



Levy in action

2021





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



Contents

New Levy-funded research projects for 2021/22

Levy in Action 2021 provides information about the investments BRANZ is making and introduces newly funded research between 1 April 2021 and 31 March 2022.

For completeness, the 2021 Levy in Action also includes several now complete research projects that did not feature in the 2020 Levy in Action.



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Building connections

In our BRANZ Annual Review this year, I have noted that the COVID-19 disruption reinforced the unique position BRANZ holds within the industry. At a time when connection – in both a professional and personal sense – was so difficult, BRANZ was fortunate that existing strong industry relationships enabled us to keep pushing forward and maintain momentum.

Our connections and relationships across the industry continue to be the lifeblood of BRANZ. They ensure we understand the linkages and interactions that influence the building system. Our work with industry colleagues, government, universities and other researchers provides invaluable insights that drive our research programme, ensuring wise investment of the Building Research Levy.

We continue to be relentlessly focused on ensuring that research undertaken or commissioned by BRANZ drives positive change both within the industry and across Aotearoa New Zealand's built environment. We also work hard to ensure our research and the knowledge we

develop gets into the hands of those in the system who can apply it in ways that make a meaningful difference.

This issue of Levy in Action highlights ways in which we are deepening our connections and working closer than ever with other system players. The featured research projects illustrate our commitment to listen, learn, join the dots and ensure our research continues to meet emerging and long-term needs.

Our work is increasingly providing evidence-based insights into the needs of building end users.

One such example is the *Building for wellbeing* project BRANZ is undertaking in collaboration with Auckland University of Technology (AUT) and government agency Kāinga Ora.

The project team is developing and testing a digital post occupancy evaluation tool to efficiently capture the qualitative perspectives of end users about the wellbeing performance of buildings. It will measure the liveability – or wellbeing – performance of buildings by considering the impact on quality of life for occupants. This qualitative data is expected to help inform the ongoing planning, design and construction of buildings that meet the wellbeing needs of New Zealanders.

We believe this project will be a game changer in terms of understanding and being able to demonstrate how well a building performs from a human perspective.

Another project featured in this publication is BRANZ's study *How do clients choose a quality builder?* BRANZ is reviewing current literature and pre-build advice and undertaking surveys and a wide range of interviews to identify and codify best practice. The project aims to provide a win:win for both clients

and builders, with each better understanding the needs and expectations of the other prior to signing a contract. There is a growing need to help guide consumers in what will likely be the most significant purchase in their lives. At the same time, the building industry has a growing need for assistance to learn how to better communicate their skills to their potential clients.

We are grateful for the strong relationships we enjoy across the wider building system. Together, we share insights, identify opportunities and tackle issues. BRANZ is confident that the research supported by the Building Research Levy will continue to add enduring value to the sector.

We warmly invite you to delve into Levy in Action to learn more about how BRANZ's research investments and work contributes to a better built environment in Aotearoa New Zealand.



Chelydra Percy
BRANZ CEO





Investing the Building Research Levy

BRANZ invests the Building Research Levy to improve the building system performance by co-creating enduring solutions that make a real difference in the lives of people in Aotearoa New Zealand.

Forging connections to maximise research impact

The Building Research Levy investment creates a trusted, independent and impartial evidence base to support enduring change.

A key driver of the Levy investment is ensuring that all research is designed with the needs of the industry and ultimately all New Zealanders in mind.

To foster the required change, BRANZ maintains strong relationships with a wide range of system players active within New Zealand's built environment. By developing and nurturing connections with industry and government, BRANZ makes sure Levy-funded research is relevant and effective. Our research is increasingly co-created alongside key users who have the ability to implement the research findings into their work.

Working together

BRANZ is committed to an enduring collaborative effort across a range of system players. We listen, learn and share information, expertise and research to explore new ideas and find practical frontline solutions.

Working with industry

BRANZ has deep connections across the building and construction industry that are fundamental to our work. These connections give us a unique perspective on how the industry works and helps to keep us informed about emerging and long-term 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 range of government organisations that interact with the building and construction system. We apply an interest-based approach to these relationships to link our capabilities with the research needs of policy makers and regulators.

By working with government, BRANZ continues 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 2021 and the Building for Climate Change programme.

BRANZ has been working with the Construction Sector Accord, a partnership between the sector and government, since its launch in 2019 to identify research that supports industry transformation. In mid-2020, the Accord expanded its Transformation Plan to include the new Environment workstream, aiming to improve environmental sustainability and support the industry to prepare for a zero-carbon future. In recognition of BRANZ's expertise in and passion for the challenge, BRANZ CEO Chelydra Percy was invited to lead the new workstream.

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 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

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. 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.

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 that the New Zealand construction sector may face in the future.

Tackling the most pressing issues

As an industry that employs around 10% of the country’s workforce, contributes 7% of GDP and supports our wellbeing, it’s critical Aotearoa New Zealand has a sound and high-functioning construction sector. BRANZ invests in research that aims to understand and identify the nature of industry issues and that delivers better outcomes for all.

Our portfolio

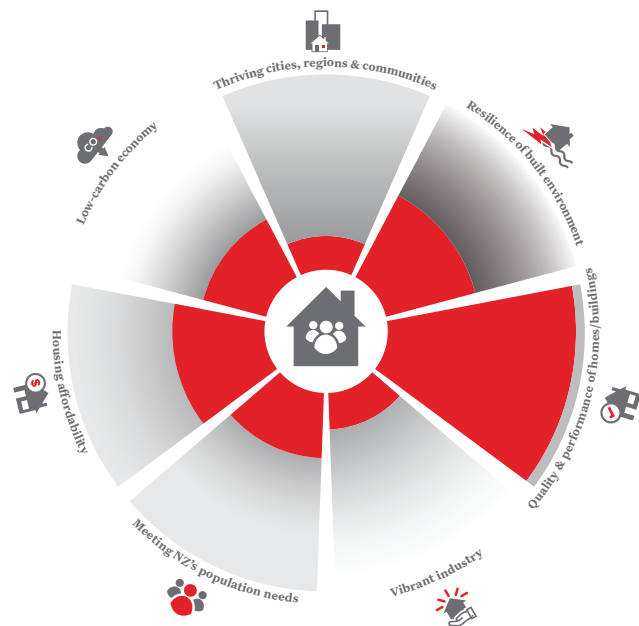
The BRANZ research portfolio outlines areas of importance to New Zealanders and the building sector and sets out our assessment of building and construction research across New Zealand. This overview informs us on where we can focus our efforts to make a difference.

Our portfolio provides a high-level view of Levy investment in research against seven key challenges for New Zealand’s built environment. As part of our annual Levy investment process, we review our existing research portfolio and engage with industry and government stakeholders to understand their priorities. This, in turn, informs our research priorities.

The graphic to the right sets out key areas in which BRANZ undertakes research and its relative strengths (red shading) and the depth of research effort across New Zealand (red and grey shading).









This Levy in Action features new research that has been funded between 1 April 2021 and 31 March 2022.

The table on the next page provides an overview of the portfolio of research that BRANZ Inc. invests in. The Building Research Levy is invested in a range of research that includes the four BRANZ Ltd programmes of research as well as other stand-alone research projects. These projects can be distinct projects or may respond to emerging or urgent issues or strategic initiatives. Research can be contracted to external providers and/or BRANZ Ltd, including postgraduate scholarships.



- BRANZ research and its relative strengths
- Depth of research effort across New Zealand

Our portfolio overview

	2019/20	2020/21	2021/22	2022+	
BRANZ programmes of research	ELIMINATING QUALITY ISSUES 	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
	WARMER, DRIER, HEALTHIER HOMES 	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
	TRANSITION TO A ZERO-CARBON BUILT ENVIRONMENT 	Programme of action launched	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
	BUILDING FIRE-SAFE DENSIFIED HOUSING 	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
Other investments	INVESTMENT ON EMERGING ISSUES 	BRANZ is able to act quickly and decisively on urgent issues as they emerge – for example, urgent work to address retrofit gap around precast concrete flooring systems			
	DISTINCT, STAND ALONE PROJECTS 	Projects initiated by researchers and end users – for example, overframing of timber buildings			
	SCHOLARSHIPS 	Helping ensure that New Zealand has strong research capability in core STEM and building science areas			
	INDUSTRY TRANSFORMATION 	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"> • Build • Guideline • Bulletins • BRANZ Facts • BRANZ Research Now • Study Reports 	<ul style="list-style-type: none"> • Seminars • Live webinars • E-Learning modules • Helpline • Information management • Advisory services 	<ul style="list-style-type: none"> • Durability verification database • Weathering site • Levy forecast • House Condition Survey 	<ul style="list-style-type: none"> • MyBRANZ Knowledge • B-RISK user support • Artisan • BRANZ CO₂NSTRUCT • ALF • LCAQuick

For more information on core activities, see www.branz.co.nz

Investing the Levy wisely to deliver *better outcomes for all*

Through responsible and responsive Levy stewardship and purposeful investment, BRANZ delivers research that provides practical solutions. We are also able to adjust our investment plans and timing through a variety of economic conditions.

Our Levy investment approach

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 20-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 20-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 Aotearoa 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.

Read more:

- ▶ **Levy Investment Portfolio Statement**
www.branz.co.nz/investing-research/

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. Most of the research undertaken by BRANZ falls under the four key research programmes. These are described further on pages 14-40.

A wholly owned subsidiary of BRANZ Inc., BRANZ Ltd operates predominantly out of the Judgeford campus near Wellington. Over 100 staff work here – most are scientists, 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 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 collaboration 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. One of the ways external research proposals are sought is through a prospectus. This is sent to industry and the research community to seek proposals to help deliver on research priorities as 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 recognises opportunities may be driven by urgent or timely insights or events and is able to undertake new research throughout the year. We use agile investment to act quickly to respond to emerging building and construction industry issues. These can be 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 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.

Impactful research

BRANZ is actively embedding co-creation of research across its research portfolio. This helps ensure that the research will contribute towards addressing systemic issues and can support the development of complete solutions. This involves working in partnership with system players including industry, government, universities and other research providers to develop and undertake relevant research.

Through co-creation and engagement from the outset and throughout research, Levy investment can support accessible and actionable research to drive changes in behavioural norms and achieve system-wide improvements.

Research investment overview

2021/22

New Levy investment and budgeted expenditure
for existing research committed for the year
1 April 2021 to 31 March 2022:

<i>Investments</i>	<i>New investment \$</i>	<i>Existing investment \$</i>	<i>Total \$</i>
BRANZ research programmes			
Transition to a zero-carbon built environment	1,501,000	949,000	2,450,000
Warmer, drier, healthier homes	693,000	2,262,000	2,955,000
Building fire-safe densified housing	489,000	838,000	1,327,000
Eliminating quality issues	204,000	480,000	684,000
Agile research investments			
Knowledge transfer and enabling activities	-	3,354,000	3,354,000
Scholarships	100,000	105,000	205,000
Stand-alone projects	460,000	1,729,000	2,190,000
Strategic initiatives*	724,000	-	724,000
Total	4,171,000	9,717,000	13,888,000

* Funded on an annual basis.

These figures are correct in representing the total Levy investment for the year as at 1 July 2021. It is subject to change due to project variations and new investments made in response to emerging issues.



BRANZ programmes of research

BRANZ invests the Building Research Levy in programmes of research that target four priority areas for New Zealand's building and construction sector:

- **Transition to a zero-carbon built environment**
- **Warmer, drier, healthier homes**
- **Building fire-safe densified housing**
- **Eliminating quality issues**

The programme approach was implemented by BRANZ in 2016/17. The programmes aim to find and develop end-to-end solutions to some of the most pressing issues facing the industry and help provide better outcomes for New Zealanders.

Each programme of research is supported by an advisory group with representatives who provide science leadership, specialist advice and guidance on industry issues. This helps to turn research solutions into practical action. Research in these programmes is led by BRANZ Ltd and can include subcontracts with external providers.

This section provides an overview of each of the four key programmes of research, and includes:

- a programme overview
- timeline graphs showing a full list of all research projects that are under way in 2021/22, including those continuing from previous years
- a summary of the new research being funded this year.

Transition to a zero-carbon built environment

Climate change has big implications for the building industry. The built environment contributes up to 20% of New Zealand's carbon footprint. To achieve Aotearoa New Zealand's goal of reducing net emissions of greenhouse gases to zero by 2050, the sector needs to develop and adopt low-carbon practices for how we design, construct and operate buildings.

What we're doing

Over the past 20 years, BRANZ has contributed to research about climate change and its impacts. This has meant collaborating with key stakeholders such as MBIE, Kāinga Ora, the Ministry of Education and others to address key challenges in relation to the transition to zero-carbon buildings. Further, the programme has been supporting industry through the creation of resources and tools to help upskill the industry's ability to assess the environmental impact of building designs. BRANZ has continued to develop a suite of carbon-footprinting tools, such as LCAQuick and CO₂NSTRUCT to help project teams calculate and reduce the carbon footprint of their building designs.

In 2019, the *Transition to a zero-carbon built environment* research programme was established to support an industry-led transition to reducing emissions. This programme aims to provide the science, knowledge and guidance for what current carbon consumption looks like and how we can cost-effectively decarbonise new and existing buildings and

building stock. It will examine the barriers, motivation and actions of the building and construction industry in preparing to transition to a net-zero carbon economy.

This programme will:

- examine how the building environment impacts climate change through the production of materials and energy efficiency performance and what can be done to mitigate this
- look at how buildings are being impacted by the effects of climate change such as extreme weather events
- assist the New Zealand Government and public to meet the needs of a future net-zero carbon economy
- promote decarbonisation across the building life cycle by encouraging leadership and decision makers to manage the mitigation of climate change

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

The current focus of the programme is on how New Zealand's building and construction sector can decarbonise buildings and what is required to do that. The environmental impact of buildings has a lasting influence on our economy. The decisions made during the design of buildings today will have an impact post-2050 as most have a service life of 60–90 years.

The current research projects within the programme are led by researchers from across BRANZ and other research providers such as Massey University, Concrete NZ and the University of Auckland. An outline of current and recent research under way within the programme is shown in the timeline on the next page.

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:

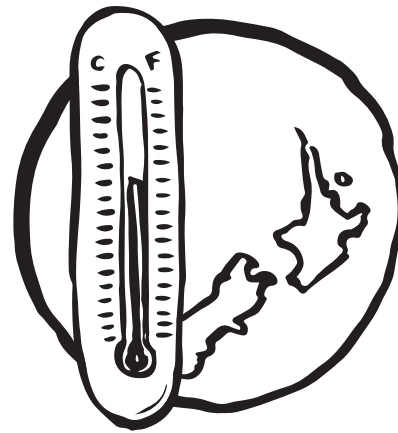
- cost-effective low-carbon solutions have been developed to decarbonise new and existing dwellings and non-residential buildings by 2030
- cost-effective low-carbon solutions are routinely implemented to inform design, maintenance and construction of dwellings and non-residential buildings from 2030.



Programme leader

Casimir MacGregor

casimir.macgregor@branz.co.nz



If you would like to know more, please visit our website
www.branz.co.nz/environment-zero-carbon-research/transition

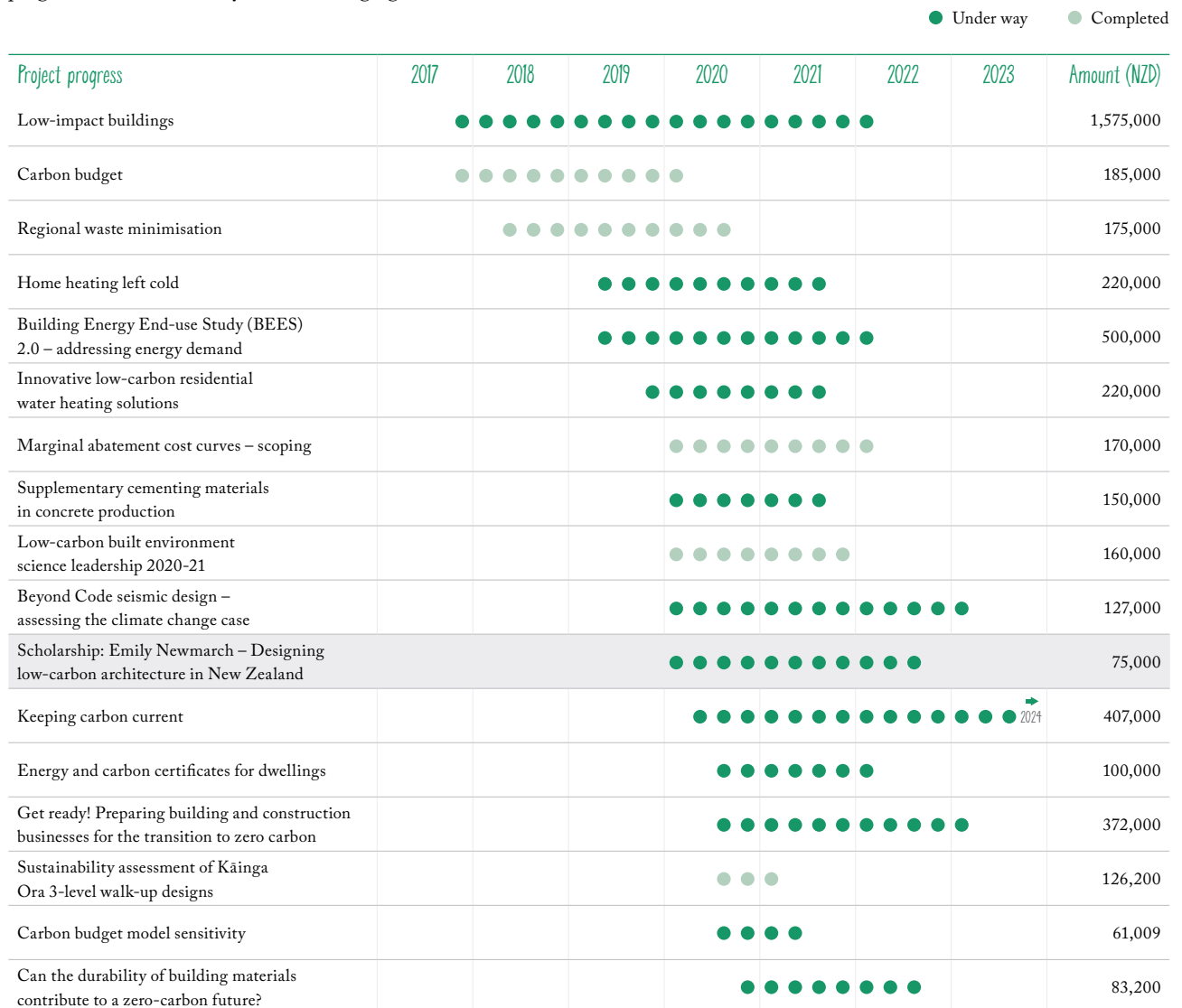
If you wish to get involved, contact the programme team: zerocarbon@branz.co.nz

The programme is supported by a Programme Advisory Group with representatives from:

- ▶ BECA
- ▶ Building Better Homes, Towns and Cities National Science Challenge
- ▶ Christchurch City Council
- ▶ The Deep South National Science Challenge
- ▶ Fonterra
- ▶ Kāinga Ora
- ▶ Massey University
- ▶ Naylor Love
- ▶ Scion
- ▶ University of Otago
- ▶ Victoria University of Wellington
- ▶ Warren and Mahoney Architects

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.



● Under way ● Completed

<i>Project progress</i>	2017	2018	2019	2020	2021	2022	2023	Amount (NZD)
Towards a New Zealand building stock model – scoping				● ● ● ● ● ● ● ●	● ● ● ● ● ● ● ●			170,000
Bio-based materials – New Zealand wood fibre insulation – proof of concept				● ● ● ● ● ● ● ● ● ●	● ● ● ● ● ● ● ● ● ●			262,000
Housing stock strategies for meeting New Zealand’s 2050 carbon target				● ● ● ● ● ● ● ● ● ●	● ● ● ● ● ● ● ● ● ●			187,600
Zero-carbon built environment science leadership 2021–24				● ● ● ● ● ● ● ● ● ●	● ● ● ● ● ● ● ● ● ●	● ● ● ● ● ● ● ● ● ●	→ 2024	343,200
Measuring our sustainability progress – second update				● ● ● ● ● ● ● ● ● ●	● ● ● ● ● ● ● ● ● ●	● ● ● ● ● ● ● ● ● ●		177,500
Marginal abatement cost curves (MACCs) – phase 2				● ● ● ● ● ● ● ● ● ●	● ● ● ● ● ● ● ● ● ●	● ● ● ● ● ● ● ● ● ●		321,800
Future of work – what do we need to know to transition to zero carbon				● ● ● ● ● ● ● ● ● ●	● ● ● ● ● ● ● ● ● ●	● ● ● ● ● ● ● ● ● ●	→ 2024	792,200
Seismic design and retrofit of hillside houses				● ● ● ● ● ● ● ● ● ●	● ● ● ● ● ● ● ● ● ●	● ● ● ● ● ● ● ● ● ●	→ 2024	694,000
Roadmap for evaluating building performance for low-carbon houses				● ● ● ● ● ● ● ● ● ●				109,600
Building capability to help transition industry to zero carbon				● ● ● ● ● ● ● ● ● ●				95,000
Scholarship: Rosa Gonzalez – Carbon case for resilient design				● ● ● ● ● ● ● ● ● ●	● ● ● ● ● ● ● ● ● ●	● ● ● ● ● ● ● ● ● ●	→ 2024	75,000
Next-generation carbon footprinting tools – scoping				● ● ● ● ● ● ● ● ● ●				153,800
Is the Code fit for a changing climate?				● ● ● ● ● ● ● ● ● ●				174,800
TOTAL								\$8,262,909

Towards a New Zealand building stock model – scoping

How many non-residential buildings do we have in New Zealand? How many homes in New Zealand can have their underfloor insulation easily upgraded? How many rental properties will be built in 2030?

At present, despite many sources of good data in New Zealand, we don't have a comprehensive physical description of the buildings as well as details of how different occupants use them.

This research aims to address this critical issue by scoping what a possible national building stock model could look like for New Zealand. It is an opportunity to look at useful information to gather on buildings, what format, who gathers it and to identify where there are gaps in knowledge.

By examining international examples while understanding New Zealand's unique characteristics, the research aims to trial a potential national building stock model that will meet New Zealand's needs. This data-intensive model would consider variations such as building types, climate locations, occupancy patterns, heating levels and insulation levels. Information could be used to understand the energy and resource consumption or track the collective impacts of building performance improvements. This model would enable stakeholders to have greater understanding of the economic, social and environmental impacts of New Zealand's buildings and how different occupants use them.

Levy investment	\$170,000
Timeframe	December 2020 – May 2022
Contact	Andrew Pollard andrew.pollard@branz.co.nz
Lead organisation	BRANZ Ltd

Seismic design and retrofit of hillside houses

Hillside houses represent a significant proportion of New Zealand's built environment, particularly in areas where sloping sites are prolific such as Wellington. However, little research has been undertaken to study seismic performance of hillside houses.

House damage surveys after the Canterbury earthquakes revealed that hillside houses are much more vulnerable than houses on non-liquefiable flat sites.

This research will study the seismic performance of subfloor bracing systems in new and existing hillside houses to help build climate and seismic resilience into our housing stock. It will consider interdependencies to address the engineering issues and the associated economic and environmental benefits and factor in solutions to support the government's zero-carbon goal. This will provide the basis for guidance on the design of subfloor framing systems in new hillside houses. It will also be used for seismic assessment and retrofit of the subfloor systems in existing hillside houses.

The guidance will help owners, building practitioners and regulators to make informed decisions about the designs (new build) and retrofits (existing) of hillside houses to reduce the vulnerability of these buildings.

Levy investment	\$694,000
Timeframe	December 2020 – June 2024
Contact	Angela Liu angela.liu@branz.co.nz
Lead organisation	BRANZ Ltd



Bio-based materials – New Zealand wood fibre insulation

Future building products will need to address the carbon footprint of new buildings including the greenhouse gas emissions that arise from both operational (energy and water use) and embodied sources (materials). Bio-based materials are likely to become increasingly important in a shift to a zero-carbon built environment.

This is a collaborative research project between BRANZ and Scion. The research will test whether a New Zealand radiata pine wood fibre insulation can be made and, if so, what its performance in New Zealand houses would look like.

Scion is developing proof of concept samples of wood fibre insulation products made with New Zealand grown radiata pine. These are envisaged to comprise batt, rigid board and loose-fill options. BRANZ will provide expertise and facilities to assess potential risks of using such a material in New Zealand construction.

The insulation will be tested to determine whether sufficient thermal properties can be achieved. The research will explore risks typical to New Zealand construction – moisture, fire, stability and durability – and possible mitigations. It will identify what, if any, changes may be necessary to the way we design, detail and build our houses to accommodate use of this material and mitigate any identified risks.

Levy investment	\$262,200
Timeframe	December 2020 – March 2023
Contact	David Dowdell david.dowdell@branz.co.nz
Lead organisation	BRANZ Ltd and Scion



PhD scholarship: Rosa Gonzalez Carbon case for resilient design

The demolition of large parts of central Christchurch after the 2011 earthquake made a strong socio-economic case for rebuilding with resilient buildings designed above the acceptable seismic standard. There are significant environmental costs in demolishing structures before the end of their design life associated with demolition waste as well as extensive carbon costs associated with reconstruction.

Rosa’s PhD research compares the life cycle environmental impacts of baseline buildings designed to current standards with above-code buildings that are designed for a higher seismic performance. She will consider seismic risk on buildings that are designed lean. These may sustain more damage in large seismic events, which has significant environmental impacts. The results will be compared to resilient buildings where the higher upfront carbon costs may be offset by limited damage following large seismic events.

Rosa’s research will provide valuable insight into the carbon cost of designing seismically resilient buildings. It can provide policy makers and stakeholders with evidence-based environmental incentives for designing structures in New Zealand for higher seismic performance.

Timeframe	April 2021 – January 2024
Contact	researchinvestment@branz.org.nz
Tertiary institute	University of Auckland

Measuring our sustainability progress – second update

In New Zealand, sustainability is one of four purposes of the Building Act 2004, where “buildings are designed, constructed, and able to be used in ways that promote sustainable development”. This project is the second update of a longitudinal study, initiated in 2012, to examine a range of sustainability-related impacts of recently consented housing being added to New Zealand’s building stock.

This research summarises information from a diverse superset of robust resources to provide a snapshot of New Zealand’s housing performance, industry readiness and governance initiatives relating to environmental, economic and social sustainability. It looks at newly consented houses in 2020 and measures a range of sustainability-related factors including carbon, water, indoor environment, functional resilience, affordability, consumer demand, industry capacity and government policy.

The metrics will be useful for policy documents, guidelines, strategic decision making, educational information and those with an interest in exceeding the minimum standards required by the New Zealand Building Code. The findings will provide insight into some of the fundamental challenges we are facing as a nation, such as climate change, energy hardship, cost of first-home ownership and an ageing demographic. The study has been designed to be updated every 4 years.

Levy investment	\$177,500
Timeframe	December 2020 – April 2023
Contact	Roman Jaques roman.jaques@branz.co.nz
Lead organisation	BRANZ Ltd

Housing stock strategies for meeting New Zealand's 2050 carbon target

The building and construction sector currently accounts for around 20% of New Zealand's carbon emissions through the energy and materials used in buildings. This research supports MBIE's Building for Climate Change programme, which delivers central government's Emissions Reduction Plan.

The research uses BRANZ's existing building stock model and residential building carbon footprint data to test different possible decarbonising strategies that could be implemented in existing houses, new houses or both. It will estimate the potential greenhouse gas savings that could be achieved with these strategies compared to business as usual, which means taking no climate action. The evaluation will consider potential embodied carbon costs (i.e. in building materials) as well as ongoing operational carbon benefits. The research will also consider emissions that occur overseas – for example, due to manufacture and transport of construction materials that are imported to New Zealand.

The research findings will be used to support policy that determines by how much our housing stock must shrink its carbon footprint to achieve New Zealand's goal of being zero-carbon by 2050. This will be based on specific operational/embodied carbon trade-offs. They will also provide a broader context to help inform government thinking.

Levy investment	\$187,600
Timeframe	December 2020 – April 2022
Contact	Roman Jaques roman.jaques@branz.co.nz
Lead organisation	BRANZ Ltd

Can the durability of building materials contribute to a zero-carbon future?

Materials used to create buildings play a significant role to in mitigating climate change through reducing emissions and improving climate resilience.

This scoping research considers the long-term sustainability of building materials from 2050 and beyond in the context of climate change. It asks, "How will building materials perform in climate change environments over the whole of their life cycles?" It considers what future New Zealand building environments could look like and explores the adoption of new materials, design strategies and the changes in building typologies. It also asks, "How durable can building materials be in a future environment impacted by climate change?"

The research will explore how to encourage material science innovation that balances durability and reducing embodied carbon of our existing and new building stock. The aim is to help develop complete carbon emission profiles and durability criteria for materials that have solutions that can significantly decarbonise new and existing buildings.

A research strategy roadmap will be developed collaboratively with researchers, industry and government to help develop materials that are durable, low in embodied carbon and with acceptable performance solutions.

Levy investment	\$83,200
Timeframe	December 2020 – September 2022
Contact	Zhengwei Li zhengwei.li@branz.co.nz
Lead organisation	BRANZ Ltd



Next-generation carbon footprinting tools – scoping

As part of MBIE’s Building for Climate Change programme for carbon reduction in New Zealand houses, the Ministry plans to incorporate greenhouse gas emission reporting into the building consent process. Carbon footprinting is likely to become part of business as usual in assessing performance of buildings in the future.

Currently, residential performance covers several largely separate issues such as thermal performance, energy efficiency, embodied and operational carbon as well as moisture risk. These could be brought together and evaluated in a coherent manner that aligns with design and consenting workflows.

This research will review what tools are currently available to building designers and explore how they can be used to develop more-integrated assessment methods. A pilot study will then bring together data sources used for carbon footprinting and explore whether they can be accessed in an

online environment by different web-based tools. The pilot study will consider data format, metadata confidentiality and the ongoing ability to update and maintain data. It will also test if the tools are user friendly for end users, their ease of use and integration with workflows.

In the short term, these tools will provide important steps towards achieving a more integrated, consistent solution for simulating building performance in New Zealand.

Levy investment	\$153,800
Timeframe	April 2021 – March 2022
Contact	Jarred Butler jarred.butler@branz.co.nz
Lead organisation	BRANZ Ltd

Marginal abatement cost curves (MACCs) – phase 2

Marginal abatement cost curves (MACCs) are graphs that capture the relative financial cost or saving associated with options to reduce greenhouse gas emissions. Put simply, MACCs illustrate the cheapest way to cut carbon.

A number of factors impact the carbon content and emissions from dwellings. This includes our choices in building products used – for example, for roof insulation, walls, floors and glazing. MACCs show the amount of emissions that could be avoided by each option over a set timeframe.

This research builds on Phase 1 MACC research which looked at the likely parameters, methodology, data inputs and outputs needed to construct MACCs for the building and construction industry in New Zealand. A collaborative research effort with stakeholder agencies such as MBIE and Kāinga Ora produced a limited series of experimental MACCs informed by New Zealand-specific datasets.

The MACCs phase 2 research aims to refine BRANZ’s methodology and produce a complete series of MACCs for the residential construction industry and will capitalise on the capability gains made during phase 1. The research will enable the industry to identify, prioritise and action abatement measures to meet the 2050 emissions target. Findings from the MACCs research could also be applied to interventions aimed at improving the environmental performance of the existing residential stock.

Levy investment	\$321,800
Timeframe	December 2020 – March 2023
Contact	Daniel Du Plessis daniel.duplessis@branz.co.nz
Lead organisation	BRANZ Ltd



Is the Code fit for a changing climate?

New Zealand is increasingly focusing on actions required to address and prepare for climate change. In the building industry, significant effort in recent years has been towards measures to support the necessary shift to low-carbon buildings. In addition to this, building performance needs to be able to accommodate the changing climate and different weather events.

This pilot research is looking at whether current design and construction practices for light timber-framed buildings can stand up to the likely effects of climate change. Adapting buildings to the effects of climate change is a broad field. There are many facets of construction and buildings that will need to be considered. The focus of this initial work is on increased wind loadings caused by more frequent and stronger weather events.

The project will also provide a methodology that can be applied to other parts of the building system. Findings from the project will feed into the revision of the Building Code standard for timber-framed buildings, NZS 3604. This will help inform where effort should be focused to make New Zealand’s buildings more resilient to climate change.

Levy investment	\$174,800
Timeframe	April 2021 – January 2022
Contact	Nick Locke nick.locke@wsp.com
Lead organisation	WSP New Zealand Ltd

Roadmap for evaluating building performance for low-carbon houses

Buildings need to be warm, dry, healthy and low carbon, but there is currently no consistent, integrated New Zealand-based online solution to evaluate whether designs will meet these performance requirements. In addition, the metrics for performance may change as New Zealand works towards meeting its zero-carbon emissions targets.

Currently, the multiple tools available to measure performance have varying scopes, methodologies, purposes, underlying data and outputs, which leads to inconsistency, inaccuracies and confusion.

This research will scope industry requirements and explore a web-based, accessible, integrated solution that draws on existing tools and data. Several issues such as thermal performance, energy efficiency, embodied and operational carbon and moisture risk may be brought together in a coherent digital solution that aligns with design and consenting workflows. The aim is to co-design a collective roadmap for evaluating building performance. Working with key stakeholder groups to co-design a vision is essential to a systems approach to possible solutions.

The research will establish a scope, methodology, process and timeframe for assessing the performance of residential dwellings during the design phase and for the purpose of gaining building consent. Ultimately, this will support the shift to warm, dry, healthy, zero-carbon new houses.

Levy investment	\$109,600
Timeframe	February 2021 – December 2021
Contact	Jonquil Brooks jonquil.brooks@branz.co.nz
Lead organisation	BRANZ Ltd

Building capability to help the construction industry transition to zero carbon

Transforming the industry to deliver zero-carbon buildings will require a paradigm shift in building and construction industry thinking. This includes processes, products, technology and people. One of the main ways of enabling the transformation of the industry is through education of the next generation of construction professionals.

This project provides funding into a wider initiative to develop a Massey University professional master's degree with a concentration on climate, energy and building performance. It supports between 5-10 master's students enrolled in the School of Built Environment at Massey University to undertake short-term research projects on climate change. Students will undertake industry-relevant projects, and the matching of students to projects will be overseen by an advisory group comprising Massey, BRANZ and industry members.

Educating the industry and future industry leaders is one of the key aims of this research initiative. Ultimately, students who graduate are knowledgeable, enthusiastic and trained in the application of the zero-carbon agenda. In the short term, a network of trained professionals will be developed whose work will ultimately lead to a change in design and building practice.

Levy investment	\$95,000
Timeframe	March 2021 – December 2021
Contact	Niluka Domingo n.d.domingo@massey.ac.nz
Lead organisation	Massey University



Future of work – what do we need to know?

This project has been co-created with key stakeholders such as the Climate Change Commission, MBIE and the Ministry of Housing and Urban Development.

What expertise is required of tradespeople and professionals to design and construct a zero-carbon building? At present, this is unknown. Many New Zealand industry and government plans and initiatives have not considered the knowledge, skills and competencies needed to address climate change and deliver zero-carbon buildings across their life cycle.

This research will consider the future of work within the building and construction industry. It will provide guidance on critical areas needed to meet our 2050 carbon-reduction targets: designing for zero carbon, building for zero-carbon and refurbishing buildings that are zero carbon.

The aim is to support the industry to develop solutions to systemic building and construction issues and to influence changes to behavioural norms. It will outline the expertise, knowledge and competencies the industry requires to transition to a net-zero carbon economy. It will also identify barriers to developing and deploying expertise across the industry.

Levy investment	\$792,200
Timeframe	December 2020 – April 2024
Contact	Casimir MacGregor casimir.macgregor@branz.co.nz
Lead organisation	BRANZ Ltd

Warmer, drier, healthier homes



The *Warmer, drier, healthier homes* research programme was established to understand and solve issues that prevent our homes from being warm, dry and healthy. Since our health and wellbeing can be significantly impacted by the unhealthy environments created in some of our homes, this research programme aims to help provide better homes for New Zealanders.

What we're doing

Over the last year, there has been growing interest in housing research and its impact to address the ongoing concerns about the condition of New Zealand's housing. This focus has given BRANZ the opportunity to align with other similar housing initiatives involving the industry, government, key stakeholders and other research providers.

Some of the findings from the programme to date played a significant role in shaping new tenancy laws, providing impartial evidence to help MBIE and the Ministry of Housing and Urban Development. This has included influencing changes to the Residential Tenancies Act and the healthy homes standards for heating, insulation, ventilation, drainage and moisture ingress.

The *Warmer, drier, healthier homes* programme along with the *Transition to a zero-carbon built environment* programme supports MBIE's Building for Climate Change programme to make differences that have a lasting impact. Collaboration with other

organisations and strengthening these working relationships are substantial to the success of all BRANZ programmes.

A recent review of the *Warmer, drier, healthier homes* programme also identified some knowledge gaps and areas of research focus for the next few years to complement our current research direction.

Addressing indoor environment issues and optimising indoor climates remains a key focus to ongoing performance improvements within our homes. Projects include the current Household Energy End-use Project (HEEP2), which aims to provide an up-to-date picture of how, where, when and why energy is used in New Zealand homes. Other projects are looking at gaining a better understanding of and ways to improve indoor air quality (IAQ) to address the increasing global evidence on the effects of IAQ on occupant health.

Research on improving the building envelope performance is aimed at acquiring a better understanding of retrofit insulation issues and providing solutions and guidance. Other building envelope research will also look at ways to facilitate the adoption of more thermally efficient building envelopes.

Developing performance and quality measures involves looking at how we can help create accepted residential building performance measurement methodologies that are used more widely by the industry. The aim is that New Zealanders gain a better understanding of the performance and quality of their home throughout its lifetime and can make better-informed decisions.

We will continue to ensure our research findings help specific audiences to not only improve their knowledge and understanding of the benefits but to have practical application. The output from this programme of research aims to enable lasting change and complement findings from the *Transition to a zero-carbon built environment* programme. We aim to provide insights and solutions to ensure New Zealand's housing stock is delivering healthy and comfortable homes that are resilient to the impacts of climate change.

An outline of current and recent research under way within the programme is shown in the timeline on the next page.

Programme objectives

The programme aims to develop the technical solutions for new buildings and a move towards higher-performing construction types, as well as deeper retrofits to existing buildings by:

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



Programme leader

Mark Jones

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If you would like to know more, please visit our website
www.branz.co.nz/healthy-homes-research

The programme is supported by a Programme Advisory Group with representatives from:

- ▶ Beacon Pathway
 - ▶ Bob Burnett Architecture
 - ▶ Christchurch City Council
 - ▶ CRESA
 - ▶ Energy Efficiency and Conservation Authority
 - ▶ Kāinga Ora
 - ▶ He Kainga Oranga, University of Otago
 - ▶ Lifemark
 - ▶ MBIE
 - ▶ New Zealand Green Building Council
 - ▶ Passive House Institute of New Zealand
 - ▶ ProClima
 - ▶ Scion
 - ▶ Wellington Regional Healthy Housing Group
-



Photo: PHINZ

Transition to high-performing buildings

This project aims to address several key knowledge gaps within the *Warmer, drier, healthier homes* research programme. It aims to provide solutions to ensure our housing stock delivers healthy and comfortable homes for all New Zealanders – homes that are durable and resilient to the impacts of climate change.

This project takes a holistic approach to develop higher-performance technical solutions for both new buildings and deeper retrofits to existing buildings. BRANZ will work with industry, other researchers and key stakeholders such as Kāinga Ora to co-design building and retrofit solutions on several priority issues.

The research will look at indoor environment issues, specifically heating and ventilation, the implications of changes in heating behaviour and the increased risk of overheating. It will consider household energy use and provide technical guidance for cost-effective, low-carbon solutions for new builds and retrofits. Research on building envelopes will focus on warm roof design solutions and how to increase thermal efficiency and reduce moisture failures.

The research will also consider occupant behaviour and comfort as buildings do not operate in isolation – they impact on and are driven by the people who occupy them.

Combining these priorities under one project ensures connectivity, encourages a systems perspective and provides flexibility to address issues as they emerge. The findings will use evidence from case studies to provide solutions for the rest of industry on how to raise building performance for low-carbon houses.

Levy investment	\$1,639,300
Timeframe	November 2021 – March 2025
Contact	Stephan Rupp stephan.rupp@branz.co.nz
Lead organisation	BRANZ Ltd

House insulation guide

MBIE is planning to update New Zealand Building Code clause H1 *Energy efficiency* and to introduce measures to meet New Zealand's emissions targets under the Climate Change Response (Zero-Carbon) Amendment Act 2019.

The current BRANZ *House insulation guide* will need to include information and additional construction types that reflect these changes.

This project will update the BRANZ *House insulation guide* to provide designers with higher-performance construction types that will exceed the minimum requirements. The revised guide will also provide guidance to the industry on ways to improve thermal performance in walls, floors and roofs beyond the minimum Code compliance requirements.

The revisions will include thermal performance data for higher-performance construction types and different climate zones and modelling of increased framing ratios (and increased thermal bridging/decreased thermal performance). It will also include updates to the thermal performance of windows and glazing to revise and correct errors in Appendix C of NZS 4218:2009.

As a large proportion of designers use the schedule method for compliance with clause H1, the BRANZ *House insulation guide* will play an important role in leading and encouraging higher-performance construction types. The revised guide is scheduled for release in the first half of 2022 in order to capture the changes that MBIE is making to clause H1 *Energy efficiency*.

Levy investment	\$160,000
Timeframe	March 2021 – March 2022
Contact	Jonquil Brooks jonquil.brooks@branz.co.nz
Lead organisation	BRANZ Ltd

Preservative-treated timber outgassing

With growing emphasis on low-carbon construction, it is likely that New Zealand will experience a substantial increase in the use of timber as a material of choice in the future. All timber products are susceptible to the damaging effects of weathering and fungal attack.

Climate change projections suggest that these timber degradation hazards will only intensify. Preservative treatments aim to eliminate or minimise such damage.

This research aims to assess if there is a linkage between timber preservatives, indoor air quality and human health. This is timely as the timber industry looks towards using more eco-friendly alternatives to traditional wood preservatives. One example is the growing interest in micronised copper azole (MCA) as a replacement for chromated copper arsenate (CCA). While widely used in New Zealand, CCA is being phased out or is already banned elsewhere in the world due to toxicity concerns.

The research will focus on the potential for outgassing – the release of trapped gasses – from current and emerging timber treatments in New Zealand for both solid timber and engineered wood products. The environmental conditions under which any outgassing occurs can then be assessed in terms of indoor air quality. This will provide reassurance that no unforeseen consequences will emerge from increased use of preservative-treated wood in the future.

Levy investment	\$599,000
Timeframe	August 2021 – November 2023
Contact	Catherine Nicholson catherine.nicholson@branz.co.nz
Lead organisation	BRANZ Ltd

Building fire-safe densified housing

New Zealand is in the process of densifying residential areas to meet housing needs. Maintaining acceptable fire safety requires active management and more technical solutions as people live closer together. As more buildings requiring these solutions are built, gaps in regulatory controls and knowledge are exposed. The *Building fire-safe densified housing* programme was developed to investigate these gaps and propose solutions to address them. It looks at the fire safety compliance pathways for densified housing and ways to improve the fire safety provisions in the New Zealand Building Code.

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.

What we’re doing

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, Building Consent Authorities and Fire and Emergency New Zealand. Other users include MBIE Building System Performance, which is responsible for Code and compliance documents to support cost-effective and fire-safe solutions for densified housing.



An outline of current and recent research under way within the programme is shown in the timeline on the next page.

Programme objectives

Key objectives of the programme are:

- densified housing fire separations and structures 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, and egress is not a barrier to densified housing building users.



Programme leader

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If you would like to know more, please visit our website
www.branz.co.nz/fire-research

The programme is supported by a Programme Advisory Group with representatives from:

- ▶ Auckland Council
 - ▶ Australian Building Codes Board
 - ▶ Building Enclosure Council New Zealand
 - ▶ Fire and Emergency New Zealand
 - ▶ Fire Research Group
 - ▶ Institution of Fire Engineers
 - ▶ Local Government New Zealand
 - ▶ MBIE Building System Performance Group
 - ▶ Meacham Associates
 - ▶ Society of Fire Protection Engineers (NZ chapter)
 - ▶ Wood Processors and Manufacturers Association
-

Risk-informed fire resistance requirements for tall residential buildings

The New Zealand Building Code *Protection from fire* compliance documents set very low fire resistance requirements for some residential buildings, especially when compared with similar international jurisdictions.

The low ratings mean there is a higher risk of unacceptable fire performance given the same severity of fire occurring in New Zealand residential buildings relative to other countries. This issue particularly affects taller multi-unit residential buildings compared to other countries with similar building control regimes.

At present, buildings above 20 storeys are outside the scope of the *Protection from fire* Acceptable Solutions and Verification Method. That means designers have to justify fire resistance for buildings above 20 storeys using alternative methods. This research provides objective analysis, based on reliability considerations, for the amount of fire resistance needed in multi-storey residential buildings, taking into account the fuel loads and presence of fire sprinklers.

The research will ensure required fire resistance ratings are sufficient to withstand burnout of a severe design fire by estimating the probability of a real fire exceeding the design severity. The findings will inform discussions regarding the scope and level of fire resistance required by the Building Code in compliance documents as well as giving guidance to designers.

Levy investment	\$140,600
Timeframe	September 2020 – December 2021
Contact	Colleen Wade colleen.wade@fireresearchgroup.com
Lead organisation	Fire Research Group

Streamlined compliance through generic product specifications – scoping

Current New Zealand fire separation compliance pathways rely on proprietary solutions provided by product manufacturers. Evidence of problems in real buildings has shown that this approach has made it difficult for designers, builders and inspectors to clearly demonstrate fire separation compliance.

The learning curve is especially difficult for those transitioning from delivering single family homes that do not require fire separations to delivering multi-unit buildings. This can result in confusion, wasted time and effort, delays during both consenting and construction, expensive rework and potentially unsafe buildings.

This research investigates the feasibility of implementing a generic solution approach for fire separation construction details applicable to low to mid-rise residential buildings. These details will also address other objectives such as structural, acoustic and environmental performance. The research will investigate similar approaches in other countries to learn what may or may not be feasible in the New Zealand context. Engagement with key stakeholders and potential new entrants to the market will be undertaken to understand the impact and consequences of introducing a generic solution approach for these types of construction details.

Levy investment	\$281,500
Timeframe	September 2020 – December 2021
Contact	Nick Appleton Nick.appleton@branz.co.nz
Lead organisation	BRANZ Ltd

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 practices to address common quality issues in building.

What we're doing

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

This programme builds 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 available, 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 continues to investigate the key interactions between clients and the industry. This will be achieved through understanding the key decision-making points in the construction process and understanding the role of design management in build quality.

An outline of current and recent research under way within the programme is shown in the timeline on the next page.

Programme objectives

The key objectives of the programme are that 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

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If you would like to know more, please visit our website
www.branz.co.nz/social-economics-industry-research/eqi

The programme is supported by a Programme Advisory Group with representatives from:

- ▶ Auckland University of Technology
- ▶ Building Consultants Ltd
- ▶ Construction Clients' Group
- ▶ Home Owners and Buyers Association Inc. (HOBANZ)
- ▶ Kāinga Ora
- ▶ MBIE
- ▶ New Zealand Certified Builders Association
- ▶ Realsure
- ▶ Registered Master Builders Association
- ▶ Specialist Trade Contractors Association

How do clients choose a quality builder?

Choosing the right builder can play a large role in determining how smoothly a build will run and the quality of build once construction is completed. Clients often report regret in their choice of builder, largely citing poor-quality building as a reason.

Clients are often unable to differentiate the quality of different builders and therefore concentrate on the lowest quoted price. As a result, high-quality builders are losing work to lower-tendering builders who underquote and make up the difference on variations or by taking shortcuts. Clients report that they have little understanding of the subcontracting model of the industry and often do not have the skills or tools to assess quality of builders before signing a contract.

This research will review current literature and pre-build advice and will undertake surveys and key informant interviews. It aims to assist clients to better ascertain the quality of their builder prior to signing a contract. It also aims to help builders communicate different levels of build quality to potential clients.

This research aims to improve the understanding of clients by mapping the decision-making process and identifying any key decision points before they sign their contract. It will engage with industry stakeholders in the residential building sector on the best ways to disseminate findings to industry. While this project is primarily aimed at residential builders and residential new-build clients, findings could also be useful for the entire building sector.



New House Owner's Satisfaction Survey

The BRANZ New House Owner's Satisfaction Survey (NHOSS) is a longitudinal study to provide ongoing trend data and information on new builds. BRANZ obtains information from people who have recently gone through the new-build experience. The current survey is primarily interested in how well the builder has performed (according to the client).

The NHOSS has been running for 10 years, and the survey is one of the few datasets available to inform the industry, government and researchers on the performance of new residential builders. This survey builds on information from the previous studies (2016–2020) and provides valuable time series information to compare industry performance to construction workloads. It is one of the few ways where information about how the industry is viewed and spoken about is available.

Data from the survey is regularly used to inform and prioritise BRANZ research. The survey provides insights into what the industry is doing well and where there is room for improvement. It is used to support industry in tracking how and where improvements can be made in the quality of both the experience and finished product of residential new builds.

Levy investment	\$130,100
Timeframe	December 2020 – March 2022
Contact	Orin Lockyer orin.lockyer@branz.co.nz
Lead organisation	BRANZ Ltd

Levy investment	\$211,800
Timeframe	December 2020 – March 2025
Contact	Orin Lockyer orin.lockyer@branz.co.nz
Lead organisation	BRANZ Ltd



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 the Building Research Levy in stand-alone research projects.

The BRANZ portfolio comprises of programmes of work and stand-alone projects. Stand-alone projects address discrete industry issues.

This section features newly funded projects, organised by the key areas by which BRANZ undertakes its research – see 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

A full list of all stand-alone projects under way in 2021/22, including those continuing from previous years, is shown on pages 52-55.

Thermal envelope modelling input

Quality and performance of homes/buildings

MBIE and BRANZ have co-funded a technical study to support the policy review of residential insulation requirements of the New Zealand Building Code Acceptable Solution H1/AS1. The policy review looks to increase R-values for wall, roof, floor and window thermal envelope requirements and improve performance of homes.

The aim of this research is to provide MBIE with information to help it propose and consult on a set of new insulation requirements for each climate zone in New Zealand. The research will provide a detailed and accurate picture of the costs and benefits of each proposed thermal envelope requirement compared with the current minimum settings.

This research covers three key aspects: thermal, financial and carbon implications. Four representative residential building typologies will be examined in detail – single stand-alone houses, 2-storey detached, medium-density and apartments. An assessment will be carried out at the individual building level for the next 50 years, examining the financial, carbon and comfort implications.

The findings will provide evidence for changes to insulation requirements for residential new builds, which will improve the overall building performance as well as the health, safety and wellbeing of inhabitants.

Levy investment	\$35,000
Timeframe	March 2021 – July 2022
Contact	Roman Jaques roman.jaques@branz.co.nz
Lead organisation	BRANZ Ltd

Designers' tool kit for light steel framing for better performance

 Quality and performance of homes/buildings

This project supported the National Association of Steel Framed Housing (NASH) to scope a research and development programme for light steel-framed buildings.

The project identified gaps and research opportunities in several key areas. This included seismic and bracing; fire, acoustics and inter-tenancy solutions; thermal performance; design for off-site manufacture, including hybrid systems and adoption of technology; and building for climate change.

NASH will now draft the first steps of its research and development programme by prioritising research questions.

The programme is intended to be collaborative in nature and designed to partner with the wider research community and the industry. This will ensure that further work aligns closely with forthcoming regulatory changes and informs existing research programmes. In partnering with builders and developers, NASH will trial learnings from this project in actual projects and measure success.

Levy investment	\$36,300
Timeframe	October 2020 – January 2021
Contact	Nick Collins gm@nashnz.org.nz
Lead organisation	National Association Steel Framed Housing



Future landlords

 Meeting New Zealand's population needs

New Zealand, in contrast to most developed countries, has experienced a long-term decrease in homeownership rates. Should this pattern continue, the proportionate increase in demand for residential rental accommodation could increase pressure on landlords to supply good-quality long-term rental accommodation.

However, increased scrutiny, regulation and compliance cost and the removal of some of the related financial benefits have made residential rental accommodation less attractive to landlords.

This research focuses on the current and future demand and supply-side dynamics governing the residential rental market. It explores historical and current homeownership and rental patterns with a view to identify the likely drivers and operating environment for landlords in the future.

This research aims to understand the long-term operating environment (market) for landlords from a longitudinal system perspective rather than being driven by current issues and medium-term challenges. It will build on the results of the third Rental Sector Survey that is being undertaken by Massey University.

The findings can support the industry to adopt a more proactive response to future demand for rental accommodation and social housing. They could also encourage the industry to consider environmental, wellbeing, living standards and quality-of-life metrics.

Levy investment	\$320,800
Timeframe	December 2020 – April 2023
Contact	Daniel Du Plessis daniel.duplessis@branz.co.nz
Lead organisation	BRANZ Ltd



Building for wellbeing



Vibrant industry

Currently, many building sector measures are based on quantitative outputs – for example, the number of houses consented and measurable performance factors such as light, humidity and temperature. A limitation of these measures is that they do not consider end-user outcomes or the lived experience of the building inhabitants or the community.

Past research on post-occupancy evaluations (POE) suggests that the subjective experiences of building occupants are being overlooked in favour of a checklist assessment of physical components and features.

This research aims to address government wellbeing objectives, which require a more qualitative approach. It will measure the liveability or wellbeing performance of buildings by considering the impact on quality of life for occupants. The research will develop and test a digital POE designed to efficiently capture the perspectives of the people living in a building about its wellbeing performance. A method will be devised to collate and analyse qualitative data to help inform the ongoing planning, design and construction of buildings that meet the wellbeing needs of New Zealanders. The POE assessment tool will be tested on a limited number of case study sites within homes.

This is a research collaboration with Auckland University of Technology and Kāinga Ora. It will allow a better understanding on how qualitative data can provide insights to housing performance.

Levy investment	\$819,000
Timeframe	December 2020 – March 2025
Contact	Michael Nuth michael.nuth@branz.co.nz
Lead organisation	BRANZ Ltd

Targeted suicide prevention activities and impact



Previous research commissioned by MATES in Construction to understand suicide by those working in the construction industry revealed a discrepancy in the previously reported number of deaths by suicide.

Initial analysis of the data from several sources suggests that previously reported suicide numbers may undercount the true prevalence of suicide in the New Zealand construction industry. This is due to a number of complex data quality and data access reasons.

The research aims to clarify the true prevalence of suicide in the construction industry and calculate the construction industry's suicide rate. Initially, it will review and define the scope of the construction industry in New Zealand. It will then examine coroner's findings to identify demographic and other factors within the industry that may contribute to or explain the higher suicide rate compared with other industries.

This work is essential to inform targeted suicide prevention efforts by the industry and provide baseline and trend data for measuring the effectiveness of these interventions.

Levy investment	\$132,059
Timeframe	September 2020 – June 2021
Contact	Victoria McArthur vmcarthur@mates.net.nz
Lead organisation	MATES in Construction

ArchEngBuild 2021



Now in its ninth year, ArchEngBuild brings together New Zealand's future industry leaders. Thirty of the country's best architecture, engineering, and construction management students take part in this intensive 3-day competition. They work together to deliver a concept design in response to a project brief.

The project brief addresses issues faced by industry and allows the students to come up with creative and innovative solutions. Students utilise their existing knowledge and draw on professional advice and resources made available to them at the event.

During their studies, these students don't usually get the chance to work with other disciplines. ArchEngBuild gives the students a unique opportunity to work as a team on a concept design. The creativity and innovation the students bring always impresses the ArchEngBuild judges. Seeing how their teammates think and make decisions has made a real difference in past participants' work lives.

Levy investment	\$70,000
Timeframe	June 2021 – October 2021
Contact	archengbuild@branz.co.nz
Project manager	Concrete NZ

"It was eye opening seeing how different disciplines work and what aspects they are considering, I thoroughly enjoyed coming up with innovative ideas."

Engineering student, University of Auckland

Scholarships

Each year, BRANZ makes funding 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 are early-stage researchers pursuing innovative projects can apply for scholarships of up to \$25,000 per year. Master's scholarships are also considered for 1-year projects, and PhD scholarships are for up to 3 years.

Five new scholarships feature in this Levy in Action. One of these contributes to the *Transition to a zero-carbon built environment* research programme and is featured on page 21. A full list of all scholarship projects under way in 2021/22, including those continuing from previous years, is shown on page 54.



Griffin Cherrill Internal moisture from thermal bridges

 Quality and performance of homes/buildings

Condensation and mould growth on internal surfaces can damage building elements. Current tools to assess the risk of internal moisture from thermal bridges accurately require large amounts of time and experience while simpler tools contain simplifications that can negatively impact results.

Griffin's PhD research aims to identify how detailed a tool needs to be to reliably assess the risk of internal moisture from timber-framed thermal bridges. A simplified but reliable tool could reduce the risk of unintended consequences when adopting new construction methods.

His research will identify a suitable whole-building simulation tool and develop a workflow to reliably assess the risk of internal moisture for industry participants with suitable skill levels.

Timeframe	April 2021 – March 2023
Contact	researchinvestment@branz.org.nz
Tertiary institute	Victoria University of Wellington



Kirill Panov

Metallic materials in geothermal environments

 Resilience of built environment

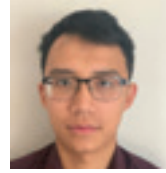
There are more than 55,000 dwellings occupied by approximately 120,000 people in the Taupō Volcanic Zone, a region that contains many high-temperature geothermal systems.

The durability, integrity and safety of buildings and their associated service-providing infrastructural assets within this zone has huge economic and societal implications for New Zealand.

Kirill's PhD research looks at the long-term performance of typical building materials and coatings in severe geothermal environments. He will use advanced material characterisation techniques to study the formation, growth and evolution of atmospheric corrosion products on mild steel, copper and zinc. By using machine learning and data science, he will attempt to create a universal model to identify all the changing environmental factors that contribute to predict corrosion behaviour.

The technical outputs from his research are intended to assist in decisions for specifying the right materials, practices and maintenance schemes for geothermal environments.

Timeframe	April 2021 – January 2024
Contact	researchinvestment@branz.org.nz
Tertiary institute	University of Auckland



Gordon Chen

Steel beam-column connections in fire

 Resilience of built environment

Steel-frame connections are designed to reliably transfer loads between structural members to prevent building collapse. During a fire, thermal expansion and contraction of steel framing occurs, resulting in forces on the connections holding the frame together. To prevent failure during a fire, connections must have sufficient capacity and ductility to retain strength and integrity at elevated fire temperatures.

New Zealand steel-frame connections are designed with ductility in mind to minimise the likelihood of brittle failure under seismic conditions. Gordon's PhD research will explore whether steel frames also have enough ductility under fire conditions. He will evaluate standardised connection ductility and develop a method that models components as a spring network to estimate overall connection ductility. This method has the ability to contribute to best-practice performance-based structural fire engineering connection design.

Making these design procedures accessible can improve predictions about the structural behaviour of steel in a fire, providing reassurance to the steel design industry and encouraging structural fire engineering design.

Timeframe	April 2021 – March 2024
Contact	researchinvestment@branz.org.nz
Tertiary institute	University of Canterbury



Mohamed Mostafa

Failure analysis of precast prestressed hollow-core floors



Resilience of built environment

The widespread use of precast floors in regions of New Zealand with high seismicity makes it necessary to understand the performance of these floors. It is not understood how precast hollow-core units that were produced in New Zealand behave when experiencing torsion. Thus, design and assessment for torsion and shear-torsion interaction of hollow-core floors are currently done with simplified analytical or empirical design methods.

Mohamed's PhD research investigates the system-level performance and torsional behaviour of precast prestressed hollow-core floors. Mohamed will test single-unit subassemblies to investigate the unit's performance when subjected to torsion. He will analyse damage data collected from a case study building that was instrumented during a strong earthquake to understand the torsional behaviour of hollow-core units produced in New Zealand.

His findings will strengthen the torsion assessment calculations and inform guidance for the newly revised *Seismic Assessment of Existing Buildings* (Yellow Book) for pre-earthquake assessment of existing buildings. Retrofit solutions will also be developed and tested to validate the proposed solution and help provide guidance on retrofit solutions.



Timeframe	August 2020 – July 2023
Contact	researchinvestment@branz.org.nz
Tertiary institute	University of Auckland

Strategic initiatives

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



Industry transformation through the Construction Sector Accord

BRANZ remains committed to supporting the industry-wide transformation we first unleashed when we launched the Industry Transformation Agenda in 2017. This call to action for the industry to unite and deliver transformative change helped pave the way for the development of the Construction Sector Accord. The Accord brought together a wide network of industry and government leaders in 2019 to identify and deliver actions under several workstreams, the goal being to create a high-performing construction sector for a better New Zealand.

In mid-2020, BRANZ's CEO was invited to lead the Accord's new Environment Workstream. This Workstream is focused on improving environmental sustainability and helping the sector prepare for changes to the way we build due to climate change. Addressing the many environmental challenges, opportunities and transitions required by construction will need to involve strong and collective leadership across the sector.

The Environment Workstream is developing a roadmap that will provide a clear, cohesive assessment of the thinking and actions the sector will be required to undertake to improve environmental performance. It draws on the significant research expertise BRANZ has in sustainability and environmental research on the built environment. The development of the roadmap is jointly funded by the Levy and the Accord through MBIE.

BRANZ is also committed to supporting work under way through the other Accord workstreams. For example, we signed up as an early member of the Accord Network launched in August 2021. We are also contributing to the Regulatory Environment Workstream, which aims to improve the building consenting system and create a single leadership voice to help shape and drive building legislative reform.

Industry leadership

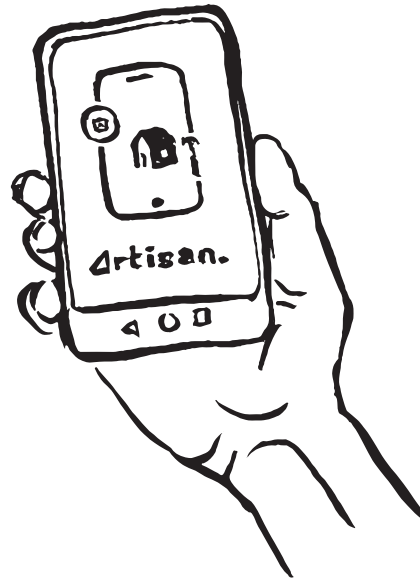
BRANZ occupies a unique place in the building and construction system of Aotearoa New Zealand. As a multi-faceted science-led organisation undertaking independent research, applying systems knowledge and supporting innovation, BRANZ maintains strong relationships with industry, government and research leaders. Our diverse networks underpin the multiple perspectives and depth of knowledge we bring to immediate and emerging issues as well as tough longer-term future-focused challenges.

This commitment to connect, listen, learn and share industry insights from across the very different worlds of research, industry, government and communities and leadership focus forms an invaluable span of knowledge. This engagement helps reinforce our core vision of challenging Aotearoa NZ to create a building system that delivers better outcomes for all. We do this both in practical and pragmatic ways within the sector as well as influencing enduring systemic change that benefits all.

Artisan

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

The state-of-the-art app allows build teams to collect photographic evidence of the build process. The app's workflow matches the existing inspection workflows used by BCAs. The resulting record provides an enduring body of evidence required for many elements of the inspection process.



Once submitted by builders, BCAs can either approve the work or send back advice on how to reach the required standard. This ultimately reduces the required number of on-site inspections and increases productivity for all parties.

Increasing use by build teams this year demonstrates that Artisan is helping them to grow their knowledge of New Zealand Building Code compliance. They are inspecting their work more closely and engaging more collaboratively in the inspection process. This is starting to deliver 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 and travel costs and saves 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 2021/22, including those that are ending and those just getting started.

<i>Project progress</i>	2017	2018	2019	2020	2021	2022	2023	Amount (NZD)
Bulletins, Research Now, Fact sheets 2021–22					● ● ● ● ● ● ● ●			160,000
Education 2021–24					● ● ● ● ● ● ● ● ● ●	● ● ● ● ● ● ● ● ● ●	→ 2024	1,710,000
Guideline 2021–24					● ● ● ● ● ● ● ● ● ●	● ● ● ● ● ● ● ● ● ●	→ 2024	90,000
Library – information management 2021–24					● ● ● ● ● ● ● ● ● ●	● ● ● ● ● ● ● ● ● ●	→ 2024	922,000
Building controls 2021–24					● ● ● ● ● ● ● ● ● ●	● ● ● ● ● ● ● ● ● ●	→ 2024	950,000
Strategic initiatives								
Artisan 2021/22				Multi-year				556,384
Stakeholder engagement 2021/22				Multi-year				142,800
Construction Sector Accord Environment workstream 2021/22				Multi-year				25,000



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