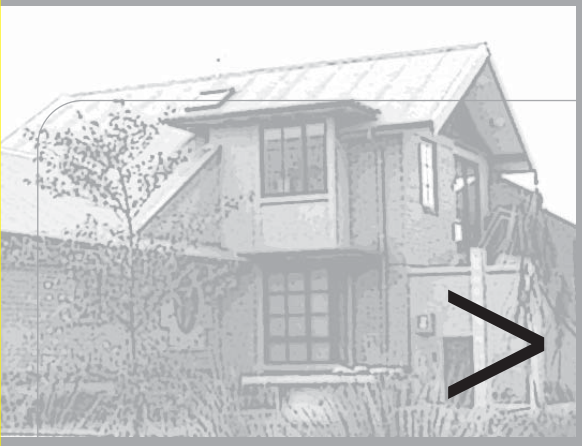


designguide

ARCHITECTURE

Housing New Zealand
Housing New Zealand Corporation

INTRODUCTION

HNZC retains its housing stock for a long time and therefore has an emphasis on sustainability, energy, efficiency and robustness of construction. HNZC requirements may exceed the New Zealand Building Code, and standards such as NZS 3604 Timber framed construction, which demonstrate minimum standards only.

The Architecture Design Guide concentrates on design principles. For specific solutions refer to the HNZC Housing Specifications, the NZBC, and relevant NZ Standards.

The Architecture Design Guide is split into four sections:

- **Building Form**
- **Building Layout**
- **Construction**
- **Services.**

These sections contain references to topics that are:

Essential

These items are required by HNZC.

Highly Desirable

These items should be included.

Desirable

HNZC considers these items advantageous.

OVERVIEW OF THIS GUIDE

IN THIS GUIDE…

SECTION 1 BUILDING FORM

Building form addresses the best use of built space or land, recognising the surrounding context and the need for privacy and amenity.
This section looks at larger scale planning including solutions to site design and urban or rural issues.

IN THIS SECTION ON BUILDING FORM…

SECTION 1 BUILDING FORM

PLANNING ISSUES

Different regions in New Zealand have different sets of planning issues. These are highlighted in documents such as the NZBC and NZ Standards where there are different requirements for items according to which region the project is in, and how the project is sited. These requirements cover issues such as provision of insulation and bracing requirements for wind.

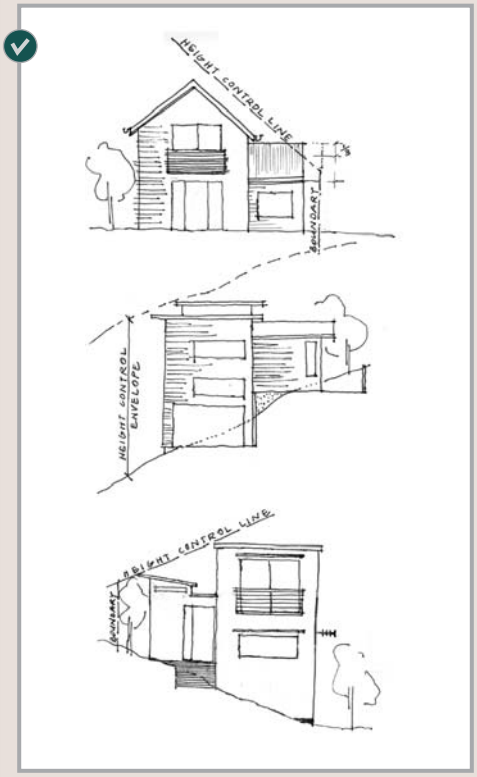
The Planning Issues section of this guide builds on information that will have been gathered in the initial stages of the project. There are further planning issues that must be addressed when designing the building. These are summarised below.

DISTRICT PLAN REQUIREMENTS

Each Territorial Local Authority (TLA) will have its own operative District Plan. This outlines all permitted, discretionary, conditional, and non-permitted activities on a site, by use of keyed maps and rules. The implications of the District Plan are important as it will outline where a resource consent is required. The following items must be checked in the plan.

- Zoning for an area (ie. establish that residential development is a permitted activity).
- The presence of any special character areas, view shafts, airport noise zones, historic areas, or other specific zoning of the site that may limit or constrain the type of development.
- Site coverage.
- Number of dwellings permitted per site.
- On site car park provision requirements (and permitted number of vehicle crossings per site).
- Height restrictions including sunlight access planes.
- Yard requirements.

Responses to regional variations in District Plan Requirements.



SECTION 1 BUILDING FORM

PLANNING ISSUES

BYLAWS

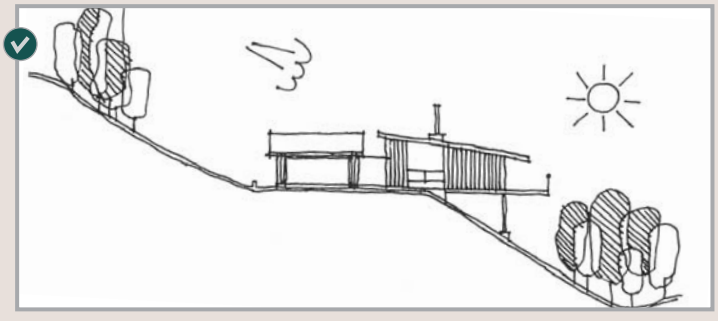
These cover local restrictions that vary from area to area within a town or city. They are set in place to protect the interests of residents of an area. It is essential that the local bylaws covering construction and use of a site are established at the beginning of a project. A guide to the type of issues that need to be checked is below.

- Noise levels (particularly relevant for construction periods).
- Permitted hours of work during construction.
- Fencing requirements. (Refer also to the land Certificate of Title for any Fencing Covenants.)

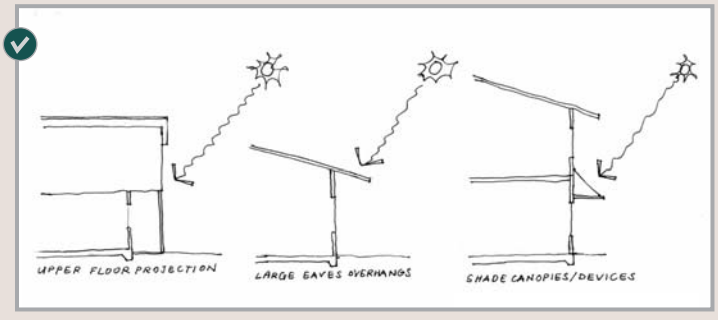
CLIMATE ZONES

There are significant temperature variations across New Zealand, and these coupled with wind conditions and humidity must be established at the start of the building design phase of a project. The following must be considered:

- Projecting eaves to protect from solar heat gain in summer and to protect the building from wind-driven rain
- Placement and size of doors and windows (this can inform where inside-outside connection will occur in the building form)
- High stud areas (where a chimney effect can be used to help reduce the heating effects of unwanted solar gain)
- Plan shape and orientation (eg. this may create lee zones, or help with cross-ventilation).



Almost every site in New Zealand has its own microclimate which modifies climate zones and is influenced by issues such as placement of surrounding buildings, significant vegetation, land form, and materials used in building and landscaping.



Projecting eaves, canopies or an upper floor can help protect a living space from summer sun.

SECTION 1 BUILDING FORM

SCALE

Scale of building form is closely related to issues raised in the Urban Design Guide, such as lot layout and efficient land use. This topic also relates to density of development, and these sections should be used in conjunction with this part of the Guide.

ELEVATION

The building form should contribute to the streetscape. Facades require articulation and it is desirable for this to acknowledge the surrounding scale.

- Building elements in the facade such as windows, balconies, cladding changes, doors or roof forms can contribute significantly to the streetscape if they are modelled in an appropriate scale.
- It is generally more successful to work with similar building element scales in facades than to use very different scale forms.

Similar building element scales successfully used in this streetscape.

ROOF FORM

Roof form is generally a strong feature of a building. In designing a roof that recognises the form of the surrounding roofs it is not always desirable to mimic the existing.

- It is recommended that a roof form appropriate to the new building be used, but it is important not to ignore the existing character of the surroundings.

Roof form used to articulate a multi-unit housing scheme and reduce its scale.

SECTION 1 BUILDING FORM

ORIENTATION

In the Site Design Guide sunlight access, topography, prevailing wind and microclimate were considered. These aspects are influential in addressing the orientation of the building form on the site. Further to these are the issues outlined below, which may modify or strengthen the original conclusions.

PUBLIC/PRIVATE

The distinction between public and private space is important outside the building and within it. Building form can be utilised to support this and to add to the sense of ownership felt towards a dwelling. The following points require attention.

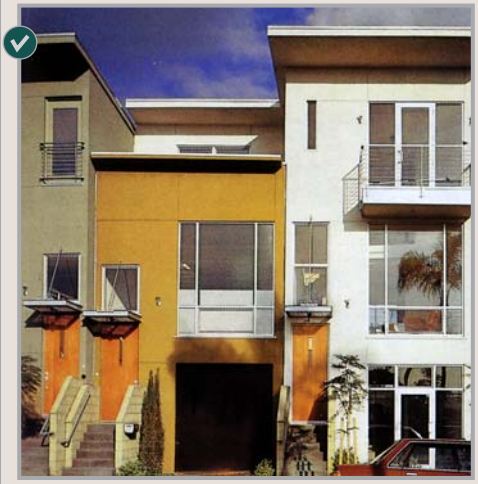
- The front path and entry door should be overlooked from inside the house.
- The path to the front entry door, and the door itself, should be clearly visible from the street. This will add to animation of the street and urban security. Refer to the Urban Design Guide.
- Progression through the house should be from the public zones (entrance, living, dining) to the private zones (bathrooms, laundry, bedrooms). Refer to the next section on Building Layout.
- Areas created by building form should have well-defined edges. Public and private areas should have clear boundaries.

GARAGES

Location of garages on a site will affect building form, which will also affect streetscape. The following considerations need to be addressed. Refer also to the Site Design Guide for notes on garaging.

- Garages must not dominate the built form in new developments.
- Garages should be integrated with the design of the building form for a dwelling, and should therefore not compromise access visibility.
- Garage form should not be repeated along a street without variation.

Main entries should be clearly visible from the street, or clearly signalled by the design of the dwelling.



Clarity of approach to these dwellings is lost. Front door position and distinction between public and private are not clear.

Garage integrated with the built form.

SECTION 2 BUILDING LAYOUT

The following topics relate to building layout (planning the way the rooms fit together) and should be worked through using the explanations and diagrams to address the issues.

Building layout will be heavily influenced by building form and also by site design, particularly the location of private outdoor space and access.

IN THIS SECTION ON BUILDING LAYOUT...

AMENITY

Amenity addresses the issues that add to the total living experience of a house. These may be items that address a specific occupier need (such as cultural needs, or universal design), or they may be general requirements that reflect the way New Zealanders live. All of these items have a common goal of increasing the quality of life a tenant will gain from living in an HNZC house.

It is important to acknowledge that some projects will be for a specific group of people such as an iwi group or elderly residents, where there are building layout requirements that must be incorporated into the project design proposals. Some of these requirements also form a part of what HNZC considers good practice to provide to all users.

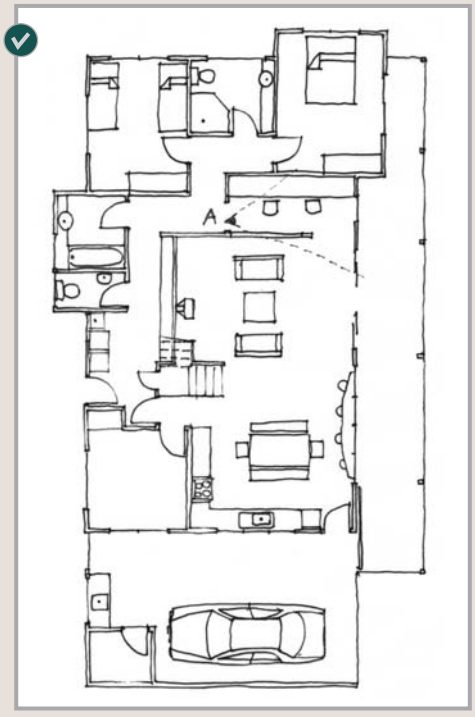
The following points outline those items that are required or desired in all projects, and highlight reference information for projects where user groups have more specific requirements.

SIZE AND NUMBER OF SPACES

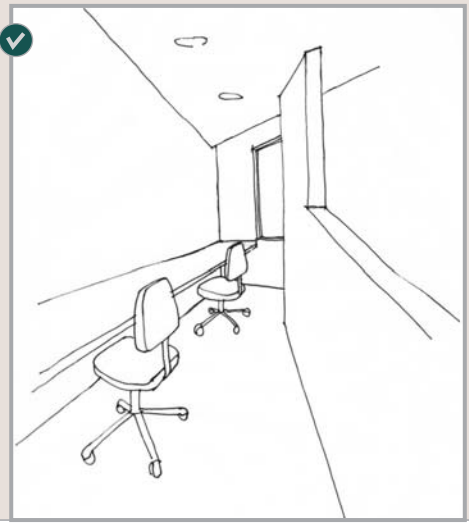
It is generally acknowledged that New Zealanders are getting bigger. Designs need to respond to this trend and provide spaces that allow easy movement. It is also important to realise that the way we occupy housing is less rigid than it was historically, and housing needs to be more flexible than it used to be.

- Likely occupancy levels must be allowed for in the planning of a development, and number and size of rooms must respond to this eg. some user groups may have large numbers of family members staying with them - this must be accounted for in the design of a dwelling.
- Kitchens and bathrooms must be of adequate size for large people to use as cramped conditions in these areas can lead to accidents. Predicted occupancy levels will determine required number of WC's and bathrooms. Refer also to Health and Safety later in this section.

Open plan living and provision of a connected study (A) area allow homework supervision for adjacent spaces.



View A: Study space. Refer plan.



SECTION 2 BUILDING LAYOUT

AMENITY

- Stairways and circulation spaces must be of adequate size, and must accommodate space requirements for furniture moving.
- Adequate internal storage must be provided for linen and clothing, cleaning equipment and kitchen utensils.
- Safe and secure storage must be provided for household poisons.
- External storage provision must be provided to house items such as lawnmowers, bicycles, and sports equipment. This should not be remote from the house and must be secure.
- Open plan living allows for more flexible use of space and may reduce corridor lengths.
- Where children are likely to be living, appropriate space should be provided for activities such as studying, in addition to sleeping space.
- Built-in shelving allows personalisation of space and should be provided in appropriate areas.

UNIVERSAL DESIGN

Universal Design principles aim to provide occupants of all physical capabilities with equally accessible housing.

- It is acknowledged that not all HNZC housing can be provided based on universal design principles, however where the principles can be met (without additional cost) they should be incorporated into the design.
- A small percentage of housing, plus housing for specific groups with limited mobility, will require the incorporation of universal design principles. In these cases the requirements outlined in the following must be met: NZS 4121: Code of Practice for Design for Access and Use of Buildings and Facilities by Disabled Persons, 2001, NZBC.

Note: there are many references which may be appropriate when designing for a community group. The two listed provide a minimum compliance requirement when designing for people with a physical disability.

Ramped access and covered verandah provided to new community building at Aranui, Christchurch.

All door handles should be lever type.

CULTURAL NEEDS

Specific cultures require some specific design responses. If you are providing housing for a Maori Community please refer to Ki te Hau Kainga, New Perspectives on Maori Housing Solutions, and if you are providing housing for a Pacific Peoples group please refer to the Pacific Housing Design Guide.

Tapu and Noa issues

In Maori society separation must be retained between certain activities.

- Tapu activities are those relating to bodily function (bathrooms and toilets). These are the most private or sacred areas.
- Noa activities are those relating to food and are the most common elements.

Tapu and Noa activities must remain separated through careful planning.

Sleepouts - Whare Tapiri

It may be acceptable to allow for sleepout space for use by an extended family. It should:

- have self-contained bathroom and toilet facilities
- be close to kitchen facilities
- be directly related to outdoor living space.

Note: security is a big issue - detached sleepouts are not desirable.

Outdoor cooking

HNZC acknowledges that outdoor cooking is a part of New Zealand life.

- The planning of a dwelling should allow for outdoor cooking.
- Health and safety of occupants is an important consideration in allowing for outdoor cooking and issues such as fire and hygiene should be acknowledged.

The above table from Ki te Hau Kainga, New Perspectives on Maori Housing Solutions, pg 30, *demonstrates Tapu and Noa relationships. Those relationships represented by a cross are undesirable, and those represented by a tick are desirable. A wave represents a neutral relationship.*

Double doors provide a flexible connection between living and dining areas.

SECTION 2 BUILDING LAYOUT

ACCESS

Access to the interior of the house should be as unobstructed and easy as possible. Where steps or ramps are necessary they should have adequate handrails to ensure safety and ease of use. These must meet the requirements of the NZBC D1 Access Routes.

FRONT DOORS

- There must be weather protection to front doors (a porch). This may require canopy and walls to protect from the prevailing wind, or a canopy alone may be sufficient.
- When providing canopy cover it is important to retain good light to the entry. Refer also to the next topic on Security.
- Main access doors should be hinged and not sliding type.
- The minimum recommended width for a front door is 910mm.

CIRCULATION

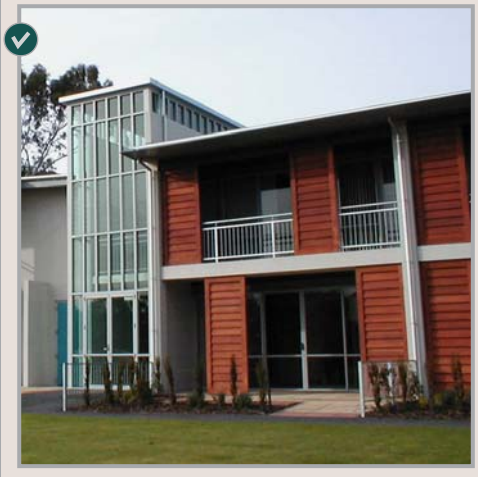
- Stair width and gradient must be such that furniture removal is not hazardous and must also meet the requirements of the NZBC.
- Corridors should be kept to minimum required lengths.
- Recommended minimum internal door width is 810mm.
- Recommended minimum corridor width for new developments is 1050mm.
- Recommended minimum depth of stair treads is 300mm including a maximum nosing of 25mm.
- Stair risers should be a maximum of 180mm.

CONNECTION TO OUTDOORS

- Safe access to outdoor living areas must be provided.
- Surfaces that are liable to become wet must be nonslip.
- Access must be sheltered by roof overhangs, porches or verandahs.
- Access should be provided with recognition of microclimate and siting.
- Outdoor space should be usable and well placed to gain sun access and privacy.
- Where construction methods and sites permit, access should be level.

Successful covered entry porch incorporated into building form where daylight and security (visibility) are not compromised.

Level access, nonslip paths, sheltered entry and roof overhangs to decks (for solar protection) successfully connect this property to the outdoors.



SECURITY

Refer also Site and Urban Design Guides for notes on Security.

VISUAL

- The front entrance of a house should be visible from within the dwelling. In existing housing where it is not possible to view this area from inside the house a door viewer must be provided that allows the viewer to see the bottom of the exterior door.
- Lighting must be provided at entry positions to a dwelling. Lights should be placed to illuminate visitors.

Visually permeable front boundary achieved through low fencing adds to the security of the houses.

EXTERIOR DOORS AND WINDOWS

- It is essential that exterior doors are strong enough to provide a secure interior to a dwelling.
- Exterior windows must be of a quality that ensures they are not easily entered. Designs should avoid situations where an easy security breach is facilitated by poor window positioning.
- Windows and doors must be lockable.
- Windows must be able to be fixed partially open to allow secure ventilation.
- Exterior secure (lockable) screen doors should be provided where appropriate to provide secure ventilation to a dwelling. These must be provided to the requirements of: AS/NZS 2803: Door Security and Screens and AS/NZS 2804: Installation of Door Security and Screens.

SECTION 2 BUILDING LAYOUT

HEALTH & SAFETY

Health and Safety are critical considerations. HNZC is endeavouring to provide safer, healthier homes. Occupancy levels have been demonstrated to be critical to a healthy living environment. These must be predicted if healthy living environments are to be provided. Additionally, the following points require attention.

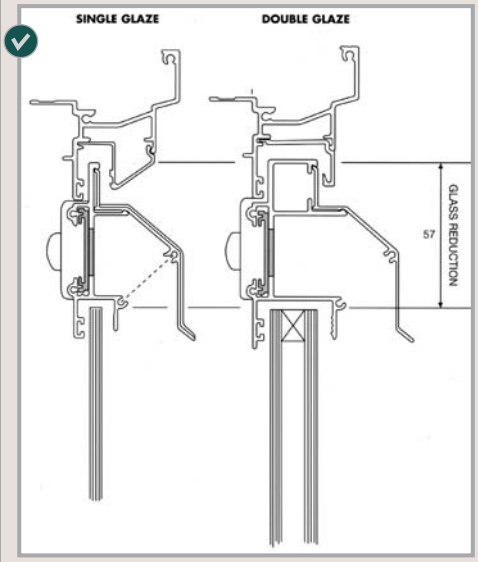
INTERNAL ENVIRONMENT

- Ventilation is required. Due to security issues it is important to provide a means of ventilating houses that is secure. Passive air vents are recommended as people may be reluctant to leave windows open, particularly at night. (4000mm² of ventilation is recommended to all habitable rooms.)
- Insulation must be provided. Insulation and ventilation work together to reduce condensation and dampness. Refer to Energy Conservation later in this section.
- Heating is required. One heat source must be provided for in the main living area of a house. If it is to be a gas burning or solid fuel burning heater then it must be flued to the outside. Refer to Energy Conservation later in this section.
- Adequate power outlets must be provided to minimise the use of double adapters, extension cords, or power boards.
- Glazing must be provided in accordance with A3/NZS 2208 Safety Glazing Materials in Building, and NZS 4223 Glazing in Buildings.
- Provide nonslip surfaces to wet areas.

SAFETY SYSTEMS

- A fire extinguisher must be provided and should be located near the kitchen.
- Smoke detectors must be installed. They should be positioned near the kitchen, living and bedrooms. Hard wired detectors are preferred.
- Fire escape should be considered in the design of a dwelling. Alternative means of escape should be provided, to minimise the risk of injury or death due to fire.

Passive ventilation grill systems allow the occupant to safely leave an unoccupied house to ventilate. Note: cross-ventilation is needed to meet air change requirements.



Separate toilet with easily accessed basin and openable window.

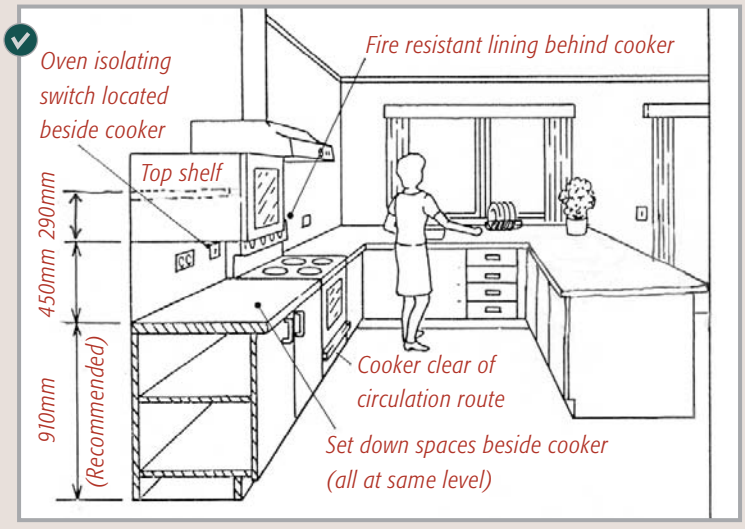
BATHROOMS

- New dwellings of over 2 bedrooms must have a WC and wash hand basin separate from the main bathroom for the dwelling. (Larger homes may require more than one bathroom dependent on predicted occupancy rates.)
- Showers must be separate enclosures - not positioned over a bath.
- Bathrooms shall have residual current device (RCD) protected electrical fittings to avoid creation of a hazard.
- Bathrooms must be well ventilated. For those areas that can not be passively ventilated, forced extracts of a suitable capacity must be installed.
- A bath should be provided for households where there will be young children.
- Level entry showers should be provided where construction type permits.
- Pedestal vanities or wall-hung hand basins are easier to clean and use than vanity type basins.
- Bathroom storage should be provided.

KITCHENS

- Ovens must not open into a traffic area and must have anti-tipping restraints.
- Bench space must be provided adjacent to cooking surfaces for placing hot items.
- Kitchens must be well ventilated. A rangehood is required where sufficient natural ventilation is not available.
- Storage needs to be accessible, and should not be predominantly positioned high on a wall.
- All bench surfaces must be durable and smooth for ease of cleaning.
- Kitchens should not be on a circulation route. (Cul-de-sac kitchens are safer than walk-through kitchens).
- Size of kitchen sink must relate to household size. Larger families often have larger pots and these are sometimes difficult to clean properly in small sinks.

A summary of kitchen safety features and recommended heights.



Level entry shower and adjustable height handset.

SECTION 2 BUILDING LAYOUT

PRIVACY

It is important to ensure that every house has adequate privacy. This is particularly important in higher density dwellings, such as terrace housing, and will require greater attention in these situations.

VISUAL PRIVACY

- Adequate visual privacy must be retained between occupancies within a development.
- Windows must not directly face those of habitable rooms or private open space in neighbouring dwellings.
- Balconies should be designed so they do not overlook adjacent private open space or habitable windows.
- It should not be possible to look from the street directly in the windows of a dwelling.

ACOUSTIC PRIVACY

- Provide adequate acoustic separation between neighbouring tenancies.
- Housing developments in high-noise areas must address reducing noise to the interior at the building envelope through construction techniques. Refer also to the Site Design Guide.
- Plumbing and services should be planned to avoid intertenancy walls. Where this is not possible systems must be acoustically insulated.
- Bedrooms in a dwelling should be isolated from external communal space by distance, planting, or alternative screening devices.
- Meeting NZBC requirements provides insufficient acoustic separation in many development situations. It is recommended that intertenancy walls respond to specific project requirements in ascertaining adequate STC ratings. For intertenancy walls STC 55 will be a minimum.
- Bedrooms in multi-tenancy developments should not be located adjacent to living areas or garages in the neighbouring unit.

A successful outdoor private space not overlooked by neighbouring units where sunlight access and connection to interior are good.

Where circumstances prevent providing a north-facing rear yard, an outdoor space and internal living areas face the street and are screened with a permeable fence.

ENERGY CONSERVATION

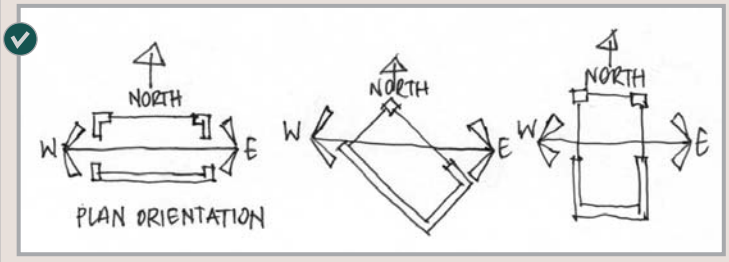
HNZC is committed to raising the energy efficiency of its housing stock. The aim is to reduce running costs through reducing reliance on high-energy systems and utilising solar collectors to provide some of the energy needs.

PASSIVE SOLAR DESIGN

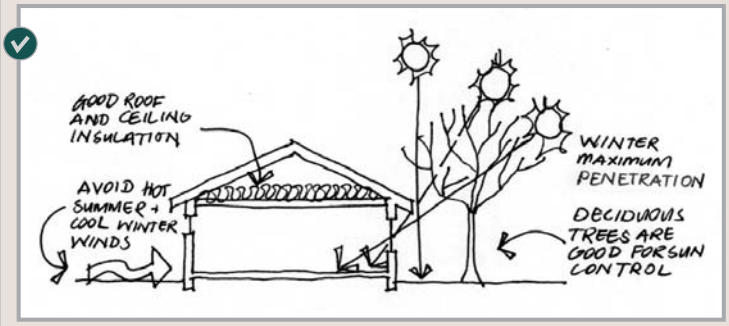
Basic principles of passive solar design should be followed where appropriate. The items below require consideration during design.

- Orientation of the building to allow for optimal North facing glazing.
- Insulation against heat loss through walls, ceilings and floors.
- Protection of glazing (particularly west facing) to prevent overheating in summer. (This can be achieved through eaves, screens attached to the house, or through planting).
- Do not use large areas of south facing glazing, or unprotected glass facing prevailing winds.
- Thermal mass in a dwelling can even out temperature extremes. When thermal mass is utilised in the interior of the dwelling, it should be positioned to receive direct sun through the glazing.

Planning of internal layout is affected by window placement and building orientation.



Planting, siting, orientation, glazing placement and well-insulated building elements all contribute towards effective energy conservation.



SECTION 2 BUILDING LAYOUT

ENERGY CONSERVATION

VENTILATION

Refer also Health and Safety on page 15-16.

- Ventilation must be provided to prevent overheating. (Openable windows positioned on opposite sides of the house will allow cross ventilation.)
- As hot air rises an unobstructed path from the ground floor of a two-storey building to the upper floor will encourage air movement through the house. Cool air is drawn into the house at the lower level and through to the upper level as it heats and rises.

INSULATION

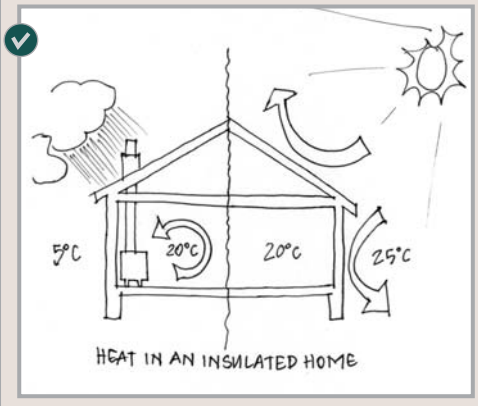
- A concrete floor slab may require perimeter insulation, depending on location. This should be polystyrene or another insulating material that does not degrade with exposure to moisture and the ground. Where appropriate (and particularly in southern areas of New Zealand or the central plateau) underfloor insulation should also be provided.
- Insulation must be provided under a suspended timber floor. Preferably this should be batt type to an adequate R value.
- Minimum insulation levels are stipulated in the NZBC. HNZC requires all projects south of Marlborough to review these in the light of project requirements.

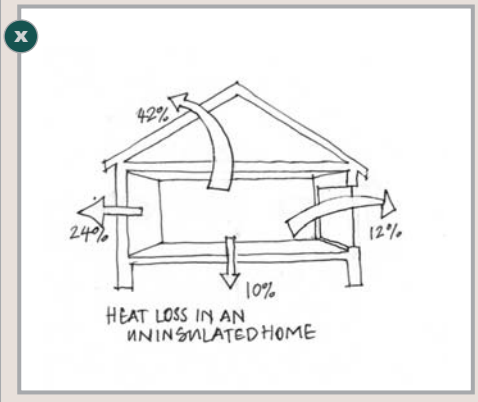
SUPPLEMENTARY HEATING

It is required by HNZC that basic principles of passive solar design will be followed in all new developments. Refer also to Health and Safety on page 15-16.

- Provision of an adequate supplementary heating source to the main living space is necessary.
- Cost of sustaining heating should be considered as a determining factor on type.
- Effectiveness of heating is enhanced by providing insulated thermal mass inside the house.

Diagram showing main areas of heat loss and retention when properly insulated.





ELECTRICITY USAGE

There are a number of ways of reducing reliance on electricity in housing. These include:

- Providing thermal blinds or curtains to windows to prevent heat loss
- Orienting the house to have a section of roof suitable for solar collection (North facing with a pitch of at least 15 degrees). This allows for a solar boosted hot water system to be utilised. Refer specific manufacturer's requirements
- Well-positioned windows will admit optimal light, and reduce the reliance on artificial lighting (do not use a plan depth of more than 9 metres)
- Encouraging the use of low energy light bulbs and appliances where possible
- Light coloured surfaces will reflect light better internally and will reduce reliance on artificial lighting.

HNZC housing with supplementary solar water heating.

WATER CONSERVATION

- All WC cisterns should be dual-flush.
- Showers should have low-flow shower heads installed.
- Collection and storage of rainwater for use should be considered. This is an issue that is particularly important in rural situations but is also now affecting urban planning as well.
- Grey water recycling systems should be used where they are practicable (eg. a community application, or a rural site).

ALTERNATIVE ENERGY GENERATION

In some areas it may be possible to utilise alternative energy generation systems. These will sometimes be necessary in rural developments. Refer to the Rural Design Guide.

- Where a community housing project would benefit from alternative energy generation it will be considered desirable by HNZC. Subject to costs being reasonable and estimates being fully detailed.

SECTION 3 CONSTRUCTION

Construction looks at crucial building elements, the initial cost of these elements, and their ongoing maintenance costs. The Construction section is broken into the following four areas:

Life-Cycle Costing

Focusing on the life-cycle principle the organisation is promoting analysis through the total cost of ownership

Sustainability

HNZC promotes passive energy systems and use renewable resources in the construction process where appropriate

Exterior Materials

Concentrates on the exterior envelope, building practices and detailing

Interior Materials

Concentrates on internal linings, and wet areas.

IN THIS SECTION ON CONSTRUCTION...

LIFE-CYCLE COSTING

HNZC is a long-term landlord owning a large number of rental properties. A strategic approach to the management of the portfolio is therefore required.

Life-cycle costing will provide a checkpoint for a project whereby immediate capital costs can be weighed up against the cost of maintaining the building over a (minimum) 15 year period.

BUILDING PROJECT COST ESTIMATES

Building project cost estimates must therefore include life-cycle costs, and address the following.

- Project building cost estimates over a life-cycle for the building for a (minimum) 15 year period, including projected maintenance of the building.
- The life-cycle costs may be verified against HNZC maintenance records.
- This information should inform material selection and construction techniques.
- When considering life-cycle costs it is desirable to select materials and systems to address occupancy costs. For this reason energy efficiency should also be considered eg. thermal mass may be used over lightweight construction where project location means that heating costs form a large portion of an occupier's expenses.

SECTION 3 CONSTRUCTION

SUSTAINABILITY

HNZC promotes the use of sustainable building practices. This must be moderated against cost and proven material performance.

When selecting materials and systems the following criteria need to be addressed.

ORIGIN

Materials must be sourced from sustainable resources. For example, Asian and Island hardwoods other than from plantations will not be acceptable.

MANUFACTURE

- Low embodied energy.
- Low effect on the environment from manufacture.
- Renewable source.
- Local resource.

INSTALLATION AND USE

- High comparable energy efficiency.
- No or negligible health risk.
- Low-irritant.

DISPOSAL

- That the effects of the disposal of materials and systems after their useful life should not be harmful to the environment.
- Materials should be recycled where possible.

Embodied energy shows the amount of energy used in manufacture.

Wool insulation	139 MJ/m3
Timber (air-dried)	165 MJ/m3
Glass fibre	970 MJ/m3
Timber (kiln-dried)	1,380 MJ/m3
Polystyrene	2,340 MJ/m3
Concrete	3,890 MJ/m3
Glass	40,060 MJ/m3
Steel	274,570 MJ/m3
Aluminium	612,900 MJ/m3

Innovation is seen here where a Gisborne glu-lamination factory off-cuts are used for a fencing product.

EXTERIOR MATERIALS

Traditionally materials for a building project were selected by a contractor or designer who had trade knowledge in their installation and detailing.

Today there are many proprietary systems in the construction industry. They are becoming more widely used by designers and contractors as a means of mitigating risk. These systems usually have building industry accreditation, warranties, and the manufacturer's producer statements attached. Although there is a perceived mitigation of risk in using these systems, often a failure is attributable to a number of factors. This may result in no clear liability.

For this reason the following principles must be addressed equally by material and proprietary system selection. Where this Guide refers to materials it requires systems to perform equally in the following areas:

- Suitability: suitability of materials and design (durable, compatible, location)
- Watertightness: deflection, drainage, and drying
- Detailing: clear detailing to prevent common building failures
- Good trade practice to mitigate the risk of building failure.

SECTION 3 CONSTRUCTION

EXTERIOR MATERIALS

SUITABILITY

Selecting materials

- Structural metal components are to meet the durability requirements of the NZBC, and NZS 3604 according to their proximity to sea and volcanic salts, and their proximity to ground, and location within the building.
- Claddings including fixing systems and flashings must adequately resist the wind, UV, and salt levels of their location.
- Paint systems must be appropriate to withstand local environmental conditions.
- Materials are to be compatible where water runoff occurs between them.

MATERIALS COMPATIBILITY CHART

MATERIAL WATER FLOWS OVER ∨ / MATERIAL WATER FLOWS ON TO >	Anodised aluminium	Powder-coated aluminium	Mill-finish aluminium	Lead	Galvanised steel	Zinc	Copper	Stainless steel	Coil-coated steel	Butyl rubber	Plastics	Cedar	CCA-treatment timber	Fibre-cement	Concrete tiles	Green concrete	Dry concrete	Clay bricks	Ceramic tiles	Cement plaster	Glass
Anodised aluminium	✓	✓	✓	✓	X	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Powder-coated aluminium	✓	✓	✓	✓	X	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Mill-finish aluminium	✓	✓	✓	✓	X	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Lead [1] [2] (not lead edged)	X	X	X	✓	X	X	X	✓	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X
Galvanised steel (unpainted)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Zinc (unpainted)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Copper [1]	X	X	X	✓	X	X	✓	✓	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Stainless steel	✓	✓	✓	✓	X	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Coil-coated steel	✓	✓	✓	✓	X	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Butyl rubber	✓	✓	✓	✓	X	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Plastics	✓	✓	✓	✓	X	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Cedar [3]	✓	✓	✓	✓	X	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CCA-treatment timber	X	X	X	✓	X	X	✓	✓	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Fibre-cement (unpainted)	X	X	X	✓	X	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X
Concrete tiles	X	X	X	✓	X	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X
Green concrete (unpainted)	X	X	X	X	X	X	✓	✓	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X
Dry concrete (unpainted)	X	X	X	✓	X	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X
Clay bricks [4] (cement mortar)	X	X	X	✓	X	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X
Ceramic tiles [4] (cement grout)	X	X	X	✓	X	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X
Cement plaster (uncoated)	X	X	X	X	X	X	✓	✓	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X
Glass	✓	✓	✓	✓	X	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

(Ref. BRANZ Bulletin 304)

Note:

1 Water runoff from these materials may cause staining on most materials

2 Lead should be primed if being used with coil-coated materials to prevent staining (manufacturer's recommendation)

3 Leachate from cedar (and redwood) may cause staining and, because of its acidic nature, attack galvanising

4 Cement-based mortar or grout causes the corrosion.

Design principles

- Metals should have exposure to rain washing.
- Place permanent ventilation openings in sheltered positions.
- Mass in a building material can provide a heat-sink to minimise interior temperature variation.
- Heavy building materials will generally result in lower maintenance costs over the life-cycle of the building.

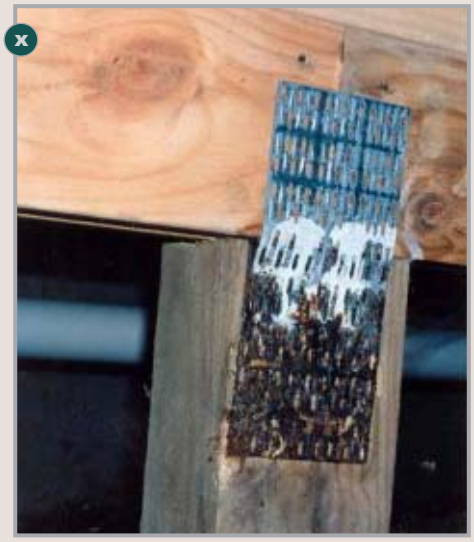
TIMBER TREATMENT

Wood-rotting fungi cause the decay of timber. These fungi require surplus moisture, air, a specific temperature range and edible timber. Damp wall and other building cavities provide an ideal environment for decay, mould and corrosion. Generally timber moisture contents above 30% are required to initiate decay, but in external wall cavities this can be easily surpassed with minor leaks from faults in cladding junctions. Once established, certain decays can sustain growth down to 20%. Dry rot has the worst reputation through its ability to transport moisture to attack dry, sound timber.

The older wet frame fungicide, H1 boric treatment, prevented or suppressed most decays at lower moisture levels. (Refer BRANZ Build May 2000). LOSP H1 treatment does not offer this low level fungicide protection, and may be difficult to distinguish from boron H1 if specified.

Given the confusion over timber-treatment types and the lack of approval in our standards of boron as a fungicide the BRANZ Weather-tight Steering Group elected to endorse H3 treatment where there was risk of decay in wall framing.

Watch reactions between different metals. In this case, the copper in the CCA timber treatment is reacting with the zinc galvanising at relatively low moisture levels.



What happens after a few years with flat wall tops, no waterproofing and penetrations through the top.

SECTION 3 CONSTRUCTION

EXTERIOR MATERIALS

WATERTIGHTNESS

HNZC prefers to mitigate the risks by solving the water-entry problems at the design and construction observation stages, believing that timber treatment alone does not offer an adequate solution to the watertightness problems. For this reason the Architecture Design Guide chooses to highlight common water entry problem areas.

Materials used in the exterior envelope of a building are subject to pressure differentials which, combined with water, increase the likelihood of leaks. It is therefore essential to meet the following requirements.

- The exterior skin of the building must provide a comprehensive barrier to repel water.
- There must be provision for a secondary barrier and water drainage from within the exterior wall and roof system (eg. building paper and flashings that also provide details for an exit route to the system).
- Well detailed provision for junctions and openings such as corners, changes in cladding, and door or window openings.
- Where the building will be exposed to wet weather extremes it should have detailed provision for air drying within the wall or roof system for when it becomes damp, such as an air cavity within the wall or roof system.

DETAILING

HNZC supports the promotion of innovation in design. Projects will explore design solutions, materials and building forms. They must also address known building failures. Building failures can compromise the life of a building, and can contribute to poor health outcomes for the occupants. HNZC will require careful detailing of the following building elements:

- **Skillion or raking roofs**

  A roof space acts as a buffer zone between exterior and interior environments, and provides ventilation to the roof system. Skillion roofs have inherent problems with ventilation, heat retention (overheating in summer and heat loss in winter), and inadequate space around recessed light fittings. They also create inaccessible cavities that make repairs or alterations difficult

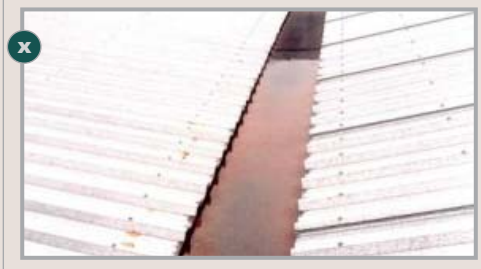
- **Nominally flat roofs**

  The NZBC requires roofs to have a minimum 1.5 degree fall. Water pooling on a roof coupled with poorly designed junctions with vertical surfaces will allow water to enter a building. Internal gutters must be wide enough to allow for easy cleaning (by broom) to prevent blockages, and a substrate of adequate thickness must be used

- **Walls and wall junctions**

  Failures often occur at joints between cladding elements, particularly at windows and doors. Details are to fully describe the proposed system, and are to avoid reliance on sealants alone for weather protection.

Avoid ponding gutters. The high local humidity and unwashed underside of the roof overhang leads to rapid corrosion.



End of butynol needs to be z-flashed under the over cladding at the end. The spreader is inappropriately placed. Should have connected directly into lower downpipe.

EXTERIOR MATERIALS

Parapets

Soffits offer protection to the top of a wall. Parapets do not offer the same protection and require careful detailing. Sloping capping flashings, careful roof/parapet wall detailing, and sufficient overflow provision must be allowed for. Gutters behind parapet walls need adequate fall with well-positioned outlets.

Internal gutters behind parapets require careful detailing at the exit junction to form an overhang and drip, plus an overflow in case of blockage.

Flat wall tops with penetrations through the top can fail. Consider the 'saddle' junction with the wall. Avoid clashes with joinery.

Lengths of timber do not form a very good 'roof'. The top of a handrail is a small roof - it needs to be sloped to shed water and be made weathertight.

- **Door and window openings**

  Generally doors and windows should meet NZS 4211, the standard for Performance of Windows, and NZS 4223, Code of Practice for Glazing in Buildings. Head and sill flashings are usually required, with jamb flashings where appropriate. Sealants must not be relied on to provide watertightness. Aluminium joinery must include drainage channels. Timber windows are used when modernising existing stock for consistency in joinery type

- **Level entry details - doors onto decks**

  Problems occur at level entry thresholds when there is insufficient water protection detailing. This can result in water entry if not addressed by attention to detailing around opening doors. Open tread decking to the building exterior mitigates the risk of trapping water through providing drainage. Where using aluminium joinery the allowance for water escape from the lower track extrusion to beyond the cladding must be detailed. In these situations always install a sill tray flashing.

A poorly conceived or installed flashing can cause leakage.

Window sealants may look sound but can easily fail. They also trap moisture from leaking joinery frames.

Galvanised steel buried into stucco has a short effective life. Ensure the jamb and sill tray flashings can collect water and drain back to the outside.

SECTION 3 CONSTRUCTION

EXTERIOR MATERIALS

- **Ground moisture**
  Inadequate ventilation or clearances to a subfloor space may cause ground moisture to enter a building. Likewise for concrete floors, clearances to exterior ground and adequate damp-proofing will mitigate likelihood of ground moisture entering a building.
- **Junction detailing**
  Where two dissimilar building claddings meet junctions must be mechanically detailed to prevent water ingress.

Parapet flashings installed before coatings to cladding applied. Water also runs off apron/barge flashing behind cladding.

Perhaps the most common roof/wall junction leak - base of apron flashing can inadvertently lead water behind cladding. Same can happen with sloping or curved head flashings. Water needs to be diverted to the outside.

TRADE PRACTICE

Good trade knowledge in the installation and detailing of the materials used in the construction of a building project, will often mitigate common building failures.

Care is required in the following areas of construction practice:

- **Construction moisture**

  There is moisture trapped within building materials during the construction of a building. Good trade practice will ensure that moisture levels are acceptable when closing in occurs

- **Timber treatment**

  All untreated timbers are liable to decay, but there are a number of species whose heartwood is extremely resistant. Examples are totara, jarrah and kwila. Cedar and macrocarpa also have naturally durable heartwood when kept dry. For other softwoods, including pinus radiata, rot will be prevented when the timber is kept dry and treated to H3 specification.

  Note: H1 treated or kiln dried timbers are not resistant to water and if they are used manufacturer's specifications should be followed carefully.

SECTION 3 CONSTRUCTION

INTERIOR MATERIALS

Rental properties require robust interior finishes. Durable, low maintenance materials are preferable for use in rental housing.

HNZC will require careful material selection of the following:

- **Flooring**
  Floor substrate must be suitable for the specific application, it must be protected from wear and tear that may compromise its integrity, and it must provide a level surface to accept flooring. Wet area floor coverings (including kitchen coverings) must provide a waterproof, easy-clean surface. Floor finishes that require regular re-coating to retain integrity are not acceptable
- **Wall finishes**
  Wet area wall finishes must be waterproof and easy to clean. Where wet wall linings meet other materials the junction must not trap water, or rely solely on sealants for waterproofing
- **Window coverings**
  Window coverings must be provided. Where applied to single glazed windows they must provide thermal resistance to heat loss.

Unsuitable material use resulting in damage due to wet floor substrate and framing.

SECTION 4 SERVICES

The chart indicates a number of issues that need to be addressed specific to building services (electricity, plumbing, communications).
Start at the top of each column and progress through the topics using the explanations and diagrams to address the issues.

IN THIS SECTION ON SERVICES...

SUSTAINABILITY

SEWAGE/STORMWATER, GREYWATER RECYCLING

There are differences in sewage, stormwater and greywater treatment in different areas of New Zealand. Some Councils encourage use of alternative methods of stormwater and greywater collection and treatment.

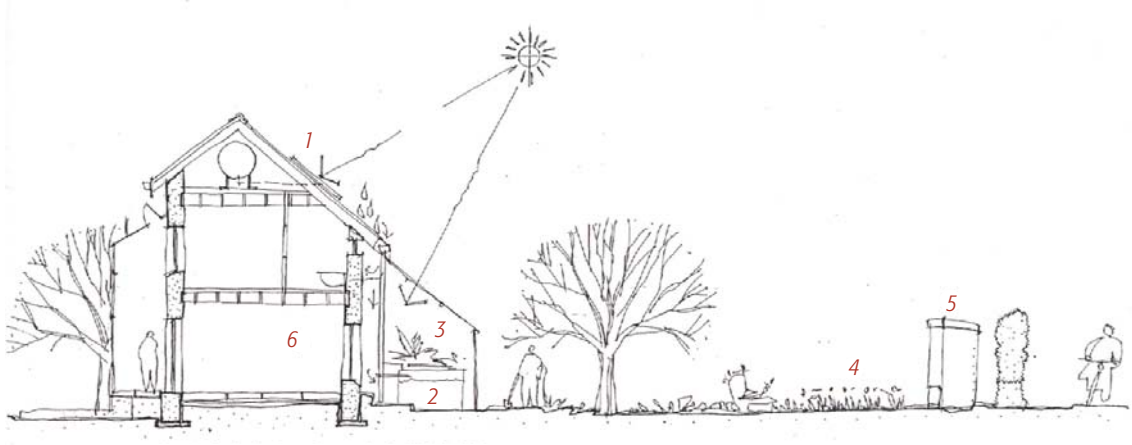
WATER COLLECTION (STORAGE)

- In rural areas a system for water collection and storage may be required due to lack of town water supply. This needs to be addressed in the planning of the site and the building, so as to be effectively accommodated.
- In some city areas it may be desirable to collect roofwater for use in the house.

ALTERNATIVE ENERGY

- Solar water heating should be considered for new developments unless site conditions or development type are prohibitive.
- Alternative energy sources may be required in some areas where connection to the main electrical grid is either extremely expensive or unreliable. In some areas solar power is a possibility, in other areas it may be necessary to engage professional advice for alternatives such as mini-hydro, or generator support.

Sustainability can be incorporated into housing provision in the ways indicated.



Dwelling section

1 solar panels for domestic hot water
2 rain water collection
3 conservatory
4 vegetables
5 compost
6 mass walls

SECTION 4 SERVICES

ELECTRICAL

POWER SUPPLY

- Power supply must be reliable.
- The cost of the power must be sustainable by the household.
- The cost of the system must not have prohibitive establishment costs.
- Use of solar power as a supplementary system for water heating should be considered where roof forms and orientation will permit.
- Alternative sources of power may be considered.

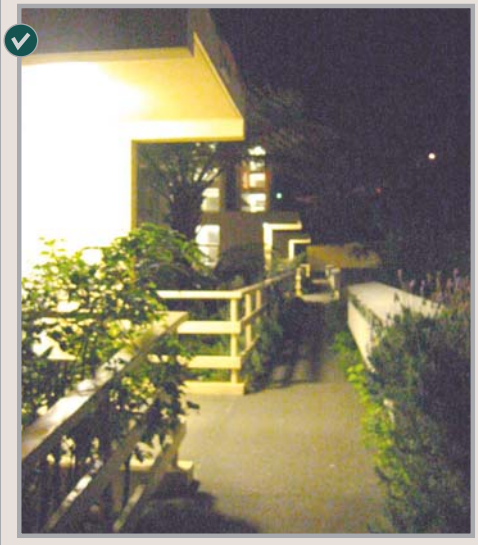
LIGHTING

- A dwelling shall have a minimum of two lighting circuits.
- Separate circuits for lighting, socket outlets and fixed wired appliances must be used.
- Adequate levels of lighting must be provided for the activities occurring in a space. For further information on lighting levels refer to NZS 4102: Safer House Design (Guidelines to Reduce Injury at Home).
- External lighting must be provided to adequately light the main accessways. Refer to the Site Design Guide.
- Task lighting above kitchen benches and bathroom mirror lights should be provided.
- Use of fluorescent bulbs should be encouraged as they have lower energy consumption and have a longer life.

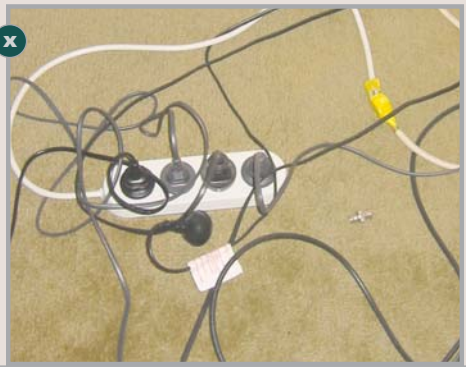
POWER POINTS

- Power points must be positioned close to work surfaces in kitchens and should be sufficient in number to supply everyday kitchen appliances.
- Power points in living areas must be accessible and positioned logically for what they are supplying (eg. a television jack needs to have at least two double power points adjacent).
- Power points in wet areas need to be residual current device (RCD) protected.

Good lighting provision to dwelling entry and approach.



Reliance on power boards and cables creates a hazard. People may trip on the cables and young children may sustain fatal injury from playing with the sockets.

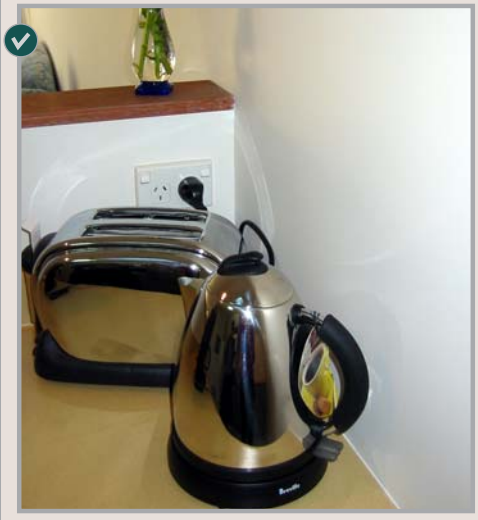


APPLIANCES

- Design for the logical appliances that a household will have, to ensure that double adapters or power boards are not required.
- Plan for the future of the house - recognise that our reliance on appliances is more likely to increase than decrease.
- All household water supply pipes must be copper, or be proven to have the same or better performance.
- Delivery of hot water to the bathroom must be tempered to 50 degrees Celsius.
- Hot water in the cylinder must be regularly heated above 65 degrees Celsius in order to prevent infection through disease.
- Minimise long lengths of pipe to remote ends of the house by keeping plumbing to a contained zone.
- The hot water cylinder should be located close to hot water outlets.

Galley kitchen - elderly housing.

Accessible power points placed logically for ease of use.



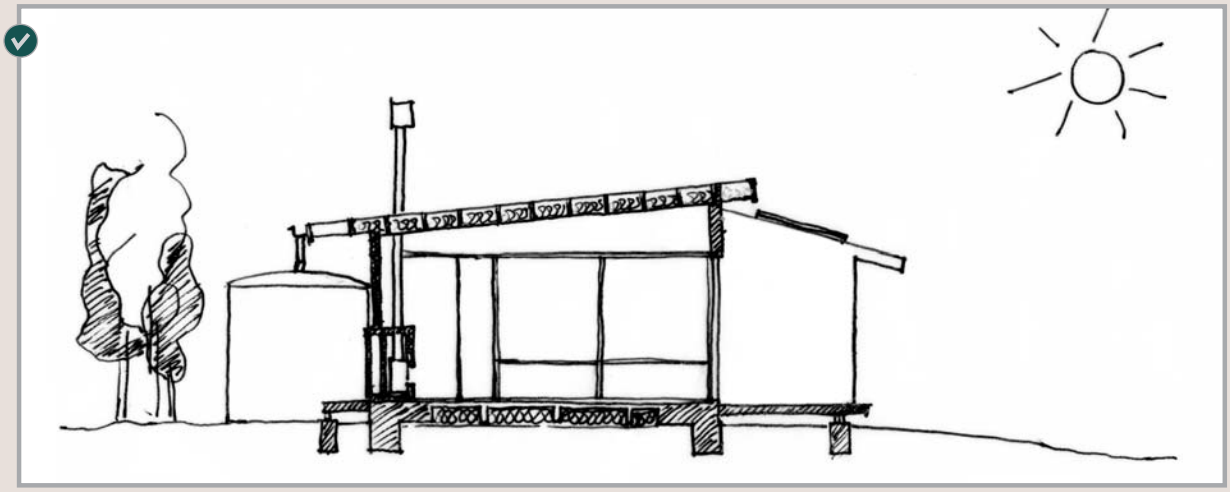
SECTION 4 SERVICES

PLUMBING

WATER SUPPLY

- Water supply must be reliable, clean and cost-effective.
- Where it is relied upon, rainwater collection and storage must be adequate to support the number of people that will rely on it at peak occupancy, in the driest part of the year. (Use information about annual rainfall levels and number of people using supply to determine size of tank required.)
- Lead free materials, and plastic guttering are recommended in water collection systems.
- If using the roof for rainwater collection, it should be kept clear of overhanging trees or vegetation, and should be inspected and cleaned regularly.
- If rainwater collection is not reliable it may be possible to use bore water. If bore water is proposed fully costed details will be needed.
- In urban situations where water supply is now charged for, it is becoming desirable to implement rainwater collection to supplement town water supply.
- Storage tanks should be located away from full sun.

Locate water tanks where they do not feature prominently from the interior or exterior of the dwelling, out of the sun and close to wet areas in the plan if possible.



STORMWATER/GREYWATER

Greywater is defined here as waste water from shower, bath, laundry, sinks, and basins. Stormwater is impermeable surface run off and roofwater collection, collected separately and usually fed back into streams and rivers or the sea.

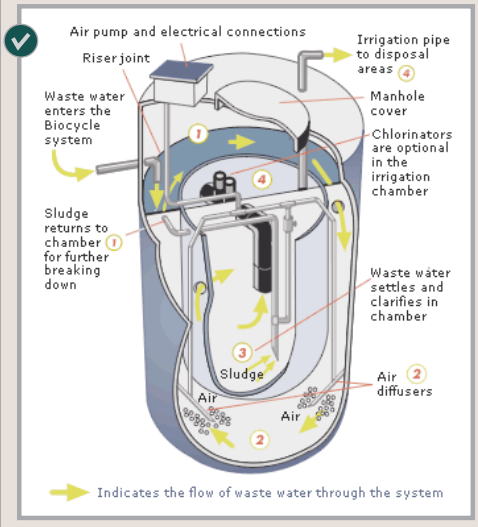
- Alternative stormwater systems are being supported by some territorial authorities, and include use of soakage pits, evaporation beds and filtration ponds. Where a comprehensive new development is being planned it is recommended that these systems be considered.
- For all developments, the use of impermeable surfaces should be minimised to reduce load on existing stormwater infrastructure systems.
- In rural situations it may be beneficial to deal with greywater and sewerage as separate systems. Greywater could provide water for gardens, and for car cleaning, etc. This can reduce demand on a rainwater supply. The water does need to be treated, to remove bacteria and chemicals and there are a number of systems available.

SEWAGE

Sewage is of concern particularly in rural areas, and provision of treatment facilities for sewage is often a necessary part of a rural development. In both rural and urban areas proximity of services should be considered early in the design work, in order to minimise the extent of the systems.

- Tanks must be sized to meet the peak needs of the users.
- Tanks need to be accessible for maintenance.
- In rural environments systems that treat the sewerage through a series of tank chambers, allowing the water to be reused on the land are preferable.
- Tanks should be sited as sensitively as possible.

An example of a four chamber sewage treatment system. (Image courtesy of BIOCYCLE.)



SECTION 4 SERVICES

COMMUNICATIONS

As a society we are becoming more dependent on communication devices in order to complete daily routines. This must be accommodated in HNZC housing.

- As internet usage becomes more common and necessary in everyday functioning our reliance on internet technology will increase. Telephone jacks must be located strategically including in areas where children are likely to be studying.
- Nearby each telephone jack there must be at least one double power point.

Telephone jack adjacent to power sockets supports flexibility of use and planning for the future.