1pm	12 noon & 2pm	11am & 3pm	10am & 4pm	9am & 5pm	8am & 6pm	7am & 7pm	6am & 8pm
MONTH OF THE YEAR								
22 December	2.90 (71°)	2.36 (67°)	1.66 (59°)	1.15 (49°)	0.78 (38°)	0.51 (27°)	0.27 (15°)	0.11 (6°)
26 February & 17 October	1.54 (57°)	1.38 (54°)	1.11 (48°)	0.81 (39°)	0.53 (28°)	0.31 (17°)	0.12 (7°)	N/A
21 March & 23 September	1.11 (48°)	1.04 (46°)	0.84 (40°)	0.62 (32°)	0.40 (22°)	0.19 (11°)	N/A	N/A
14 April & 31 August	0.78 (38°)	0.75 (37°)	0.62 (32°)	0.47 (25°)	0.27 (15°)	0.09 (5°)	N/A	N/A
21 June	0.45 (24°)	0.42 (23°)	0.32 (18°)	0.23 (13°)	0.06 (4°)	N/A	N/A	N/A

Worked example:

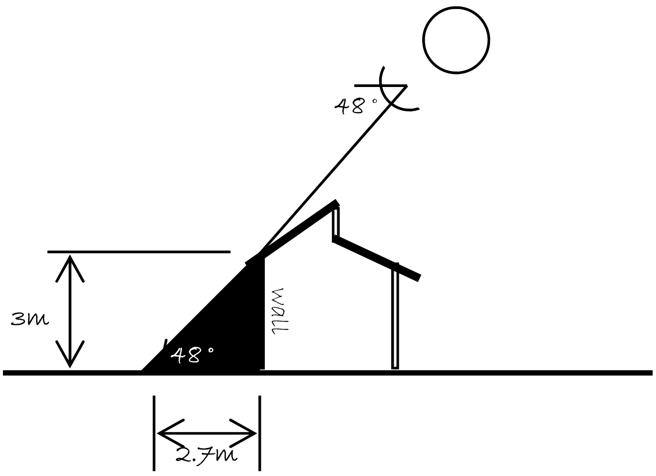
To find the length of shadow (SL) thrown from a 3m high wall along flat ground around 12 noon (Eastern Standard Time) on the 23rd September.

Shadow Length = Height of wall / (value for Tan 48 degrees in relevant cell in Table 2)

$$= \frac{\text{Height}}{\text{Tan } 48^\circ}$$

$$= \frac{3m}{1.1}$$

$$= 2.7m$$



3b) Slopes and shadow lengths

The slope and aspect of land has a significant impact upon the extent of shadows produced.

Generally speaking, north facing slopes generate smaller shadows than south facing slopes (See page 7):

- Consequently in energy efficiency terms, north-facing slopes permit closer spacing without loss of potential solar heat and natural light gain. (Shorter shadows)

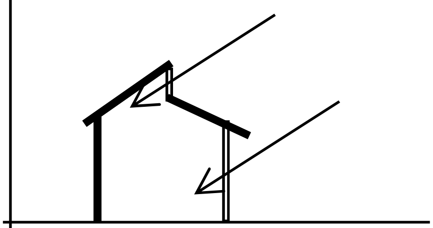
- The potential for, and degree of, overshadowing is higher on south-facing slopes.

- Spacing buildings too closely on south-facing slopes can cause severe overshadowing.

Subdivisions may or may not have taken these matters into account during the design process.
There are however, various planning and building design solutions which can utilise the sun's energy as much as possible, for instance:

- Taller buildings/structures/vegetation/etc, can be located on the lower part of south-facing slopes, with lower developments on the northern side.

- Roofs can be designed to allow sunlight to enter.

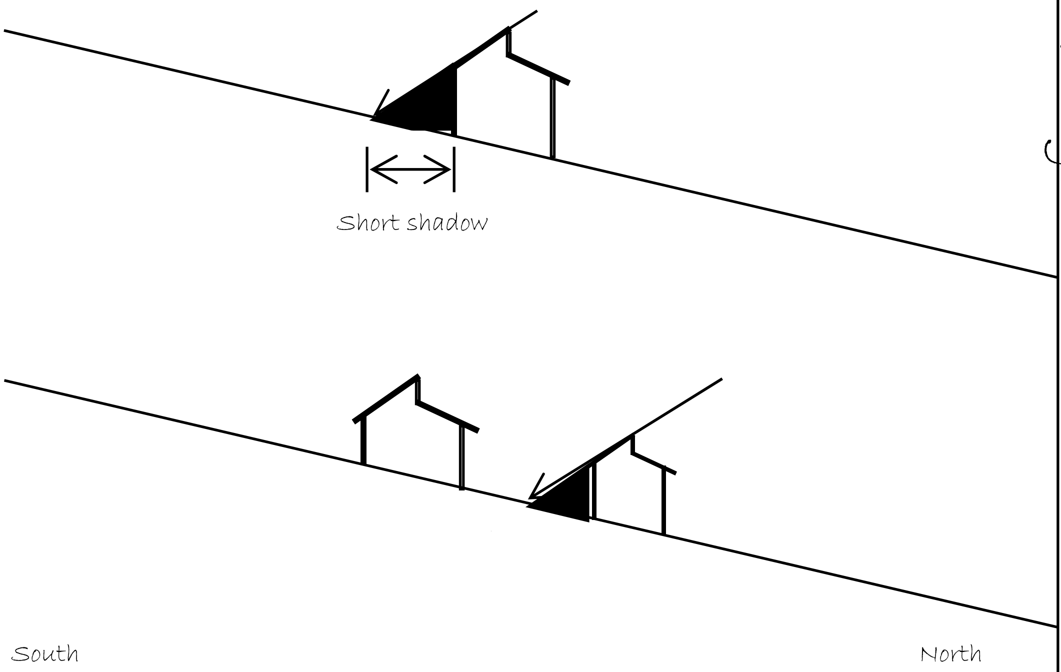


Roofs can be designed to allow sunlight to enter to provide natural heat gains and lighting.

Principle 3 Spacing of buildings

(to avoid overshadowing)

3b) Slopes and shadow lengths

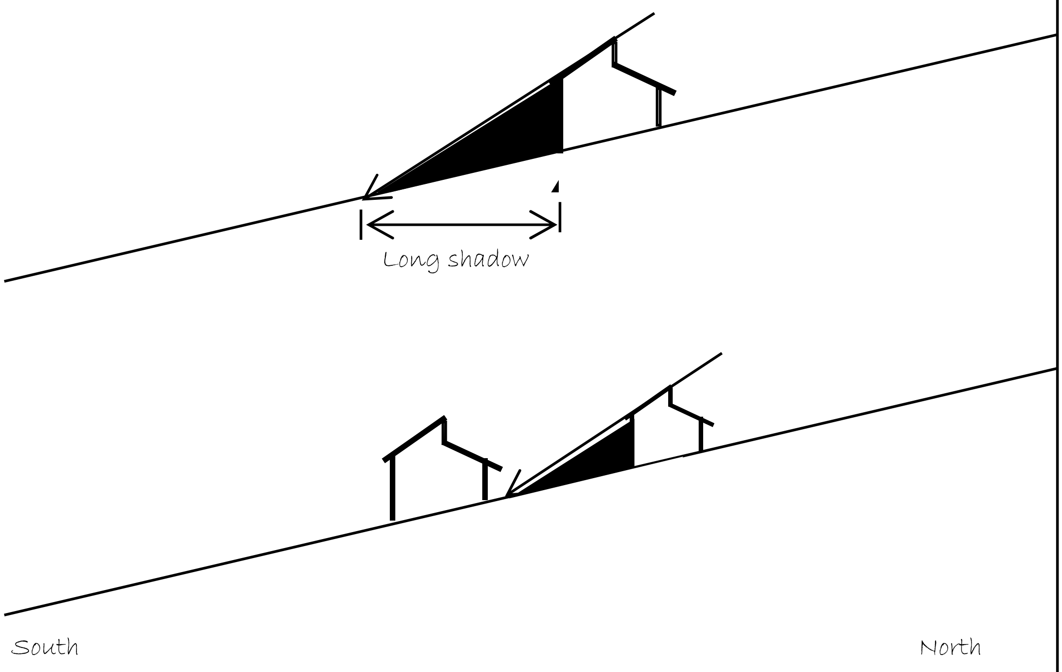


North Facing Slopes

Principle:
north facing slopes generate smaller shadows than south facing slopes.

Application:
Locate taller developments on the upper side of the north facing slope.

Buildings can be quite close together without overshadowing.



South Facing Slopes

Principle:
The potential for, and degree of, overshadowing is higher on south-facing slopes.

Application:
Locate taller developments on the lower side of the south facing slope.

Space building apart to avoid overshadowing.

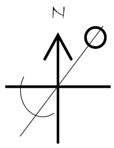
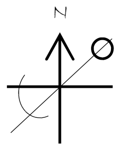
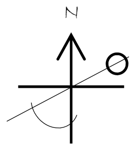
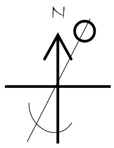
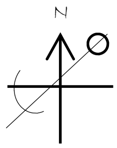
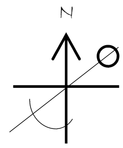
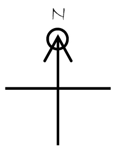
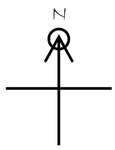
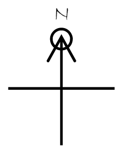
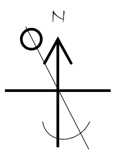
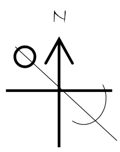
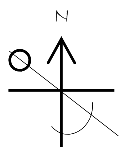
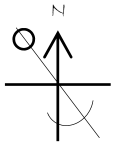
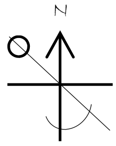
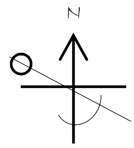
Principle 3 Spacing of buildings
(to avoid overshadowing)

3c) Shadow direction

To work out the approximate direction of where the shadow will fall in relation to the building, structure or vegetation, refer to **Table 3.**

TABLE 3

Shadow directions from a building/structure vegetation at various times of the year and day. (Eastern Standard Time)

	21st June	21st March & 23rd September	22nd December
9am	 42°	 55°	 77°
11am	 14°	 22°	 37°
Noon	 0°	 0°	 0°
1pm	 15°	 22°	 37°
3pm	 42°	 55°	 77°

4a) Building layout

The physical form of buildings influences their ability to;

- make best use of the sun's energy, natural light, and
- to employ natural ventilation (from prevailing winds).

The layout of spaces within houses in relation to the movement of the sun though the sky is an important factor in terms of energy efficiency.

Spaces in houses need to be laid out to suit the way in which the residents want to live. Four categories of space are common to most houses; they are:

- Living (lounge, dining, family, kitchen, study, etc.)
- Sleeping (bedrooms)
- Service (bathroom, kitchen, laundry, storerooms)
- Circulation (entry, hallways, corridors)

The northern sides of buildings are good locations for living areas, which usually have the largest heating and lighting requirements.

The centre, east, west and south sides of houses are good locations for sleeping, service and circulation areas.

Principle 4 Building design and construction

4a) Building layout continued...

Service zones

The kitchen and bathroom are two of the most expensive elements of a building. If the design of these elements is efficient, the use of resources, both financial and material, can be reduced.

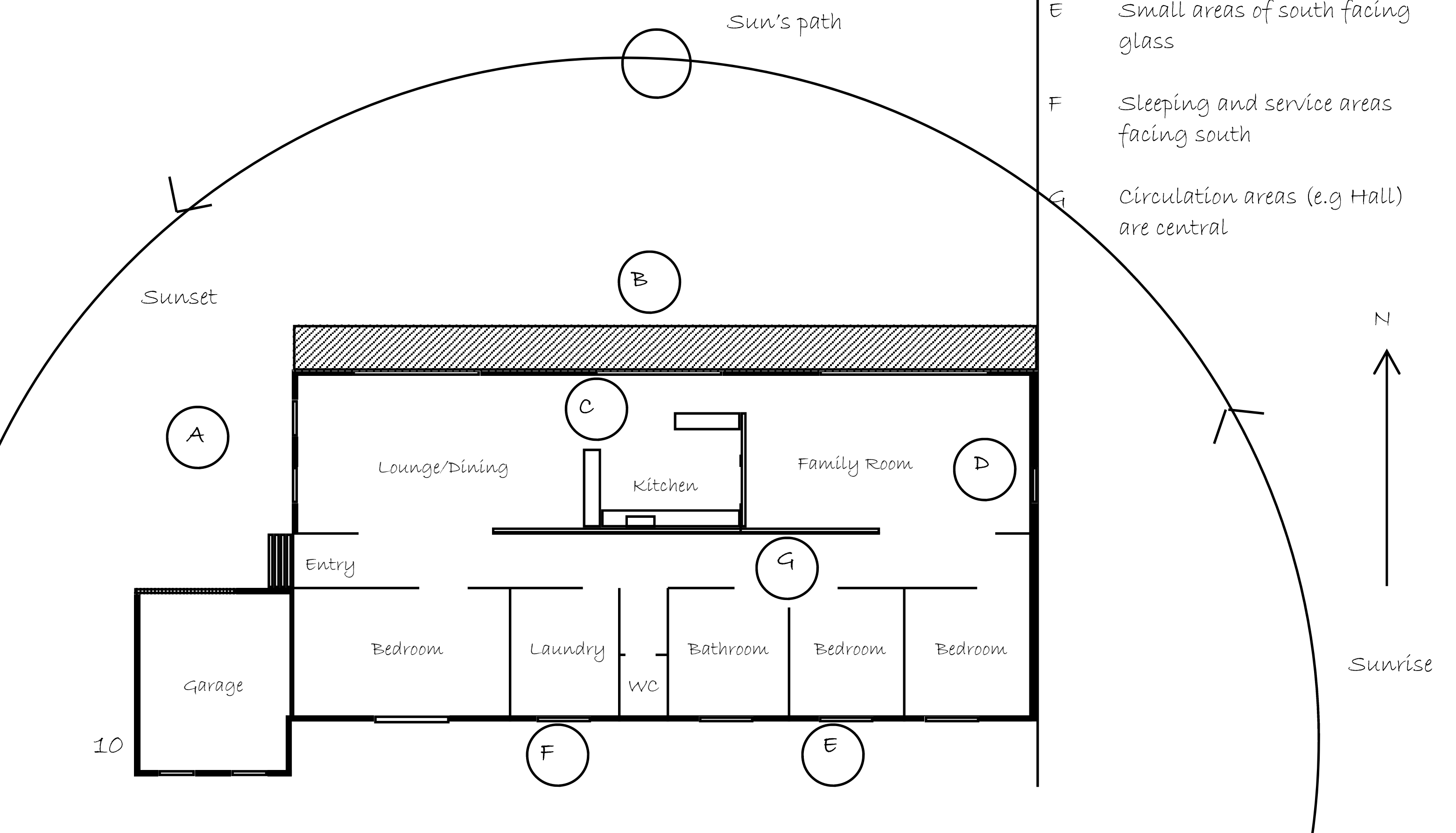
Service rooms: kitchen, bathroom and laundry should be grouped together. This reduces the amount of piping required to service the building.

It is important to insulate the hot water cylinder and locate it as close as possible to the point of use, to reduce the required piping and minimise heat loss.

Note:
As hot water travels through the pipes it cools, thus the closer the source (hot water cylinder) is to the point of use (kitchen, bathroom) the less energy is wasted (and thus money is saved on energy costs.)

Passive Solar Principles,
Key:

- A Small areas of west facing glass with external shading
- B Large areas of north facing glass with external shading of summer sun
- C Main daytime living areas facing north
- D Small areas of east facing glass
- E Small areas of south facing glass
- F Sleeping and service areas facing south
- G Circulation areas (e.g Hall) are central



4b) Windows walls, Roofs and Floors

Windows are the main means of achieving desired solar heat gains, natural light and ventilation. However, they can also be a major route of internal heat loss and excessive heat gain resulting in overheating.

Walls also offer opportunities for solar heat gain, but again can be a major source for internal heat loss through:

- Exhaust fans and vents,
- Gaps around window,
- Door frames,
- Joints between walls, ceilings and floors,
- Up flue of open fireplaces, etc.

Roofs and floors offer opportunities to maintain internal comfort levels, but also provide avenues for undesirable internal heat loss through un-insulated floorboards and ceilings.

The following pages offer some solutions to maintaining the appropriate levels of comfort for people living in buildings.

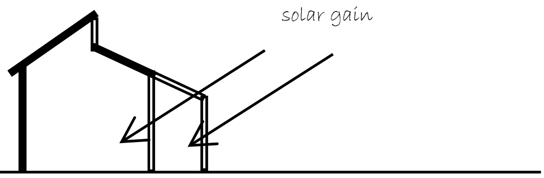
4c) The role of sun spaces

Sun spaces

As the name suggests, in addition to extending living space, Sun spaces can greatly enhance use and enjoyment of the sun's heat and light.
Sun spaces can also assist with ventilation management.
Sun spaces are best used as thermal buffers, serving as an intermediate space between indoor and outdoor environments.

Ideally, sun spaces face north and are free of overshadowing. The use of double glazing and insulation in the floor and side walls will assist in lengthening the time in the day and year in which the sun space will be comfortable.

High and low level opening vents and blinds need to be provided in the space to help repel excessive summer heat. Main building walls, windows and doors facing the sun space should be insulated to the same standard as any other part of the external building shell. This will help avoid summer overheating and winter heat-loss within the main building.



In addition to extending living space, Sun Spaces can greatly enhance use and enjoyment of the sun's heat and light.

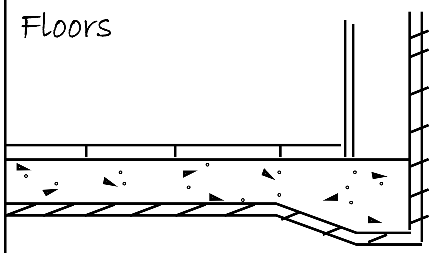
Roof insulation

A high standard of roof insulation is one of the most cost effective ways of saving energy. A roof can also be designed to incorporate solar panels and skylights, making further use of the sun's energy.

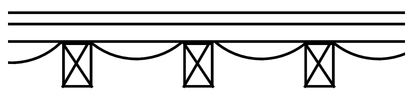
Floors

Floors can be insulated to reduce internal heat loss, to assist in maintaining higher internal surface temperatures and to minimise draughts. Different types of floor construction require different insulating methods. Therefore, choice of construction and extent of insulation are important considerations.

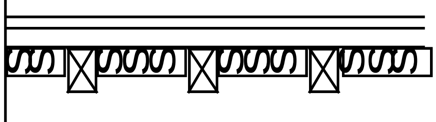
Floors



A Concrete Slab Floor
Tiles or Carpet, concrete and 50mm Polystyrene sheet = R2.00



A Timber Floor
Carpet, floor, air space and reflective foil = R1.12



A Timber Floor
Carpet, floor, and insulation batts/boards/blankets = R 1.92

R = Thermal Resistance to the passage of heat provided by an element (Roof, floor, wall etc.)

Windows

Size:

Large windows placed on the side of a building orientated within the range which takes as full advantage of as possible the sun's energy for heating and daylight (see Principle 2, page 3), will admit more sunshine to heat and light the building.

Large windows however, can provide diminishing returns as they allow heat to be lost to the outside if un-insulated. Windows may also increase the likelihood of summer overheating if inappropriately positioned.

Small windows placed on the eastern, western and southern facing elevations help to reduce potential summer overheating and loss of heat in winter. Insulating windows will further assist these aims.

Type of glazing:

The use of double glazing, or glass that has been coated to limit solar gain or heat loss, will reduce the amount of light passing through the windows. However this is offset by the improved heat insulation which these forms of glazing offer.

Frames:

The material of window frames has a large impact on heat loss through windows. Frames made of conductive material (e.g Aluminum), transmit substantial amounts of heat out of the building. This is poor in terms of energy efficiency, increasing heating requirements, and therefore costs.

Energy efficient alternatives include timber frames and frames with thermal breaks. Initially these frames are more expensive than standard frames, but permanently reduced heating costs more than recover the cost in the medium to long term .

Window design:

The design of windows is very important to regulate the amount of sunlight, heat and cooling air entering buildings. Windows which allow the size of openings to be varied are the most effective.

External surfaces:
Through careful planning and design, the need to screen or filter sunlight with blinds or curtains can be effectively removed.

External shading:
External shading from appropriately sized overhanging structures such as eaves, pergolas, awnings, window shutters and louvres can be designed to moderate solar gain in summer and faciliate solar gain during winter.

Internal shading:
Internal shading devices such as blinds, drapes, and curtains will only reflect a portion of the sun's energy back outside. Whilst this may reduce heat gain to some extent, it is more effective to prevent the unwanted heat from entering the building in the first place. This method also ensures that light levels can be moderated independently of temperature.

Air leakage

4d) Paths for air leakage

There are a number of places in houses where air can leak out, the diagram on page 15 illustrates some of these.

Below are suggested solutions, to minimise heat loss and draughts:

- Skylights provide a number of avenues for air leakage. By using double glazing or glass which has been coated to limit solar heat gain/loss, the amount of heat lost through the glass is greatly reduced whilst retaining the additional light they provide. During installation, all gaps between the skylight and the main building should be packed with appropriate insulating material.

- Some light fittings need to be vented into roof spaces to avoid heat build-up. Such venting provides for substantial heat loss. Installing low-voltage, compact fluorescent, or other non-vented lighting is an energy efficient alternative.

- Exhaust fans are designed to transfer significant amounts of air from inside the building. This is not always desirable– e.g on cool days. By installing exhaust fans which snap shut when not in use, heat loss will be reduced.

- Fire places (especially open ones) also transmit significant amounts of air out of buildings.

  Installing dampers to close off chimneys when not in use and sealing around gaps between flues and main buildings with appropriate insulating material will significantly reduce internal heat loss.

Note:
Consideration should be given to air leakage issues whilst considering ventilation requirements. The ability to moderate the amount of air passing through a building is critical:

Good design: Cosy in winter/ cool in summer
Poor Design: Draughts in winter/stuffy in summer

Air leakage equates with waste of both energy and money.

When a building is heated, energy is transferred from the heater to the air. If substantial amounts of air are passing out of the building and lost, then a substantial amount of the money spent on heating is also wasted.

In order to reduce the waste of both money and energy air leakage should be minimised.

4d) Paths for air leakage

Continued...................................

Gaps around windows and doors provide many opportunities for much heat loss from within buildings.

Avenues for air leakage can be minimised by:

- packing gaps with appropriate insulating material prior to fitting architraves and lining boards.

- filling smaller gaps between architraves and wall lining with caulking compound, and

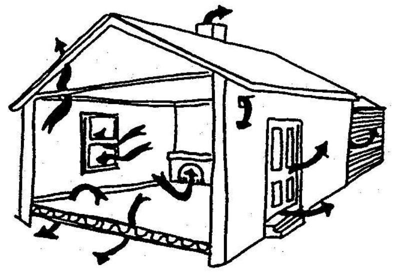
- installing rubber or foam seals around edges of windows and external door frames.

Gaps between floors and walls, and between floorboards, provide opportunities for heat loss.

Again air leakage can be minimised by:

- packing gaps with appropriate insulating material prior to fitting floors and wall linings, and

- filling smaller gaps between floor boards and wall linings with caulking compound, and installing underfloor insulation.



Paths for air leakage

Gaps between new building extensions and existing buildings can provide many opportunities for heat loss. Air leakage can be minimised by:

-packing gaps between both structures with appropriate insulating material, and

- filling smaller gaps with caulking compound, and installing appropriate insulation.

4e) Thermal mass

Tasmania's cool temperate climate means that the storage of heat through thermal mass is an important factor in achieving occupant comfort.

'Thermal mass' describes materials which have the ability to absorb and store heat. Generally, the heavier and denser the material, the more heat they will store, and the longer it will take to release that heat.

To take as full advantage of the sun's energy as possible, buildings need to be constructed of materials which have good thermal mass, such as rock, stone, bricks and concrete.

To be most effective it is suggested that consideration be given to locating such materials:

- Inside the insulated fabric of buildings.
- In north-facing living areas where they can absorb directly the winter sun and light.

Thermal Mass:

The higher the value, the higher the heat storing capacity of the material.

Table 4 (page 17) compares the approximate thermal mass of materials commonly used in building construction.

Thermal Mass of Water
Whilst not a common building material, water has been used successfully in the construction of walls and has exceptional thermal mass properties (838kj.m2k.) This figure is twice that of Dolerite, the material with the next highest heat storing capacity.

4 e) Thermal mass continued.........

TABLE 4: Thermal Mass of Various Materials

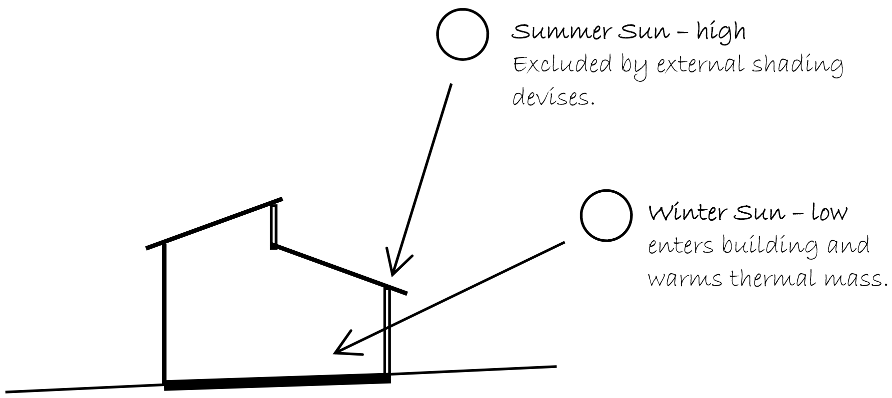
Material	Thickness of the Material (mm)	Thermal Mass (in kj/m²K)
Dolerite (Rock / Stone)	200	433
10-31 solid brick	190	410
Adobe	200	340
Concrete	100	221
Adobe / Mudbrick	200	200
Concrete block	90	194
Clay brick	113	187
10.01 regular brick	90	151
Clay brick (3.5kg solid + 0.5kg mortar)	110	142
Clay brick (3.0kg face + 0.5kg mortar)	110	124
Aerated concrete block	100	50
Fibre cement sheet (compressed)	18	32
Wood flooring (hardwood)	19	25
Weatherboard (softwood)	15	16
Fibre cement sheet	6	8
Plasterboard	10	8
Glass	3	6
Expanded polystyrene (EPS-class SL)	50	1.8
Cork	6	1.6
Rockwool (batts)	50	1.5
Fibreglass (batts)	50	0.5
Air	50	0.5

Principle 4 Building design and construction

Thermal mass

4e) Thermal mass continued.........

The sun's light falls upon the earth at varying angles depending upon the time of year. As illustrated below, summer sun is 'high', winter sun is 'low'. This offers opportunities to control the amount of solar gain, e.g moderate summer heat/gain and maximise winter heat/gain.



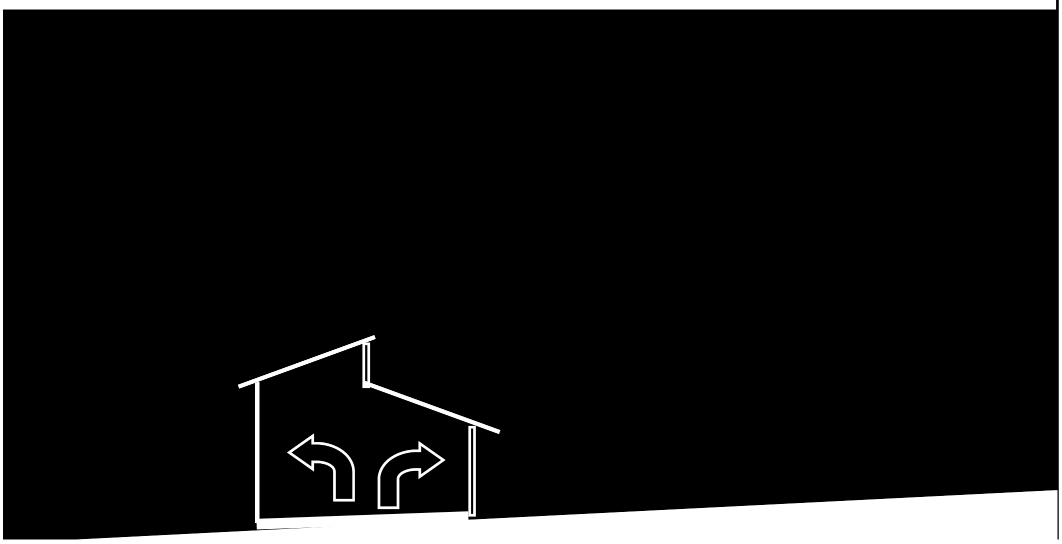
Thermal mass soaks up heat

Day

During the day:

In **summer**, external shading devices prevent internal walls and floors with thermal mass being exposed to summer sun. They remain cool, providing relief from the prevailing heat.

Low **winter** sun enters the building through large north facing windows. Internal walls and floors with thermal mass soak up the heat.



Heat radiates back into room

Night

During the Night:

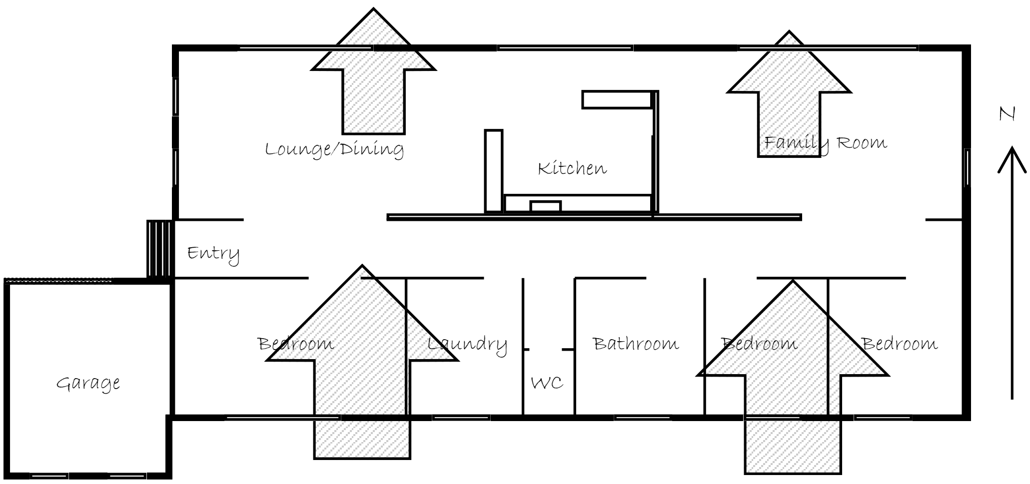
In **summer**, when evenings can be hot, thermal mass, having been isolated from hot summer sun during the day, remains cool providing comfortable ambient temperatures.

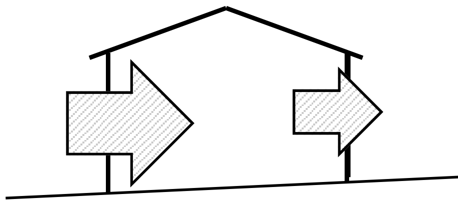
In **winter,** when evenings are generally cold, the heat absorbed by the thermal mass, and stored during the day, is released back into rooms.

4f) Ventilation and cooling

In Tasmania, attention usually focuses on providing warmth in winter, without much thought to ventilation and cooling in summer. Often there is scope to accommodate both at the same time.

Careful thought to building design, in particular window location, size, and type, can reduce reliance on artificial ventilation systems (such as air conditioning and electric fans) Prevailing natural breezes can be used to provide ventilation.





- Orientate buildings to benefit from south/easterly to southerly cooling afternoon summer breezes.

- Ventilation needs to be controllable in order to prevent unwanted heat loss.

- A rule of thumb suggests that the openable size of any opening should not be less than 5% of the floor area of the room to which it belongs.

- Locate openings on opposite sides of the building and in line with each other to assist ventilation cooling by prevailing breezes.

- But remember; windows facing east and west need to be smaller than those facing north and will probably require shading to protect from morning and afternoon sun. Windows on the south will need to be as small as possible to minimise heat loss in winter.

It is important to consider air leakage when facilitating ventilation. See notes on page 14 and 15.

Openable windows and doors need to be appropriately placed and large enough to allow for effective cross-ventilation; i.e to allow air to enter the building from one side, pass through and out the other side, replacing warm inside air with cooler outside air.

4g) Insulation

Insulation performs two important functions when installed in windows, walls, ceilings and floors. It:

- reduces heat loss through the building shell.
- reduces potential for the inside of buildings to overheat.

Installation of insulation in combination with correct building orientation, appropriate thermal mass and window design can deliver appropriate thermal comfort levels, with minimal need for artificial heating.

The insulation effectiveness of materials is expressed in terms of their resistance as R-Values. The larger the R-Value, the more effective the insulation.

The following minimum R-values are required, by the Building Code of Australia, for Hobart:

- Roofs/Ceilings to have insulation added with an R-Value of 3.5; resulting in a total R-value of about 3.9.
- Brick Veneer/Weatherboard/Cement Sheet Walls to have insulation added with an R-Value of 1.5; resulting in a total R-value of about 1.9.
- Concrete Block/Cavity Brick Walls to have insulation added with an R-Value of 1.0; resulting in a total R-value of about 1.9.
- Floors to have insulation added with an R-Value of 1.0; resulting in a total R-value of about 1.7.

Table 5 (page 21) indicates the R-Values of various common types of construction, both un-insulated and insulated.

4g) Insulation continued

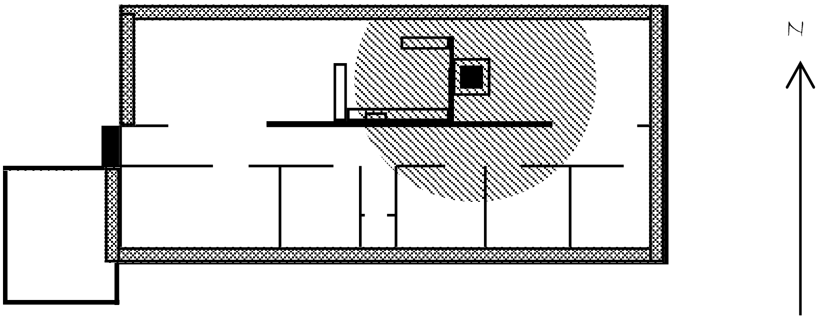
TABLE 5 R-Values for various types of Construction

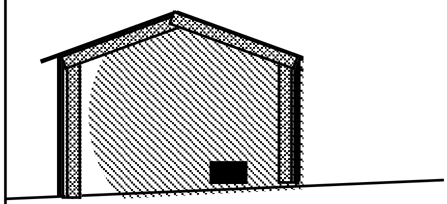
Type of Construction	Total R-Value
Un-insulated Construction Unlined and un-insulated Roofs and ceilings.	0.70 (Summer) 0.35 (Winter)
Un-insulated weatherboards with 10mm plasterboard internal lining.	0.54
Un-insulated brick or block veneer with 10mm plasterboard internal lining.	0.53
Un-insulated brick or block cavity wall.	0.53
Mud brick (300mm thick).	0.24
Autoclaved aerated concrete (200mm thick) and render coated.	1.71
Single glass windows without curtains.	0.17
Double-glazed windows without curtains.	0.34
Un -insulated Concrete Floor	0.26
Un- insulated Timber Floor	0.1
Insulated Construction Roofs with R3.5 insulation.	3.90
Weatherboards with 10mm plasterboard lining and reflective foil insulation between.	0.92
Weatherboards with 10mm plasterboard lining and R2 insulation between.	2.78
Brick or block veneer with 10mm plasterboard internal lining and reflective foil between.	1.48
Brick or block veneer with 10mm plasterboard sheet internal lining and R2 insulation between.	2.50
Brick or block cavity wall with 50mm polystyrene sheet between.	1.85
Single skin insulated block wall (200mm thick), rendered outside, with 10mm plasterboard on the inside.	1.75
Hollow cement blocks (2x90mm thick) with 30mm polystyrene sheet between.	1.58
Single glass with close fit curtains.	0.5
Double glazing with close fit curtains.	0.68
Floorboards, carpet, airspace, with reflective foil under.	1.12
Floorboards, carpets, with insulation batts, boards or blanket under.	1.92
Concrete floor, carpets or tiles, with 50mm thick polystyrene sheet.	2.00

Note:
For more information on insulation installation see:
Your Home Technical Manual
Www.yourhome.gov.au/technical

4g) Heating

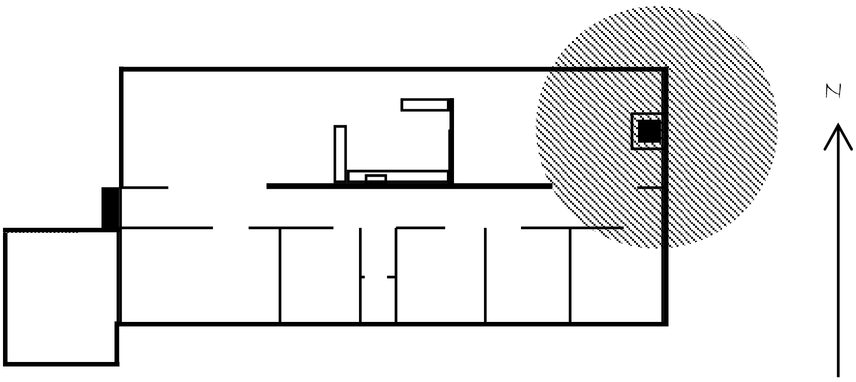
Good Practice

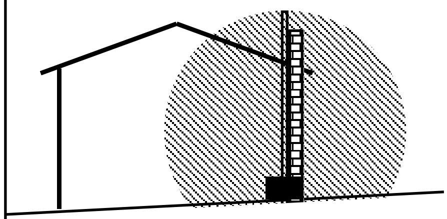




Heater is inside the insulated building envelope, heat generated is kept within the building.

Poor Practice





Heater is within an un-insulated building and on an exterior wall, heat generated is transferred outside – and lost.

Principle 5 Landscaping

Landscaping is an important consideration in terms of maximising the energy efficiency of buildings. It is critical to the core objectives of energy efficiency. It can:

- facilitate solar heat gain,
- reduce potential for overheating in summer,
- minimise cold air draughts in winter and
- provide maximum daylight gain.

Poorly placed vegetation and inappropriate positioning of buildings in relation to existing trees can undermine these objectives.

A key aim of landscaping for solar heat gain is to avoid overshadowing. It is important, therefore, to pay particular attention to the spacing of landscaped elements (i.e earthworks, walls and vegetation) in relation to buildings and the sun's path through the sky.

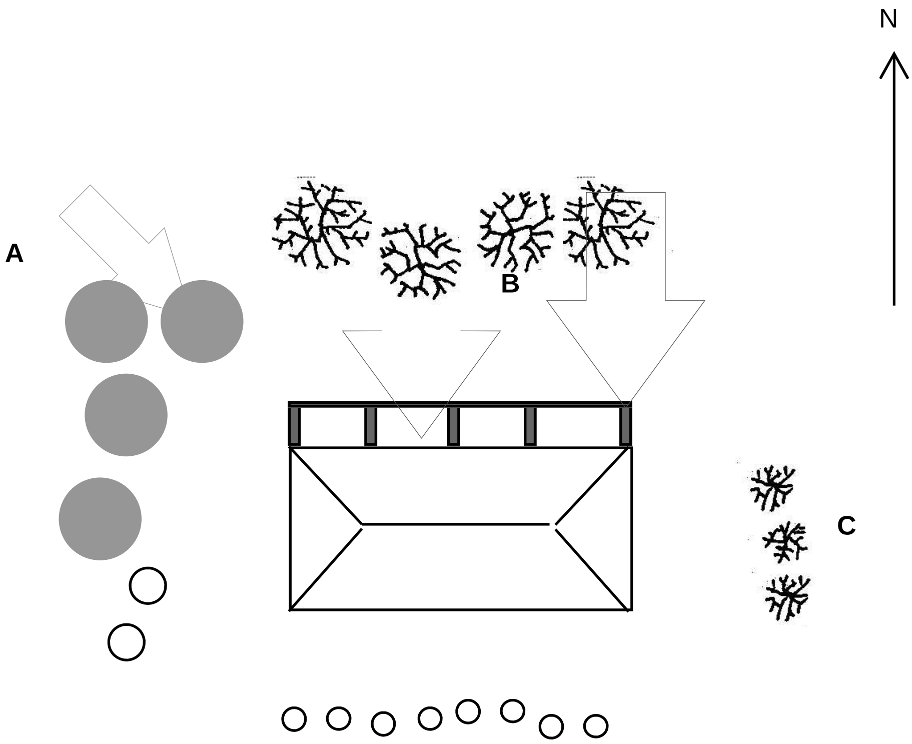
Generally, vegetation, when mature, should not block winter sun from entering windows or from reaching solar collectors (e.g solar panels)

Vegetation placed close to buildings, particularly on their north and east facing sides, can also help to reduce over-heating in summer or late afternoons, although its use for such purposes needs very careful thought. Deciduous (leaf shedding) vegetation offers particular possibilities because it can provide extensive shading in summer, when in leaf, and allows sunshine to filter though bare branches in winter when leaves have fallen.

Landscape design can also prevent cold winds from passing through development causing unwanted draughts.

A mixture of species is most effective at providing high and low level protection from cold winds.

Vegetation can serve as a windbreak, i.e to block and deflect cold winds. Selection of species should be made carefully, having regard to their height, spread and long-term screening capability. For example, some species begin life as dense bushy saplings proving good shelter from cold winds at ground level. However when fully grown their canopy is confined to the top of the tree, casting long shadows and letting wind pass virtually unimpeded between slender trunks below.

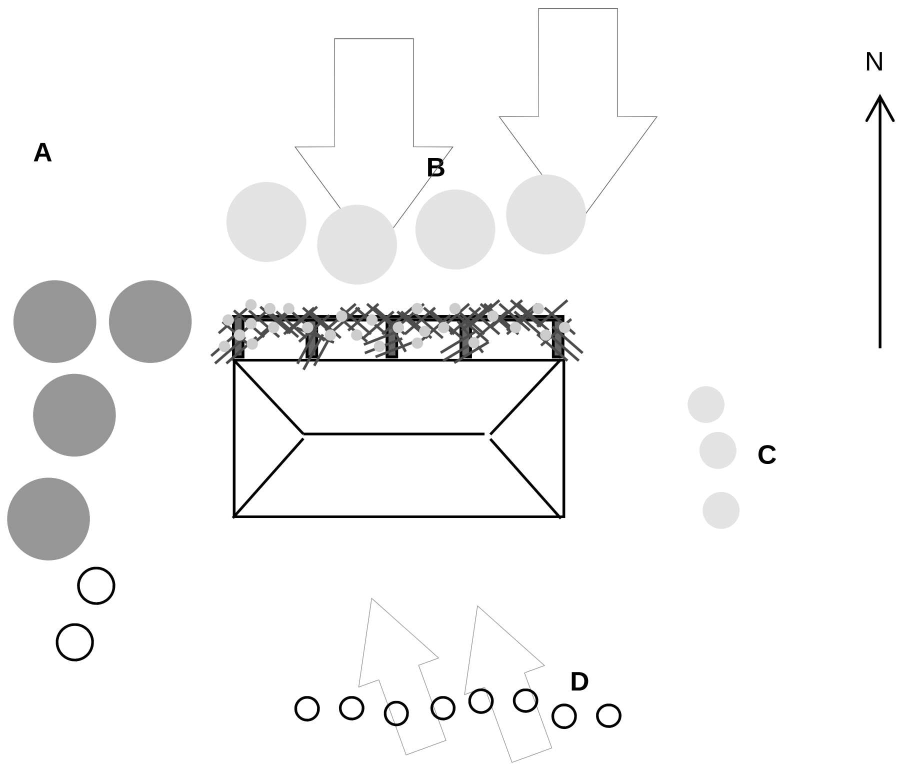


Winter

Winter

A
Non-deciduous vegetation to west provides shelter from cold prevailing winds from the north/ west

B & C
Deciduous vegetation to north and east facilitateS entry of light and warmth.



Summer

Summer

A
Non-deciduous vegetation to west provides shade from afternoon sun to reduce chance of building overheating.

B
Deciduous vegetation shades building.

C
Small deciduous trees to shade east façade walls and windows.

D
Low planting facilitates cooling south easterly breezes.

Landscaping in Sensitive Areas

Notwithstanding the above discussion on landscaping to maximise energy efficiency of buildings, the preferred treatment is not always appropriate for reasons such as:

- Native bushland conservation and character of area.
- Adverse visual impact.
- Bushfire threat minimisation and Management.

Where these issues are relevant they should take precedence over landscaping for energy efficiency as they involve matters of long-term environmental/ ecological sustainability and safety.

Mutually acceptable solutions can often be developed.

When considering developing or living in bushland areas, it would be prudent to first discuss proposals in terms of landscaping with Council staff, prior to the lodgment of the application or implementation of the energy efficient landscaping design.

Acknowledgments / Further Information

Australian Government—*Your Home Technical Manual*
Www.yourhome.gov.au/technical

Australian Greenhouse Office & Australian Building energy Council (2001) Your Home Your Future Your Lifestyle , Australian Greenhouse Office.

Australian Greenhouse Office (1999) *"Scoping Study of Minimum Energy Performance Requirements for Incorporation into the Building Code of Australia",* Commonwealth of Australia.

Australian & New Zealand Solar Energy Society (1994) *"Solar Kit"*, ANZSES, Hobart.

Department of the Environment, Transport and the Regions (1999) *"Planning for Passive Solar Design",* BRECSU, United Kingdom.

Department of Infrastructure Planning (2000) *"Draft Residential Code",* Department of Infrastructure, Victoria.

Department of Primary Industries and Energy (1992) *"Energy Efficient Australian Housing",* 2nd Ed., Australian Government Publishing Service, Commonwealth of Australia.

Department of Primary Industries and Energy (1996) *"Site Planning in Australia",* Australian Government Publishing Service, Commonwealth of Australia.

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Telephone: (03) 6230 5305, Facsimile: (03) 62 30 5380
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Housing Industry Association Limited (2000) *"PATHE - Energy Management - Guide for Residential Building",* Housing Industry Association, Australia.

Housing Industry Association Limited (2001) *"PATHE - Insulation Management - Guide for Residential Building",* Housing Industry Association, Australia.

Leichhardt Council (1994) *"Leichhardt Energy Efficient Housing Program",* Leichhardt Council, NSW.

Standards Australia (1993) *"Australian Standard - AS2627.1 - 1993"*, Standards Australia, NSW.

Sustainable Living Tasmania—www.tasmanianenvironmentcentre.org.au

Suggestions for Improvements

Any feedback or suggestions on how these guidelines could be improved are welcomed. Please contact the Hobart City Council;

Telephone: (03) 62 382 155
or
Write to: Hobart City Council
GPO Box 503 E
Hobart 7001

Notes

HOBART
CITY COUNCIL

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