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# Sustainable building in the Queenstown Lakes District

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## Foreword

# Sustainable building in the Queenstown Lakes

These guidelines are intended as starting point for developers and the construction industry in the Queenstown Lakes region on how to improve the sustainability of their buildings. Sustainability is effectively 'getting more for less'; improving a building's performance while reducing its environmental impact. Through delivering a sustainable building, developers can reduce running costs, reduce emissions both in construction and in use, improve comfort of occupants, increase resale value and address New Zealand's growing energy dilemma.

Sustainability has become a key issue in recent years, in both central and local government policy making, and sustainable building has a critical role to play in the path to sustainable development. In a recent press release, Helen Clark summed up the benefits of sustainable building: “Creating more efficient houses and commercial buildings is a triple win for New Zealanders’ health, our environment and our power bills.”

Central Government requires councils to consider the social, environmental, economic and cultural impacts of their policies and planning[i]; Queenstown Lakes District Council is showing a proactive approach to sustainability which will raise the bar both for landowners, developers and businesses in the Queenstown Lakes region. The scale of the building industry in the Queenstown Lakes means that developers, designers and builders can have a significant influence on sustainable development in the region.

The guidelines that follow offer general information on sustainable building. Each project will have its own unique challenges and opportunities.

If the principles of sustainability are adopted early in a project, and adhered to throughout from conception to commissioning, the result will be a high quality building that performs well for generations, while protecting our precious environment.

## Sustainable Building in the Queenstown Lakes

Below, a list of factors which make a building sustainable are shown in their order of priority in the Queenstown Lakes Region. Note that priorities will vary from region to region and also, to a lesser extent, from site to site and building to building.

| | | Priority | Benefit: Health | Benefit: Comfort | Benefit: Energy use/ CO2 emissions | Benefit: Pollution | Benefit: Resource use |
|---|---|---|---|---|---|---|---|
| **1** | **Insulation** | | ◊ | ◊ | ◊ | | |
| **2** | **Passive solar design** | | ◊ | ◊ | ◊ | | |
| **3** | **Sustainable heating systems** | | ◊ | ◊ | ◊ | ◊ | |
| **4** | **Sustainable water heating systems** | | | | ◊ | | |
| **5** | **Building management** | | | ◊ | ◊ | | |
| **6** | **Site management** | | ◊ | | | ◊ | ◊ |
| **7** | **Sustainable subdivision design** | | | | ◊ | ◊ | |
| **8** | **Energy and water efficient lighting and appliances** | | | | ◊ | | ◊ |
| **9** | **Reducing water consumption and treating waste water** | | | | | ◊ | ◊ |
| **10** | **Building materials** | | ◊ | | ◊ | ◊ | ◊ |

## Contents

# Introduction to sustainable building: Sustainability, comfort and energy efficiency

**Sustainability** in buildings refers to many things, including energy efficiency, indoor air quality, embodied energy, construction waste and recycling, pollution and toxicity in manufacture of building materials, comfort, affordability, aesthetics, consumption of finite resources, landscape and degradation of land. Sustainability in the context of housing means creating comfortable, durable and healthy homes that have a low impact on the environment.

**Comfort** means that the internal temperature of a building is maintained at a comfortable level without the occupants spending an excessive amount on heating. The factors that most directly affect comfort are the quality and thermal efficiency of the building envelope, and the effectiveness of the heating system. 18°C is an appropriate target for internal temperature for all habitable rooms in dwellings, according to the World Health Organisation.[ii]

**Energy efficiency** means creating a building envelope and building services that result in low energy consumption while the building is in use. Energy efficiency has wider implications in terms of carbon emissions, either directly as in the burning of gas for water heating, or indirectly as in electricity generated from non-renewable sources. Energy efficiency will also help slow the increase in the demand of electricity. Energy efficiency is directly related to the running costs of a building: energy efficient buildings cost less to run. Using heating energy more efficiently also improves local air quality since the majority of heating comes from burning wood.

## Passive Solar Design

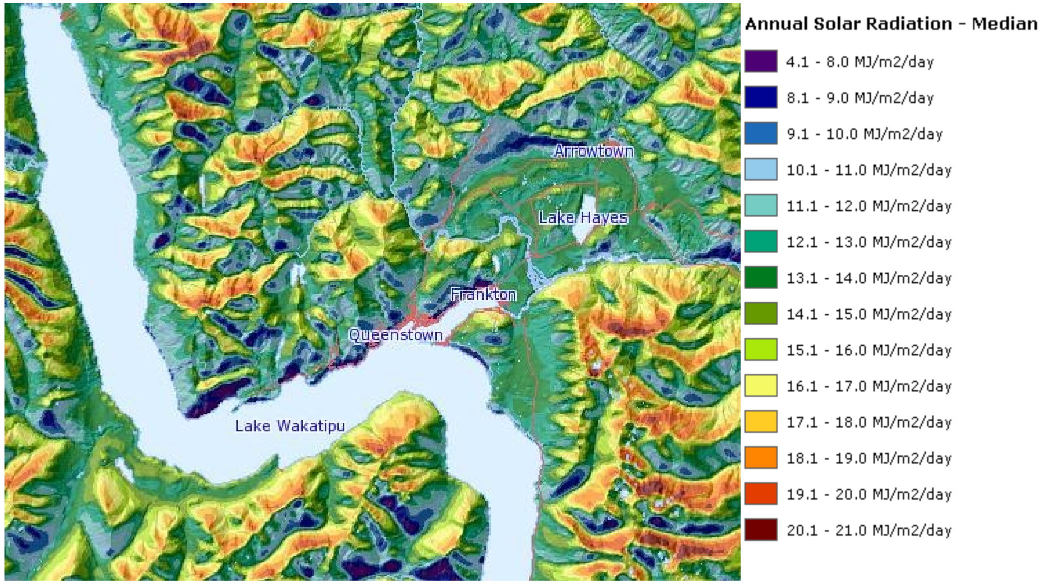
Queenstown Lakes District has a sunny climate but the nights are often cold. The sun's energy can be used as a free heat source. The following guidelines should be followed to make the best use of heat from the sun.

Orientation

Where possible all dwellings should have North facing living areas and an area of North facing roof to utilise active solar systems. Buildings should be oriented on an East-West axis (long facade facing North i.e., a rectangular building platform). Each 10 degrees orientated away from North adds approx 2% to a building's annual energy consumption. Roofs should always have generous eaves, or some other form of shading, to the north to shade from high summer sun.

Thermal Mass

An essential part of passive solar design is thermal mass. How a building is constructed, and what materials are used, determines the quantity and location of thermal mass. The function of thermal mass in building is to store heat, usually from the sun, for when it's needed. It is also used to absorb excess solar heat in summer. In other words thermal mass is used to regulate temperature in buildings. Thermal mass is usually used to store heat collected during the day and release it during the night.




Solar radiation map from the GrowOtago website

**Notes on thermal mass:**

- In order to take advantage of thermal mass, solid floors must be exposed (not lined with carpet or timber); at least in the 6m perimeter closest to the North façade. Areas of 'warmer' materials like carpet or timber flooring can be localised, especially in rooms that don't get much sun. Solid walls should be exposed or finished with solid plaster, not wall board.

- It is possible to have too much thermal mass in a building, which will result in too much heat being absorbed by the mass and not reradiating it. This can be checked easily on ALF[iii], a simple piece of software, available from BRANZ, which can calculate the energy consumption of a building.

## Glazing

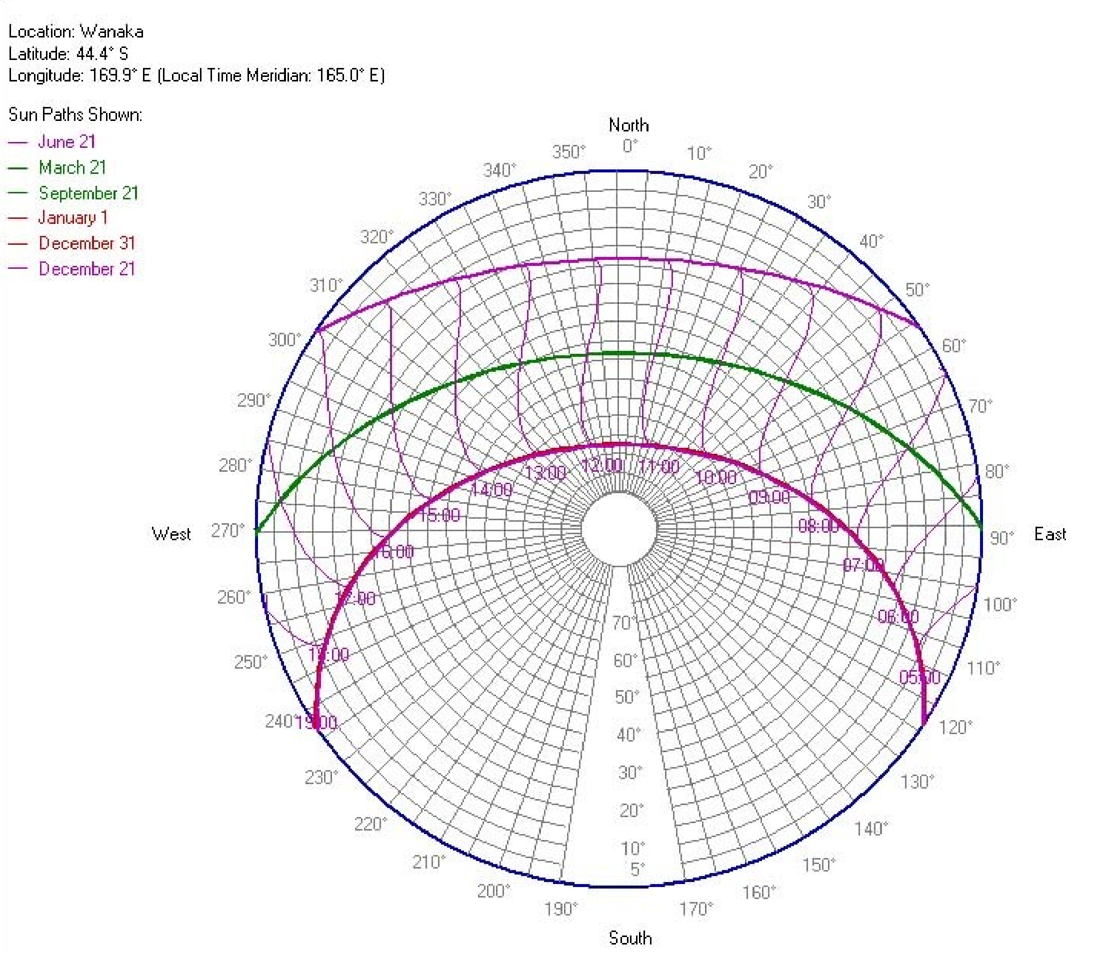
The R-value recommended for glazing in this report can be met with a **double glazed unit with a lowE coating, 12mm cavity and Argon gas fill**. Windows should predominately face North, Northeast or Northwest. Windows on South and West facades should be small in size.

**Notes on Glazing:**

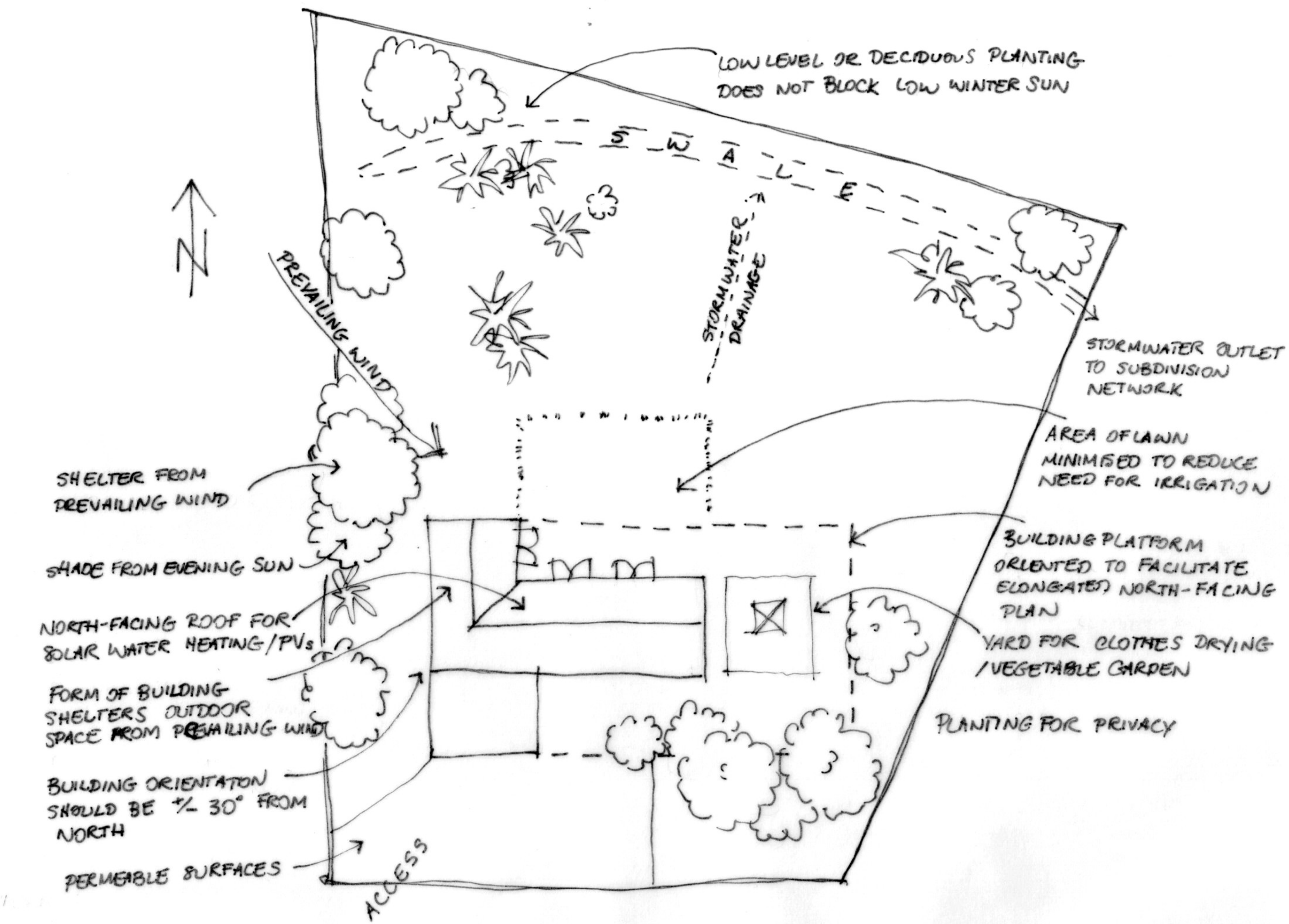
- If there is a lot of South facing glazing it should be well insulated with thermally lined curtains
- West facing glazing should be shaded from the sun using shutters, planting or pergolas to prevent overheating in Summer.
- Window frames of good thermal performance, low environmental impact should be specified. Developers are encouraged to specify timber, thermally broken aluminium or composite (aluminium/timber).
- Tinted glazing can be used to reduce the risk of overheating in the summer, although this can reduce useful solar heat in Winter. A better solution is to provide overhangs or adjustable shading (shutters, canopies, blinds).

## Passive ventilation

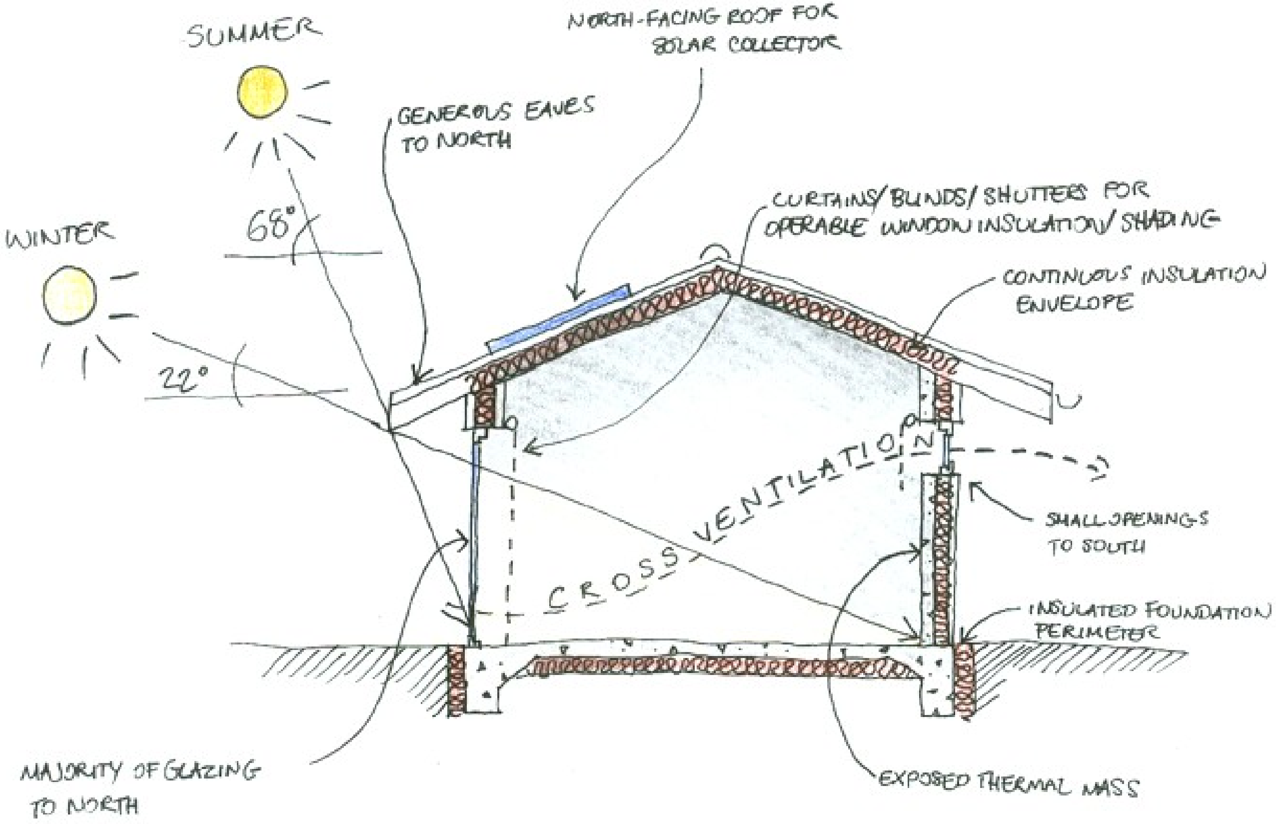
Narrow plans are necessary for passive solar heating and, if operable windows or vents are designed on both sides, also facilitate natural ventilation. Naturally or passively ventilated buildings use the form of the building to encourage airflow and remove excess heat in summer. See the diagram on page 9.




Sun path diagram for Wanaka




**Passive site design**




**Principles of passive solar design**

## Insulation

Glasswool is generally the most cost effective form of insulation for framed construction, although natural alternatives like sheep's wool can perform just as well. For solid construction, where rigid, water resistant insulation is required XPS (Extruded polystyrene) insulation is recommended (XPS is the only form of fully water resistant insulation).

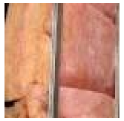
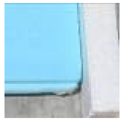
Table 1 shows the recommended R Values for insulation in the Queenstown Lakes District.

**The heating benefit indicates the heating energy consumption of the best practice building compared to a building built to current Building Code requirements.**

**Table 1: Best practice R-values**[iv]

| **Construction type** | **non-solid** | **Solid** |
|---|---|---|
| **Roof** | 3.5 | 4.0 |
| **Walls** | 2.6 | 1.9 |
| **Floor** | 3.1 | 1.9 |
| **Glazing/Roof-lights** | 0.48 | 0.48 |
| **Indicative heating benefit** | **44%** | **48%** |

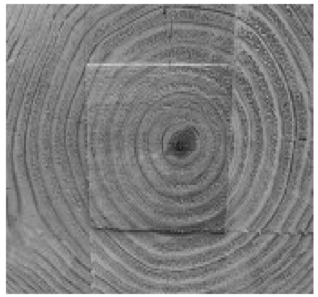
Table 2: Insulation compared

| | Insulation type | Application | | | Available R-values ($m^2K$ /W) | Comparative R-values ($m^2K$ /W) of 100mm of insulation | Comparative cost /$m^2$ | Pay-back period |
|---|---|---|---|---|---|---|---|---|
| | | Roofs/ ceilings | Walls | Floors | | | | |
|  | **Glass fibre batts** | ▪ | ▪ | | 1.8, 2.2, 2.6, 3.2, 3.6,4.6 | 2.2 – 2.6 | $8.15 | 2.9 years |
|  | **Polystyrene** | ▫ | ▪ | ▪ | 0.45, 0.6, 1.1, 1.4, 1.5, 1.7, 1.8, 2.0, 2.1 | XPS: 3.4<br>EPS: 2.4 – 3.0 | $14.72 | 5.9 years |
|  | **Polyester batts** | ▪ | ▪ | | 1.6, 1.8, 2.2, 2.6, 3.0, 3.2 | 1.6 – 1.8 | $9.84 | 3.6 years |
|  | **Wool batts** | ▪ | ▪ | | 1.6, 1.8, 2.2 , 2.6 | 1.6 – 1.8 | $12.28 | 4.2 years |
|  | **Foil faced blanket** | ▫ | ▫ | ▪ | 1.2, 1.3, 1.8, 2.0 | 2.4 – 2.6 (2 x 50mm) | $16.87 | 5.7 years |
|  | **Straw** | | ▪ | | 9+ (500mm) | 9.0 (500mm) | ≈ $5 per bale | - |

**Notes on insulation:**

- Contractors should follow the publication *BRANZ Bulletin 357: BRANZ Thermal Insulation of Houses* which outlines good practice for installing insulation.
- In ceilings or roof cavities two layers of batts can help reduce heat loss through gaps. Two layers of R2.2 are 20% cheaper than one layer of R.4.6 and, although the extra labour may absorb this saving, it is unlikely to be more expensive.
- Recessed down-lights should not be installed; unless the fittings can be insulated over. (See the section Appliances and Lighting). Designers must ensure that there is adequate clearance between insulation and building paper.
- In solid (concrete slab) floors the external perimeter of the foundations and the metre of floor slab closest to the perimeter is where most heat is lost. **These areas are the most important places to be insulated**. 50mm XPS (extruded polystyrene) is recommended.
- Contractors should note that EPS (expanded polystyrene) reacts with uPVC sheathing on electrical cables; in situations where polystyrene will come into contact with cabling, XPS should be used.

## Building materials



Materials, ideally, should:

- be **sourced locally** to minimise the energy required to transport it
- be **benign**, and should not give off toxins once installed
- **not pollute the environment** during their manufacture
- be **durable**
- **not be energy intensive** to produce
- have **renewable, recycled, or recyclable** content

Often these factors are conflicting and will vary from project to project and from product to product, but here is a comparison of some common (and some not so common) building materials:

**Table 3: Materials compared**

| | Embodied Energy | Renewable, Reusable, Recyclable? | Toxicity | Performance in use | Similar alternative material and properties |
|---|---|---|---|---|---|
| **Rammed Earth** | Low if earth on site used and not stabilised or fired | Reusable if not mixed with stabiliser or fired | Low | Not very durable unless stabilised or fired; needs additional insulation, good thermal mass | Earth or unfired clay blocks |
| **Timber** | Low if sourced locally and air dried (as opposed to kiln dried) | Renewable. Reusable if good quality to start with; recyclable as fuel. | Depends on preservative | Flexible- can be used as structure and cladding. | Glulam- greater structural strength; uses timber off-cuts; but if the glue is formaldehyde based may give off toxins |
| **Concrete** | Low by weight but more overall due to amount needed. Cement very energy intensive | Recyclable as aggregate. Not useable | Cement is corrosive and an irritant; Toxic if PFA used as stabiliser | Flexible, durable, good thermal mass | Lime-based concrete- Lime requires less energy in production but not as durable |
| **Steel** | High. Can be reduced by two thirds if recycled | Reusable if mechanically fixed. Steel generally has some recycled content. Steel is recyclable | Low | Durable and strong, but creates thermal bridges (allowing escape of heat) if not lined with continuous insulation. Can be prefabricated | Timber or LVL I beams: Lower embodied energy and lighter |
| **Strawbales** | Low | Renewable | Non-toxic, breathable | Good insulation, not very durable. Large building footprint | Hemp/lime panels- walls can be thinner for same insulation value; infill only |

**Notes on concrete:**

Concrete is not a 'sustainable' material, in that it is manufactured from non-renewable resources and is polluting and energy intensive during manufacture. However, it is also durable, cheap, and inert, is a familiar material and has unique properties. It also has one of the highest thermal capacities of any building material. Its ability to store the sun's heat makes it an appropriate material for sustainable buildings in this climate, despite its environmental disadvantages.

**Notes on timber:**

Where framed construction is used, timber should always be used in preference to steel. Where timber is used, either as framing, cladding, or internal finish, it must come from an FSC (Forest Stewardship Council) or sustainably managed source. Where timber treatment is required always use the least toxic preservative possible: i.e. Douglas fir or untreated kiln dried (UTKD) radiata pine for hazard class H1.1; boron for H1.2; Tanalith E for (up to) H4.

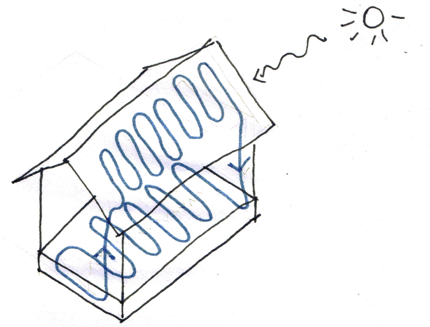
**Notes on internal linings:**

- Where plywood or MDF are used as internal finishes, specify low formaldehyde products. These are readily available in New Zealand.
- Linoleum should be specified in preference to PVC flooring.
- Where solid plaster can be used as an alternative to gib-board it should be specified in preference, as less waste is generated.
- Designers should consider minimising the use of carpet, which can hold dirt, mould and other allergens; carpeting over concrete floors also isolates the thermal mass from the interior of the building. Where carpet is specified, use carpet with low VOC (Volatile Organic Compounds) content and recyclable fibre and backing content.[v]
- Paints with low VOC content should be specified. All paints are required to state the VOC content in their labelling. Environmental Choice[vi] paints must not contain more than 70g/litre VOCs. Water based paints generally contain fewer VOCs than solvent based paints.

## Sustainable heating systems

Heating systems should be as energy efficient, responsive, non-polluting as possible and ideally fuelled by renewable resources. The following heating options should be considered (in order of preference):

- **Solar heating system**. If the site has a good Northerly aspect and is not shaded in winter, an active solar heating system, plus a supplementary heat source (choose from preference below) is a good solution. A basic solar heating system consists of a circuit of plastic pipes under the roof cladding running into a circuit in the floor slab.[vii] On a site with approximately 1920 sunshine hours/year (average for Queenstown[viii]) a



In-slab solar heating

system like this can provide 47% of total heating demand for house[ix]. Sites can be checked on the **GrowOtago** website.[x]

- **Wood burner**. Wood burners need to be energy efficient and clean-burning. They must be at least a minimum of 65% efficient and have a $PM_{10}$ emission standard of < 1.5g/kg. [xi] In some areas (such as Arrowtown) a lower $PM_{10}$ emission standard may be required to be met (refer to the Otago Regional Air Plan). A list of wood and wood pellet burners and their assessed $PM_{10}$ emission levels can be found on the Ministry for the Environment website: www.mfe.govt.nz/laws/standards/woodburners/authorised-woodburners.html

Wood pellets

- **Wood pellet burner**.[xii] Wood pellet burners are an emerging product in New Zealand, having become well established in Europe and North America. They use compressed wood waste to provide particularly efficient heating (with low $PM_{10}$ emissions).

- **Heat pumps.** Although electricity in New Zealand is at least partly sourced from non-renewable sources, electric heating may still be the most practical option for many households. Heat pumps are the most efficient form of electric heating.

In order to achieve the minimum standard of 18ºC in all rooms it is not sufficient to simply heat one room with one of the above products. To achieve sufficient temperatures in all rooms one of the following should be employed:

- **Heat transfer system**. A heat transfer system should be used to distribute heat to all occupied rooms (wood burner must be sized to heat whole house). [xiii] Heat transfer systems can be fitted with relatively little cost when incorporated at the time of construction.

- **Central Heating.** Wood pellet (or other renewable fuel source) in-slab or radiator (water-based) central heating. Central heating may be more cost effective for multi-unit buildings.

## Water heating systems

The following options are good energy efficient ways to heat water. In order of preference:

- **Solar water heating system**. These can be either evacuated tube or flat plate systems. [xiv] All systems must be fitted with appropriate timers and thermostats to ensure good performance. More information on solar water heating systems is available at the Sustainable Wanaka website[xv].The back-up system should be electric storage. [xvi]

- **Hot water heat pump**. Heat pumps can also be used to heat domestic hot water. If the site has a limited solar resource (i.e. areas which receive little winter solar radiation) heat pumps are the next best option after solar water heating.

Cylinders

'A' grade hot water cylinders should be specified.

Wetbacks

Wetbacks are encouraged (BRANZ have found them to be an appropriate form of heating in climates with long heating seasons[xvii] such as the Queenstown Lakes District). Again, minimum standards for solid fuel burners should be complied to. Pellet burners should be chosen in preference to wood burners as these are generally more efficient and produce fewer emissions.

## Water supply and waste water

Queenstown Lakes District has one of the highest per capita water consumption rates in New Zealand. More than half of current water consumption is attributable to irrigation (to lawns and gardens etc). It is notable that as well as many parts of the District having very limited supplies of water, the infrastructure and pumping requirements of water supply are energy intensive and can be costly to the community. There are many ways in which water consumption can be reduced or water can be recycled.

**Notes on ways to improve water efficiency:**

- Installing dual flush or low flush toilets (toilets that use only 3 litres for a half flush or 4.5 litres for a full flush are available)
- Installing composting toilets
- Installing aerators on all taps and low flow adaptors on shower heads. These give the impression of a normal flow but use less water by aerating the water as it leaves the tap.
- Front load washing machines typically use less than half the water of top loaders[xviii]
- Appliances should have a minimum of an ‘AAA’ water use rating. Appliances can be checked on http://www.energyrating.gov.au/

Rainwater harvesting

Low annual rainfall in the Queenstown Lakes region means that rainwater can generally only be used to supplement reticulated supply. A 120 $m^2$ roof during a dry year in Wanaka could provide 2 people with average consumption requirements with enough water to flush toilets and irrigate their gardens (assuming 10% outside water use only) or, for a family of four with average consumption, about 20% of their total requirements[xix]
An easier way to make use of rainwater is to use it for irrigating lawns and gardens.

Guidance on rainwater harvesting can be found on the Sustainable Wanaka website.[xx]

Stormwater

When designing a subdivision, a strategy for managing stormwater should include the following:

- Minimise hard surfaces to reduce run-off. Where hard surfacing is necessary, permeable paving, like grass blocks, turf pavers or concrete segmental paving should be used instead.

- Swales should be specified instead of stormwater drains where possible.

- Specify non-toxic surfaces (paving, roofing materials) so that stormwater can be discharged safely into the ground onsite. Acceptable roofing materials are listed in table 4. Some options for permeable hard surfacing are also listed.

- Minimise run-off by collecting rainwater from roofs which can be stored in holding ponds and used for irrigation.

- The effects of stormwater in heavy rainfalls can be partially mitigated by 'green' or planted roofs which slow the flow of run-off. They also have the benefit of visually blending the building with the landscape.

| | |
|---|---|
| Flat roofs: | TPO membrane, rubber (i.e. not PVC or bitumen) |
| Pitched roofs: | Clay tiles, corrugated steel (galvanised steel, Zincalume, Coloursteel), concrete tiles (i.e. not painted unless paint approved for drinking water collection. Not copper, lead, timber shingles only if untreated) |
| Spouting and guttering: | Stainless steel, non-PVC plastic |

Table 4: Benign roofing materials

Greywater recycling

Greywater is water from your bathroom basin, shower, kitchen sink and laundry. Only water from the bathroom sources can effectively be recycled as it contains fewer contaminants than water from the kitchen or laundry. One of the most effective water saving/treatment applications is the direct use of grey-water for irrigation. Some systems redirect water from showers and bathroom sinks to an underground irrigation system[xxi] . These systems have no storage, which complicates grey-water recycling in other systems. One potential negative result of using this system is that irrigation only comes from grey-water when the house is occupied; at other times fresh-water (on a timer) will need to be diverted to the irrigation system.

Onsite waste water treatment

On-site sewage treatment systems are also expensive and rarely make economical sense on sites that are connected to waste water services or sites close to existing services. However, in some locations, where connection to existing services will be disruptive and costly, onsite sewage treatment may be a feasible option. Options include:

- Reedbeds/ constructed wetlands

- composting toilets
- septic tanks and drainage fields

A services engineer can help design the system most appropriate for the site and the brief.

A newly planted constructed wetland

Measuring water use

Water meters should be installed in all new buildings. Monitoring water usage will allow the council to identify leaks and wasteful users. In areas where charging for water has been adopted water consumption has fallen by 15 – 35%. [xxii]

## Renewable energy

Renewable electricity generation systems are best installed at the time of construction but can be relatively easily retrofitted at a later date. In almost all applications where renewable electricity is incorporated into a development, it will be appropriate to connect the system to the national grid and to arrange to export power. This will ensure a constant and reliable power supply.

There are several options for onsite renewable electricity generation. The Sustainable Electricity Association of New Zealand (www.seanz.org.nz ) can offer advice on all of them. It should be noted that resource consents may sometimes be required to install renewable energy constructions.

Photovoltaics

Photovoltaics have the advantage of having no moving parts and being relatively maintenance free. However, they are expensive and their output varies considerably throughout the year. They generate direct current power, which means that an inverter will be required to convert the power into 240V electricity. Orientation and shading of the site will influence the potential solar resource for electricity generation. The orientation and pitch of the roof - and allowing space for batteries and an inverter - are also important considerations when installing photovoltaics. The optimum pitch of a panel in the Queenstown Lakes is 35° for a grid-connected system and 30° for a stand alone system (Latitude minus 10° and 15° respectively- NZPVA)

Wind

Wind power generators cost less than Photovoltaics on a kW to kW basis and are also an established technology. However, turbines can be visually intrusive and are only suitable for sites that have consistent wind speeds.

Combined Heat and Power
These are a relatively new technology for domestic applications in NZ: However, a Christchurch based company have been exporting to Europe for several years.[xxiii] This technology is based on the Stirling engine and generates heat and power from one fuel source. The fuel is usually gas but could be methane gas from a bio-digester, biodiesel, woodchips or wood pellets.

Small hydro
Small hydro turbines can produce power more consistently than solar or wind and is reasonably cost effective. Only an option where an on-site resource exists

## Appliances and lighting

On average, every household now has 33 appliances.[xxiv] Annually, household energy demand is increasing by 1.5%, while the cost of energy for households has increased 16% since 1995.[xxv]

Lighting

Natural day lighting is always preferable to artificial day lighting. Shallow house plans – orientated towards the North – are easier to light with natural light than deep plans.

- For pendant lighting compact fluorescents should be provided. The New Zealand Government has recently announced it is considering phasing out traditional incandescent light bulbs. Compact fluorescent bulbs use 5 times less energy than traditional incandescent bulbs, which are extremely inefficient as much of the energy input is wasted as heat. Replacing 4 incandescent bulbs with good quality compact fluorescents will cost around $30 and save about $75 every year.[xxvi]

- Halogen lighting, like incandescent lighting, also wastes energy as heat. Because of the potential fire risk of this, ceiling insulation must be cut around recessed down-lights (or have a clearance specified by the luminaire manufacturer), which causes further energy to be wasted as heat escapes through the gaps in insulation. Therefore recessed down-lights should be avoided, unless the manufacturer specifies that their product can be insulated over.

An alternative to CFL lighting is clusters of LEDs (Light Emitting Diodes). This room is lit with LEDs.

- Exterior lighting and security lights should be either controlled by motion sensors or timers.

Appliances

- Consider whether electric towel rails are really necessary. If electric towel rails must be provided, they should be on a timer, and set to come on for no more than 2 hours in the morning and 2 hours in the evening. Appliances should have a minimum star rating, as outlined in Table 5. These recommendations are based on the highest 3 ratings available for each appliance (that are available in New Zealand):

Appliances can be compared at www.energyrating.gov.au

| **Appliance** | **Minimum star rating** |
|---|---|
| Clothes dryers | 2 ½ |
| Clothes washers | 4 ½ |
| Dishwashers | 4 |
| Refrigerators/freezers | 5 |

Table 5: minimum recommended star rating of appliances

Measuring energy use

Electricity meters with a digital display which show consumers exactly how much power they are drawing at any one time could be mounted in a prominent position where they can be seen.[xxvii]

## Building management and user education

Changing ingrained behaviour is a lengthy process but many sustainability features can be undermined unless users understand them. The following actions can help ensure that the intended benefits are realised:

- Provide users with control over their internal environment, e.g. lots of openable windows, central heating with thermostats in each room, adjustable shading. Make systems easy to operate
- Install monitoring devices – water meters and electricity meters – should be accessible, and preferably actually visible, to the occupant.
- Provide residents with a **basic 'users' guide'** to the building. The guide should explain how to get the best performance out of the building and its systems (heating, water heating, water, etc.)

## Sustainable subdivisions

***'Subdivisions and the neighbourhoods they become last for a very long time... It is essential that we get the design right the first time.'*** [xxviii]

Developers subdividing should follow guidelines as outlined in the New Zealand Standard, *Subdivision for People and the Environment*. In particular:

1) Conduct a site evaluation that considers solar access, soils, vegetation, water resources, and important natural areas. This should then form the basis of the subdivision design.

2) Let the landform and vegetation influence the design. Working with an uneven site can promote a variety of building styles, while designing road layouts around existing vegetation may result in a more interesting subdivision layout. Where excavation is necessary, retain the topsoil and use it for landscaping elsewhere on the site.

3) Clustering sections will stimulate variety in layout, foster a sense of community, allow for more land to be left untouched, and condense servicing. Following this approach on a district wide basis will help retain the character of the Queenstown Lakes region, on which its tourism industry relies.

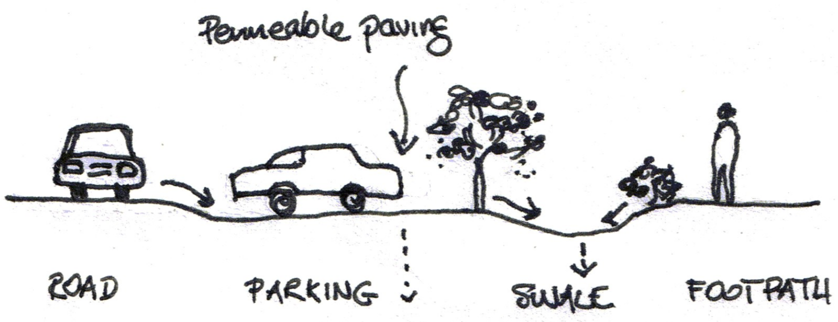




Image of a swale

4) Infrastructure such as swales for storm-water and constructed wetlands for waste water treatment can be landscaped to form features which can double as reservoirs for irrigation.

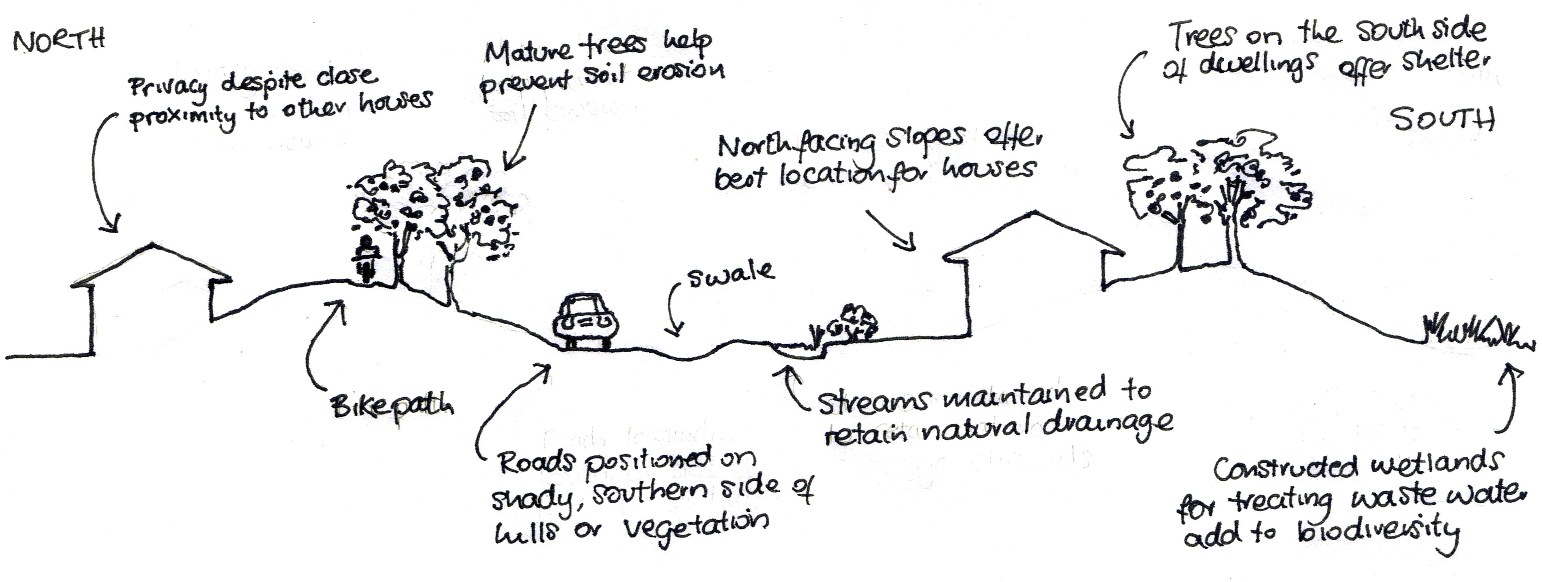
5) Within a subdivision, allow for a variety of densities and uses. Residential zones that include amenities are likely to be more socially successful: local

employment opportunities could reduce the need to commute, and social focuses such as shops or cafes, or public spaces like parks, can stimulate the development of successful communities. Discuss with the Council the potential to include non-residential uses in residential zones.

6) Sections should be dimensioned and orientated to facilitate passive solar design. Building platforms should be elongated along an East-West Axis to the South side of the section to maximise area for North facing gardens and to cut down on overshadowing from other buildings. If possible, sections should be located on North facing slopes.

7) Look beyond the immediate site. How will the subdivision reflect the character of the local landscape? How will the subdivision be linked to nearby amenities? Wildlife corridors within the site should be maintained, and vegetation should appear natural and continuous.

In some instances this approach could reduce the number of sections on the site because some land will be left undeveloped. However, for several reasons, the economic potential of the site may not necessarily be reduced. Sustainable subdivisions require fewer earthworks and less infrastructure (because natural drainage systems are preserved). Retaining existing vegetation can make the subdivision more desirable because the sections will have mature trees which create privacy. Landscaping can also provide shelter from strong winds or shade in summer which in turn makes for a more pleasant outdoor environment. Furthermore, retaining native species is especially beneficial since these are likely to require less irrigation than exotic species, resulting in reduced water consumption. Existing landscape features should be the focus of public areas which will become assets which add value to the subdivision.




**Queenstown Lakes District Council are producing Subdivision Guidelines that will elaborate on some of these principles, which should also be considered when they become available.**

Transport

Transport energy offers a particular challenge in the Queenstown Lakes region. The low population density makes public transport an unfeasible option and as developments spread further from urban centres, the potential for commuting by cycle or on foot are reduced.

- Is the development close to a bus link? Consider providing for an additional stop at the subdivision, or discuss the issue with the Council. If a bus stop is nearby create walking routes in the subdivision to make it easily accessible.
- Where bus routes do not currently exist, consider the possible future use of the roads for buses in the subdivision design. Provide connectivity in the road network of the subdivision so that a bus would be able to easily access the area in the future.
- Provide cycle/walking paths along roads. Some additional paths across subdivisions where there are no roads make cycling a more attractive option, and could also reduce the need for so many roads
- Provide basic amenities within a development so that car trips to larger urban centres are reduced. For example providing for a dairy, if acceptable in planning terms, will save many people having to make long trips for basic goods.


Cycling instead of driving will help reduce carbon emissions

## Site practice

Construction waste makes up 50% of all waste generated in New Zealand.[xxix] Much of this is unused material in the form of off-cuts. The recommendations made in this section also meet some of the objectives of the QLDC Waste Management Strategy.[xxx]

The follow points should be considered for all housing developments:

Designers

- Sizing building elements or room sizes to fit tile or sheet dimensions will minimise off-cuts.
- Rationalising the number of different materials in the design is more economical and means more potential for reuse within the same project.
- If earthworks are part of the building programme the excavated material could be incorporated into the landscape design.

Contractors

- A tidy site will reduce the likelihood of materials being damaged before and while they are being used. A designated central area for cutting of materials and a space set aside for reusable off-cuts makes it easier for the team to use materials efficiently. Ensuring that unused materials are protected from the elements will reduce wastage through water damage. Contractors should also ensure that materials only arrive on site on the day that they are needed. Toxic or hazardous materials should be treated with respect and the contractor should have to draw up a Spill Response Strategy for potential accidents.

- Bins for segregating waste should be positioned in a central location or next to the site skip. Inert building materials such as concrete, bricks, concrete, stone and glass could be reused, recycled or diverted to clean-fill sites if they are kept separate.

- Drawing up a Waste Management Plan can be a useful exercise and will make all staff involved in the project more waste aware. Wanaka Wastebusters can be consulted for assistance in this regard. See the BRANZ 'Easy guide to reducing construction waste' for further guidance. There are a number of free publications on reducing construction waste available on the REBRI website.[xxxi]

Offcuts segregated and stored neatly in a central location

**Appendix 1:**

The minimum insulation standards in the Building Code are under review. These are the proposed new values (schedule method):

***Table i) Department of Building and Housing (DBH) proposed R-values for revised building code***

| | Non-solid construction | Solid construction | |
|---|---|---|---|
| Roof | R3.1 | R3.5 | R3.5 |
| Walls | R2.1 | R1.4 | R1.1 |
| Floor | R1.9 | R1.9 | R1.9 |
| Glazing | R0.26 | R0.26 | R0.31 |
| Roof-lights | R0.31 | R0.31 | R0.31 |

New Zealand Standards have provided a Publicly Available Specification on Insulation (NZS 4244:2003). The 'better' practice levels are based on the proposed revision to the building code. Here is a summary of the recommended levels of insulation for 'better' and 'best' practice:

***Table ii) NZS 4244:2003 (Climate zone 3, non-solid construction)***

| | Code | Better | Best |
|---|---|---|---|
| Roof | 2.5 | 3.1 | 3.5 |
| Walls | 1.9 | 2.1 | 2.6 |
| Floor | 1.3 | 1.9 | 3.1 |
| Glazing | 0.15 | 0.26 | 0.48^ |
| Heating benefit | - | 25% | 47% |

^ Timber frame, lowE glazing.
*overheating. Provide shading and cross-ventilation for summer cooling

This author has modelled a solid construction building using code, better and best levels (better is the DBH proposed code, best is based on practically achievable R-values using readily available insulating products) using a generic house design in the Queenstown climate. These were the results

***Table iii) IES thermal software (non-solid construction)***

| | Code | Better | Best |
|---|---|---|---|
| Roof | 2.5 | 3.1 | 3.5 |
| Walls | 1.9 | 2.1 | 2.6 |
| Floor | 1.3 | 1.9 | 3.1 |
| Glazing | 0.15 | 0.26 | 0.48^ |
| Heating benefit | - | 23% | 44% |

***Table iv) IES thermal software (solid construction)***

| | Code | Better | Best |
|---|---|---|---|
| Roof | 3.0 | 3.5 | 4.0 |
| Walls | 1.0 | 1.4 | 1.9 |
| Floor | 1.3 | 1.9 | 1.9 |
| Glazing | 0.26 | 0.26 | 0.48 |
| Heating benefit | - | 25% | 48% |

***Appendix 2:***

For more tips on creating sustainable buildings and subdivisions, go to:

| | |
|---|---|
| **Sustainable Wanaka** | www.sustainablewanaka.co.nz |
| Sustainable Business Network | www.sustainable.org.nz |
| Ministry for the Environment | www.mfe.govt.nz<br>Sustainable buildings |
| NZ Green Building Council | www.nzgbc.org.nz |
| **Beacon Pathway** | www.beaconpathway.co.nz<br>www.nowhome.co.nz |
| EECA | www.eeca.govt.nz<br>www.energywise.org.nz |
| **Smarter Homes** | www.smarterhomes.org.nz |
| Earth Building Association | www.earthbuilding.org.nz |
| REBRI<br>(Resource Efficiency in Building) | www.rebri.org.nz |
| BRANZ | www.branz.co.nz<br>Sustainable Foundations |
| **Level** | www.level.org.nz |
| Eco Design Advisors | www.ecodesignadvisor.org.nz |
| Green Homes Scheme | www.greenhomescheme.org.nz |
| Landcare Research | www.landcareresearch.co.nz |
| NZ Photovoltaic Association | www.photovoltaics.org.nz<br>www.seanz.org.nz |
| Sustainable Living Programme | www.sustainableliving.org.nz |
| The Natural Step | www.naturalstep.org.nz |
| CarboNZero | household calculator |

| | |
|---|---|
| **QLDC** | www.qldc.govt.nz |
| NZ Wind Energy Association | www.windenergy.org.nz |
| Meridian Energy<br>Save the Planet | Energy calculator<br>www.savetheplanet.co.nz |
| Waitakere City Council | Building Sustainability |
| Consumer's Institute | www.consumer.org.nz<br>Appliance running costs |
| NZWWA<br>(Water and Wastes Association) | www.nzwwa.org.nz |
| NZ Forest Certification | www.nzcertification.com |
| Green Office Guide | www.greenoffice.org.nz |
| **Eco Bob** | www.ecobob.co.nz<br>Eco building forum |

| | |
|---|---|
| SEANZ<br>(Sustainable Electricity Association of NZ) | www.seanz.org.nz |
| BBE<br>(Building Biology & Ecology Institute) | www.ecoprojects.co.nz |
| Greenpeace NZ | www.green-peace.org/new-zealand |
| WWF NZ | www.wwf.org.nz |
| Christchurch City Council | www.ccc.govt.nz/Environ-ment/ |
| Waitakere City Council | www.waitakere.govt.nz |
| Sustainability Council of NZ | www.sustainabilitynz.org |

[i] The Local Government Act (LGA) 2002
[ii]WHO (1987), Health impacts of Low Indoor Temperatures
[iii] ALF3: The Annual Loss Factor Method, 3rd Edition", Building Research Association of New Zealand (BRANZ), 2000. Version 3.1.1. This programme is purchasable at an approximate cost of $90 - see http://www.branz.co.nz/main.php?page=ALF%20Software
[iv] The insulation standards in this report are based on the New Zealand Standard Publicly Available Standard on Insulation.
[v]'Interface' carpeting is designed to minimise wastage in its production, use and replacement. http://www.interfaceinc.com/
[vi] http://www.enviro-choice.org.nz/
[vii] http://www.floorstore.org/
[viii] Data from NIWA: http://www.niwascience.co.nz/edu/resources/climate/sunshine/
[ix]Author's own calculations
[x] http://www.growotago.orc.govt.nz
[xi] The ORC Air plan change can be found at http://www.orc.govt.nz
[xii] Wood pellets for burners are currently available either retail from Invercargill or delivered from Christchurch from Nature's Flame. If a sufficient demand is generated in the future the supplier can arrange for bulk delivery of pellets to the Queenstown Lakes region: When demand exceeds 2 tonnes per year bulk delivery becomes feasible. http://www.naturesflame.co.nz . Queenstown Lakes District Council advocate pellet burning as a sustainable heating choice and it is anticipated that as uptake of this technology increases pellets will become increasingly accessible in the District.
[xiii] MfE Warm Homes Technical Report(2005): Detailed Study of Heating Options in NZ
[xiv] System based on EECA's findings when published
[xv] http://www.sustainablewanaka.co.nz/index.php?option=com_content&task=category&sectionid=7&id=91&Itemid=57
[xvi] Of the water heating systems monitored by BRANZ, electric storage had the Least daily energy consumption + standing losses: BRANZ SR 141(2005) Energy Use in New Zealand Households, Report on the Year 9 Analysis for the Household Energy End-use Project (HEEP)
[xvii]BRANZ SR 141(2005) Energy Use in New Zealand Households, Report on the Year 9 Analysis for the Household Energy End-use Project (HEEP)
[xviii] http://www.sustainablehouseholds.org.nz/issuepdfs/water_at_home1.pdf
[xix] Based on an average per person consumption of 200 litres per day, rainfall falling on a roof area of 120m2 during a dry year (Wanaka: 60,000 to 70,000 litres), minus 10% to take account of leakages and first flush wastage.
[xx] http://www.sustainablewanaka.co.nz
[xxi] http://www.watersmart.co.nz/greywater_recycling.html
[xxii] http://www.sustainablehouseholds.org.nz/issuepdfs/water_at_home1.pdf
[xxiii] http://www.whispergen.com/
[xxiv] BRANZ study report 155 (2006) Report on the year 10 Analysis for the Household Energy End-use Project (HEEP)
[xxv]CHRANZ Fact Sheet (2006) Affordable housing in NZ
[xxvi] http://www.waitakere.govt.nz/AbtCit/ec/bldsus/energy.asp
[xxvii] http://www.centameter.co.nz/
[xxviii]SNZ HB 44:2001 Subdivision for People and the Environment
[xxix] http://www.mfe.govt.nz/issues/waste/construction-demo/index.html
[xxx]Waste Management Strategy (April 2003), Queenstown Lakes District
[xxxi] http://www.rebri.org.nz/