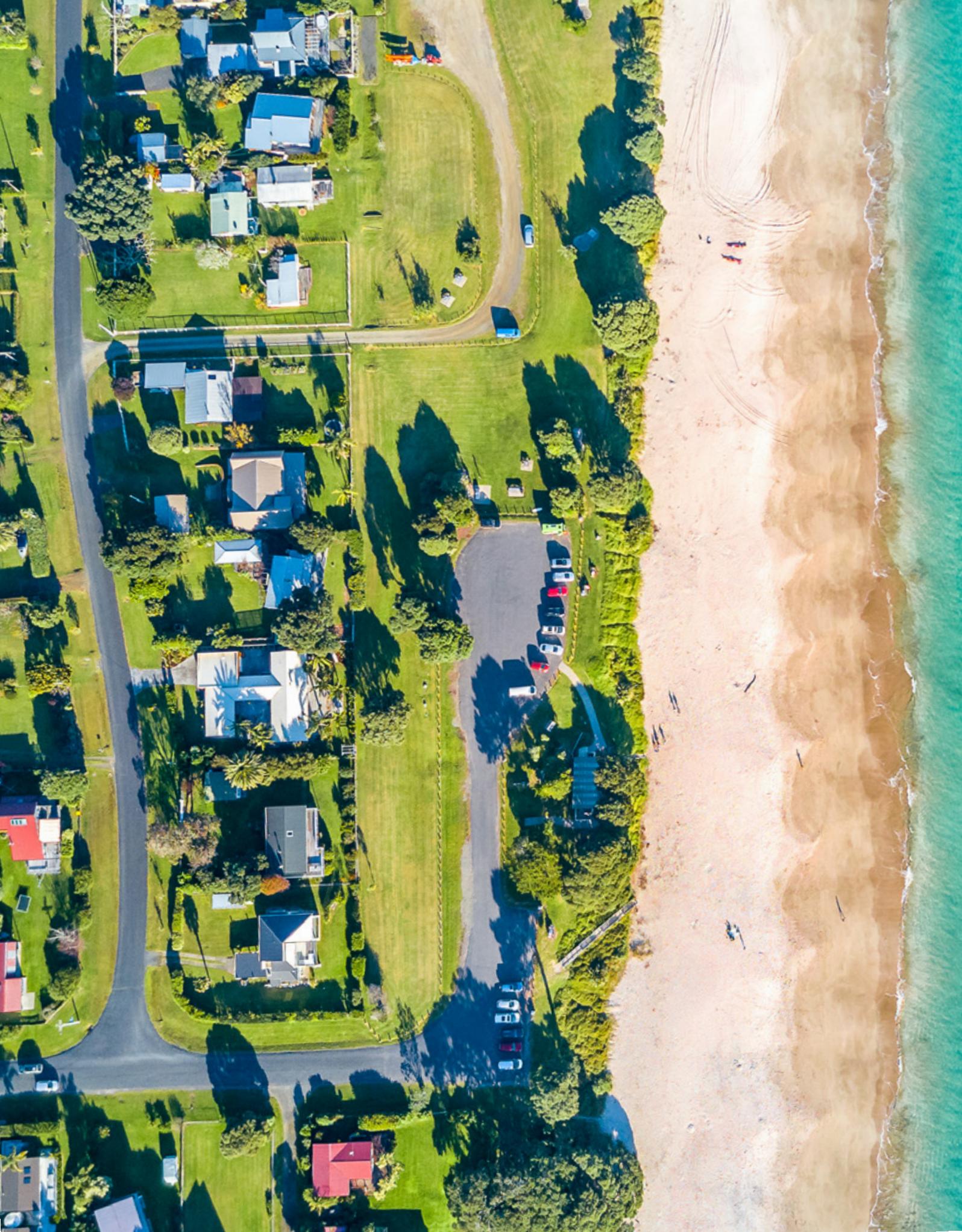




**Levy in Action  
2020**



**Challenging Aotearoa NZ to  
create a building system that  
delivers better outcomes for all.**

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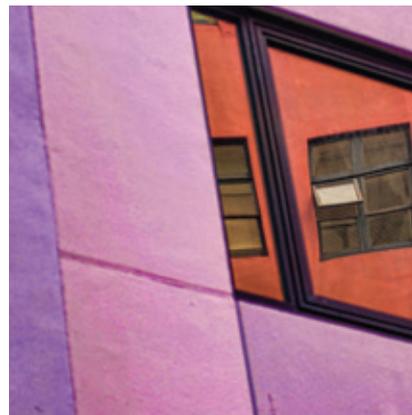


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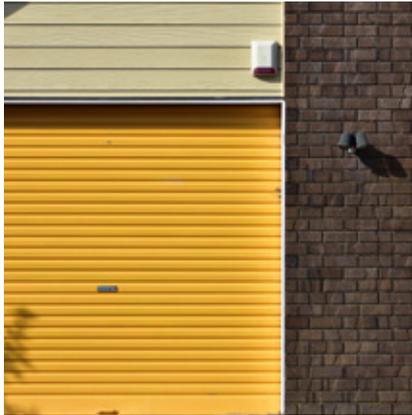
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# Looking ahead

## If the COVID-19 pandemic teaches us anything, it is the importance of resilience. Having the capacity to adapt and respond rather than just react is critical for our sector, now and in the future.

For BRANZ, this is front of mind as we continue to invest the Building Research Levy, to meet the emerging and long term needs of the industry. For 50 years, our team of scientists, engineers and professionals have been passionately committed to ensuring the built environment is the best it can be. We have investigated the macro and micro issues facing the industry and our research has made a difference for the future of the sector and the lives of all New Zealanders.

During this time, we have been committed to adapting and designing research that offers practical solutions for the industry. This was highlighted by the Minister of Research, Science and Innovation, the Hon. Dr Megan Woods, at our 50th birthday celebrations in February 2020. She said, “The people of BRANZ have been constantly adapting to meet the ever-evolving needs of our building and construction sectors”.

The ability and capacity to adapt remains a strength of BRANZ, especially as the impact of COVID-19 continues to unfold. This *Levy in Action* issue illustrates our commitment to continually adapt our research to meet the changing needs of the industry.

Highlights this year include the work of our researchers to develop projects in closer collaboration with key stakeholders. The concept of co-design is being actively embedded across our research portfolio working in

partnership with industry, government, universities and other research providers.

For example, the Household Energy End Use 2 (HEEP2) project fosters this approach. It seeks to update our understanding of how energy is used by New Zealanders in their homes. We have engaged with organisations, such as Kainga Ora and Statistics NZ, to identify key questions, the data needed and design the research methodology. This will help ensure that the research outcomes lead to a better understanding of how New Zealand can improve the indoor environments of our homes by informing government policy and industry practices.

Another example of our increased use of co-design is the development of our Transition to a Zero-Carbon Built Environment programme. Our research teams have worked closely with industry and government to support an industry-led transition. We are already realising early successes with this approach. The programme has contributed to the Ministry of Business, Innovation and Employment’s Climate Change programme and assisted the Ministry of Education to develop their Environment Action Plan to achieve zero carbon.

As Minister Woods observed, BRANZ has a long history of adapting to meet the changing needs of the sector and this agility forms a critical strand of our resilience DNA. We are proud of this and confident that the research supported by the Building Research Levy this year will also contribute to building the resilience of the sector.

Chelydra Percy  
BRANZ CEO





# Investing the Building Research Levy

The Building Research Levy plays a key role in improving the building and construction industry, ensuring New Zealanders receive the greatest possible benefits from the investment.

## **Making a difference for the industry**

The Building Research Levy investment provides a trusted, accessible and actionable evidence base to lay the foundation for New Zealand to build on.

A key driver of the Levy investment is ensuring that the research is designed to make a difference for the industry and ultimately for New Zealanders.

From the micro to the macro, BRANZ ensures Levy funded research can and does contribute effectively. To do this, we partner with industry and government to keep the research accessible. The research is designed alongside key users who have the ability to action the research findings.

# Developing a system-wide view of industry needs

BRANZ is committed to an enduring collaborative effort across industry and government to ensure real barriers to improving the building system are uncovered, debated and resolved.

## Working with industry

BRANZ has deep connections across the building and construction industry that are fundamental to our work. Collaboration provides a unique system-wide perspective of how the industry works and keeps us informed about emerging issues.

We also engage with a wide range of industry organisations and experts to understand industry research and information needs. This keeps our work grounded and focused on real-world practical solutions.

## Engaging with government

BRANZ works closely with a number of government organisations involved with the building and construction industry. We apply an interest-based approach to these relationships to link our capabilities with the research needs of policy makers and regulators. We co-design the research to ensure that our work provides the maximum value and helps develop complete solutions for the industry.

By working with government, BRANZ can continue to:

- support the Ministry of Business, Innovation and Employment (MBIE), as the building regulator, with the revision of the Building Code, relevant compliance documents and standards
- ensure that government decisions around buildings are informed by robust up-to-date research
- present new opportunities to maximise value from government investment in public buildings, such as schools and state houses

- maintain ongoing dialogue with key government stakeholders to stay abreast with current trends, challenges and opportunities
- make submissions on proposed regulatory changes affecting buildings, such as the Building Amendment Bill 2020 and the Building for Climate Change programme.

Since the inception of the Construction Sector Accord in April 2019, BRANZ has been a vocal supporter and committed partner of the Accord. We will continue sharing connections, knowledge and insights to support the sector-wide effort.

## Collaborating with researchers

Our relationships with universities, Crown Research Institutes (CRIs) and other research providers are also essential to BRANZ. We currently work with more than 20 research organisations from across New Zealand. Shared information helps inform priorities for funding, ensuring we aren't duplicating effort and we are playing to our respective strengths.

## Connecting with the international community

BRANZ maintains a watching brief on key international trends and developments facing the building and construction industry.

Some offshore developments can have direct implications for New Zealand, such as changes to shared international standards. Our international scanning can also highlight information about opportunities or issues we may face in the future.

Many BRANZ researchers and scientists are members of international collaborative groups. This enables us to participate in the international science community and share that expertise within New Zealand. Of particular note, BRANZ is a member of the International Council for Research and Innovation in Building and Construction. We also work with our Australian colleagues through the Australian Building Codes Board.

# Integrating industry needs into investment priorities

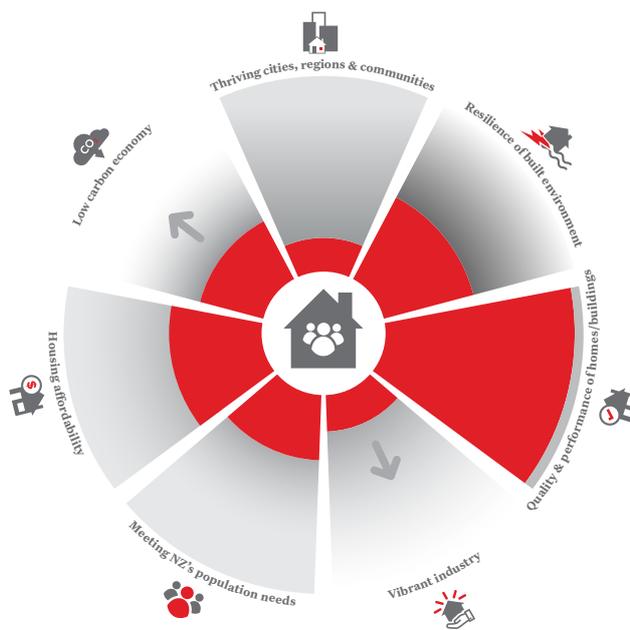
Building and construction impacts on New Zealand’s economy, environment and people’s wellbeing. BRANZ invests in research that aims to understand and identify the nature of industry issues to deliver better outcomes for all.

## Our portfolio

The BRANZ portfolio sets out a research perspective of the building and construction industry and the barriers it faces. It outlines building and construction research across New Zealand and identifies where we can focus our efforts to make a difference.

Our portfolio provides a high-level view of broad outcomes of research that address the New Zealand building and construction industry’s needs. As part of our annual Levy investment process, BRANZ reviews our existing research portfolio and seeks feedback from industry and government stakeholders on their priorities. This, in turn, informs our research priorities.

The graphic to the right sets out key areas in which we undertake research. It shows the relative strengths (red shading), the depth of research effort (grey shading) and areas where research has the opportunity for increased effort (arrows).



- BRANZ research and its relative strengths
- Depth of research effort across New Zealand
- Areas where there is opportunity for increased research

# Our portfolio overview

[Indicative examples]	2019/20	2020/21	2021/22	2022+	
COMPONENTS SHAPED BY LEVY INVESTMENT PORTFOLIO STATEMENT (LIPS)	<b>ELIMINATING QUALITY ISSUES</b> 	Priority problems tackled through new focus and tools	New types of knowledge transfer focus on behaviour change	Research provides evidence that quality problems are being addressed	Quality issues are being addressed as solutions take hold
	<b>WARMER, DRIER, HEALTHIER HOMES</b> 	Key insights support shift in quality of existing rental housing stock	Solutions to lift the quality of indoor environments in high-density living are being developed	Solutions around improved indoor living conditions are rolled out	Evidence from this programme has led to policy changes lifting the quality of both new and existing housing stock
	<b>TRANSITION TO A ZERO-CARBON BUILT ENVIRONMENT</b> 	Programme of action commenced	Existing solutions being shared and new solutions being fast-tracked	Tools to support low-carbon building are becoming mainstreamed	Low-carbon construction has become mainstreamed as a core element of New Zealand's building system
	<b>FIRE-SAFE DENSIFIED HOUSING</b> 	Key partners brought together to identify action around high-density living	First projects from new programme begin	New solutions developed	Shift in construction practices around fire safety begins on back of new insights driven by the programme
<b>INVESTMENT ON EMERGING ISSUES</b> 	Urgent work to address retrofit gap around precast concrete flooring systems	BRANZ is able to act quickly and decisively on urgent issues as they emerge			
<b>DISTINCT, STAND-ALONE PROJECTS</b> 	eg: Overframing of timber buildings	Projects initiated by both researchers and end users			
<b>SCHOLARSHIPS</b> 	Helping ensure that New Zealand has strong research capability in core STEM and building science areas				
<b>INDUSTRY TRANSFORMATION</b> 	Industry Transformation Agenda development and evolution in alignment with Construction Sector Accord	Projects developed that tackle root cause challenges faced by building systems	Project solutions trialled, refined and rolled out	Shift in industry performance can be measured against baseline	

**Core activities** that make our research and knowledge accessible and actionable

Publications	Services	Long-term studies	Tools
<ul style="list-style-type: none"> <li>Build</li> <li>Guideline</li> <li>Bulletins</li> <li>BRANZ Facts</li> <li>BRANZ Research Now</li> <li>Study Reports</li> </ul>	<ul style="list-style-type: none"> <li>Seminars</li> <li>Live webinars</li> <li>E-Learning modules</li> <li>Helpline</li> <li>Information management</li> <li>Advisory services</li> </ul>	<ul style="list-style-type: none"> <li>Durability verification database</li> <li>Weathering site</li> <li>Levy forecast</li> <li>House Condition Survey</li> </ul>	<ul style="list-style-type: none"> <li>MyBRANZ Knowledge</li> <li>B-RISK user support</li> <li>Artisan</li> <li>BRANZ CO<sub>2</sub>NSTRUCT</li> <li>ALF</li> <li>LCAQuick</li> </ul>

For more information on core activities, see [www.branz.co.nz](http://www.branz.co.nz)  
 Details on all BRANZ projects are published annually in our [Levy in Action](#).

# Investing responsibly and responsively to make a difference

Wise Levy stewardship and purposeful investment enables BRANZ to deliver research that informs solutions to industry issues. We are also able to adjust our investment plans and pace through a variety of economic conditions.

## Our Levy investment approach

In contrast to 2019, today's operating environment is more challenging. The social and economic effects of the COVID-19 pandemic are likely to be far-reaching. At the time of writing, the long-term impact of the COVID-19 lockdown on the New Zealand economy, including the building and construction sector, is uncertain.

BRANZ Inc. receives the Building Research Levy. This is directly linked to the levels and values of building consents.

BRANZ is able to invest in and support research through economic cycles in a careful, transparent and considered way. We do this through our long-term Levy utilisation policy. It uses a 10-year model to create a stable, sustainable platform for BRANZ to invest the Building Research Levy effectively. This helps manage any increases or reductions in the Levy income.

In practice, when the Levy income increases, we are prudent to expand our investment. Then, when the Levy income decreases, we don't have to make unnecessary or drastic cuts.

This enables us to adjust our plans and pace of investment and still maintain our core commitment to a high-performing industry. We anticipate that this financial approach will assist BRANZ's financial stability, despite the current economic uncertainty.

## Levy utilisation policy

The long-term Levy utilisation policy sets out how BRANZ will effectively manage the Levy by:

- determining a baseline Levy investment sum using the 10-year model – this is incorporated into the annual BRANZ Group budget for investment in Levy-funded activities
- investing the baseline Levy investment sum in internal and external research and knowledge dissemination
- investing the Levy in an open, transparent and contestable way
- ensuring that any investment in core internal capability is linked to BRANZ's long-term strategic priorities
- investing to avoid unnecessary duplication of capability and facilities across New Zealand
- ensuring the availability of funding for maintenance and investment in property, plant and equipment
- maintaining appropriate cash reserves.

## Allocating the Building Research Levy

BRANZ is responsible for providing effective stewardship of the Building Research Levy. This demands robust decision-making processes, a commitment to transparency and disciplined management of Levy investments.

The BRANZ Inc. Board determines how much of the Levy is spent on research and knowledge dissemination.

The BRANZ Levy Investment Portfolio Statement outlines high-level investment signals around existing and new priority areas for Levy investment. It is an open and transparent mechanism through which BRANZ Inc. sets out its investment priorities and invites proposals seeking Levy funding.

BRANZ Inc. invests the Building Research Levy through a range of mechanisms:

- Investments that target work initiated and contracted with BRANZ Ltd (this can include subcontracts with external providers).
- Investments that target work initiated and contracted with external providers (this can include subcontracts with BRANZ Ltd). This includes scholarships to support the next generation of researchers and help support capability in New Zealand's tertiary education institutions.
- Agile investments that can respond to urgent issues or take advantage of opportunities that may emerge outside of programmed investment rounds.
- Strategic initiatives that invest in significant activities above and beyond BRANZ's baseline of research investment.
- Investments in infrastructure to develop and maintain building research capability.

To ensure research is of a high quality, all investment proposals undergo a rigorous assessment process.

## BRANZ Ltd

BRANZ Ltd is New Zealand's primary building research provider and is nationally and internationally recognised as a centre of building science expertise. BRANZ Ltd carries out industry-good research and co-develops solutions to address systemic industry issues.

A wholly owned subsidiary of BRANZ Inc., BRANZ Ltd operates predominantly out of the Judgeford campus near Wellington. Over 100 staff work here – of whom most are scientists and researchers or experts in knowledge dissemination.

Research proposals put forward by BRANZ Ltd are reviewed by the Levy Allocation Advisory Group (LAAG). This group of independent assessors is appointed by the BRANZ Inc. Board. It is made up of leaders and experts drawn from the Building Research Advisory Council and the wider building and construction industry. MBIE also participates on this advisory group, in recognition of the strong connections between Levy-funded research and government regulatory and policy direction. The group aims to provide independent expert advice that can give confidence to the BRANZ Inc. Board on the focus and quality of BRANZ Ltd research.

## External providers

Collaborating with other providers is an important part of how BRANZ strives to deliver best value from the Levy. There is significant expertise within universities, Crown research institutes and independent research providers to complement BRANZ-based specialist teams.

Sometimes, this can involve external providers being directly contracted by BRANZ Inc. to carry out projects. Other times, external providers act as part of a team of subcontractors to BRANZ Ltd to deliver Levy-funded work.

BRANZ works hard to be open and transparent about how external providers can access Levy funding. External proposals are sought through an open call for ideas – the publication of a research prospectus. The prospectus is sent to industry and the research community seeking proposals to help deliver on research priorities outlined in the Levy Investment Portfolio Statement.

Levy funding is also invested in outstanding postgraduate scholars to work on industry issues. This supports the next generation of researchers and builds on our ties to tertiary education institutions, helping support their capability.

## Emerging issues

Most of our research investments are delivered through the annual funding rounds described above. As part of our portfolio approach, we also recognise the importance of being an agile investor. We want to be able to respond to opportunities and issues outside the usual investment cycles.

BRANZ can quickly respond to emerging building and construction industry issues and invest in discrete pieces of timely work such as a publication or guidance on a pressing issue. These out-of-cycle investments can come from ideas identified and developed within BRANZ or from external organisations.

## Strategic initiatives

BRANZ also invests the Levy in strategic initiatives beyond the core baseline investment in research. These are typically focused on national strategic opportunities and are approved by the BRANZ Inc. Board.

BRANZ's strategic investments have ambitious goals and aim to have long-term, positive and far-reaching outcomes.

## Infrastructure

BRANZ Inc. also invests Levy funding in developing and maintaining building research capability at its campus.

This research infrastructure is a key national asset. Capital investment in property, plant and equipment is undertaken at BRANZ through a cyclical process targeting progressive improvement. By understanding the value and quality of existing assets and identifying future needs, we can develop a programme of capital requirements and understand investment priorities.

A Campus and Asset Management Plan shapes these investments. The plan creates visibility of the potential size and scale of investment in property, plant and equipment at BRANZ over the next 10 years. This supports the Board in making individual project investment decisions relative to the size and scale of other likely investments.

# Research investment overview 2020/21

New Levy investment and budgeted expenditure for existing research committed for the year 1 April 2020 to 31 March 2021:

Programmes	New investment \$	Existing investment \$	Total \$
Warmer, drier, healthier homes	933,000	1,961,000	2,894,000
Transition to a zero-carbon built environment	596,000	1,280,000	1,877,000
Fire-safe densified housing	429,000	887,000	1,315,000
Eliminating quality issues	445,000	50,000	495,000
Knowledge transfer and enabling activities	95,000	2,819,000	2,914,000
Scholarships	18,000	228,000	246,000
Stand-alone projects	2,009,000	2,144,000	4,152,000
Strategic initiatives*	1,081,000	-	1,081,000
<b>Total</b>	<b>5,606,000</b>	<b>9,369,000</b>	<b>14,974,000</b>

These figures are correct in representing the total Levy investment for the year, as at 1 July 2020. This is subject to change due to project variations and new investments made in response to emerging issues.

\* Funded on an annual basis.

For completeness, the 2020 Levy in Action also includes several now complete research projects that did not feature in the 2019 Levy in Action.



# Furthering programmes of research

BRANZ research programmes develop comprehensive solutions to pressing industry issues.

We bring together a range of experts to undertake research that leads to accessible, actionable insights and develops solutions to resolve systemic industry issues.

In 2019/20, BRANZ undertook a review of its four research programmes to realign the outcomes of the programmes so that they are specific, measurable, realistic and time-bound. BRANZ committed to seek input from programme advisory groups to ensure that research programmes are complementary to each other and linkages between programmes are well understood.

Following the review of the four existing programmes and development of two new ones. We:

- wound down *Medium-density housing* and *Exceeding the minimum*
- refreshed and refocused the *Eliminating quality issues* and *Warmer, drier, healthier buildings* programmes
- implemented two new programmes – *Transition to zero-carbon built environment* and *Building fire-safe densified housing*.

# Warmer, drier, healthier homes

Unhealthy homes and buildings diminish the health of the people who live and work in them. This programme was established to understand and solve issues that prevent buildings from being warm, dry and healthy.

## What we're doing

The programme, established in 2016, aims to address building issues that affect people's health. A strong focus is placed on getting the best teams in place with collaboration between research organisations across New Zealand. We work together with industry to address key issues.

Initially, the programme investigated weathertightness, roof moisture issues and indoor air quality (including insulation and ventilation). The purpose was to improve our understanding of the relationship between building science and occupant health. These insights informed the development of implementable solutions to building warmer, drier, healthier buildings in New Zealand.

Over the last four years, the findings from the programme have helped improve New Zealanders' lives. They played a significant role in shaping new tenancy laws, providing impartial evidence to help MBIE and the Ministry of Housing and Urban Development (HUD). Findings from the programme also influenced changes to the Residential Tenancies Act and the healthy homes standards for heating, insulation, ventilation, drainage and moisture ingress.

The research has been integral in developing a national tier 1 statistic for housing quality – designed to help improve our overall understanding of housing in New Zealand. Work with Statistics New Zealand (Stats NZ) has led to new insights around housing from the New Zealand General Social Survey, which measures New Zealanders' wellbeing.

A HUD, MBIE, BRANZ and Stats NZ collaboration, with support from other agencies, has also worked towards the development of a prototype housing quality statistic.

A 2019 programme review showed that, overall, there has been progress on the nature and causes of home performance. This programme addresses ongoing concerns over the condition of New Zealand's housing stock and increasing evidence globally on the effects of indoor air quality (IAQ) on occupant health.

The review also showed a significant overlap with the proposed redefined *Exceeding the minimum* research programme. As a result, the *Exceeding the minimum* programme became part of this redefined programme, commencing April 2020.

The next phase of work meets the demand for answers on a range of factors affecting IAQ, evidence of its effects and the need for further solutions leading to healthy homes. The focus of research in the programme has narrowed from buildings to residential housing.

### Programme objectives

By 2030, all New Zealand homes have the capability to consistently provide warm, dry and healthy environments in an affordable way. This will be achieved by:

- addressing indoor environment issues;
- improving the building envelope performance;
- developing performance and quality measures;
- improving knowledge and understanding of the benefits.

### Programme leader

Mark Jones  
mark.jones@branz.co.nz

## Effective curtains



The benefits of well-fitting curtains or blinds to help prevent heat loss through windows are frequently quoted in home performance advice, by EECA, Eco-Design Advisors and Home Performance Advisors.

This advice is taken onboard by curtain banks, which provide low-cost or free curtains to low-income households for an estimated 5,000 households per year. However, some curtain banks and the Home Performance Advisor network are concerned that there is insufficient evidence to support what is considered and has been adopted as best practice.

The research builds on advice from Consumer NZ and involves a literature review of previous research in this area. It investigates the novel use of thermal cameras for both measuring and visualising the heat flow processes around window coverings.

The research will determine and rank the factors that make an effective curtain. It will also ensure a reliable evidence base to provide the best curtain advice. The evidence base could make a huge difference in terms of cost savings – for example, if having a floor-length curtain is not as essential to effectiveness, this would save on materials. It could

also inform on improved outcomes for householders – best practice ensures maximum benefit in thermal comfort or lower energy bills.

The results will contribute to improved home performance advice. This will inform any future update of the healthy homes standards and provide advice for policy makers to address heat loss from windows for rental properties. The inclusion of curtains as a requirement to reduce heat loss through the building envelope and to reduce thermal discomfort will benefit occupants. Specifically, this work will help develop and promote cost-effective solutions to help all New Zealand homes be warm and dry by 2030.

Levy investment	\$45,000
Timeframe	November 2019 – September 2020
Contact	Greg Overton greg.overton@branz.co.nz
Lead organisation	BRANZ Ltd

## Mechanical ventilation with heat recovery performance measurements

Compared with supply or extract-only ventilation systems, heat recovery systems appear to be better suited to ventilate New Zealand homes. They tend not to pressurise the building envelope, and their energy loss through overventilation is usually smaller. However, these systems also have optimal settings and conditions in order to maximise the energy return that can be expected from them. As such, heat recovery systems often don't perform to the designer's and the owner's expectations.

The research project investigated ventilation system performance in both new designs and home alterations. The research aimed to identify the set of parameters that impair mechanical ventilation with heat recovery (MVHR) effectiveness and inform the industry on why MVHR systems are often not performing as expected. These parameters can then be addressed in the design and build phase and will contribute to improved building performance.

This project addressed inconsistencies in previously reported results and conclusions. It repeated some experiments around the MVHR unit in the BRANZ experimental house including remeasuring the temperatures at the ventilation diffusers and exit ports. Sensors were installed in the house and the attic and measured both the airtightness and the pressure in the MVHR ducting to calculate the air losses. The MVHR system performance was measured at different outdoor temperatures with and without additional duct insulation.

Updated results will be used as a basis for ongoing research for the *smart ventilation and indoor environmental quality* project. The evidence will also support changes in MVHR system installation practice essential at the building design stage.

Levy investment	\$60,000
Timeframe	July 2019 – August 2019
Contact	Aidan Bennett aidan.bennett-reilly@branz.co.nz
Lead organisation	BRANZ Ltd

## Household energy end-use project

Household Energy End-use Project (HEEP2) is an update of the original Household Energy End-use Project (HEEP), which ran from 1996–2010.

HEEP provided an understanding of how, where, when and why energy was used in New Zealand homes. That picture is now 15 years old and does not account for a host of building, social and technological changes in the intervening period, including the Warm Up NZ scheme, the use of household appliances (such as heat pumps) and rising fuel costs. This has prompted widespread interest in an updated household energy use study.

HEEP2 involves data collection to understand how energy is used in New Zealand homes. The original feasibility project fostered a culture of co-design, and as a result, we will continue working with Stats NZ to recruit households for the study. The dataset will be used to inform initiatives and policies that will reduce the number of houses with temperatures below WHO-recommended levels and the number of households facing energy hardship. It will also provide the science and development of solutions to help improve energy efficiency and conservation and reduce greenhouse gas emissions associated with our housing stock.

The ability to track these parameters over time will help New Zealand meet the challenges of fighting climate change and energy hardship and improve the indoor environments provided by our housing stock.

Understanding how and why energy is used in New Zealand homes will inform research in both the *Warmer, drier, healthier homes* and *Transition to a zero-carbon built environment* programmes.

Levy investment	\$2,085,000
Timeframe	November 2019 – March 2024
Contact	Greg Overton greg.overton@branz.co.nz
Lead organisation	BRANZ Ltd

## Energy hardship home performance advisor capability

Energy hardship goes hand in hand with home performance. Without the income to pay for heating or address home performance issues, families will continue to live in cold damp houses. Improved energy efficiency and lower energy use is one part of the answer to alleviating energy hardship.

Sector stakeholders including Home Performance Advisors (HPA) have long understood that energy hardship (and its causal factors) contributes to the complexities many households experience in maintaining a warm, dry, healthy home.

This capacity-building project aims to support and work with the HPA training programme to develop a new online HPA course. The course will be targeted at addressing the impact of energy hardship on households living in vulnerable circumstances. It will be offered to those working on the frontline with communities and households vulnerable to energy hardship. This includes budget advisors, health and social workers and anyone else wishing to gain this knowledge. The training will enable these frontline staff to have informed conversations about household energy with their clients and empower households to make educated choices about their energy use.

This project is co-funded by EECA.

Levy investment	\$100,000
Timeframe	June 2020 – November 2020
Contact	Vicki White vicki.white@branz.co.nz
Lead organisation	BRANZ Ltd

## Indoor air quality research centre for New Zealand

Research in indoor air quality (IAQ) is sparse, fragmented and uncoordinated. Little is known about the pollutant levels in New Zealand homes. The intention of this project is to coordinate the research effort through the establishment of an IAQ Research Centre.

The aim is to create a critical mass of research expertise and provide a platform for the coordination, expertise consolidation and resource sharing among a range of organisations. Researchers involved come from the National Institute of Water and Atmospheric Research (NIWA), University of Otago (Medical School), Massey University (Construction), GNS Science and BRANZ. Once established, other New Zealand-based organisations will be approached and asked to join.

IAQ research is important to understand the health burden indoor pollutants cause. A key focus is to gain a better understanding of the pollutant exposure loads in New Zealand buildings. Some of the contributing factors are that homes are more airtight and that the effects of ventilation and the source of pollutants are not fully understood.

The major output of the 3.5 years will be an IAQ research roadmap laying out knowledge gaps and identifying research priorities to close those gaps. We expect to conduct joint research proposals and workshops, and produce journal papers and presentations. This will also yield increased industry and stakeholder engagement as IAQ-related knowledge will be made available from a central source.

Levy investment	\$45,000
Timeframe	November 2019 – September 2020
Contact	Manfred Plagmann manfred.plagmann@branz.co.nz
Lead organisation	BRANZ Ltd

## Retrofit insulation

It is estimated that there are over 600,000 houses in New Zealand that lack wall insulation – mostly those constructed prior to insulation requirements being introduced in 1978. Retrofitting wall insulation to these houses is essential in improving the New Zealand housing stock. This will ensure warmer, drier and healthier environments for the occupants, and reduce energy use and the environmental impact of housing.

The research, one of a series of projects, will extend previous work on providing guidance and focus on the installation of insulation when there is no underlay present. Many of the New Zealand houses without wall insulation do not have an underlay between the framing and cladding. Although there are recommendations to address the lack of building paper, there are risks or issues with some of the options. Often, the use of the insulation is not optimised. This project will investigate alternative solutions that may allow a greater thickness of insulation to be installed without compromising the management of water that gets past the cladding.

There are a limited number of cost-effective solutions available for homeowners, particularly for cases where there is a lack of building underlay. This research will evaluate a range of representative bonded insulation products both with and without a range of drainage plane materials. It will determine which combinations of insulation material and/or drainage plane material provide the lowest risk of water transfer in the wall cavity. Results will provide a better understanding of these insulation issues and the ability to develop solutions to improve indoor environments and optimise building envelope performance. Results will be disseminated to improve knowledge within the industry as well as for the owners, suppliers and users of residential buildings.

Levy investment	\$364,000
Timeframe	November 2019 – March 2023
Contact	Greg Overton greg.overton@branz.co.nz
Lead organisation	BRANZ Ltd



## Warm roofs – understanding recent trends in New Zealand

BRANZ roof research over the last years has concentrated on cold roofs and passively ventilating these to minimise moisture risks. This scoping project will enable BRANZ to better understand warm roof system technology, its benefits, potential shortcomings and recent developments. As part of the research, BRANZ will also estimate the embodied carbon footprint for a number of common warm roof systems.

Warm roofs have the potential to improve the performance and resilience of New Zealand educational, commercial and residential buildings by improving thermal performance and avoiding condensation issues. Essentially, a warm roof is a bonded sandwich with an outer waterproof shell, thermal insulation in the middle and a rigid inner sheeting (often metal). Warm roof designs are becoming more popular in New Zealand.

A better understanding of warm roof systems available in New Zealand will assist both the Ministry of Education and MBIE. It will inform their decision making in choices around warm or cold roof systems. Schools would benefit from warm roof designs as they have suffered from moisture problems with cold roof construction. This project ties in with results of previous work and field studies where we have seen that, even with vented roof cavities, moisture issues cannot be avoided under all circumstances.

Levy investment	\$96,000
Timeframe	November 2019 – April 2021
Contact	Stephan Rupp stephan.rupp@branz.co.nz
Lead organisation	BRANZ Ltd

## Housing and wellbeing – analysis of new housing survey data

Independent, robust, nationally representative data on the condition of New Zealand housing provides the evidence base necessary to inform policy and monitor changes and progress over time. Maintaining an up-to-date and accurate picture of the condition of our housing stock is essential to inform and support policy. The government has used the BRANZ House Condition Survey (HCS) extensively in developing the Healthy Homes Standards for rentals to make a difference to the living environments for New Zealanders.

This research uses new housing quality data from the Pilot Housing Survey (PHS) and General Social Survey (GSS) to provide up-to-date evidence on and new insights into housing condition and occupant wellbeing. It will explore the association between subjective (GSS) and objective (PHS) housing data and self-reported physical, social and economic wellbeing. This will be done in close collaboration and partnership with Stats NZ and HUD, maintaining and building on the relationships developed in delivering the PHS.

This project will analyse and report on key findings from the surveys to complement and enhance the existing suite of HCS results. BRANZ brings its experience in analysing and interpreting housing survey data and benefits from insights and expertise from policy analysts and statisticians.

Results will provide updated evidence on the condition of New Zealand housing and how this distributes across the population. This research will also guide the development of an appropriate and effective measure of housing quality and help define priorities for improving our homes. Findings will contribute new evidence and insights to help understand the association between house condition and occupant wellbeing.

Levy investment	\$174,000
Timeframe	November 2019 – August 2021
Contact	Vicki White vicki.white@branz.co.nz
Lead organisation	BRANZ Ltd

## Understanding the barriers to delivering higher-performance buildings



High-performance structures need to be designed and built well to avoid long-term damage from interstitial condensation or weathertightness. As we strive for better-performing structures, the available margin for error reduces. This ensures that designers, Building Consent Authorities (BCAs) and those on site understand this is important.

Industry feedback shows consenting plans that differ from New Zealand Building Code minimum typically requires significant effort, due to higher-performing structures taking necessary deviations from typical Acceptable Solutions. The difficulty likely comes from a level of risk aversion on behalf of BCAs, as they are understandably considering their exposure.

This project will provide targeted information from our research programmes based on a set of case studies. This will help raise the level of understanding of all parties involved, particularly when considering the risks of moisture ingress. BRANZ has considerable knowledge in this space, stemming from our long history of experimental facilities and partnership with the Fraunhofer Institute for Building Physics. This emphasises benchmarking of computer models against reality.

Higher-performance assemblies necessarily require several layers in the construction. The interplay between the material properties of these layers become a risk if due diligence is not undertaken. Hygrothermal simulation tools like WUFI are used to study the movement of heat and moisture through building assemblies and are useful to demonstrate the level of risk in an assembly. This research, along with other work under way, will contribute to efforts to create a hygrothermal assessment methodology that will bring consistency in the application of WUFI to assess risk.

Levy investment	\$117,000
Timeframe	November 2019 – March 2021
Contact	Stephen McNeil stephen.mcneil@branz.co.nz
Lead organisation	BRANZ Ltd

## Affordable housing for generations – operating costs



BRANZ is part of a multi-agency multi-disciplinary team delivering the *Affordable Housing for Generations* (AHFG) research programme, under Phase 2 of National Science Challenge 11 ‘Building Better Homes, Towns and Cities’. AHFG aims to address the severe undersupply of functional, affordable housing and provide tools and solutions that will help ensure an affordable housing stock for multiple generations in New Zealand.

BRANZ is leading a workstream to look at how the dwelling (design, materials used), impacts operational costs associated with energy and water use, and repairs and maintenance. Other contributing researchers are from Motu, University of Victoria Wellington, University of Otago and National Science Challenge 11 programme directors. The workstream seeks to answer the question: What is the real cost and therefore the real price of dwellings? This component is a key part of the wider multi-year \$3.5 million AHFG research programme.

This project will explore how better building design, materials and systems can reduce the operating costs of

dwellings and their occupants over their lifetime. It will also explore if upfront cost-saving measures merely shift the price of a dwelling into higher running and repair costs for the dwelling. This includes looking at ‘price pressing’ reflected in the use of lower-cost materials, short-life systems, lack of universal design and avoidance of whole-house heating and solar systems.

The analysis will use a number of existing datasets and data sources, including the Household Economic Survey and Pilot Housing Survey. This data can inform housing condition, energy efficiency, materials, systems and services. The project will also look at how such factors correlate with occupant-reported affordability, comfort and issues affecting the home.

Levy investment	\$92,400
Timeframe	March 2020 – April 2024
Contact	Vicki White vicki.white@branz.co.nz
Lead organisation	BRANZ Ltd

## Building beyond minimum requirements – a literature review

NZ Institute of Economic Research (NZIER) completed a literature review of the economic assessment of the costs, benefits and methods for the construction of houses designed and built to standards that exceed the minimum Building Code requirements.

This literature review identified and summarised international and domestic evidence of the benefits and costs of building beyond the minimum and their relevance to New Zealand. Knowledge gained in the review identified several possible options that contributed to the aim of the programme.

These options included establishing guidelines for the assessment of costs and benefits in construction and greater assessment of the non-market costs and benefits, including environmental and health impacts. It also advocated the use of multi-disciplinary teams that include economists as experts in the assessment of market and non-market costs and benefits.

Levy investment	\$30,450
Timeframe	June 2019 – September 2019
Contact	Michael Bealing michael.bealing@nzier.org.nz
Lead organisation	NZIER

## Moisture and mould growth



### Sarah Buet

#### Scholarship

It is well known that excessive internal moisture is a leading cause of mould growth within residential houses. Clause E3 *Internal moisture* of the New Zealand Building Code sets out to control internal moisture within a house to reduce the likelihood of mould growth. However, there are currently no prescribed methods that practitioners can use to show that they have complied with this clause.

Tools used by practitioners in order to predict internal conditions of houses tend to rely on a range of assumptions and may not give accurate results. The goal of this research is to produce the analysis to support the development of improved moisture modelling tools for use by the building and construction industry.

The research will utilise the data collected in the BRANZ Pilot Housing Survey (PHS) on the internal conditions (temperature and relative humidity) of 80 houses throughout New Zealand. The PHS data will be 'cleaned' to understand the reality of the internal conditions within the New Zealand residential housing stock across the country. Statistical tools will be used to compare the measured data with the theoretical models and to find out if discrepancies can be attributed to the construction or to activities within the houses.

The research will explore if these models and tools are able to be improved to predict the likelihood of moisture and consequent mould growth more accurately in New Zealand residential homes.

Levy investment	\$20,000
Timeframe	May 2020 – February 2021
Contact	researchinvestment@branz.co.nz
Tertiary institute:	Victoria University of Wellington

## Progress in the *Warmer, drier, healthier homes* programme

This timeline shows all the projects that are either part of this programme or contributing to it. It shows the timing of each project and how much we're investing. If you would like to know more about this programme, please contact the programme leader directly: [mark.jones@branz.co.nz](mailto:mark.jones@branz.co.nz).

■ Under way  
 ■ Completed  
 ■ On hold

Warmer, drier, healthier homes project progress	2017	2018	2019	2020	2021	2022	Amount (NZD)
Façade testing	Jan 2014						410,000
Occupant behaviour	Oct 2014						430,000
Scholarship: Phoebe Taptiklis – maintenance and dampness	Mar 2015						75,000
Quantifiable evidence of going beyond Code	Nov 2015						204,000
Ridge and fascia vent design and performance	Jan 2016						175,000
Scholarship: Mike Bedford – daycare environmental conditions	Mar 2016						75,000
New Zealand's experimental buildings	Apr 2016						395,000
Airtightness trends	Apr 2016						400,000
Roof design	Apr 2016						165,000
Ventilation performance in large-span roofs	Apr 2016						320,000
Exposure to indoor air quality at school	Aug 2016						100,000
Nature of indoor air pollution in New Zealand homes and garages	Aug 2016						100,000
School Monito Box	Aug 2016						100,000
Identifying the sources and characteristics of particulates	Sept 2016						100,000
Impact of energy-saving building design on occupant health	Sept 2016						94,000
Airtightness of apartments	Oct 2016						650,000
Indoor environment and fungal exposure	Oct 2016						183,000
Internal moisture Verification Method	Oct 2016						90,000
Risk assessment – retrofitting wall insulation	Oct 2016						310,000
Indoor air quality in new homes	Nov 2016						53,000
Air quality in high-performance houses							148,000
Roof design pathway							210,000

<b>Warmer, drier, healthier homes project progress</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>	<b>2022</b>	<b>Amount (NZD)</b>
Growing up in New Zealand							720,840
Performance of higher-specced windows							372,000
Pollutant levels in modern homes						Mar 2023	515,000
Risk assessment tool for roof ventilation							470,000
Model buildings for the next generation of the New Zealand Building Code						Mar 2023	1,600,000
Feasibility of an updated residential energy-use study							280,000
Corrosion rates in vented cavities							187,000
Fungal exposure in New Zealand homes							325,000
Chemical contamination of building materials							800,000
Cost-benefit analysis methodologies							150,000
Roof ventilation calculator							150,000
Smart ventilation and indoor environmental quality							1,250,000
Scholarship: Jarred Butler – mould in New Zealand bathrooms							20,000
Home performance SCOPE							120,000
Scholarship: Karin Henshaw – public housing transitions							20,000
Scholarship: Louise Bullen – environmental impacts of New Zealand’s grid electricity							20,000
Regional healthy housing stocktake							30,000
Experimental buildings							35,000
Mechanical ventilation with heat recovery performance measures							60,000
Effective curtains							45,000
Warm roofs – understanding recent trends in New Zealand							96,000
Housing and wellbeing – analysis of new housing survey data							174,000
High-performance assemblies							117,000
Retrofit insulation						Mar 2023	364,000
Household Energy End-use Project (HEEP)						Mar 2024	2,085,000
Indoor air quality research centre for New Zealand						Mar 2023	545,000
Affordable housing for generations						Apr 2024	145,763
Scholarship: Sarah Buet – moisture and mould growth							20,000
Energy hardship Home Performance Advisor capability							199,000
<b>Total</b>							<b>15,702,603</b>

# Transition to a zero-carbon built environment

The built environment contributes approximately 16% of New Zealand's carbon footprint.

This programme examines how buildings impact climate change through the production of materials and energy efficiency performance and what can be done to mitigate this.

## What we're doing

New Zealand has committed to address climate change in several ways. The Climate Change Response (Zero Carbon) Amendment Act 2019 was passed by Parliament in November 2019. The Act:

- sets up a framework of five-year emissions budgets for achieving a greenhouse gas emissions reduction target
- establishes a new independent Climate Change Commission to provide expert advice to government, keep us on track and to hold successive governments accountable
- creates a legal requirement to prepare for, and adapt to, the effects of climate change.

The construction sector contributes about 16% of New Zealand's greenhouse gas emissions, the majority being the long-lived gas carbon dioxide (CO<sub>2</sub>). Buildings can have a long service life of 60–90 years. Their environmental impact has a lasting influence on our economy. The decisions made during the design of buildings today will have an impact post-2050.

The building and construction industry has a core role to play in how, as a society, we seek to mitigate emissions through:

- adopting solutions and tools for designing and constructing buildings with a long useful life and low embodied carbon over their life-cycle
- designing buildings to be deconstructed for reuse or recycling and/or repurposed for the changing needs of future building users.

The *Transition to a zero-carbon built environment* research programme will support an industry-led transition that meets the needs of a future net-zero-carbon economy. This will be achieved through decarbonisation across the building life cycle and by encouraging leadership and decision making across the industry to manage the mitigation of climate change.

The programme will also seek to ensure that New Zealand society has guidance and is enabled to design, build, operate and decommission zero-carbon buildings.

## Programme objectives

The programme aims to support industry, government and the public so that, by 2050, the building and construction industry is delivering net-zero-carbon buildings in an affordable way.

Key objectives of the programme are:

- cost-effective low-carbon solutions have been developed to decarbonise new and existing dwellings and non-residential buildings by 2030
- cost-effective low-carbon solutions are routinely implemented to inform design, maintenance and construction of dwellings and non-residential buildings from 2025.

## Programme leader

Casimir MacGregor  
casimir.macgregor@branz.co.nz

## Innovative low-carbon residential water heating solutions

Water heating contributes to approximately 30% of a typical household's operational carbon and energy use. There are several new innovative low-carbon residential water heating technologies that show promise to greatly reduce the carbon, energy and lifetime costs of the more traditional systems. If used more widely, there is considerable potential for these new lower-carbon replacement technologies to benefit consumers, lines companies and the environment.

This project seeks to compare these new water heating systems to the best-case technologies (air-sourced heat pumps) for the New Zealand context. Specific issues to investigate include lifetime carbon impacts, system flexibility and control, energy balance, lifetime costs and sensitivity of household behaviour.

This project has implications for New Zealand's upcoming carbon commitments (international obligations), infrastructure costs due to peak loading (lines, retailers and generators) and fuel poverty (national equity). It also has consequences for New Zealand's national security, due to our reliance on non-renewable energy sources.

This project will help to improve decision making for consumers, suppliers and specifiers wanting to reduce their energy and carbon footprint by choosing the best low carbon water heating options available.

Levy investment	\$100,000
Timeframe	April 2020 – March 2024
Contact	Roman Jaques roman.jaques@branz.co.nz
Lead organisation	BRANZ Ltd



## Get ready! Preparing building and construction businesses for the transition to zero carbon

Building and construction businesses need to plan and create strategies to reduce greenhouse gas emissions and adapt to the changing climate. How can industry best act?

The research project will analyse the barriers, opportunities and challenges that industry faces to address climate change. It will also provide insight into what guidance and support businesses may need. The research will use a mixed-methods approach to understand what changes are needed within building and construction businesses to transition to a net-zero-carbon built environment. To understand the preparedness of businesses to transition to zero carbon, an initial industry-wide survey will provide benchmarking data. This survey will be repeated to track any progress.

To share industry experiences, case studies will be undertaken with early adopters highly engaged in addressing climate change. Case studies will also be undertaken with disengaged building and construction businesses to understand the decisions, motivations and barriers for addressing climate change operationally.

The project will also conduct an audit of zero-carbon, zero-energy, sustainable buildings within New Zealand to understand how industry is operationally addressing greenhouse gas emission reductions.

The research will be presented at industry forums. This will provide an opportunity to exchange information, learn about the impact of climate change and encourage an informed and coordinated change across the building system.

Levy investment	\$372,000
Timeframe	April 2020 – March 2022
Contact	Casimir MacGregor casimir.macgregor@branz.co.nz
Lead organisation	BRANZ Ltd

## Marginal abatement cost curves – scoping

The average New Zealand home far exceeds the desired carbon footprint needed to meet the government’s commitment to be carbon neutral by 2050. This research will enable local and central government and the industry to identify, prioritise and action abatement measures to meet the 2050 emissions target.

Currently, there are no building sector-specific marginal abatement cost curves (MACCs) for New Zealand. As such, a simple and powerful tool for informing carbon abatement investment or expenditure decisions is required. This research will explore the likely parameters, methodology, data inputs and outputs necessary to construct MACCs for the New Zealand building and construction industry.

MACCs allow users to prioritise the range of solutions and technologies in which they are prepared to invest at a price point with which they are comfortable. A MACC provides a simple visualisation of the cost-effectiveness of a range of interventions aimed at reducing greenhouse gas emissions in terms of cost per tonne of carbon dioxide equivalent saved. It allows a clear comparison of the range of interventions available, based on their relative cost per tonne of carbon saved, by grouping intervention options from least to highest cost per tonne.

The development of New Zealand-specific MACCs aligns with MBIE research priorities. It will help stakeholders involved in decisions to commission, design and operate new and existing residential and non-residential buildings. This will help them to make informed investment and expenditure decisions that lead to carbon abatement in our buildings.

Levy investment	\$170,000
Timeframe	January 2020 – March 2022
Contact	Daniel Duplessis daniel.duplessis@branz.co.nz
Lead organisation	BRANZ Ltd

## Sustainability assessment of Kāinga Ora building design

With the passing of the Zero-Carbon Act, Kāinga Ora has identified climate change as a key focus area. BRANZ is working alongside Kāinga Ora to obtain a richer, more complete dataset to deliver lower-carbon homes.

Kāinga Ora, as a major developer of social housing in New Zealand, provides a large volume of three-level walk-up apartments that feature a mix of one and two bedroom units. This project aims to evaluate four alternative building systems that may be applied to the design.

The research will look at predicted thermal performance using energy simulation, including estimated energy use for space heating or cooling to maintain comfortable temperatures and estimated temperatures if operated passively. It will use BRANZ's LCAQuick tool to calculate the life cycle carbon footprint of each building system and apply life cycle costing. It will also undertake a moisture risk assessment, including WUFI modelling.

The research will inform decisions to develop building design.

Levy investment	\$126,200
Timeframe	April 2020 – October 2020
Contact	David Dowdell david.dowdell@branz.co.nz
Lead organisation	BRANZ Ltd



## Beyond Code seismic design – assessing the climate change case

Currently, research into seismically resilient buildings does not include environmental considerations from a life cycle perspective. This project covers the supervision of a PhD student who will assess the climate change case for designing and constructing high-rise buildings that go beyond the current Building Code requirements.

In international building codes, the current seismic design philosophy is based on the principle that a large earthquake can cause controlled extensive damage without building collapse and loss of life.

Buildings damaged beyond economic repair are perceived by the public to be single use and an unacceptable waste of resource and cost. Post-earthquake, many modern buildings constructed to required standards now sit unoccupied due to concerns about future seismic performance, residual capacity and cost of repair. While the performance of the buildings was generally as expected, these expectations of building seismic performance have not been well communicated to the public.

This research will contribute to a better understanding of the climate change case when designing more seismically resilient buildings.

Levy investment	\$127,000
Timeframe	January 2020 – March 2023
Contact	David Dowdell david.dowdell@branz.co.nz
Lead organisation	BRANZ Ltd

## Keeping carbon data current

BRANZ research has revealed a significant gap between the life cycle greenhouse gas emissions of our new dwellings and the carbon budget within which they should be operating.

The building and construction industry will increasingly need access to carbon data to make informed decisions that will reduce such emissions through good design and materials choices. To obtain this understanding of the carbon implications of our buildings across their life cycle, the project will use carbon foot-printing or life-cycle-assessment measurement.

The most up-to-date accurate data is essential for carbon footprinting. This will ensure more reliable, relevant calculations to help better understand the climate change impacts of our construction materials and buildings.

BRANZ plays a key role in delivering this data to the New Zealand building and construction industry via the BRANZ CO<sub>2</sub>NSTRUCT database and LCAQuick. New data from manufacturers and other sources is becoming available all the time, meaning that BRANZ data can quickly become dated. It is important that the information and tools provided to the industry are maintained and trusted.

This four-year project will aim to maintain and update the environmental impact data behind BRANZ CO<sub>2</sub>NSTRUCT and LCAQuick. It will include an update to the calculated carbon budget models for residential and commercial buildings in 2020/21.

Levy investment	\$407,000
Timeframe	April 2020 – March 2024
Contact	David Dowdell david.dowdell@branz.co.nz
Lead organisation	BRANZ Ltd

## Energy and carbon certificates for dwellings

Energy Performance Certificates (EPCs) have been identified as a core policy and opportunity to help address climate change and improve building stock performance. This research will examine different international methodologies of standardising dwelling thermal and carbon assessments needed for a practical EPC and determine their fit for New Zealand. The focus is to provide the groundwork for a successful EPC scheme. This can be used for multiple applications – for central government decision makers to inform the policy through to building owners, occupiers and real estate actors.

New Zealand has approximately 1.7 million dwellings. For 99.9% of these there is no information on how they perform thermally year round and consequently the comfort they provide. The aim is to address the knowledge gap in understanding ongoing energy needs and associated carbon required for these dwellings. By examining international efforts in this area, this project seeks to improve the ability to better understand, plan and manage our housing stock.

For the potential new homeowner, an EPC provides a greater understanding of how their building will perform in comparison to other buildings in the same climate. The EPC informs their year-round heating or cooling costs and the potential to transfer savings to mortgage repayments.

For the existing homeowner, an EPC provides a clear pathway for improved year-round thermal comfort, either room by room or for the whole house, and the financial implications resulting from this.

Understanding the international success factors and challenges of the design, implementation and maintenance of dwellings will inform the development of a methodological framework for a New Zealand-appropriate EPC.



Levy investment	\$100,000
Timeframe	April 2020 – March 2024
Contact	Roman Jaques roman.jaques@branz.co.nz
Lead organisation	BRANZ Ltd

## Carbon budget model sensitivity

A carbon budget is the amount of greenhouse gas emissions allowed over a period of time to keep within a global temperature rise threshold. A carbon budget captures the finite limits on a planet-wide scale and relates them to greenhouse gas emissions at the building scale.

Carbon budgets model the emissions from all sources in a building's life cycle, not just the energy consumed to operate the building. Carbon budgets can be more meaningful than the measures of energy efficiency alone currently being used in many countries.

This project will test a recently developed carbon budget model for New Zealand for stand-alone housing, medium-density housing, apartments and commercial office buildings. It will enable a better understanding of the sensitivity of the outputs to input parameters.

The project will identify modelling assumptions and input data that have the most significant impact on carbon budgets. This work will improve the robustness of our building carbon budgets in New Zealand. It aims to produce a robust metric that may be used for policy and other applications in the future.

Levy investment	\$55,155
Timeframe	June 2020 – November 2020
Contact	Sarah McLaren s.mclaren@massey.ac.nz
Lead organisation	Massey University

## The identity of a low carbon home



### Emily Newmarch Scholarship

Significant amounts of carbon are embodied in materials or emitted during a building's life cycle. As such, the building and construction industry has a big role to play in reaching carbon zero by 2050.

For architects and designers, the most effective way to achieve this goal is to ensure that buildings are designed and specified with low-negative embodied carbon in the building materials. However, designing for low-embodied carbon residential architecture in New Zealand can be viewed by some as time-consuming and aesthetically restrictive.

This research will explore how considering a zero-carbon future can be combined with the aesthetic ambitions of the New Zealand home. The study will analyse existing case studies, coupled with interviews and workshops with the architects who designed them. It will seek to understand how choices on main materials, construction systems and energy impact the environmental performance of the building. It will also explore the strengths and weaknesses of existing carbon measurement tools in their application to a New Zealand home.

The findings will be shared to educate architects and designers on how to use an aesthetic-driven design process to lower the amount of embodied carbon in their buildings. The goal is to empower architects and designers to participate in climate action by providing a more intelligent and informed design service to consumers.

Timeframe	To be completed by October 2022
Contact	researchinvestment@branz.org.nz
Tertiary Institute	Victoria University of Wellington

## Low-carbon concrete production



A net-zero-carbon economy by 2050 requires major changes in construction technology and materials. Concrete in New Zealand is made with relatively high Portland cement levels. With current technology, it is impossible to eliminate carbon emissions associated with manufacturing the granular substance known as clinker.

This research explores supplementary cementitious materials (SCMs) that could replace a proportion of the currently used Portland cement in the short to medium term. It aims to identify ways to reduce barriers and risks for using significant levels of SCMs in concrete production, thereby reducing carbon emissions associated with Portland cement clinker.

The research investigates SCMs, both in terms of classification and optimising performance, to allow easy adoption of the technology by designers and construction staff. An experimental programme will assess how locally

available SCMs can be best classified and utilised in concrete production in New Zealand. Findings from countries that use significant levels of SCMs in concrete will also be collated and interpreted.

Results will inform the classification system for cement and concrete producers, guidance on how to specify and use low-carbon concrete in construction, and tools to evaluate carbon reduction. A technical report will support the revision of NZS 3101.1&2: *2006 Concrete structures standard*.

Levy investment	\$150,000
Timeframe	January 2020 – October 2021
Contact	Rob Gaimster rob@concretenz.org.nz
Lead organisation	Concrete New Zealand

## Progress in the *Transition to a zero carbon built environment* programme

This timeline shows all the projects that are either part of this programme or contributing to it. It shows the timing of each project and how much we're investing. If you would like to know more about this programme, please contact the programme leader directly: [casimir.macgregor@branz.co.nz](mailto:casimir.macgregor@branz.co.nz).

■ Under way  
■ Completed

Transition to zero carbon built environment project progress	2017	2018	2019	2020	2021	2022	Amount (NZD)
Low impact buildings		■ Under way					1,575,000
Carbon budget		■ Under way					185,000
Regional waste minimisation		■ Under way					175,000
Home heating left cold			■ Under way				180,000
Building energy end use study - addressing energy demand			■ Under way				500,000
Innovative low carbon residential water heating solutions				■ Under way			175,000
Marginal abatement cost curves – scoping				■ Under way			170,000
Scholarship: Emily Newmarch – the identity of a low carbon home				■ Under way			20,000
Low carbon concrete production				■ Under way			150,000
Low carbon built environment science leadership				■ Under way			100,000
Beyond code seismic design – assessing the climate change case				■ Under way			127,000
Energy and carbon certificates for dwellings				■ Under way			100,000
Get ready! Preparing building and construction businesses for the transition to zero carbon				■ Under way			372,000
Keeping carbon data current				■ Under way			407,000
Sustainability assessment of Kāinga Ora building design				■ Under way			1,126,200
Carbon budget model sensitivity				■ Under way			52,155
<b>Total</b>							<b>5,414,355</b>

# Fire-safe densified housing

In built-up urban environments, fire is a serious hazard. This programme was created to make it safer for people to live in close proximity. It looks at fire safety in high-density housing and ways to optimise the fire safety provisions in the New Zealand Building Code.

## What we're doing

The government has identified fire safety as a top priority for improvement in the building system, particularly as demand for higher-density housing increases.

New Zealand Building Code clauses C1-C6 *Protection from fire* have been identified as one of the 'higher density 8' (HD8) Building Code clauses that need updating to support higher-density housing solutions. Launched in 2020, the research programme will inform changes to the Building Code fire safety clauses, Acceptable Solutions and/or Verification Methods that will facilitate the construction of more densified housing.

The programme goal is that by 2030 New Zealand building fire safety regulations will provide clear pathways to cost-effective, high-performing and innovative densified residential buildings. These regulations will ensure that high-density housing meets both societal and occupant fire-safety and fire-resiliency expectations.

This year, a new programme advisory and stakeholder panel will be established, along with the development of a stakeholder engagement plan. Refined success criteria will look at how outcomes can be best transferred to the building and construction industry. The programme will continue current and previously funded research projects that are aligned to and form part of the programme. This includes combustible façade fire safety and fire-safe use of timber.

Key users of this research will be fire safety practitioners, designers, BCAs, and Fire and Emergency New Zealand. Other users include MBIE, which is responsible for Code and compliance documents to support cost-effective and fire-safe solutions for densified housing.

## Programme objectives

- Densified housing fire separations and structure provide a known level of performance and safety in the event of a structurally significant fire.
- The building and construction industry as well as occupants are confident that densified housing combustible materials are being used effectively while maintaining societally acceptable fire-spread risk.
- All building users are confident that they can safely and comfortably egress densified housing in a fire emergency. Egress is not a barrier to densified housing building users.

## Programme leader

Kevin Frank  
kevin.frank@branz.co.nz

## Fire performance of hollowcore floors



Since 2006, numerous seismic improvement measures were introduced to hollowcore floor designs because of serious concerns about their performance in earthquakes. However, little consideration has been given to the impact of these changes on fire performance.

Most existing multi-storey buildings have precast hollowcore floors. Many of these buildings are residential apartment buildings or are being converted. This has raised safety concerns from the industry around fire performance and potential risks.

The research investigates the fire performance concerns of hollowcore floors constructed according to New Zealand practices. It will aim to ensure that any future proposed seismic retrofit solutions of hollowcore floors in existing buildings will not compromise the fire performance of the buildings.

The research will aim to prevent fire performance being compromised by the seismic improvement measures implemented. It will provide fire rating information about current hollowcore floor details that can be used in fire engineering designs. Verification Methods will be developed to measure the effect of the proposed seismic retrofit solutions on the fire performance of precast concrete hollowcore floors. These will be available for fire engineers to help protect lives and reduce costs associated with fire compliance in future.

Levy investment	\$475,000
Timeframe	November 2019 – April 2023
Contact	Angela Liu angela.liu@branz.co.nz
Lead organisation	BRANZ Ltd

## Indoor pollutants in buildings exposed to fire

Fire effluent can spread widely beyond the immediate building and lead to contamination of surrounding buildings and the environment. Many pollutants produced when a building combusts are associated with both short-term and long-term adverse health effects.

The potential for acute toxicity is high after a fire and the presence of pollutants from combustion may have long-lasting effects. Unless there is obvious contamination, including smell or sight of smoke, returning occupants are unlikely to be driven to remediate. As a result, they may face long-term exposure to elevated levels of indoor pollutants after a fire.

Exposure to other combustion products has been linked to acute and chronic respiratory irritation. In addition, acid gases can be corrosive to building materials. Research into fire toxicity is largely focused on the immediate hazard to people trying to escape from a building fire. However, studies on firefighters suggest that long-term exposure to fire effluent results in an increased risk of numerous types of cancer.

This project aims to better understand the types and levels of pollutants present in buildings that have been exposed to fire smoke to understand the extent of health risks to occupants. The research will develop a method for sampling indoor pollutants after a fire, including both gaseous and solid deposits.

<b>Levy investment</b>	\$119,000
<b>Timeframe</b>	January 2020 – December 2021
<b>Contact</b>	Anna Walsh anna.walsh@branz.co.nz
<b>Lead organisation</b>	BRANZ Ltd

## International guidelines for fire design of timber buildings

In 2010, the Research Institutes of Sweden published the European technical guidelines for fire safety in timber buildings. Since then, there has been an emergence of research, testing and new timber technology.

An international interest group on the fire safe use of wood is planning to develop an international version of these guidelines. This project will coordinate New Zealand's contribution to the guidelines. International best-practice advice will then be made available to New Zealand designers of timber buildings.

The revised guidelines will help to ensure a coherent approach to the fire design of timber buildings especially for newer types of structural mass timber. The guidelines will cover the extended use of design codes, standards and practical guidance. It will also include examples of fire-safe design and principles of performance-based design. The guidelines will provide current information for architects, engineers, educators and regulatory authorities.

<b>Levy investment</b>	\$89,000
<b>Timeframe</b>	March 2020 – January 2022
<b>Contact</b>	Andrew Buchanan andy.buchanan@canterbury.ac.nz
<b>Lead organisation</b>	PTL Structural Consultants

## Lithium batteries – fire risks associated with buildings



Lithium batteries release highly toxic combustion byproducts, such as hydrogen fluoride and carbon monoxide, that pose immediate risks to life. In addition, there are long-term health and environmental implications.

The push towards low-carbon renewable energy sources, such as photovoltaic (PV) systems and energy storage systems (ESS) has led to growing use of these materials in residential buildings. Further, an increasing interest in constructing more densified housing developments has resulted in the need to accommodate PV and ESS technologies in buildings. This has led to an increase in the risk and management of ignition and fire spread.

This research seeks to understand the risk of failure of lithium batteries in residential buildings. Identified risk situations include where an ESS is fixed to the combustible cladding (such as timber weatherboards) of a residential building. Also when an electric vehicle is parked and being charged in a residential garage. This research will also quantify the risks associated with lithium battery technologies and provide information to the industry about the risks associated with new energy storage technologies.

This information can be used by MBIE and other regulators to support future updates to relevant documentation that includes consideration of the risks around these new technologies.

This project will feed into work by the Battery Industry Group. Its research aims to understand both the whole life cycle and the circular economy of large batteries, with a view to develop a stewardship scheme prior to ultimately recycling them. This project will also contribute to the potential new fire programme investigating the fire-safety of densified housing in New Zealand.

Levy investment	\$360,000
Timeframe	January 2020 – June 2024
Contact	George Hare george.hare@branz.co.nz
Lead organisation	BRANZ Ltd

## B-RISK continuous integration verification and validation stage II – end-user approach

B-RISK is a software application developed by BRANZ to analyse fire safety and smoke spread in buildings. B-RISK has established itself as the zone model of choice by New Zealand fire engineers. It provides the tools to support innovative fire design of buildings. This can lead to a variety of outcomes including the construction of more cost-effective, sustainable or safer buildings.

B-RISK is used to demonstrate building compliance with the fire Verification Method C/VM2 and for use in Alternative Solutions. However, BCAs are increasingly risk-averse and routinely request that software users provide evidence of model validation. Therefore, verification and validation (V&V) processes are essential for future fire designs with relevant V&V data able to be provided in fire engineering reports.

This project will implement a basic system of continuous integration for demonstrating model validation primarily for quality assurance purposes. The work will extend the V&V process to allow users to perform a user-customised V&V and give different end users the ability to generate personalised V&V reports. The diversity of B-RISK end-user applications demands a flexible approach to providing users with verification and validation information along with a user-friendly interface.

The additional flexibility will support designs that use specific submodels within the software, including spill plumes for the design of atria smoke control or for predicting sprinkler response times.

Continued use of the software by fire engineers highlights the ongoing need to maintain and support the B-RISK fire software.



Levy investment	\$164,000
Timeframe	December 2019 – March 2022
Contact	<a href="mailto:anna.deraadt@branz.co.nz">anna.deraadt@branz.co.nz</a>
Lead organisation	BRANZ Ltd

## Progress in the *Fire-safe densified housing* programme

This timeline shows all the projects that are either part of this programme or contributing to it. It shows the timing of each project and how much we're investing. If you would like to know more about this programme, please contact the programme leader directly: [kevin.frank@branz.co.nz](mailto:kevin.frank@branz.co.nz).

- Under way
- Completed
- On hold

Fire-safe densified housing project progress	2017	2018	2019	2020	2021	2022	Amount (NZD)
Fire-safe use of timber construction II							1,120,000
Fire safety of combustible façades in NZ							1,030,000
Industry knowledge of building assembly fire performance evaluation							215,000
B-RISK support							74,000
Densified housing – reliability analysis of fire resistance requirements							4,000
B-RISK continuous integration verification and validation stage II – end-user approach							164,000
Lithium batteries – fire risks associated with buildings						Jun 2024 →	360,000
Indoor pollutants in buildings exposed to fire							119,000
Fire performance of hollowcore floors						Jun 2023 →	475,000
International guidelines for fire design of timber buildings							89,000
Property file data mining – fire risk							178,000
<b>Total</b>							<b>3,828,000</b>

# Eliminating quality issues

To create a better building system, eliminating poor-quality practices and materials in construction is critical. This programme aims to help the industry understand how to change its practices to address common quality issues in building.

## What we're doing

BRANZ has been working with industry to address poor construction quality and support changes in building practice.

The programme will build on previous research that has shown emerging trends in what contributes to quality issues. The programme goal covers three key areas:

- **Communication:** Identifying ways for better information flow between all the key players in the construction process.
- **Technologies:** Understanding what technological solutions are, what else is on the horizon and how they will benefit construction.
- **Higher standards of work:** Some common causes of quality issues can be easily fixed. Other issues could be resolved with additional support, training or even rethinking of systems and processes. This would lead to a significant improvement in workmanship, reducing the number of quality issues in new builds.

This year, the programme will continue research into the interaction between new-build clients and the industry. It will also include research to understand the roles that project managers and design management play in build quality and undertake a survey of new-build housing to identify specific research needs.

A 2019 programme review identified an ongoing need for the programme, with a shift towards helping solve quality issues.

## Programme objectives

The building and construction industry will:

- identify common quality issues that occur in construction
- understand why some previous work to solve common quality issues has not been successful
- understand the need to change its practices
- determine the best way to reduce the incidence of common quality issues
- eliminate common quality issues by using existing knowledge
- eliminate quality issues by designing new solutions.

## Programme leader

Matthew Curtis  
matthew.curtis@branz.co.nz

## Client communication during new builds

Two factors were identified in BRANZ research that negatively impact overall client satisfaction during the house-building process – poor communication and access to correct information.

Breakdowns in communication between the client and builder may lead to quality defects that either cannot be remedied or can only be remedied at a significant cost for all involved.

This project will seek to improve communication of essential knowledge to both clients and builders. It will also aim to avoid situations where the relationship between builder and client breaks down because of poor communication practices. The research will adopt a mixed-method approach using a combination of surveys, focus groups and key informant interviews.

The work will ensure that the industry has an enhanced understanding of the customer's expectations during a build. The aim is to identify a more-effective strategy of communicating with clients and avoid costly communication breakdowns in future residential construction.

Levy investment	\$145,000
Timeframe	April 2020 – March 2021
Contact	Orin Lockyer orin.lockyer@branz.co.nz
Lead organisation	BRANZ Ltd



## New house survey (update)

In 2014, BRANZ worked with the industry to identify the best way to collect data on the incidence of quality issues in new-build housing. Industry stakeholders, who represented a variety of commercial and residential builders and designers, overwhelmingly stressed the need for an independent inspection of buildings to understand how new-build quality is changing.

BRANZ then undertook inspections of new housing throughout the construction process. The survey found that approximately 8% of new houses inspected had some form of compliance defect, indicating serious concerns about each of those houses. Most houses had some form of quality or appearance defect. The average number of quality or appearance defects was four per house.

This follow-up study will assess the impact of our prior research and how quality incidences have changed since 2014. It will allow BRANZ to understand what the incidence of each type of defect is and what components these defects are affecting. Being able to quantify how quality has changed over the past five years will help us understand the impact of our previous work on eliminating quality issues. It will also focus future research on areas of high need, particularly if the incidences of quality identified are different from the 2014 results.

The goal of this research is to reduce the incidence of common quality issues in new build residential properties by providing greater technical information on high-incidence quality issues.

Levy investment	\$340,000
Timeframe	April 2020 – March 2022
Contact	Matthew Curtis matthew.curtis@branz.co.nz
Lead organisation	BRANZ Ltd

## Improving design management

Poor design management is one reason why projects go over budget and over time. Integration between design disciplines during the prebuild phase is essential for accurate pricing during contract negotiations. It is also critical to pick up on design conflicts before they manifest during construction works. This requires effective project management from someone who understands the risks inherent in the design phase.

Unlike other construction disciplines, such as engineering and building, there are no minimum qualifications for project managers. Additionally, there is no compulsory membership to a professional body that sets best practice for performance.

This research will investigate ways that the discipline of project management in New Zealand can add greater value within the design phase of the construction project life cycle. The study will seek industry opinion on what the fundamental competencies of the project management role in New Zealand should be in relation to design. It will also assess whether project managers typically display the proficiency expected.

The project explores whether this should involve setting training and performance standards in areas such as design management and whether such standards should be voluntary or enforced via regulation. This research could result in the New Zealand building and construction industry better addressing competency deficits through establishing new training standards for project managers. This could benefit designers, contractors and clients alike by limiting clashes and reducing variations and time wastage.

Levy investment	\$330,000
Timeframe	August 2020 – July 2022
Contact	Michael Nuth michael.nuth@branz.co.nz
Lead organisation	BRANZ Ltd

## Progress in the *Eliminating quality issues* programme

This timeline shows all the projects that are either part of this programme or contributing to it. It shows the timing of each project and how much we're investing. If you would like to know more about this programme, please contact the programme leader directly: [matthew.curtis@branz.co.nz](mailto:matthew.curtis@branz.co.nz).

■ Under way  
■ Completed

Eliminating quality issues project progress	2017	2018	2019	2020	2021	2022	Amount (NZD)
New House Owners' Satisfaction Survey	← Apr 2016						250,000
What is quality in buildings	← Jan 2016						140,000
Evidencing quality issues – what can industry data tell us?	← Jan 2016						54,150
Prioritising quality	←						150,000
Adopting new ways							130,000
Clerk of works costs and benefits							55,000
Knowing enough to ask							200,000
Persistence of weathertightness issues							150,000
Eliminating quality issues – procurement							230,000
Measuring new-build quality							170,000
Scholarship: Kimberley Russell – Identifying BIM procurement							20,000
Facilities management industry census							40,000
The economic cost of quality defects							96,370
Client communication during new builds							145,000
New house survey (update)							340,000
Improving design management							330,000
<b>Total</b>							<b>2,500,520</b>



# Delivering evidence-based knowledge

BRANZ invests in a diverse range of research outside of the research programmes. These can be stand-alone research projects, scholarships or strategic initiatives.

# Stand-alone research

## BRANZ invests Building Research Levy in stand-alone research projects.

The BRANZ portfolio comprises of programmes of work and stand-alone projects. These are targeted at priorities from the Levy Investment Portfolio Statement. The stand-alone projects address discrete industry issues.

The projects featured in this section are organised by the key areas by which BRANZ undertakes its research. Refer to *Our Portfolio* on page 8.

### Guide to icons in this section



Thriving cities, regions and communities



Resilience of built environment



Quality and performance of homes/buildings



Vibrant industry



Meeting New Zealand's population needs



Housing affordability



Low-carbon economy

For more information about the BRANZ portfolio, see page 8.

A full list of all stand-alone projects under way in 2020/21, including those continuing from previous years, is shown on pages 75-76.

## Communities under construction

 Thriving cities, regions and communities

The shortfall of housing in New Zealand has necessitated the construction of entirely new urban communities across the country. These urban communities are a mixture of areas undergoing heavy construction in amongst 'islands' of existing and/or completed residential and commercial construction.

This research will identify the impact construction has on residents in these rapidly growing in-progress communities, including factors like coping with dust and noise alongside other health and safety factors.

The research will draw from prior overseas research, and already developed schemes, testing its feasibility in New Zealand. For example, it will investigate schemes like the Considerate Constructors Scheme ([www.ccscheme.org.uk](http://www.ccscheme.org.uk)) – a voluntary scheme developed in the UK. Constructors who adopted this scheme had more effective strategies to mitigate the impacts of their construction activities because of the partnered approach they took with the client and the wider community.

The overall aim is to first identify the extent of the issue within New Zealand. If applicable, the project will develop a range of best-practice advice and protocols for contractors to improve the liveability of communities during ongoing development.

Levy investment	\$248,000
Timeframe	April 2020 – March 2023
Contact	Orin Lockyer <a href="mailto:orin.lockyer@branz.co.nz">orin.lockyer@branz.co.nz</a>
Lead organisation	BRANZ Ltd

# Seismic design of low-rise and mid-rise hybrid residential buildings



Resilience of built environment

This research is in response to a previous BRANZ Canterbury earthquake survey whose main finding highlighted the seismic vulnerability of residential buildings constructed using hybrid structures. Such buildings were found to perform far worse than their single-material counterparts, such as buildings made of light timber framing (LTF) only. Currently, no design guidance is available to inform the construction of these buildings.

Despite this, a large proportion of the 250,000 new houses being built each year nationwide are hybrid structures. Many of these builds are single-storey and multi-storey buildings that use LTF with additional bracing elements such as plywood, plaster, concrete and steel to provide adequate seismic strength.

By using numerical simulations and experimental testing, this research will investigate the specific seismic issues of low-rise and mid-rise hybrid residential buildings. Seismic engineering principles will be developed to help inform the design of mid-rise residential buildings of mainly light timber frame construction with hybrid bracing. The aim is to enrich the technical tools available to provide seismic resilience and consistency on a nationwide scale. This should result in reduced engineering costs and higher build quality.

The research will also develop an engineering basis for the potential expansion of the Acceptable Solution NZS 3604 *timber-framed buildings*. The aim to increase building resilience will help deliver substantial economic savings. In case of a seismic event, there are potential savings in insurance costs for homeowners with increased confidence in hybrid building structures.

Levy investment	\$1,153,000
Timeframe	April 2020 – October 2023
Contact	Angela Liu angela.liu@branz.co.nz
Lead organisation	BRANZ Ltd



## Earthquake-prone public buildings – balancing life safety risks and communication costs



Following the 2011 Canterbury and 2016 Hurunui/Kaikōura earthquakes, the focus on seismic risk and associated seismic assessment process led to the rapid closure of several public buildings throughout the country. The introduction of the Building (Earthquake-prone Buildings) Amendment Act in 2016 has reinforced risk perceptions through the legal requirement for certain buildings to have seismic assessments undertaken.

This research will investigate the key drivers leading to earthquake-prone building use decisions (closure/non-closure) and understand how earthquake-prone engineering risk information is interpreted, evaluated and acted upon. It will evaluate the socio-economic impacts of rapid closure of public buildings and decisions to continue the use of public buildings designated as earthquake-prone. It will then identify and develop tools, resources and processes to help public authorities to confidently and transparently make earthquake-prone building decisions.

The outcomes will help territorial authorities to better identify and understand risk scenarios and inform their decision making related to earthquake-prone buildings. Local authorities will have the evidence base to communicate their decision-making logic to the public, potentially ensuring greater community buy-in and support.

Levy investment	\$125,000
Timeframe	April 2020 – October 2020
Contact	Michael Nuth michael.nuth@branz.co.nz
Lead organisation	BRANZ Ltd

## A real-world investigation – seismic performance of precast floors



This is a joint project between BRANZ and Wellington City Council. It studies original design and construction details and the potential retrofit solutions of Wellington’s existing buildings with precast hollowcore floors.

The research will identify the number of variations, the precast floor support details, the vulnerability of each and the scale of the potential problem. It will look at the completed seismic strengthening work.

At a practical level, this work will provide practitioners with robust tools for making decisions about existing buildings with precast floors. It will include options to demolish, mitigate through targeted retrofitting or retain the floor as is. Due to the magnitude of its potential impacts, the insurance industry, building owners and occupiers and consenting authorities are taking a great deal of interest.

This project will complement research under way through the ReCast research programme, which will deliver reliable and practical tools for seismically assessing and retrofitting precast hollowcore floors. To date, the overall success of the programme to deliver practical and feasible retrofit solutions is due to the collaborative approach with engineering practitioners that have real-world experience.

Levy investment	\$245,000
Timeframe	November 2019 – December 2021
Contact	Angela Liu angela.liu@branz.co.nz
Lead organisation	BRANZ Ltd

## Structural insulated panels – durability, seismic and fire performance

 Resilience of built environment



Prefabricated building systems are becoming more prevalent in New Zealand in an effort to provide resilient buildings that are high quality, affordable and can be quickly constructed. Structural insulated panel (SIP) systems have been used worldwide for many decades. They provide excellent insulation performance, which can improve energy efficiency and include a high degree of off-site prefabrication.

With SIPs having the potential to provide improved building stock for New Zealand, it is important to understand their long-term and short-term performance. This project will investigate whether SIP buildings will perform adequately when subjected to environmental conditions and natural hazards in New Zealand.

The project will extend the initial BRANZ test programme to investigate the durability and long-term performance of small-scale SIP samples after accelerated ageing to New Zealand conditions. Seismic performance testing will determine how SIP structural bracing systems perform when subjected to seismic loading. Load and displacement data on SIP wall configurations will be compared with

New Zealand Building Code requirements on structural performance and control specimens on existing bracing systems. A literature review will be undertaken to better understand the known issues relating to the fire performance of typical SIP systems used in New Zealand.

Having a robust methodology for assessing the long-term performance of SIPs will support industry innovation by providing manufacturers with a compliance pathway that does not currently exist. Designers and specifiers will have increased confidence and data to inform the use of SIP systems as an energy-efficient prefabricated option for resilient buildings in New Zealand.

Levy investment	\$620,000
Timeframe	December 2019 – December 2021
Contact	Anna Walsh anna.walsh@branz.co.nz
Lead organisation	BRANZ Ltd

## BRANZ experimental buildings

 Quality and performance of homes/buildings

The development of BRANZ’s westside campus means that several existing test buildings will need to be moved or demolished. The roof container facility, roof/ceiling test building and weathertightness building will no longer be functional. Losing them would hinder the ability to undertake research.

Our test buildings have been the basis for work conducted by the Building Performance Research Team to provide valuable research on topics including weathertightness, ventilation and interstitial moisture. This work has underpinned changes in the Building Code over the last 20 years.

A review of our current buildings has proposed two new laboratories and the repurposing of two existing buildings to ensure adaptable and future-proofed research facilities.

This proposal is to fund the design development of these buildings to ensure an informed funding decision is made. By having detailed designs available, this project aims to initiate construction in a timely manner and reduce the negative effects of the fire and structure laboratories redevelopment.

The upgraded facilities will aim to meet research needs long into the future and support all four objectives of the *Warmer, drier, healthier homes* programme.

Levy investment	\$97,000
Timeframe	November 2019 – September 2021
Contact	Greg Overton greg.overton@branz.co.nz
Lead organisation	BRANZ Ltd

## Compliant materials verification

 Quality and performance of homes/buildings

Previous BRANZ research identified that non-conforming products have an annual cost of up to \$232 million for residential and commercial construction. The building and construction industry needs help to tackle the serious problem of non-compliant materials and product substitution.

High-profile non-compliance cases have made media headlines in recent years, including steel, plumbing materials, electrical wiring and autoclaved aerated concrete panels. The industry has repeatedly called for the development of a building product register. This idea is currently being investigated as one potential solution. Another suggested solution is to require all building products used in New Zealand to have a minimum set of verified information associated with them.

This project aims to scope the practicality of supplying a materials verification component to either solution. This would generate a unique chemical fingerprint for a building product, adding another layer of product authentication.

Working together with our stakeholders, this project aims to make a significant tangible difference to the industry through enabling a substantial reduction in non-compliant building materials in the national supply chain. The building and construction industry will benefit from improved quality assurance – from manufacturers, suppliers and retailers through to builders, regulatory bodies and building owners.

Levy investment	\$275,000
Timeframe	August 2019 – September 2021
Contact	Catherine Nicholson catherine.nicholson@branz.co.nz
Lead organisation	BRANZ Ltd

## BRANZ monitoring network

 Quality and performance of homes/buildings



BRANZ has established over 100 outdoor exposure testing sites across New Zealand. These sites are used to evaluate the environmental performance of metals, plastics and timbers to meet specific research or consultancy needs. Exposure testing and other forms of monitoring provide well-grounded baseline data. The monitoring data informs material durability assessment, required by the New Zealand Building Code, and methodology development for testing materials.

Instead of a long-term strategic outlook, many testing sites responded to specific business needs as they arose. The sites are not always positioned to efficiently and effectively capture the critical data needed across BRANZ. Often the data cannot be compared and mined to deliver the most value.

This project will review a range of monitoring activities and sites across the country currently used for BRANZ research and testing projects. The aim is to create a more cohesive and integrated approach to the collection and use of fundamental data from the various testing sites.

A proof of concept will be undertaken using the exposure sites that are key to material durability and performance evaluation in terms of climate, corrosivity zones and air pollutants (geothermal, industrial or marine). The project will involve developing agreements for site access and data ownership, improving data collection tools and verifying data quality and reliability.

The group of standard reference exposure sites will form a BRANZ performance monitoring network across the country for long-term material performance monitoring.

Levy investment	\$460,000
Timeframe	April 2020 – March 2023
Contact	Zhengwei Li zhengwei.li@branz.co.nz
Lead organisation	BRANZ Ltd

## Durability within wall cavity and subfloor space

 Quality and performance of homes/buildings

Most residential buildings in New Zealand are located in areas with moderate to high marine influences. These conditions cause building materials to gradually deteriorate and can change the micro-environments that exist within building structures. Research shows that micro-environments can have prevalent influences on material durability and service life.

Building micro-environments, particularly wall cavities (an important component of timber-framed buildings) and subfloor spaces (approximately 80% of New Zealand residential dwellings have subfloors), have not been studied systematically. This research aims to understand how these micro-environments respond and to establish correlations between atmospheric corrosivity, micro-environmental condition and material performance.

Having a complete picture of representative building micro-environments will enable BRANZ to assess Building Code durability requirements with greater certainty. E2/AS1 and relevant standards use an atmospheric corrosivity zone – a micro-environment approach to specify materials to meet the minimum durability requirements. This approach is not always being applied appropriately in practice.

The research will deliver a fit-for-purpose information catalogue of building environmental profiles. It will inform the design of better lab-based methodologies for the durability evaluation of new and innovative materials. Through this work, BRANZ will be able to better support the industry in making informed decisions about material specifications and maintenance schemes for improved building performance, resilience and sustainability.

Levy investment	\$564,000
Timeframe	April 2020 – March 2024
Contact	Zhengwei Li zhengwei.li@branz.co.nz
Lead organisation	BRANZ Ltd

## Let-in plywood bracing evaluation

 Quality and performance of homes/buildings

Let-in plywood bracing is an approach to provide lateral load bracing while being able to retain a level surface for installing cavity battens or directly fixed wall cladding. This is a historically accepted practice used on buildings constructed according to NZS 3604. However, several councils are no longer permitting let-in plywood bracing installed on the outside of a timber-framed wall beneath the battens or directly fixed cladding. This is due to a lack of solid published information about its performance and acceptance.

Let-in bracing requires that wall studs and plates be rebated, resulting in stud and plate depths being reduced to less than the typical 90 mm. This has raised questions about the reduction in performance potentially caused by this decrease in depth. While some research and testing has been done, there has not been any definitive decision and design guidance on this issue. This method of providing bracing has never been fully legitimised in any standard or BRANZ publication.

This project engages with stakeholders and practitioners to determine the extent of the problem and evaluate test data and design implications for using this bracing method. This will inform decisions about whether the use of let-in plywood bracing is within the Code requirements. It will also explore if it is possible to achieve a nationwide approach that is acceptable to all BCAs throughout New Zealand.

The research will also consider the potential for durability, insulation, acoustic, fire and other criteria that could potentially be compromised by using this construction technique. It will explore the effects of these criteria on the completed building.

Levy investment	\$84,500
Timeframe	December 2019 – July 2021
Contact	David Carradine david.carradine@branz.co.nz
Lead organisation	BRANZ Ltd

## Mould-resistant surface

 Quality and performance of homes/buildings



The BRANZ-funded House Condition Survey found that approximately 49% of houses examined had visible mould present. In addition to potential health implications, poor indoor air and environmental quality have potential implications for the appearance, performance and service life of building materials and surfaces.

Currently, the main approach for mould control is the removal of excess moisture. In areas where good ventilation cannot be achieved or moisture loads are very high due to unfavourable occupant behaviour, mould can still grow and flourish. Consequently, there is a need to develop additional contingencies that can better control mould growth that work in parallel with ventilation.

This project will aim to deliver an improved understanding of how a building surface can be engineered to interfere and discourage mould propagation and growth.

The research will look at how modifying building surfaces, such as material nature, roughness, morphology, texture

or wettability, could reduce indoor deposition and accumulation of fungal spores, their nutrients and/or condensation. It will also review whether environmentally friendly applications onto building surfaces could deactivate fungal spores when deposited to hinder their growth under indoor environmental conditions using energy-efficient processes.

This capability of identifying promising, smart material-surface systems will provide a platform to optimise and implement practical solutions for better control of mould, enabling better living environments in our buildings.

Levy investment	\$55,000
Timeframe	April 2020 – March 2021
Contact	Zhengwei Li zhengwei.li@branz.co.nz
Lead organisation	BRANZ Ltd

## Thermal performance of houses is in the detail

 Quality and performance of homes/buildings

This research will produce a set of credible high-performance construction details (HPCD) suitable for conventional residential buildings intending to exceed the minimum performance requirements of the New Zealand Building Code (NZBC). The HPCD will also apply to buildings designed to meet the Passive House performance criteria. These details will enable a better transition to warmer, drier and healthier new houses based on HPCD that have already been successfully applied when building Passive Houses in New Zealand.

The aim is to make information available on how to safely and reliably exceed the minimum Building Code in terms of thermal performance to a much wider audience. This includes designers, architects and BCAs. The HPCD information will include details on thermal performance, carbon footprint, indicative cost to build and buildability. The information will enable typical conventional details used in New Zealand to be compared with details that can deliver better thermal performance.

Construction details developed by this project are expected to inform regulatory changes to NZBC clause H1 *Energy efficiency*, currently being reviewed by MBIE. BRANZ is also planning to utilise these construction details in its publications and seminars. A long-term aim is for HPCD to become Acceptable Solutions to the NZBC and be recognised by relevant standards.

Levy investment	\$158,000
Timeframe	March 2020 – October 2020
Contact	Jason Quinn jason@sustainableengineering.co.nz
Lead organisation	Passive House Institute New Zealand (PHINZ)

## Thermal bridging in external walls – stage two

 Quality and performance of homes/buildings

This research builds on the challenges and opportunities identified in the Levy-funded project *Measuring the extent of thermal bridging in timber-framed walls*. It will aim to deepen the understanding of key factors influencing the practice of overframing in timber-framed residential new builds. It will also examine the impact of high framing ratios on thermal bridging and explore solutions for advanced framing techniques to overcome current shortcomings.

The findings will help inform the industry of the impact of heat loss through external walls in new builds and the scoping of more efficient wall systems. Identifying advanced framing solutions and communicating these solutions to industry will lead to improvements in the thermal performance of residential new builds.

This research will highlight promising construction techniques that could be rapidly adopted with little complication and with as few changes as possible to current regulation and/or compliance regimens. This will help resolve issues identified in the earlier research, such as overframing and subsequent lack of thermal insulation in walls.

This research will be carried out in collaboration with another Levy-funded project – *Thermal performance of houses is in the detail*. It has strong buy-in from the building regulator – MBIE Building System Performance branch. Preliminary results from this research will inform changes to NZBC clause H1 *Energy efficiency* to help improve thermal comfort and efficiency of New Zealand new homes. Results of this research will be utilised in BRANZ publications and seminars.

Levy investment	\$149,560
Timeframe	March 2020 – December 2020
Contact	Verney Ryan verneyr@beaconpathway.co.nz
Lead organisation	Beacon Pathway

## Performance of magnesium oxide boards

 Quality and performance of homes/buildings



Magnesium oxide (MgO) boards offer an alternative to traditional fibre-cement-based boards and are often selected because they are low cost, fire resistant and reusable.

MgO boards can be produced with a range of chemical compositions that subsequently determine the product's suitability to internal or external applications. Currently, there are no criteria to assess MgO board products for use in New Zealand. There is also a lack of understanding about the performance of different MgO boards in different applications. As a result, the product may be misused and lead to failure.

This research will aim to better understand how generic MgO boards perform in cladding, sheathing, face layers in

structural insulated panels (SIPs) and as internal linings. It will identify whether a given MgO board composition is suited to a given application.

By providing a better understanding about any potential performance variability, this research will empower the industry to use MgO panels with confidence.

Levy investment	\$169,000
Timeframe	December 2020 – August 2021
Contact	Anna Walsh anna.walsh@branz.co.nz
Lead organisation	BRANZ Ltd

## Towards durable timber structures – phase 2

 Quality and performance of homes/buildings

This research seeks to understand the impact of timber type and different treatments on moisture dynamics. It will explore how this affects the durability of the whole structure leading to improved durability and performance of timber structures across New Zealand. Moisture directly impacts the durability and performance of timber structures and everything associated with them, including fixings, preservatives, biological growth and micro-structural changes.

Phase one of the *Towards durable timber structures* research to measure timber moisture dynamics has identified unique, location-dependent moisture patterns and corrosion/timber variations.

Phase two will use the geographically unique data collected to develop modelling systems for corrosion. It will then scope the development of a Verification Method to support the management of moisture content in timber through design. This will allow a broader range of the industry to meet the Acceptable Solution or Alternative Solution requirements of the Building Code.

This research will apply current methodologies to more complex timber products within the engineered wood product family, such as laminated veneer lumber and cross-laminated timber.

Stakeholder engagement will ensure that the data is useful and usable and increases the understanding of the durability of the timber structure in various environments. Access to location and region-specific data will allow better-informed decision making for new housing and retrofitting existing housing.

Findings will provide information on the durability of timber-based buildings, clearer maintenance requirements and guidance informed by robust information. The project seeks to improve the information for end users and, ultimately, benefit the whole building system.



Levy investment	\$1,120,000
Timeframe	November 2019 – March 2025
Contact	Kathryn Stokes kathryn.stokes@branz.co.nz
Lead organisation	BRANZ Ltd

## Building for wellbeing – scoping a research programme



BRANZ has recently adopted a new strategic approach that applies systems thinking to the built environment. Systems thinking represents a broadening of perspective that explores the dynamic relationship occurring between the material, natural and human environments.

Buildings are more than just physical structures. We carry out our lives in buildings. They become homes, workplaces, schools, institutional or recreational spaces, healthcare and other community facilities. Our buildings impact on the quality of life and wellbeing of the people who inhabit them. These impacts are not currently well understood or prioritised when buildings are designed, built, maintained or altered.

Wellbeing is a topic that is already embedded into the BRANZ research programmes. However, until now, this research has been conducted disparately and without a coordinated BRANZ-wide response.

This research explored BRANZ's capability to deliver unique and useful research to add value to the current evidence base in the building for wellbeing area. It identified research gaps and asked whether BRANZ could fill them and make a useful contribution. It explored how a co-lab could utilise the expertise of staff across different teams to coordinate wellbeing-related building research across BRANZ.

The findings are being used to determine whether BRANZ can make a useful contribution and what that programme of work might look like to deliver upon the government's key strategic goals.

Levy investment	\$170,000
Timeframe	October 2019 – September 2020
Contact	Michael Nuth michael.nuth@branz.co.nz
Lead organisation	BRANZ Ltd

## Value proposition for data standardisation



As the use of technology in the building and construction industry grows, it generates more and more data. Being a large, fragmented industry means that there is no strategic or macro view of how best to manage, invest in and leverage this data. Data is generated and used in silos for different purposes, resulting in little value being ascribed to standardising or linking across these silos.

This research will aim to identify where the best return could be had for any investment in data (including standardisation or other sharing capabilities) across the building and construction industry. It will identify the purpose of the data collection, who uses it and how it is used. The goal is to develop a macro picture alongside key industry players and to advance a shared view of any potential future investment value.

By creating a common understanding of the value of data standardisation and sharing initiatives, interested parties could agree on priorities and invest appropriately. In the longer term, investing in the right data standardisation and sharing projects will increase efficiency and ensure that the use of technology in the sector generates greater value.

Levy investment	\$35,780
Timeframe	January 2020 – June 2020
Contact	tyson@thirdbearing.co.nz
Lead organisation	Third Bearing Ltd

## How do we get a healthier building and construction industry for small and medium-sized enterprises?



Low levels of wellbeing have the potential to impact the quality, profitability and productivity of the construction sector. As such, BRANZ research has identified small business owners as a priority area for further research, to understand the role of wellbeing within the industry.

This research project will address how to support improved mental health and enable owners of small and medium-sized enterprises (SMEs) to thrive in the current climate. It will aim to better understand what is contributing to this poor state of wellbeing and identify what can be done to improve it.

By understanding the pressure points for SMEs, we can support evidence-based development and implementation of interventions to address existing negative wellbeing. This project aims to gather evidence about workplace factors that enhance or degrade mental health to enable the implementation of a consistent mental health assessment tool.

As part of the Construction Sector Accord, BRANZ will work closely with Construction Health and Safety New Zealand (CHASNZ) in their lead role for industry health, safety and wellbeing. This work supports the shared goal of increasing productivity and the health and safety initiative.

Levy investment	\$200,000
Timeframe	April 2020 – March 2022
Contact	Anne Duncan anne.duncan@branz.co.nz
Lead organisation	BRANZ Ltd

## Mental health and the builder-client relationship



Anecdotal evidence suggests that the builder-client relationship is a significant cause of stress for some builders, and it may contribute negatively to their mental health. Clients often report that building a house is a stressful experience.

This research will investigate the prevalence of builder-client relationship stress and the impact it has on builder mental health. The research will examine both builder and client experiences to understand why this relationship breaks down and what can be done to improve it.

If the results of this study indicate this relationship is a significant cause of stress, it will inform the industry to identify solutions that assist builders and clients with communication. The goal is to improve mental health by turning builder-client interactions into a rewarding part of a builder's job.

Levy investment	\$99,740
Timeframe	November 2019 – September 2020
Contact	Kate Bryson kate@axonconsulting.co.nz
Lead organisation	Axon Consulting Ltd

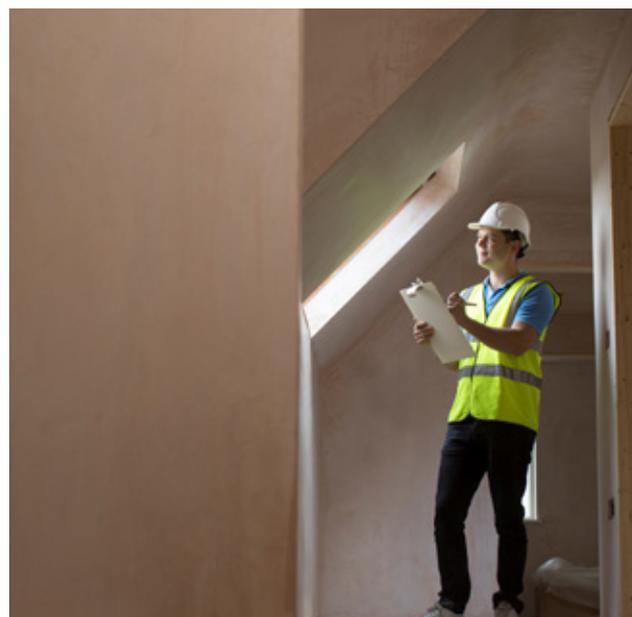
## Improving the uptake of mental health support



MATES in Construction is an evidence-based workplace suicide prevention model, developed to reduce high suicide rates in the building and construction industry.

This project helps build a picture of the effectiveness of mental health support for construction workers in New Zealand. It will begin to evaluate MATES New Zealand training and its impact on attitudes towards suicide and help seeking for New Zealand construction workers.

Results will help inform the delivery of MATES. This will ultimately improve attitudes to suicide and help seeking for New Zealand construction workers.



Levy investment	\$94,980
Timeframe	February 2020 – February 2021
Contact	Victoria McArthur vmcarthur@mates.net.nz
Lead organisation	MATES in Construction (NZ)

# Automated Building Code compliance checking for prefab designs



Prefabricated building is a promising solution to address the housing affordability and supply challenge in New Zealand. However, manual assessments of prefabricated buildings for compliance with the Building Code is a potentially error-prone and time-consuming process, adding to the challenge of meeting timely delivery expectations.

Some automation efforts observed internationally have shown an improvement in the productivity and performance of Building Code compliance processes. This research will investigate what lessons New Zealand can learn from international efforts.

The research will aim to identify key barriers and provide recommendations for adopting automated Building Code compliance for prefabricated designs in New Zealand. It will analyse selected international and New Zealand cases that deliver automated Building Code compliance, checking and focusing on transferring evidence-based knowledge and experience to New Zealand. To validate the proposed recommendations, it will then implement the latest automated Code checking technologies on two real New Zealand prefabricated designs.



Levy investment	\$130,442
Timeframe	November 2019 – September 2021
Contact	Yang Zou yang.zou@auckland.ac.nz
Lead organisation	University of Auckland

## Digital product data for lifting productivity



A 2017 BRANZ report into traceability of construction products found that the cost incurred across New Zealand for non-conforming products is estimated at \$232 million. A National Product Catalogue (NPC) offers a means to address this problem. Subsequently, there has been considerable discussion in the media and public policy circles on the idea of a building products library.

This research aims to lift construction sector productivity through widespread sharing of digital product data using the NPC. It will identify stakeholder needs, expected public and stakeholder benefits, relevant internationally standardised product master datasets and system requirements to make information publicly available.

The challenge in creating a digital library is ensuring the master data becomes a trusted product. It must be readily accessible to users and include standardised structured product assurance information, safety data sheets, Building Information Modelling (BIM) data and other technical information. The project will aim to create an open system where a public Application Programme Interface is used to share NPC data. The data could then be made freely accessible or only to authorised users

Wider sharing of NPC data nationally would ensure that readily accessible and trusted digital product data is available for product assurance and compliance. The data could also be used in the automation of the building consent and inspection processes and for the identification and management of hazardous building materials.

Levy investment	\$154,062
Timeframe	November 2019 – July 2020
Contact	Nick Allison nick.allison@gs1nz.org
Lead organisation	GS1 New Zealand

## Future connections with consenting systems and third-party technology



Building Consent Authorities (BCAs) are increasingly adopting online services for managing building consents and related processes. The building and construction industry is also adopting a range of technology solutions, including BIM and online solutions for creating project and construction specifications.

There is an opportunity to leverage these technologies to improve the quality and timeliness of the consenting system. In turn, this will improve information and knowledge about the quality of buildings. This research will focus on finding ways to improve the integration of third-party technology as part of the building consent process.

It will also aim to identify how improved connections between BCAs and third-party technologies could enhance outcomes for the consenting process. Further, it will identify the challenges and opportunities that exist for these connections and which key interventions would best facilitate the connections.

Levy investment	\$74,880
Timeframe	November 2019 – April 2020
Contact	Tyson Schmidt tyson@thirdbearing.co.nz
Lead organisation	Third Bearing Ltd

# How do we get a healthier building and construction industry for worksites?



BRANZ research has identified that the construction industry experiences high numbers of suicide and workers suffering from depression compared to other industries. This research is the second phase of more work in the general area of wellbeing in the industry.

Conflict on a construction site between contractors and their subcontractors is common and often part of normal contractual tension. Several possible cultural factors suggest that bullying behaviours could be one reason why rates of suicide and depression within construction are uncommonly high.

This research will explore worksite culture and the experiences of workers on site to identify the causes of poor wellbeing outcomes. It will aim to understand how and to what extent such factors impact the wellbeing of workers.

The research will support the evidence-based development of targeted interventions to address the causes of work site bullying. It will aim to implement solutions around harm prevention as well as improving the overall wellbeing of workers on building sites.

BRANZ will work with the industry to develop preferred options. A collaborative approach may lead to the implementation of a consistent mental health assessment tool for worksites.

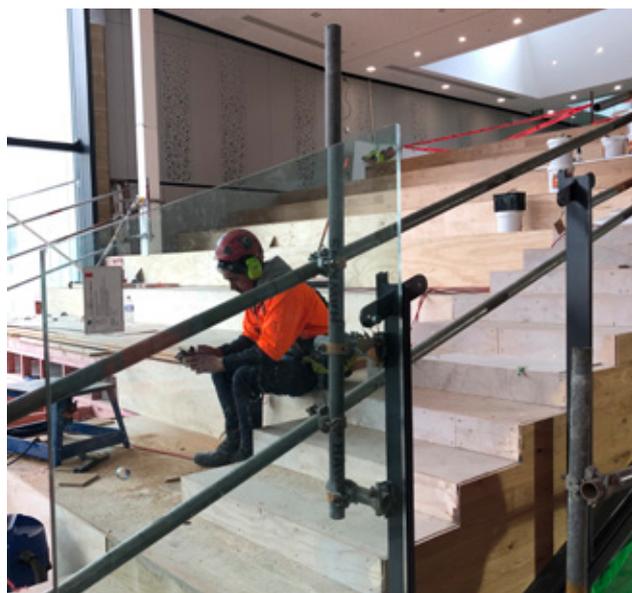
Levy investment	\$205,000
Timeframe	April 2020 – April 2021
Contact	Anne Duncan anne.duncan@branz.co.nz
Lead organisation	BRANZ Ltd

## Towards effective use of technology in the construction industry



New Zealand's building and construction sector has been slow in adopting new technologies, and its labour productivity has stagnated accordingly. With population growth, demand for affordable housing and infrastructure, and capacity constraints within the built environment, there is a pressing need for the construction sector to transform. New technology may have a role to play.

This research will aim to review technologies available globally and assess the readiness of the New Zealand construction sector. This will help the sector assess the resources, infrastructure and skills needed for them to be technology ready.



Levy investment	\$200,000
Timeframe	November 2019 – September 2021
Contact	Alice Chang-Richards yan.chang@auckland.ac.nz
Lead organisation	University of Auckland

## Monitored at work? Real-time employee monitoring technology



Real-time employee monitoring technologies (REMT) are beginning to be implemented worldwide and are likely to be quickly introduced to the New Zealand building and construction industry.

At present, there are concerns about the application of REMT in New Zealand as we know very little about how it's best used. This research will identify any legal, ethical and behavioural concerns for REMT implementation across the New Zealand building and construction industry. It will include the trial application of a REMT product that can demonstrate how the industry can address critical concerns identified in the early stages of the project.

This research will help inform guidelines for employees and employers, reduce concerns about the use of real-time employee monitoring technologies and understand associated benefits. Such improvements could include increased productivity and traceable safety data.

Levy investment	\$139,274
Timeframe	November 2019 – March 2022
Contact	Kenneth Tak Wing Yiu t.yiu@massey.ac.nz
Lead organisation	Massey University

# Construction sector performance – learning lessons and finding opportunities



What gets measured gets managed. Traditional measures of construction sector performance focus on economically driven output measures such as productivity and throughput. This, in turn, drives behaviours that are output focused. Such measures provide little insight into what is happening within the system and often send signals too late that problems may exist.

Aligned with the government move towards a wellbeing framework (New Zealand Treasury’s Higher Living Standards), performance measures for critical sectors need to move beyond important output-focused economic metrics. The challenge for the construction sector is to move to capture leading information that reflects our desire for quality, resilience, sustainability and wellbeing.

Effective measures can help focus cross-sector action to achieve better outcomes for communities that rely on the sector. It also will improve short-term and long-term outcomes for the businesses and individuals that make up the construction industry. This research will review the use and effectiveness of construction sector measurement systems used internationally and look at other industry sector performance measurement systems.

Based on the findings, the project will work with the New Zealand construction sector to propose a performance measurement approach. The approach will aim to develop an effective construction sector performance measurement framework to drive performance and indicate where intervention is needed. It would also enable policy evaluation and measure the impact of shocks or disruptions.



Levy investment	\$197,000
Timeframe	November 2019 – June 2020
Contact	Charlotte Brown charlotte.brown@resorgs.org.nz
Lead organisation	Resilient Organisations Ltd

## Performance measurement in building and construction



The performance of the building and construction industry is imperative to sustaining New Zealand's economic wellbeing. The industry contributes to employment, capital formation and its close integration with the rest of the economy. In New Zealand, measuring the performance of the construction sector relies on macro-economic data. The general conclusion is that productivity growth has been stagnating.

Existing studies often assess the performance from different levels using data aggregated at the sector level (official productivity statistics) or disaggregated at the firm level (the Longitudinal Business Database). The issue with this approach is a lack of consistency regarding whether productivity growth has deteriorated or accelerated. This causes a challenge while designing policies and strategies that govern future growth.

The framework commonly used to assess performance in existing literature involves three assessment levels: industry level, firm level and project level. This study will provide a critical examination of performance measures at each of the assessment levels used by the building and construction industries in different countries.

The research will explore how the measures are constructed and used. It will also identify who is using the measures and why. It will check the fundamental assumptions underpinning the measures and identify the problems and inconsistencies associated with these measures. The findings from this study will be used to propose a chain of performance measures at various assessment levels that can be used by New Zealand's policy makers and industry practitioners.

Levy investment	\$40,000
Timeframe	October 2019 – March 2020
Contact	Nan Jiang nan.jiang@aut.ac.nz
Lead organisation	Auckland University of Technology (AUT)

## ArchEngBuild 2020



Now in its ninth year, ArchEngBuild brings together the country's best architecture, engineering, and construction management students to work together. This intensive three-day competition requires students to learn how to work together across disciplines to deliver a project. The aim is that they take this experience into their professional careers. Students need to utilise existing knowledge and draw on professional advice and resources available to them on the day.

ArchEngBuild has been cancelled in 2020 due to the COVID-19 pandemic.



Levy investment	\$54,000
Timeframe	January 2020 – September 2020
Contact	archengbuild@branz.co.nz
Lead organisation	Concrete NZ

# New Zealand's private rental sector 2020

 Meeting New Zealand's population needs

Compared to owner-occupied and state housing, private rental housing is often of poorer quality and offers less security of tenure. In 2013, 42% of New Zealand residents were living in rental accommodation. Of the households who reported paying rent in the 2018 Census, 83.5% rented from a private person, trust or business (Stats NZ, 2019).

This research will replicate a 2015/16 study of New Zealand's private rental housing sector to investigate changes over time in the aspirations, experiences and intentions of tenants and landlords. It will seek to gain a better understanding of interactions between tenants, property managers and landlords at critical stages in a tenancy, including entry, negotiating repairs or modifications and exit.

It will explore the quality of life offered by different types of dwellings and the tenancy experiences of specific groups of tenants. It will also investigate how interactions between parties in the private rental sector were impacted by recent changes to tenancy regulations.

The mixed-methods study will be undertaken via a computer-assisted telephone survey of 1,100 tenants and 400 landlords from across Auckland, Wellington, Christchurch and Dunedin. There will also be follow-up in-depth interviews with subgroups of survey respondents – both tenants and landlords.

The research will inform local government policy of housing affordability and the ongoing review of regulations by central government to improve the supply and quality of housing in the private rental sector. Auckland Council is contributing to the research, as it sees the value in informing its activities and policy work, particularly relating to homelessness and affordable housing.



Levy investment	\$249,918
Timeframe	March 2021 – August 2022
Contact	Karen Witten k.witten@massey.ac.nz
Lead organisation	SHORE & Whariki Research Centre, Massey University

## Census data quality

 Meeting New Zealand's population needs

In the 2018 Census, Stats NZ used other data sources to supplement the results of the 2018 tenure outcomes. This may have affected the ability to compare the 2018 results to previous Census results. This is important for policy analysts and researchers looking at housing market trends.

This research investigated whether the use of the other data sources affected the reliability and comparability with previous years.

Levy investment	\$10,060
Timeframe	February 2020 – March 2020
Contact	Ian Mitchell ian.mitchell@livingstonassociates.co.nz
Lead organisation	Livingston and Associates Ltd



## Mapping the consumer landscape

 Meeting New Zealand's population needs

Consumers have the potential to be significant agents for transformation in the building and construction industry system. By asking the right questions of their builders and designers, they could be key drivers of system change.

Lack of consumer knowledge is a significant barrier to potential improvements to New Zealand's housing stock. Informed consumers are more likely to provide bottom-up demand and advocacy for better buildings for New Zealanders. The interface between designers, builders and their clients (consumers) is a critical one when it comes to building and maintaining better houses in New Zealand. 'Better' includes energy-efficient, low-carbon, sustainable, resilient, accessible, warm, dry and healthy. A well-informed consumer base can engage more effectively to produce better homes.

Initial research and anecdotal evidence indicate that consumers are not well informed about buildings and that relevant New Zealand-based information is hard to find, piecemeal and fragmented. There is little data on what consumers need and how best to deliver that information. This project will provide a roadmap for an evidence-based, systematic and coordinated approach to consumer education and information and will identify the most effective role for BRANZ in this field.

This strategic approach can also be monitored, measured and utilised by organisations that BRANZ has partnered with in recent years, particularly in making houses warmer, drier and safer. The long-term outcome is a consumer base that is better informed and better equipped to engage with industry to improve New Zealand homes.

Levy investment	\$150,000
Timeframe	January 2020 – April 2021
Contact	Jonquil Brookes jonquil.brookes@branz.co.nz
Lead organisation	BRANZ Ltd

# The future landscape for residential landlords in New Zealand

 Meeting New Zealand's population needs

This feasibility study will look at the current and future market for landlords and the requirements of the operating environment that they are likely to face.

The core research question asks: “Who are the landlords of the future, and what challenges are they likely to face, given anticipated changes in New Zealand’s population structure and rental patterns?” Many market, socio-economic and behavioural factors will be considered, including political and institutional settings.

The research will explore the apparent failure of the market to provide affordable homeownership options, with more New Zealanders facing a lifetime of renting. Consideration will be given to the influence of changes to the tax environment governing property investors (landlords), access to finance and regulatory compliance requirements.

The future provision of quality rental accommodation is likely to be driven by a society that is sensitive to environmental concerns, wellbeing and improved living standards. The research will therefore also consider projected changes to New Zealand’s future population demographic, consumption patterns and the expected impact on the type, design and location of dwellings.

Should this project determine that further research is warranted, a targeted proposal will be put forward. This will include collaborative arrangements to govern a cross-agency research project.



Levy investment	\$50,000
Timeframe	March 2020 – March 2021
Contact	Daniel Du Plessis daniel.duplessis@branz.co.nz
Lead organisation	BRANZ Ltd

# Scholarships

## Each year, funding is made available for outstanding postgraduate scholars in New Zealand tertiary institutions.

The scholarship programme brings diversity to the BRANZ portfolio of investments, supports future research and strengthens our relationships with tertiary education providers. The scholars undertake research that brings new findings and perspectives to the building and construction industry.

Scholars with excellent academic credentials that early-stage researchers pursuing innovative projects can apply for scholarships of up to \$25,000 per year. Master's scholarships are usually for one-year projects, and PhD scholarships are for three years.

Two new PhD scholarships contribute to BRANZ research programmes and are featured on pages 23 and 32. A full list of all scholarship projects under way in 2020/21, including those continuing from previous years, is shown on page 77.

## Future design thinking for construction – a partnership pilot



This is a pilot initiative with the Victoria University School of Architecture. A new funding model will be trialled with the Advanced Manufacturing and Prototyping for Design (AMPD) Research Laboratory to ensure successful research is built on and continued from one year to the next.

The initiative will aim for students, industry and BRANZ to work closely together to identify and support projects that move beyond architectural theory into practical application. Students will be supported to design and test their ideas.

AMPD will distribute the funds in support of various design-based research projects and activities. Funds will provide scholarships to students. Additionally, students will receive materials, project support and information dissemination to the industry and research community, ensuring knowledge transfer to incoming researchers from previous work.

The AMPD research group focuses on using technology in the building and construction industry as a tool to enhance, alter and even disrupt current methods of building. The group's research covers the full spectrum of the building and construction industry from design to manufacturing through assembly, to provide technological alternatives to existing working methodologies.

AMPD aims, through its students and research, to develop new construction technologies and capabilities to use it. This approach aligns to the *Vibrant industry* component of BRANZ's research portfolio.

Levy investment	\$99,000
Timeframe	October 2019 – March 2021
Contact	researchinvestment@branz.org.nz
Tertiary institute	Victoria University of Wellington

## Pre-contamination of wallboard with fungi

 Quality and performance of homes/buildings



### Elaine Ting Yen Khor

The widespread problem of mould contamination in New Zealand homes impacts on the health of its occupants. A 2016 Danish study found that new gypsum wallboard was often pre-contaminated with moulds and only required water damage to be activated.

This research will investigate whether there is pre-contamination of new gypsum wallboard with *Stachybotrys* and other potentially harmful fungi in New Zealand. The findings will be integral to understanding whether fungal spores are present in new building materials.

The research will help determine preventive measures to minimise the contamination of gypsum board by potentially harmful and detriogenic fungi.

Timeframe	November 2019 – June 2021
Contact	researchinvestment@branz.org.nz
Tertiary institute	University of Auckland

## Seismic performance of precast floors

 Resilience of built environment



### Mohamed Mostafa

Buildings with precast floors make up a large percentage of the commercial building stock in New Zealand's cities. Given the high seismicity of New Zealand, it is necessary to understand how precast floors and buildings may perform at a system level during an earthquake.

While the details for these floor systems have been improved in new buildings, existing buildings designed before 2006 can be prone to significant damage and potential floor collapse during an earthquake.

The research will undertake a detailed forensic analysis of a case study detailing a modern building with a precast floor damaged during the 2016 Kaikōura earthquake. Data collected by the building's instrumentation will be analysed to understand the observed seismic performance compared to the expected seismic response.

The analysis will provide a means of assessing the extent to which existing laboratory testing is representative of in-service structures. It will also lead to the improvement of modelling tools. Insights gained will inform guidance on seismic assessment and retrofit of buildings with precast concrete floors. This includes *The Seismic Assessment of Existing Buildings* (Red Book) for pre-earthquake assessment of existing buildings.

This project will provide an internationally unique opportunity to study, in detail, the seismic performance of an instrumented modern building that was damaged in a strong earthquake.

Timeframe	September 2019 – July 2020
Contact	researchinvestment@branz.org.nz
Tertiary institute	University of Auckland

## Mid-rise commercial timber construction

 Quality and performance of homes/buildings



### Shannon Griffiths

This research seeks to explore the spatial or architectural opportunities that timber design presents in relation to commercial development in the New Zealand context. Specifically, it will explore context, industry and consumer perceptions and current attitudes towards corporate working environments and mid-scale timber design construction.

While timber products are used extensively in the low-rise housing market, New Zealand has the opportunity to show leadership internationally in the use of timber products for mid to high-rise scales. The technology to build mid-scale designs in timber is continually developing.

The use of renewable, sustainable New Zealand timbers in our commercial buildings will greatly increase the quality of building stock and work towards a future of carbon-neutral construction.

Timeframe	To be completed by March 2021
Contact	researchinvestment@branz.org.nz
Tertiary institute	Victoria University of Wellington

# Strategic initiatives

Nothing less than an enduring collaborative effort across the whole system will achieve the much-needed transformative renewal of the sector. BRANZ remains committed to working with other sector leaders to catalyse change across the industry and ensure we deliver what is ultimately needed – better outcomes for New Zealanders.

Strategic initiatives supported by the Building Research Levy this year include industry transformation and further development of Artisan, a digital solution that helps councils and build teams work together more effectively.

BRANZ's strategic investments have ambitious goals and aim to have long-term, positive and far-reaching outcomes.

## Industry Transformation Agenda

In 2016, BRANZ began driving industry-wide commitment to change by championing the use of the Industry Transformation Framework, initially developed by the World Economic Forum. BRANZ worked with key industry partners to modify the Framework for the New Zealand context.

This developed into the Industry Transformation Agenda (ITA) – a call to action to the industry to unite around the framework and deliver transformative change. The call resonated with stakeholders across the industry and within government.

We are delighted that this foundational work helped pave the way for the development of the Construction Sector Accord, a shared vision by government and industry to transform the sector. Since its launch, we have partnered with the Accord and identified research and activities that support its outcomes. This work will continue.

In August 2020, BRANZ's CEO became the lead for a new Accord environmental workstream. This work will identify actions and opportunities for the industry to connect and leverage scale, good practice and capabilities to lead change in this increasingly urgent driver for the sector. BRANZ will support this workstream through use of relevant knowledge and expertise and by drawing on our strategic connections across the research, construction and other sectors.

Our core work on the ITA also informed our ambition to build on our unique system-wide perspective of all the different aspects of the industry. We are increasingly using this perspective to develop deeper systems capability. We will focus on how to measure system health and have begun work to identify system indicators to provide insight and perspective on sector performance. This collaborative work across the system will draw on relevant work and data being collected from several sources.

## Industry leadership

BRANZ values and engages with a wide span of industry, government and research leaders. To ensure we remain connected and contribute effectively to emerging issues, the BRANZ Board and executives will continue to explore future-focused challenges. To support this work, we will identify strategic engagement and communication priorities, facilitate discussion on challenging issues, encourage new knowledge and establish proactive approaches to tackle difficult problems. We will also celebrate industry achievements and champion the work of those engaged in driving future-focused change.

## Artisan

Artisan is a digital quality assurance tool BRANZ developed as an industry transformation initiative to support Building Consent Authorities (BCAs) and build teams that deliver better residential build outcomes.

The state-of-the-art app allows builders to photograph and record the build process each step of the way. The app captures the workflow format that matches the process used by BCAs. The resulting record provides the evidence required for many elements of the consent process, which builders can inspect, capture and submit online.

The BCAs can either approve the work or send back advice on how to reach the required standard, ultimately reducing the required number of on-site inspections.

Increasing use by Auckland Council this year demonstrates that builders are growing their knowledge of New Zealand Building Code compliance. They are inspecting their work more closely and engaging more collaboratively in the consent process. This is delivering better-quality outcomes on residential build sites.

BCAs using the app have found that they can approve building consents more efficiently as fewer on-site inspections are required. This also reduces health and safety risks, travel costs and time.

Artisan ensures there is an enduring permanent record for each building. Over time, such records will provide a source of valuable data that can be used to study long-term building performance in New Zealand.



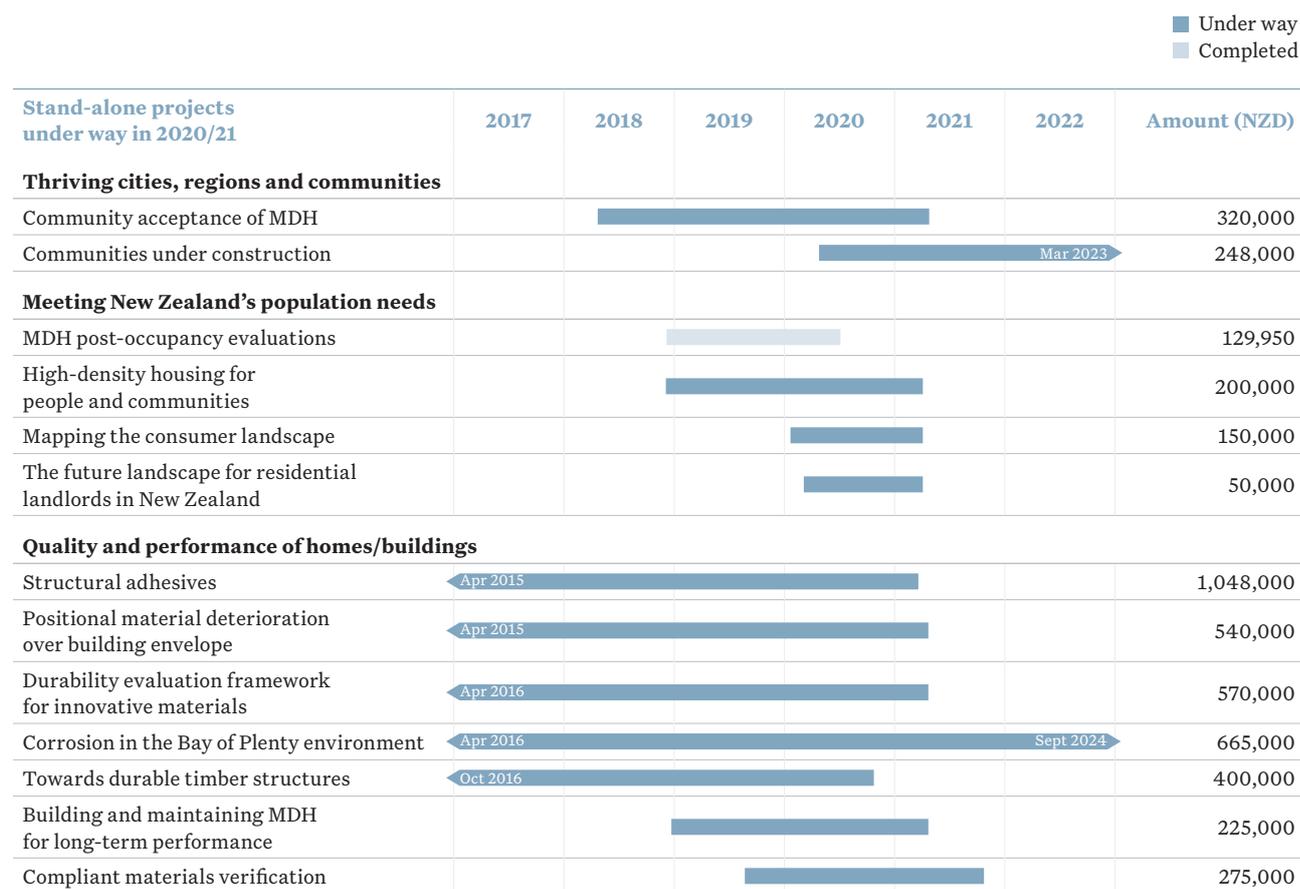


## **Our investment in detail**

This section details all the stand-alone projects under way in 2020/21, including those that are ending and those just getting started.

# Stand-alone projects under way in 2020/21

This timeline presents the individual research projects in progress in the 2020/21 year. It shows the timing of each project and how much we're investing across a diverse range of areas. Details for projects described in this document are correct at time of publication but may be subject to change. Work completed in previous years can be found in previous issues of Levy in Action. If you would like to know more about any project listed here, we welcome your interest and invite you to email [researchinvestment@branz.org.nz](mailto:researchinvestment@branz.org.nz) or speak to our programme leaders directly.





<b>Stand-alone projects under way in 2020/21</b>	2017	2018	2019	2020	2021	2022	Amount (NZD)
How do we get a healthier building and construction industry for worksites?				■			205,000
How do we get a healthier building and construction industry for small and medium-sized enterprises?				■			200,000
BIM user and client surveys				■			23,000
<b>Resilience of built environment</b>							
Robust building system testing		■					50,000
Foundations on sloping sites		■					95,000
ReCast floors		■					1,053,161
A real-world investigation – seismic performance of precast floors				■			245,000
Structural insulated panels – durability, seismic and fire performance				■			620,000
Earthquake-prone public buildings – balancing life safety risks and communication costs				■			125,000
Seismic design of low-rise and mid-rise hybrid residential buildings				■			1,153,000
<b>Low-carbon economy</b>							
Residential water use	◀ Apr 2016	■					656,468
<b>Knowledge transfer and enabling activities</b>							
Advisory services 2020/21				■			430,000
BRANZ levy forecasts 2020/21				■			40,000
BRANZ monitoring network				■			460,000
B-RISK support 2020/21				■			74,000
Build magazine 2020/21				■			940,000
Building controls 2020/21				■			250,000
Bulletins and factsheets 2020/21				■			160,000
Durability verification database 2020/21				■			10,000
Education 2020/21				■			570,000
Guideline 2020/21				■			30,000
Library – Information management 2020/21				■			290,000
Materials and characteristics survey 2020/21				■			95,000
MyBRANZ Knowledge and digital knowledge transfer				■			1,303,000
<b>Scholarships</b>							
Julia Thompson – Natural ventilation for large audience space	◀ Jan 2015	■					75,000
Phoebe Taptiklis: Maintenance and dampness	◀ Mar 2015	■					75,000
Dan Court-Patience – Buckling restraining brace connections		■					75,000







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