BRANZ

ISSUE 650

BULLETIN

BUILDING BEYOND CODE MINIMUMS

June 2020

- Many new houses are constructed to just meet the minimum requirements of the New Zealand Building Code.
- Better-performing houses may cost more to build but are much more comfortable to live in and have reduced running costs to offset the upfront cost.
- Our houses will need to perform considerably better to help meet long-term national net-zero carbon targets.

1 INTRODUCTION

1.0.1 The New Zealand Building Code sets out performance criteria that all building work must comply with. Minimum requirements in the Code, in Acceptable Solutions and referenced standards cover areas from thermal insulation to ventilation levels.

1.0.2 Available evidence suggests that the majority of new houses are constructed to a quality that complies with these minimum requirements, but only a few go higher. These 'bare minimum' houses are the poorest-performing homes that can legally be built. Many of the minimums are low compared to those in other developed countries such as Australia, many European states and the United Kingdom.

1.0.3 Houses built or renovated with a 'Code-plus' or 'exceeding the minimum' approach give better performance. In addition to exceeding the minimums in the Building Code and standards, this approach includes consideration of aspects not addressed in the Code, such as passive solar design and environmental performance.

1.0.4 The benefits of Code-plus are improved liveability and healthier indoor environments, better accessibility, durability and resilience, greater energy efficiency and reduced building running costs. This approach is also likely to help New Zealand achieve its target of net-zero emissions of greenhouse gases (other than animal-produced methane) by 2050. (Climate change issues are dealt with more fully in Bulletin 651 *Climate change, net-zero carbon and the building industry*.)

1.0.5 In some cases, higher-performing houses have few or comparatively low additional costs. Examples include optimising passive solar benefits and specifying water-efficient fixtures and appliances and LED lighting.

1.0.6 In other cases, while going beyond Code may have a higher upfront cost, lower running costs can recoup the initial cost within a reasonable timeframe. BRANZ has made calculations to determine what options produce the strongest economic case. (See, for example, Study Report SR346 *The value of sustainability – costs and benefits of sustainability and resilience features in new houses*.)

1.0.7 Financial assistance is available from government and local authorities and banks for installing better insulation and more energy-efficient heating or for renewable energy systems, but this is often for retrofits rather than new builds.

2 BUILDING DESIGN

2.0.1 The decision to construct a home to a better standard than Building Code minimums needs to be made with the client early in the design process. Decisions to enhance performance may have an impact on the orientation of the building on site and may need to consider shade from neighbouring buildings or landscape features, use of indoor spaces, space and water heating options and choices of construction methods and materials.

2.0.2 There has traditionally been an intense focus on the upfront cost of house construction and comparatively little consideration of running costs. Clients (including developers) often focus on what can be seen – large living spaces, attractive bathroom and kitchen fixtures – and think less about performance. Where building above Code minimums requires additional upfront cost – for example, to specify R4.0 or R5.0 insulation in the roof – the client may need to be given help to understand increases in comfort and reductions in running costs that justify the upfront cost.

2.0.3 While designers, builders and building consent authorities are familiar with Acceptable Solutions for Code compliance, there are alternatives that should be considered that may result in better building performance.

3 PASSIVE SOLAR DESIGN

3.0.1 Good passive solar design can give substantial long-term benefits in comfort and running costs. One BRANZ research project assessed 210 randomly selected new detached houses that met Building Code minimum requirements but did not take advantage of passive solar design. Using computer modelling, BRANZ found that the average house required two to three times the amount of heating energy to maintain comfortable conditions compared to a house of similar price that incorporated passive solar design. (While space cooling is not required as much as space heating in many parts of New Zealand, this also needs to be considered at the design stage.)

3.0.2 Passive solar design includes:

- optimising the orientation of the building on site – ideally, living spaces should face north to get warmth from the sun in winter
- careful design of glazing, with most windows facing north, smaller windows facing south and natural ventilation provided for
- use of exposed thermal mass inside the house to collect heat during the day for release at night
- designing shading to the east, west and north orientations that reduce overheating during the warmer months
- designing out thermal bridges as far as possible, especially in glazing and framing
- going beyond minimum insulation requirements to keep the home warm in winter and cool in summer.

3.0.3 There are numerous examples around New Zealand of what can be achieved. Beacon Pathway's NOW Home built in Auckland provided enhanced features at a similar cost to nearby similarly sized, more traditionally built homes. Average winter temperatures (without additional heating) exceeded 18°C in the living room and 16°C in the bedrooms. Space heating requirements for the NOW Home were 8 kWh/m² compared to the mean for 70 Auckland houses (calculated through computer modelling) of 26 kWh/m² – more than three times as much.

3.0.4 Many new houses can be cold inside for the equivalent of several months over a year when not actively heated. Computer modelling of a sample of Christchurch homes consented in 2012 found that, on

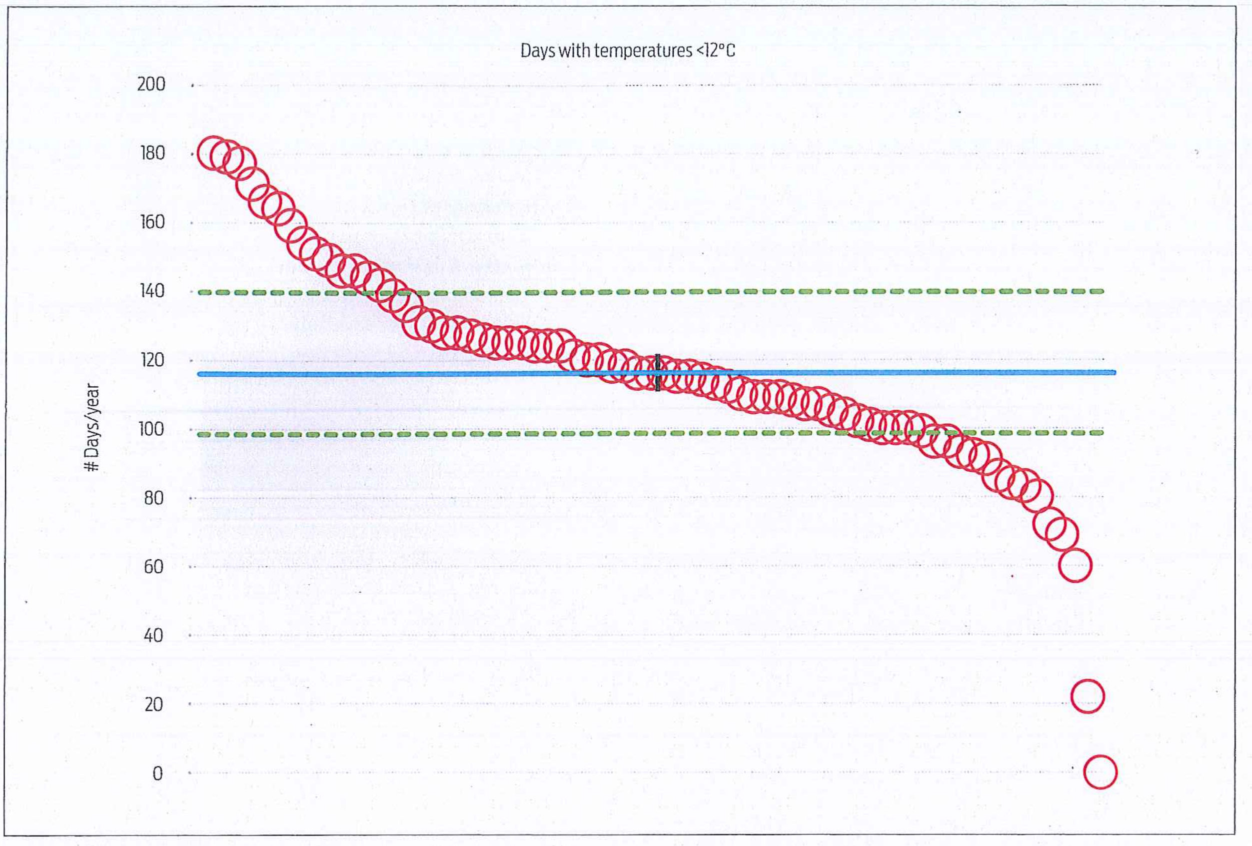


Figure 1. The number of days per year the main living room temperatures are below 12°C when not using active heating in a sample of Christchurch houses consented in 2016.

average, the mean indoor temperature dropped below 12°C for 125 days (Figure 1). For houses consented in 2016, the average was 116 days. One house with excellent passive solar design features and that was clearly well insulated stood alone, having zero critically cold days.

3.0.5 Optimal passive solar design means that, for large parts of New Zealand, expensive fixed heating systems are not required – simple plug-in heaters are sufficient for the short periods when additional heating is required to bring a house up to a temperature above 18°C (and higher for vulnerable occupants).

3.0.6 Passive solar design should also consider shading to avoid summer overheating. Samples of Christchurch houses consented in 2012 and 2016 were found to have lounges that overheated around three times more often than the NOW home, suggesting that shading was not considered properly in design.

3.0.7 Use of thermal simulation software is strongly encouraged to optimise design for year-round thermal comfort and resource efficiency. Tools allow designers to easily and accurately assess the impact of shading, thermal mass, varying insulation levels and orientation in a design. BRANZ Bulletin 602 *Thermal modelling tools for houses* has more information.

4 THERMAL INSULATION

4.0.1 Minimum construction R-values for buildings with any wall type in the schedule method of NZS 4218:2009 *Thermal insulation – Housing and small buildings* are:

- roof – R2.9 in climate zone 1 (Northland, Auckland, Franklin District and the Coromandel Peninsula) and climate zone 2 (the rest of the North Island except the Central Plateau) and R3.3 in climate zone 3 (the Central Plateau of the North Island and all of the South Island)
- walls – R1.9 in climate zones 1 and 2 and R2.0 in climate zone 3
- floors – R1.3 nationwide
- windows and glazing – R0.26 nationwide.

4.0.2 Installing better-than-Code insulation is always easier and cheaper to do during construction than as a retrofit.

4.0.3 BRANZ calculations show that extra roof insulation and floor slab insulation is economic in cooler regions. There is an economic case to specify R4.0 roof insulation in the lower North Island, R5.0 roof insulation in the lower South Island, slab footing insulation in the lower North Island and whole-slab insulation in the lower South Island. For households that heat their homes to high levels in the winter, more insulation, including additional roof insulation, becomes cost-effective. (However, these benefits are reduced or lost in retrofits if older downlights that cannot be covered with insulation are not replaced with energy-efficient LED downlights that can be covered. Heat escapes around older-style downlights into the roof space.)

4.0.4 Calculations from the BRANZ *House insulation guide* show that adding R1.0 perimeter insulation is equally effective for both plain concrete slabs and waffle pod slabs, with an increase in R-value of 30–50%. (This is the rigid foam insulation – typically polystyrene – placed vertically against the outside face or perimeter of a concrete floor slab or foundation wall.) The combined effect of perimeter and underslab insulation is an almost doubling of the R-value, which equates to halving of the heat loss.

4.0.5 Installing R2.8 wall insulation is possible in 90 mm wall framing, but to achieve higher R-values, 140 mm framing is required (an additional R1.5 can be added). This has a thermal benefit beyond just the thicker insulation. Increasing timber frame depth increases the thermal resistance. Depending on the choice of cladding and design, fewer framing members will be needed, so the total area occupied by thermal bridges will reduce. The insulation's overall effectiveness will be much higher.

4.0.6 SNZ PAS 4244:2003 *Insulation of lightweight-framed and solid-timber houses* provides guidance on insulation that gives better performance than the minimums required.

5 GLAZING

5.0.1 Windows can account for up to 40% of heat losses if the home is built to minimum requirements. Going beyond these minimums reduces the need for active heating or cooling, giving occupants greater comfort and reduced running costs.

5.0.2 New houses in New Zealand rarely specify better-performing glazing, as indicated in the findings of the BRANZ study of 210 randomly selected homes – 70 in Auckland, 70 in Hamilton and 70 in Christchurch. Only 4% of Auckland, 0% of Hamilton and 1% of Christchurch houses specified glazing with higher R-values than standard non-thermally broken aluminium-framed double glazing. Yet this upgrade would have reduced the average space heating requirements in Auckland by 26%, Hamilton by 14% and Christchurch by 16% and paid for itself in reduced space conditioning costs.

5.0.3 The minimum construction R-value for windows and glazing in the schedule method of NZS 4218:2009 is R0.26. For much of New Zealand, insulating glass units (IGUs, typically double glazing) are necessary to meet overall requirements, but even when they are not required, they are recommended (Table 1). Their performance can be considerably enhanced:

- Where aluminium frames are used, specify thermally broken aluminium frames. These have a spacer with a high level of thermal resistance between the inner and outer parts of the aluminium frame.
- Specify a low-emissivity (low-E) coating on the glass. This microscopically thin, transparent coating reflects long-wave infrared energy so light/heat can pass in one direction but not the other. There are now many different types of low-E coatings, which offer many different options to maximise performance.
- Consider using timber, uPVC or composite window frames, which have better thermal performance than aluminium.
- Consider using IGUs with argon gas between the panes of glass – this can reduce the amount of heat conducted across the gap and improve the R-value of the glazing by 5–20%.

5.0.4 BRANZ research has shown that, if thermally broken aluminium frames and glazing with a low-E coating are used instead of the aluminium double glazing that just meets Code requirements, the insulation value increases by around 65% and heating energy costs in the house can be reduced by up to 24%. Other materials such as PVC and timber frames can give similar or even greater benefits.

5.0.5 Guidance can be found in the Window Energy Efficiency Rating System (WEERS), a voluntary 6-star rating programme that compares the thermal performance of windows (Figure 2). It was developed by BRANZ in conjunction with the Window & Glass Association New Zealand and government agencies. The more stars, the better performing the window.

6 VENTILATION

6.0.1 Houses constructed today are considerably more airtight than houses of the past. While this reduces uncontrolled ventilation and heat loss, the risk is that new houses will not be sufficiently well ventilated – some new houses have moisture, mould or other pollutant

Table 1. Comparison of typical window R-values (frame and glass).

WINDOW FRAME	SINGLE GLAZING	IGU – 4 MM GLASS AND 8 MM AIR SPACE	IGU – 4 MM GLASS AND 12 MM AIR SPACE	IGU – 4 MM GLASS, 12 MM AIR SPACE AND LOW-E PANE	IGU WITH LOW-E PANES AND ARGON GAS FILL	IGU – 4 MM GLASS, 12 MM AIR SPACE, LOW-E PANE AND ARGON GAS FILL TRIPLE GLAZED
Aluminium	R0.15	R0.25	R0.26	R0.31	R0.32	R0.53
Thermally broken aluminium	R0.17	R0.30	R0.31	R0.39	R0.41	R0.77
Timber	R0.19	R0.34	R0.36	R0.47	R0.51	R1.00
uPVC	R0.19	R0.34	R0.36	R0.47	R0.51	R1.00

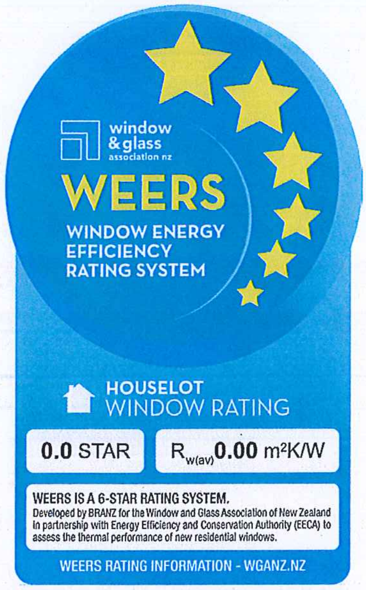


Figure 2. A WEERS label.

problems. BRANZ recommends the strategy 'build tight, ventilate right'.

6.0.2 BRANZ research has indicated that opening windows wide even for 10–15 minutes a day can provide effective ventilation, reducing excess moisture levels inside a house (see 'Open windows for dry home' in *Build* 108). There is other research, however, that indicates that occupants are not doing this.

6.0.3 Exhaust ventilation such as ceiling or wall vents and rangehoods over cooktops ducted to the outside should be installed in bathrooms and kitchens to remove moisture. Clothes dryers (other than condensing dryers) should also be vented directly to the outside.

6.0.4 Other forms of mechanical ventilation addressing the whole house may be necessary. Typically, these need to be matched with heating to keep the home warm. Balanced ventilation systems that incorporate heat recovery are the preferred option. These ducted ventilation systems have two fans – one to draw air in from outside and one to remove stale internal air. An air-to-air heat exchanger recovers heat from the internal air before it is discharged and warms the incoming air with the recovered heat. A BRANZ trial found that around 75% of the heat from outgoing air can be recovered. Careful design and installation are critical – actual delivered efficiency can drop below 30% if ducting air and heat losses are not properly considered (typically when ducting is outside the thermal envelope). Inside the thermal envelope is the best location for the system, although for retrofits, the roof space may be the only option (but is far from ideal). During installation, balancing extract and intake airflow is critical for achieving optimal efficiency. The ventilation rate needs to be adjusted for the house volume to achieve the desired air exchange rate (0.35 air changes per hour).

6.0.5 Cold roof spaces can suffer from high moisture levels leading to condensation, especially on metal profiled cladding materials. Entrapped construction moisture, high indoor humidity levels in combination with an air-leaky ceiling are possible causes for increased moisture levels in the roof cavity. Installing passive ventilation elements to the roof space adds resilience by increasing the air exchanges and removing excess moisture.

7 MATERIALS USE

7.0.1 Building materials have an environmental impact from their extraction as raw materials through construction (including construction waste) and use through to their reuse and eventual end-of-life disposal. Specifying materials carefully can ensure lower environmental impacts while still meeting budget goals.

7.0.2 Life cycle assessment (LCA) evaluates the potential environmental impact of a material, product or system over its life cycle. Some building products come with environmental product declarations (EPDs), which give a summary of information about their environmental impacts.

7.0.3 BRANZ has two free Excel spreadsheet tools that assist in lowering the environmental impact of materials at the preliminary design stage:

- LCAQuick combines outputs of materials and energy simulations together with environmental impact data to calculate a building's environmental impact.
- The MaCC Tool (Materials and Carbon Comparison Tool) allows the fast and easy assessment of roof, wall, window and floor elements comparatively, in terms of their lifetime carbon intensities.

7.0.4 Some building and construction products carry ecolabels from independent organisations that allow assessment of their environmental performance. Environmental Choice New Zealand has specifications covering a wide range of building products from floor coverings to ready-mixed concrete. There are many international labelling schemes. With timber, for example, look for timber from plantation forests certified by the FSC (Forest Stewardship Council) or PEFC (Programme for the Endorsement of Forest Certification).

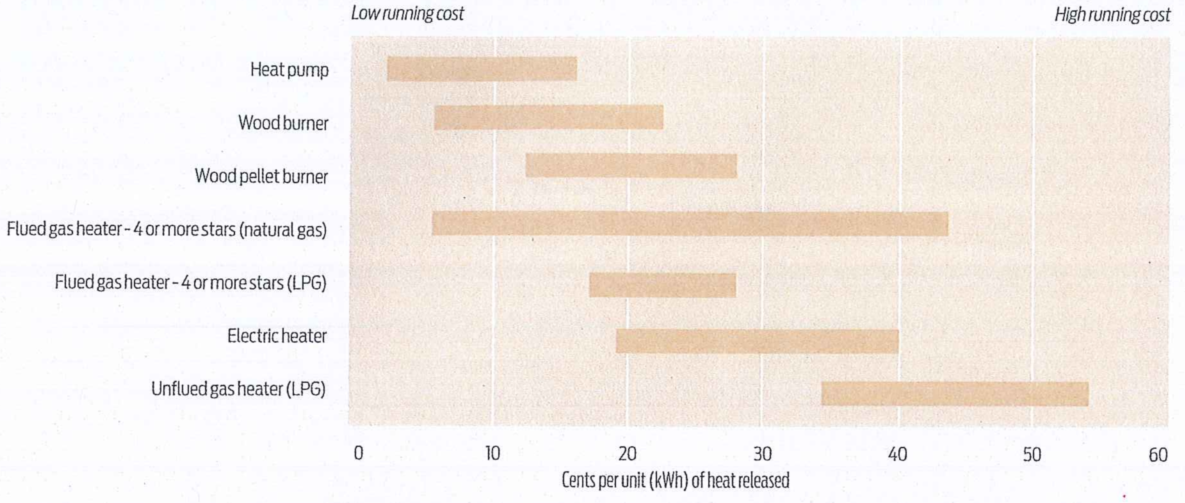
8 ENERGY

8.0.1 The most efficient way of providing a warm and comfortable living environment with comparatively low running costs is good passive solar design that has been examined and fine-tuned using a thermal simulation tool. In many parts of the country, a well-considered design can reduce the requirement for active heating and cooling to a few days a year.

8.0.2 For days when active heating is required, there is an enormous difference in the running costs and energy use of the different options available (Table 2). Heat pumps have the lowest running costs overall, while wood burners are a good option for people with access to cheap or free firewood.

8.0.3 Water heating can account for up to a third of the energy use in a house. For many households, electric hot water cylinders are not the best option in terms of

Table 2. Approximate comparative running costs of different space heating options, from lowest to highest cost.



Note 1. Unflued gas heaters are not recommended. Apart from the high running costs, they produce large amounts of water vapour. In the 2018 Census, almost one-third of the households that relied on portable gas heaters had problems with mould.

running costs (although they are cheaper to buy and install than some of the other options). The government website www.energywise.govt.nz has a tool to help compare systems. This gives estimates for upfront costs, yearly running costs and lifetime costs. Some options with low upfront costs have high lifetime costs, while some with high upfront costs have lifetime costs that are thousands of dollars lower.

8.0.4 LED lights use significantly less power than standard incandescent bulbs. To provide the same level of light as a 100 watt incandescent bulb, an LED uses just 15 watts (Table 3). BRANZ has estimated the payback period for LED lights can be as short as 6–18 months. Clearly, where there is a choice of lighting types, LEDs should be specified. Where recessed downlights are planned, consult the drawings and details in NZS 4246:2016 *Energy efficiency – Installing bulk thermal insulation in residential buildings*.

8.0.5 There is an economic case for some households – especially those that use a lot of electricity during the day – to install photovoltaic (PV) generation systems, but careful calculation is required. Recent New Zealand research has suggested that PV systems are not particularly beneficial at reducing carbon (CO_2 emissions), mainly because New Zealand grid electricity is already largely produced from highly efficient low-carbon renewables such as hydro and wind. Most common PV panels are produced in a carbon-intensive manufacturing process, and there are uncertainties around end-of-life disposal.

8.0.6 Solar water heating systems are in a different position to PV because they have the advantage of time shifting energy needs – the hot water tank is essentially a battery recharged in daytime sunshine. There is not a good economic case for solar water heating in every household – careful calculation is required for these too before determining whether this is the best option.

9 WATER

9.0.1 Specifying water-saving devices and appliances adds relatively little to construction costs and can have fast payback, especially in areas where water is metered and charged for separately. Where water saving applies to hot water, it reduces energy costs too.

9.0.2 The benefits can be significant. Monitoring in Beacon Pathway's Waitakere NOW Home found that

Table 3. Comparable energy use of different types of lighting.

LED equivalent (watts)	CFL equivalent (watts)	Halogen equivalent (watts)	Incandescent equivalent (watts)
15	24	70	100
12	20	52	75
8	15	42	60
6	12	28	40
4	7	18	25

water efficiency measures reduced the family's water use by a quarter, to under 120 litres per person per day, compared to the average in the Waitakere area of 165 litres. Because water is metered and paid for separately in Auckland, this reduction gives the occupants a direct financial benefit of $570 a year.

9.0.3 Under the Water Efficiency Labelling Scheme (WELS), certain products must display a WELS label with a star rating for relative water efficiency – the more stars, the better, up to a maximum of 6 – and a water consumption or water flow figure. Specifying products with more stars can give considerable water savings. Fixtures and appliances covered by the scheme include:

- clothes washing machines
- dishwashers
- lavatories
- showers
- taps.

9.0.4 In circumstances where clients can compost their organic kitchen waste, encourage this rather than a kitchen waste disposal unit. These units can use a considerable amount of water and shift the problem of dealing with the organic waste further down the line to sewage treatment stations.

9.0.5 Rainwater tanks provide resilience benefits as an emergency supply of water, and where territorial authorities require hydraulic neutrality, rainwater tanks may be required for compliance. BRANZ research indicates that they are not the best option for every household, however, with long payback periods in some areas. Focusing instead on reducing average daily (per capita) residential water consumption, as the first half of this section does, is likely to be a better approach.

9.0.6 Greywater – wastewater from baths, showers and hand basins – can sometimes be reused for irrigation or, with appropriate treatment, toilet flushing. This takes pressure off reticulated water supply networks and sewerage systems. These systems require maintenance that must be discussed with clients before they make a decision. Greywater systems are particularly suited to rural areas where there are on-site wastewater systems and larger house sites.

9.0.7 Stormwater management is getting increasing attention, often as a result of changing council requirements that mean that new residential developments cannot discharge additional stormwater into the council's system and so must treat all stormwater on site.

9.0.8 Stormwater can be disposed of:

- into a local authority stormwater system – either directly or by slow release through an on-site detention tank
- into a soak pit, following the guidance in New Zealand Building Code Verification Method E1/VM1
- into a raingarden with suitable planting
- into a retention tank, to store water for gardening, toilet flushing and so on (but not drinking)
- into a water tank for all household requirements.

10 RESOURCES

10.0.1 Measuring and comparing options for improving performance of New Zealand homes can be a complex task. There are a number of resources and organisations that can help:

- BRANZ resources:
  - Thermal modelling software BRANZ ALF 4.0 – BRANZ Bulletin BU602 *Thermal modelling tools for houses* has more details.
  - The Level website – www.level.org.nz.
  - Features on the main www.branz.co.nz website such as Up-Spec, LCAQuick and Universal Design.
- Eco Design Advisors (EDAs) give free advice and are accessible through a number of councils around the country – www.ecodesignadvisor.org.nz.
- The New Zealand Green Building Council operates Homestar, New Zealand's environmental certification scheme for all housing (explained below) – www.nzgbc.org.nz.
- Beacon Pathway is a research-based organisation working to bring New Zealand's homes to a high standard of sustainability – www.beaconpathway.co.nz.
- Home Performance Advisors (HPAs) is an initiative of the Community Energy Network, Toimata (previously Enviroschools) and Beacon Pathway. These agencies provide an advisory service nationally – www.beaconpathway.co.nz.
- The Superhome movement is a non-profit, industry-led group pushing for more energy-efficient homes – www.superhome.co.nz.
- Passive House Institute New Zealand provides a whole-of-house energy and thermal efficiency building performance standard and certification system and was established in 1996 in Germany as PassivHaus – www.passivehouse.nz.
- The Smarter Homes website was relaunched by MBIE in 2017 – www.smarterhomes.org.nz.
- Lifemark is the champion for universal design – the design approach that provides environments that are accessible to all people of all abilities at any stage of life. Lifemark has a formalised assessment process and rates the comprehensiveness of a design. Lifemark runs an accredited partnership programme for building professionals – www.lifemark.co.nz.
- The government's Energywise website has useful tools and calculators for water heating systems and home appliances in particular – www.energywise.govt.nz.

10.0.2 On the Homestar rating tool, many Code-compliant homes today would rank the equivalent of around 3–4 stars. A 6-star home (the minimum certification given to new homes) is warmer and healthier and costs less to run. A 10-star rated home is a top-performing house across energy use, comfort, health, water, waste, operation, proximity to amenities, materials and management.

10.0.3 A desktop analysis of 10 Building Code-compliant houses and terraced homes was carried out to estimate the additional cost needed to achieve a higher Homestar rating. The designs analysed were those of actual new buildings at Hobsonville Point, Auckland. The findings were that:

- a 6-Homestar dwelling costs approximately 3% more to construct than a typical Building Code-compliant dwelling, and payback is estimated at 6 years based on operational savings
- a 7-Homestar dwelling costs an extra 4%, and payback is estimated at 7 years based on operational savings, with comfortable conditions faster and easier to achieve.

10.0.4 These additional upfront costs can be reduced when there are a number of similar homes in a development.

11 WHO SHOULD DRIVE BETTER-PERFORMING BUILDINGS?

11.0.1 BRANZ research into builders' views on how much they should guide their clients on sustainability choices found that many simply delivered what the client wanted. BRANZ interviewed 10 of New Zealand's largest builders in Auckland, Christchurch and Tauranga. Most builders did not believe their role was to advise clients on which features to include and which ones had the best payback periods.

11.0.2 The builders said that a very small proportion of clients asked about specific sustainability and resilience features. Most clients preferred to spend money on "things you can see". Several builders are already incorporating sustainability and resilience features as standard in their specifications. However, this varies widely from builder to builder. The most common feature was above-Code insulation.

11.0.3 There is some evidence that building practitioners are overly optimistic about the standard of houses they are constructing. A BRANZ study asked various industry professionals to describe which of three categories best described the performance of the last house they worked on – 'meets the minimum standard', 'incorporates substantial high-performance aspects' or 'exemplifies world best practice'. Overall, 6% rated their last house as meeting world best practice, a proportion not matched by reality. None of the building control officers selected this option. Overall, 84% of building control officers said the last house they worked on met the minimum standards – the lowest-performing category.

11.0.4 BRANZ has also examined consumer decision making about the choice to exceed New Zealand Building Code minimum requirements. The research found that it is challenging for consumers to build beyond Code:

- Consumers see the Building Code as a high-quality solution rather than the minimum standard.
- There are varying levels of consumer trust and confidence in building professionals. When consumer and builder share similar values, such as an interest in sustainability, exceeding the minimum is more likely to happen.
- Many consumers are uncertain whether they will remain in a property long enough to receive a return on the initial capital outlay.

12 MORE INFORMATION

BRANZ BULLETINS

BU571 *Thermal mass*

BU576 *Edge insulation of concrete floor slabs*

BU579 *WEERS Window Energy Efficiency Rating System*

BU598 *Insulating glass units*

BU602 *Thermal modelling tools for houses*

BU607 *Passive ventilation*

BU629 *ALF 4.0 Building performance index calculator*

BU630 *Roof space ventilation*

BU651 *Climate change, net-zero carbon and the building industry*

BRANZ PUBLICATIONS

BRANZ *House insulation guide* (5th or later edition)

BRANZ STUDY REPORTS AND EXTERNAL RESEARCH REPORTS

SR333 *Valuing sustainability and resilience features in housing*

SR342 *Measuring our sustainability progress: Benchmarking New Zealand's new detached residential housing stock*

SR346 *The value of sustainability – costs and benefits of sustainability and resilience features in new houses*

SR391 *The cost of Homestar: A case study on how to achieve a 6–10-Homestar rating for stand-alone and terraced housing in Hobsonville Point*

SR402 *The choice to exceed: Consumer perspectives on building beyond Code in New Zealand*

SR426 *Measuring our sustainability progress: New Zealand's new detached residential housing stock (first update)*

ER19 *Getting universal design into new builds and major renovations*

ER27 *Doing better in residential dwellings: Going beyond the Code in energy and accessibility performance*

ER43 *Green mortgages: Financial incentives to design and build high-performance homes*

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BRANZ Find www.branzfind.co.nz

HEAD OFFICE AND RESEARCH STATION
1222 Moonshine Road, Judgeford, Porirua, New Zealand
Private Bag 50 908, Porirua 5240, New Zealand
Telephone 04 237 1170 - Fax 04 237 1171
www.branz.nz

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