



LEVY IN
ACTION
2018



CONTENTS

Foreword.....	4
Understanding your priorities.....	6
Investing wisely - stewardship of the Building Research Levy	10
2018/19 allocation overview.....	11
Investing to deliver value to the building industry	12
Investing to tackle the issues that matter.....	14
● Embracing medium-density housing.....	19
● Exceeding the minimum	29
● Eliminating quality Issues	39
● Towards warmer, drier and healthier buildings.....	49
Low-carbon transition - proposed programme.....	60
Keeping people and buildings safe from fires - proposed programme	64
Distinct stand-alone research	66
Scholarships.....	74
Appendix - All projects under way in 2018/19	78



Chelydra Percy
Chief Executive Officer

FOREWORD

New Zealand is at a crossroads in the conversations about our built environment.

The importance of decent housing and public buildings to our lives is the focus of government, industry and the public. Sadly, the stories continue to grow about the troubled times within the construction sector and the daily struggles of everyday New Zealander's living in substandard homes. We hear about homes that aren't the liveable environments needed to meet the way we live today and in some cases aren't even fit to live in. Newly built homes, schools and hospitals are facing big repair bills far too early in the life cycle of their existence. Families are struggling with unaffordable rents and high house prices. Building firms are struggling with capacity and in some cases going under, despite a booming industry and strong demand for their services.

Everyone has a point of view: central government, local government, iwi, private businesses, investors, renters, owners, architects, builders. There are differing opinions on the problems our industry faces and almost as many ideas about the road industry needs to travel to change things.

One thing everyone seems to agree on is that change is needed if we are to do better.

I agree. But real lasting change isn't going to be easy. It isn't something that will be achieved quickly.

Our built environment is shaped by a complex and diverse system of interdependencies. Many elements need to come together for new homes and buildings to succeed and meet our society's needs. Land, infrastructure, finance, insurance, procurement,

design, construction, management, occupation – these are all crucial. With such a complex system, it's perhaps not surprising that it is struggling to deliver.

And this is at the heart of matter. New Zealand needs a high-performing building system. Our need is for better buildings to meet our society's changing needs. We can't achieve that with our current building system's trajectory.

The good news is that there is a real appetite for the hard work required to drive meaningful change. Over the past year, BRANZ has been talking with business, community and government leaders about what is required to transform our building system. There has been overwhelming support for an agenda that can help shape this.

The timing couldn't be better. The government has launched the ambitious programme to deliver KiwiBuild. Measures have been introduced to lift the standards of existing homes. Work has begun on how we shift to a low-carbon future. There are bold, stated ambitions to lift the living standards of future generations of New Zealanders. Building matters are front and centre as part of the solution.

All this focus and attention comes with a recognition that we can't go on as we have before. The prize is a galvanised industry and government focussed on the transformative change New Zealand needs.

Change of this scale requires sustained, concerted effort. It needs commitment, drive and determination. It calls for fresh thinking and innovation. New ideas, new solutions and new outlooks are needed. More of the same isn't going to be good enough.

I firmly believe research and science have key roles to play. Researchers and scientists will be instrumental in changing the way industry contributes to how we live and work in coming years.

BRANZ will play its part in supporting this change.

We've been asked to help lead the conversation and forge a framework for sustained effort – the Industry Transformation Agenda.

Through our actions and investment in research and knowledge dissemination, we can help tackle the issues facing the building industry and building users.

Delivery of the change promised by new research, like that set out in this *Levy in Action*, takes time. I've always been aware science moves at a different pace to policy. That's why not being afraid to look beyond immediate priorities is so important. Almost four years ago BRANZ launched our flagship programmes on medium-density housing; exceeding minimum standards; warmer, drier and healthier homes and buildings; and tackling quality issues. The solutions promised by these initiatives are now starting to come through and some of the highlights from these programmes are shared in this document. It's rewarding for our researchers and scientists to see how their hard work is paying off. Industry and policymakers are looking for answers. And because we invested wisely, BRANZ can help.

Reading through this *Levy in Action*, I'm proud of the contribution and difference BRANZ is making to the lives of millions of New Zealanders. I'm also confident about what we can achieve in the coming years as we gather momentum to lift the overall performance of the building system.

UNDERSTANDING YOUR PRIORITIES

BRANZ delivers impartial and independent advice, underpinned by robust science and authoritative evidence.

The Building Research Levy plays a key role in improving all aspects of New Zealand's building industry. Through the Levy investment, needs across the industry – from design through to construction – are addressed.

But the Levy can't fund or support everything. BRANZ can't solve all issues facing the industry. Decisions are needed about prioritising of investment. BRANZ takes a considered, portfolio-based approach to investment and stewardship. Choices are made to deliberately balance investments across a range of priorities.

Several key sources are used to help determine where Levy investment is made. BRANZ works hard to assess your industry needs, and this plays an integral part in shaping the work funded within our portfolio.

Surveying your needs

For more than two decades, BRANZ has systematically surveyed the industry to gain insight into your research and information needs. In recent years BRANZ has partnered with MBIE to undertake an Industry Needs Survey (INS). This tells us what the industry seeks and values from BRANZ. The last survey, in 2016, signalled more information on weathertightness, housing affordability and the costs and benefits of alternative construction materials were wanted.

It also told us that our investment in knowledge dissemination was important and a go-to source of highly trusted information. It confirmed BRANZ as the top choice for technical insights and industry good practice.

In late 2017 we began working with Colmar Brunton Research to review this approach to gathering industry insights. This is with a view to piloting a new approach in 2018.



Working with industry

Connections with industry are fundamental to our work. These help us understand and establish the focus of industry research. Such connections are used as:

- » industry and researchers work together during the research phase, sharing ideas and discoveries
- » BRANZ works with industry to make sure findings and insights can be turned into accessible, actionable knowledge
- » BRANZ checks back in to test the difference the work has made.

BRANZ can draw extensively on these networks to gather intelligence on emerging and ongoing industry concerns.

An important part of this is the Building Research Advisory Council (BRAC). BRAC members are drawn from across the key industry trade and professional bodies. The council includes representation from

consumers and government. BRAC meets twice a year but bilateral engagement with nominating bodies takes place throughout the year. BRANZ is also a member of the Construction Industry Council (made up of senior figures drawn from industry bodies) and the Construction Strategy Group (construction industry business leaders). These two industry peak bodies provide important forums for discussions on key industry concerns.

Many BRANZ researchers and teams are also engaged directly with the industry on specific initiatives and as recognised experts on advisory groups. Researchers are consistently working with industry and government colleagues to tackle known issues and explore potential challenges that may require attention. Also, calls to the BRANZ industry helpline and discussions at BRANZ seminars and training events allow us to talk with and listen to those on the front line.



Working with government

Another key source of information about needs and priorities is the government. BRANZ and MBIE work closely on building and housing issues. BRANZ will be establishing new relationships with the Ministry of Housing and Urban Development once this is established, from 1 August 2018. MBIE is represented on key BRANZ groups such as BRAC and those that assess research proposals seeking Levy funding. The strong relationship with MBIE helps provide important insight into policy priorities. It enables sharing of information on industry concerns. It also supports sharing of key information about future New Zealand Building Code and standards development. As BRANZ is a key provider of research in this space, this is particularly important.

Our relationships with diverse organisations such as EECA, Ministry for the Environment and Ministry of Health support ensuring the public perspective and needs are considered as part of our priority setting.

Developments in the science sector can also have important implications for the focus of the Building Research Levy. As a research organisation, BRANZ monitors key developments in science infrastructure and funding. This can influence Levy investment, such as by highlighting new or changing capabilities. A key way BRANZ stays informed about these developments is through its connections with MBIE. Also critical are relationships with universities, Crown research institutes (CRIs) and other research organisations. BRANZ has ties to the Royal Society of New Zealand and is a member of the Independent Research Association of New Zealand (IRANZ).

International issues

BRANZ maintains a watching brief on key international trends and developments facing the building and construction industry. This is important for keeping up with global trends and developments. Some of these can have immediate and direct implications for New Zealand, such as changes to shared international standards. Other developments can have less immediate implications. International information can highlight opportunities or issues New Zealand may have to contend with in future. A good example is how BRANZ has drawn on work done internationally on industry transformation.

BRANZ researchers and scientists maintain extensive networks and many are members of specific international collaborative groups. This enables our team to tap into global knowledge, capabilities and experience, bringing that back to New Zealand. BRANZ's membership of the CIB, the international organisation of building research providers, also enables access to a wealth of other research and expertise. This includes information about the challenges facing other countries and the priorities they are focussing their efforts on.

Closer to home BRANZ is working with colleagues in Australia, recognising the many building and construction standards they share with New Zealand. We do this through our work with the Australian Building Codes Board.

INVESTING WISELY – STEWARDSHIP OF THE BUILDING RESEARCH LEVY

BRANZ is committed to ensuring the industry gets the greatest possible benefits from Levy investment.

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

BRANZ gets its research income from Building Research Levy receipts, which are directly linked to the levels and values of building consents. This means Levy income is subject to the same boom-bust cycles as the industry. It requires careful and considered management. BRANZ has a long-term Levy utilisation policy in place that helps manage these ups and downs in Levy income. A 10-year rolling forecast model has been developed to create a stable, sustainable platform. This enables BRANZ to invest the Building Research Levy effectively. In practice, when Levy income increases, BRANZ is prudent on expanding its investment. This way, when Levy income decreases BRANZ doesn't have to make unnecessary or drastic cuts.

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

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

The long-term Levy utilisation policy is reviewed annually.

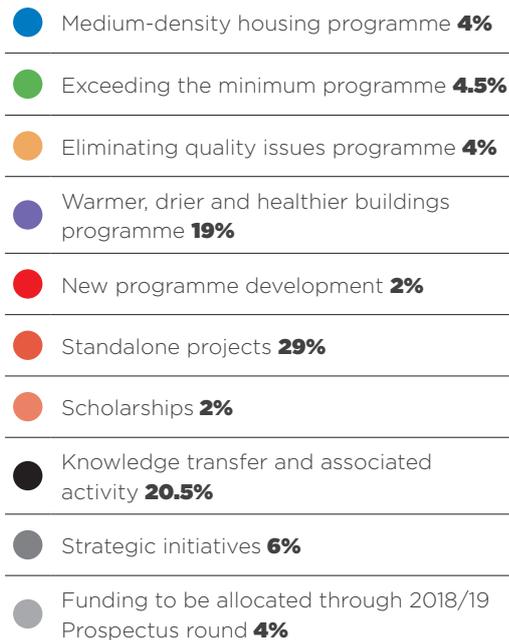
2018/19 ALLOCATION OVERVIEW

The BRANZ Board Inc. approved \$16,685,000 Building Research Levy investment for 2018/19.

This represents the total Levy investment for the year at the time of publication. It includes new research investments as well as budgeted expenditure for existing research commitments planned during this 12-month period.

The distribution is subject to change due to project variations and new investments made in response to emerging issues.

The total figure of \$16,685,000 comprises \$14,862,000 of operational expenses and \$1,823,000 of capital expenses. The capital expenses exclude investments in the campus and other infrastructure assets.



INVESTING TO DELIVER VALUE TO THE BUILDING INDUSTRY

The BRANZ Inc. Board determines the amount of baseline Levy investment to be spent on research and knowledge dissemination activities.

Investment in BRANZ Ltd

BRANZ Ltd is New Zealand's primary building research provider and centre of expertise. It has the largest group of building industry researchers in New Zealand. It is a wholly owned subsidiary of BRANZ Inc. and operates predominantly out of its Judgeford campus near Wellington. Most of its 110 staff are scientists and researchers or experts in knowledge transfer.

The annual Building Research Levy investment is allocated to work undertaken by both BRANZ Ltd and external providers. A significant proportion is invested with BRANZ Ltd.

To ensure the work funded by the Building Research Levy is of a high quality, it is subject to robust scrutiny. Proposals undergo a vigorous assessment process.

This process for BRANZ Ltd includes the use of independent assessors appointed by the BRANZ Inc. Board. This Levy Allocation Advisory Group (LAAG) is made up of leaders and experts drawn from the Building Research Advisory Council and the wider industry. The Ministry of Building, Innovation and Employment (MBIE) also participates on this advisory group in recognition of the strong connections between Levy-funded research and government regulatory and policy direction. The aim of this group is to provide independent, expert advice that can give confidence to the BRANZ Inc. Board on the focus and quality of BRANZ Ltd research.

Investment with external providers

There is significant expertise within universities, CRIs and independent research providers to complement BRANZ-based specialist teams. Working in partnership and collaborating with other providers is an important part of how BRANZ strives to deliver best value from the Levy for New Zealanders.

Sometimes this can be external providers directly accessing investment and being contracted by BRANZ Inc. to carry out projects. Other times it can be through these providers acting as subcontractors to BRANZ Ltd as part of teams to deliver Levy-funded work. Primarily BRANZ Inc. seeks out external proposals through the publication of a Research Prospectus. The Prospectus is sent out annually to the wider research community, seeking proposals to help deliver on research priorities.

Investing in young researchers

Each year BRANZ also puts aside Levy funding for outstanding postgraduate scholars in New Zealand tertiary institutions.

This scholarship programme is an important part of BRANZ's portfolio of investments. It funds early-stage researchers to bring their energy and ideas to bear on industry issues. It also supports the next generation of scientists and researchers. Through this investment, BRANZ deepens its ties to New Zealand's tertiary education providers, helping to leverage their expertise and inform each other's work.

Being an agile investor – tackling pressing needs

Most of BRANZ's research investments are delivered through the annual funding rounds described above. But as part of its portfolio approach, BRANZ also recognises the importance of being an agile investor, able to respond to opportunities and issues outside these cycles.

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

Strategic initiatives

From time to time BRANZ also invests the Levy in strategic initiatives, beyond the core baseline investment in research. These are typically focussed on national, strategic opportunities and are approved by the BRANZ Inc. Board. For example, BRANZ worked with the industry in developing the Homestar rating tool. It also partnered with the design and building community in establishing the national specification system Masterspec.

More recently BRANZ has invested the Levy in two major new strategic initiatives aimed at driving transformative change in the industry. One, Artisan, is looking to deliver a new direction for quality assurance for the built environment. The other initiative is work on a system-focussed New Zealand Industry Transformation Agenda, inspired by the *Shaping the Future of Construction* report released by the World Economic Forum in 2016. This agenda reflects many of the issues we face here, albeit on an international scale. We see it as having the potential to transform the industry into a cohesive, productive contributor to the economic and social wellbeing of New Zealanders.

Investment in the campus and assets

BRANZ also invests Levy funding in developing and maintaining the specialised hub of building research capability at Judgeford, outside Wellington.

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, BRANZ can develop a programme of capital requirements and understand investment priorities.

A Campus and Asset Management Plan shapes these investments. The plan creates visibility of the potential size and scale of investment in property, plant and equipment at BRANZ over the next 10 years. This supports the Board in making individual project investment decisions relative to the size and scale of other likely investments. Recent investments have seen a major overhaul of the fire research facilities, and further major investments are planned for redeveloping ageing infrastructure at Judgeford.

The level of capital investment required in property, plant and equipment is a key part of the long 10-year model that supports BRANZ's Levy investment. BRANZ's Long-Term Levy Utilisation policy is explicit about the importance of this capability. It notes that BRANZ will effectively manage the Levy by planning for and making capital investment in internal and external facilities and capability.

INVESTING TO TACKLE THE ISSUES THAT MATTER

The issues facing New Zealand's built environment have come into even sharper focus over the past 12 months. Demand for the evidence and solutions our work can provide has increased. As part of our strategy, we work hard to understand the issues that require action, both today and in the future. We know that establishing much needed evidence and developing solutions can take time. Investment prioritisation and planning is needed so we can be well placed to offer solutions when required.

We are continuing to stretch our thinking around how we can ensure the industry – as well as New Zealanders – gets the best possible benefits from Levy investment. Over the past 12 months, our portfolio thinking has developed further.

In 2017/18 we issued our first Levy Investment Portfolio Statement (LIPS). This sets out clearly our key investment signals for the year ahead. This statement also shows how we are acknowledging the work of other research providers and funders. In setting our priorities and sending our investment signals, we also assess this important landscape. We want to make positive choices about how best to work with others to utilise the funding and teams available.

Programmes accelerated and delivering results

Two years ago we launched our first four programmes aimed at finding and developing end-to-end solutions to some of your most pressing industry issues.

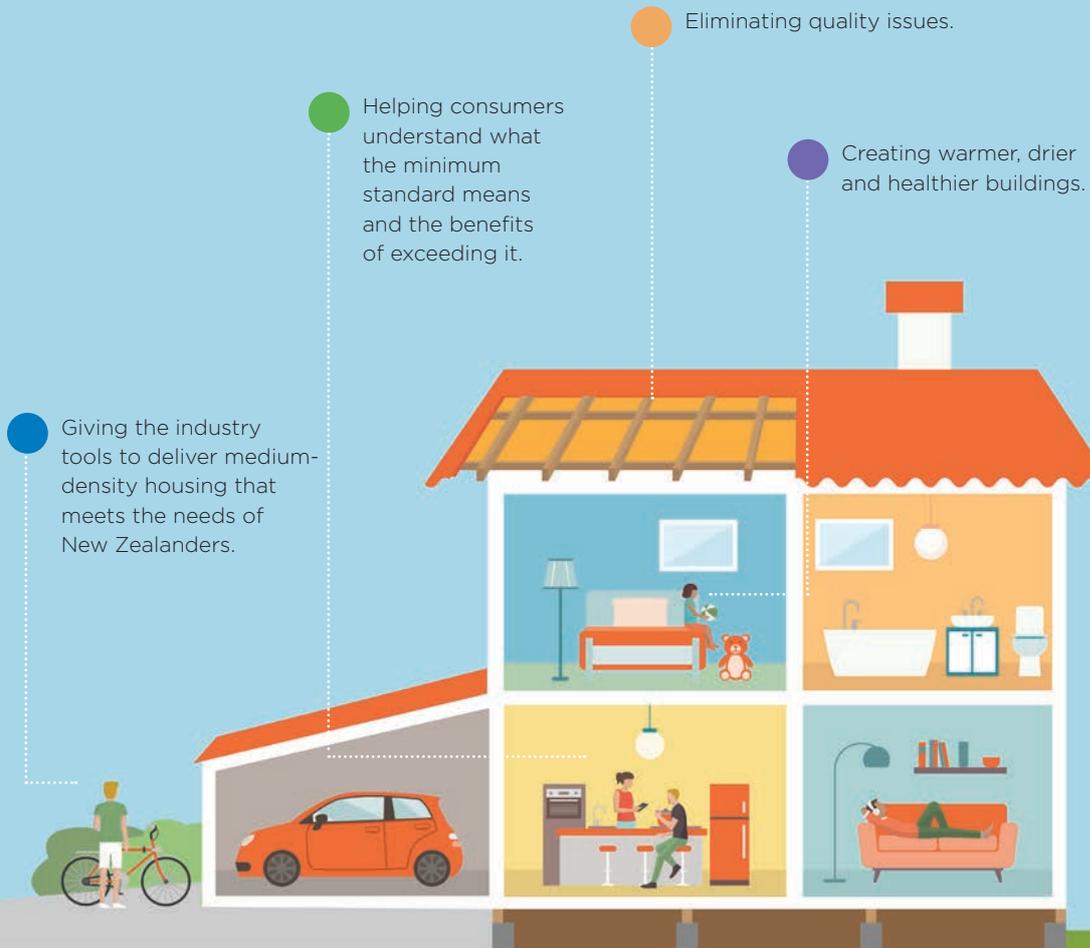
The programme approach has enabled BRANZ to work differently to unlock the right New Zealand and global teams. Our programmes are bringing together government, researchers and industry, with different disciplines and experience, to work in new ways and with new levels of investment.

Last year we wanted to accelerate the work of our programmes. Feedback from government and industry confirmed that these were essential pieces of work on key issues facing New Zealand. Government initiatives such as KiwiBuild, changes to lift rental housing performance and the first-time measuring of housing quality in the Census called on the work of our programmes. Because we had the programmes in place and research well under way, BRANZ could support these key legislative changes and national initiatives. Our creative approaches and thinking around science and research are inspiring the delivery of better buildings for New Zealanders. They are also leading to demonstrable impact on our society.

We are pleased to share some of these highlights from the programmes in the next section. We will also talk further about what the programmes aim to achieve in the year ahead.

Much of this success has been possible because we have consistently sought feedback from industry and government on the programme activities and focus. Because of this, they've remained dynamic, able to respond to changes in our environment and industry needs. Programme advisory groups have been instrumental in this. Their feedback has confirmed the direction and provided valuable information that continues to support adjustments to the programmes in the year ahead.

The past year has reconfirmed importance of the programmes and the solutions they provide. Because of this, BRANZ will continue to invest a significant allocation of Building Research Levy in the four programmes of work in 2018/19. These are:



Scoping two new programmes of work in 2018/19

We are expanding this successful approach in two new areas. These new programmes of work are demanding concerted effort from multi-disciplinary, multi-organisational teams over a number of years.

The first is a national priority and one where we need to act now - climate change. In 2018/19 we are funding a new programme on the **built environment's contribution to a low-carbon economy**. Our focus in 2018/19 is scoping this critical work with key stakeholders. It is well established that New Zealand needs to make the transition to a low-carbon economy. We have international obligations and agreed-on targets we must meet. The built environment has a key role to play in this. The changes required are significant. They will alter the buildings the industry delivers and how it goes about its work. We need a clear, agreed-on approach to the action required. We also need to work hard to provide the information that will support this change.

The second new programme is focussed on **keeping people and buildings safe from fire**. While the new carbon programme is driven by a pressing international need, the motivation behind scoping a fire programme is quite different. The focus of this work in 2018/19 is to help improve how the fire research community in New Zealand co-ordinates and prioritises its work. New Zealand has a relatively small community of interest around fire and buildings. There are good conversations among experts and users that can be built on. The intention is to capitalise on this expertise and assess whether a different approach to directing and co-ordinating work will deliver better results.

Distinct, standalone research

Looking beyond the programmes, we know distinct pieces of research into other industry needs still require support through Levy investment. This is part of BRANZ's commitment to maintaining a balanced portfolio of research investment and maintaining investment in important research capability. These standalone projects must also demonstrate how they are addressing industry needs.

Strategic initiatives

As part of our portfolio approach, BRANZ also invests the Levy in strategic initiatives from time to time. These are additional to the core baseline investment in research. They are typically focussed on national strategic opportunities and are approved by the BRANZ Inc Board.

Two major initiatives receiving investment in 2018/19 are Artisan and foundational work on the New Zealand Industry Transformation Agenda.

Both are multi-year commitments with the potential to deliver enduring and radical improvements to the sector and New Zealand.

Artisan

Artisan offers a digital solution to see, assess, fix, verify and record each step in the residential build process, accessible to all involved. It has the potential to remove at least 75 per cent of onsite inspections and deliver a lasting record of build quality. The software in development is targeted to be piloted in key building consent authorities in October 2018.

Industry Transformation Agenda

The idea to develop the Industry Transformation Agenda (ITA) was initiated by BRANZ in partnership with several other industry leaders in early 2017. It is well recognised that our building and construction industry is fragmented and inflexible. It struggles with skills shortages, boom-and-bust cycles, procurement issues and uneven risk allocation. It also lags other industries in using technological opportunities and digital innovations.

The ITA's ambition is to develop a way for the building and construction industry to embrace quality, efficiency and technology to create a better future for everyone it touches.

New Zealand is far from unique in having a building and construction industry not fit for purpose in the 21st century. This is a global problem, as recognised by the World Economic Forum's 2016 report "Shaping the future of construction."

Drawing closely on this work, the team developed a New Zealand-specific agenda. After consulting widely with our industry to refine it, the team launched the agenda in August 2017 at the Registered Master Builders Association forum Constructive 17. It received overwhelming support from conference attendees.

The Industry Transformation Agenda takes a systems approach to building and construction sector transformation. It focusses on root causes of pain within the system. And it urges ongoing and active collaboration of all major players including government.

In the New Zealand context, six areas have been prioritised for action:

- » risk management
- » integrated planning
- » adoption of new technologies
- » shared learning
- » information flows
- » next-generation capability.

A suite of leadership conversations on leading transformation has also been launched to underpin this work.

BRANZ is leading the Industry Transformation Agenda start-up programme and providing resources for events, tools and communication. We welcome your feedback on the Agenda and any developments that might inform its focus.

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EMBRACING MEDIUM-DENSITY HOUSING

Why this is a priority

New Zealand faces a housing crisis due to a rapidly growing population. Building consent authorities are stretched. There is a well-documented skills shortage in the construction industry. Soaring prices are putting homeownership out of reach for many. As New Zealand grapples with these pressures, medium-density housing (MDH) is emerging as an increasingly popular alternative to traditional standalone housing.

MDH has been part of New Zealand's housing landscape for many decades but is not necessarily a popular choice. New Zealanders have traditionally preferred standalone housing – the 'quarter-acre paradise'. For MDH to be a successful part of the solution to New Zealand's housing crisis, it must be built fit for purpose. It must meet the needs of those who live in it and be accepted by the communities who live around it.

The importance of this programme has come into sharp focus with the new government's introduction of the KiwiBuild programme. KiwiBuild aims to deliver 100,000 affordable homes over the next decade. A large proportion of them are expected to be medium-density. BRANZ and our programme collaborators are already working closely with the Ministry of Business, Innovation and Employment (MBIE) to share insights from our research and offer advice.

Hand in hand with this is the growing demand for information. A key role for BRANZ is providing impartial, authoritative, trusted information that can be easily accessed. We also recognise that people want information as soon as possible. Because of this, the MDH programme is communicating evidence as it emerges. We have also heard that the industry wants a simple, clear access point. That is why we will launch the MDH Online Hub this year – New Zealand's one-stop shop for all things MDH.

The story so far

Over the past year, the MDH programme has carried out key research examining the technical aspects of building MDH. Research into cladding performance, fire spread, airtightness and construction quality is providing new insights into how we can improve our building of MDH. The results of an 'MDH acoustics' project highlighted the need for whole-of-building design and integrated building systems.

Early research in the programme has shown that industry must upskill the existing workforce if it is to deliver the MDH New Zealand needs. It will also need to recruit more skilled workers across the board.

Fortunately, we aren't starting with a blank sheet. It will be essential to leverage the MDH expertise that already exists in the building industry. Our research has identified who the MDH experts are and how they can best transfer their knowledge to the rest of the industry.

The consenting process has also been identified as a sticking point to delivering these much-needed homes for New Zealand.

Our work has also highlighted the significance of liveability to gaining acceptance of MDH. A tool has been developed to help residents and developers assess the factors that make an MDH dwelling a desirable and successful housing option.



KNOWLEDGE INTO ACTION

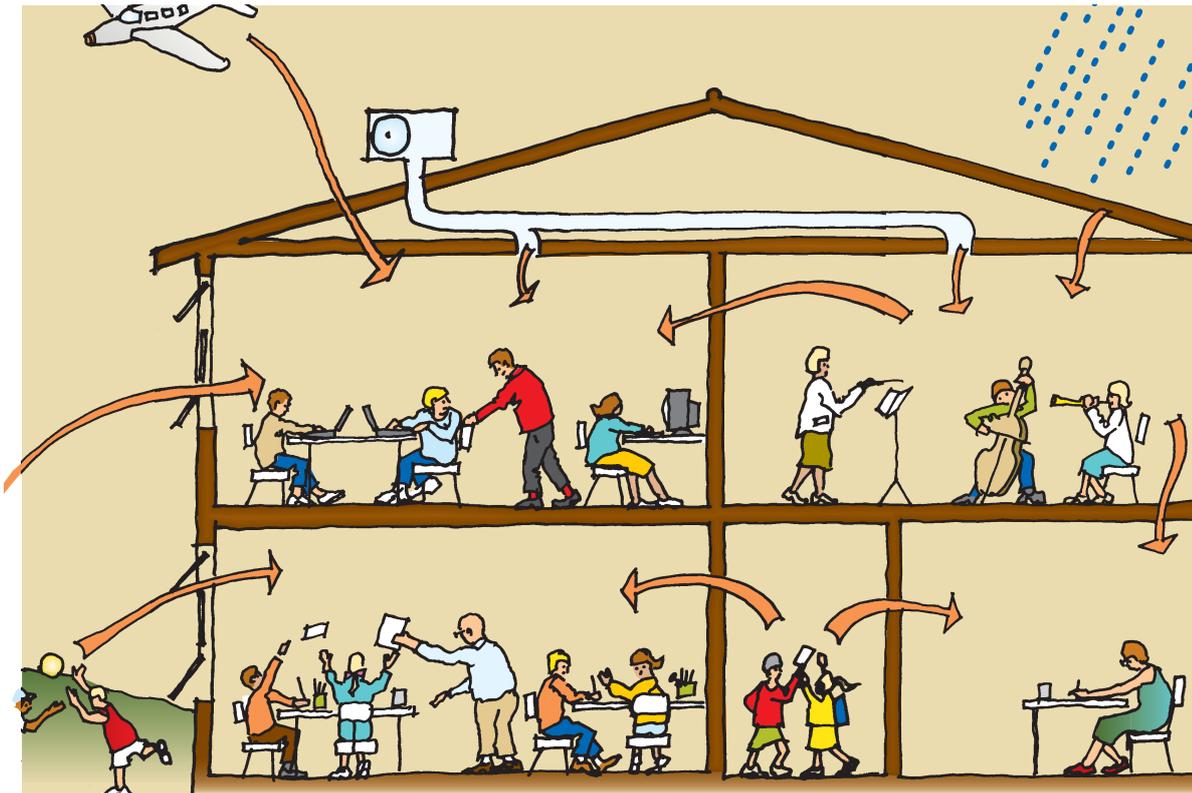
Performance of cladding systems for MDH

The increase in medium-rise housing presents some challenges to the design community. One is around cladding selection. Should curtainwall systems, typically associated with higher-rise buildings, be used? Or can typical low-rise residential claddings simply be extended up to buildings higher than 10 metres?

This research has been investigating how residential-style claddings perform under loadings expected of taller buildings.

The insights from our tests are feeding into MBIE as the building regulator. We have provided recommendations about what the new tests should comprise, including higher test pressures, seismic loading and airtightness measurements.

This research will feed into the Building Code and lead to MDH facades that remain weathertight and structurally sound over their lifetime.



KNOWLEDGE INTO ACTION

Rating tool to guide individuals, developers and community

A prototype tool has been developed that both residents and developers can use to assess the viability of a specific MDH project.

The tool can rate aspects of a planned development according to 30 criteria of liveability and sustainability. These include building quality, storage, noise control, privacy, shared facilities, outdoor spaces, security, ability to personalise a dwelling and capacity for community engagement. It also evaluates aspects of sustainability including light, warmth and dryness, energy-efficiency, water supply and recycling.

The tool was then tested with residents and developers of two existing apartment complexes in Auckland.

The recommended next stage is to develop the evaluation tool further, reflecting varied demographics, and consult with housing-industry stakeholders about its application.

The study, co-funded by BRANZ and MBIE and undertaken by Beacon Pathway, follows up on the MDH programme's early attitudinal work. It explores the wider framework of liveability and functionality, and how well medium-density housing contributes to a sense of community.

The next chapter

The first stage of the programme's research work gathered evidence of societal attitudes towards medium-density housing. The programme is now exploring practical solutions to some issues causing resistance to this style of housing.

The next phase has a strong emphasis on communicating this knowledge effectively, so it is both accessible and actionable.

Focussing on industry need, we will undertake a survey of MDH technical issues they encounter. The results of this study will inform the development of future technical research projects.

Residents of MDH will be surveyed about their experiences of maintaining their dwellings. By looking at MDH we have built in the past, this project aims to discover what are the common mistakes or high-maintenance aspects we can avoid or improve on in future.

Two new projects will also look more closely at the acceptance of MDH. The first will investigate how communities feel about new MDH built within existing neighbourhoods. The second study investigates the housing preferences of future first-home buyers and how MDH fits into this.

Other new research aims to deliver:

- » technical information on constructing facades
- » a tool to help developers and occupiers assess the liveability of MDH developments
- » information on skills gaps – which building practitioners have the interest and ability to respond to the demand for new MDH.

Making a difference

This programme will give the industry the tools it needs to build high-quality, affordable medium-density housing. It will also educate, incentivise and inspire the industry for this new wave of housing.

Medium-density housing in New Zealand will meet the needs of its occupants and be accepted by the wider community.

Critical success criteria

1. The building industry has the technical information it needs to design and build quality, affordable and desirable medium-density housing.
2. The building industry has the skills needed to design and build quality, affordable and desirable medium-density housing.
3. Medium-density residential buildings are maintained to sustain long-term performance.
4. Everyone has a shared understanding of how to ease medium-density housing through the building and consents process.
5. Communities increasingly accept the reality of and appreciate the benefits of medium-density housing.



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Coming in the year ahead

MEDIUM-DENSITY HOUSING

	2018	2019	2020	2021
NOTE This timeline shows work to be carried out in 2018/19 and beyond. Work completed in previous years can be found in previous <i>Levy in Action</i> timelines. Or you can contact the programme leader for more information.				
PROGRAMME LEADERSHIP 2018/19	● ● ● ●	● ● ● ●		
1. The building industry has the technical information to enable the design of quality, affordable and desirable MDH				
? What are the technical issues that affect MDH?				
Defining MDH – defining medium-density housing for NZ	● ● ● ●			
The new MDH market – Supply-side analysis	● ● ● ●			
MDH construction quality survey	● ● ● ●			
The new MDH market – Demand-side analysis	● ● ● ●			
Testing cladding for performance in MDH				
Fire spread in lower roofs in MDH	● ● ● ●			
Tools to measure liveability of MDH	● ● ● ●			
Acoustic design of MDH				
Timber composite floors – Scoping	● ● ●			
Industry-identified technical issues facing MDH	● ● ● ● ● ● ● ●	● ● ● ●		
International literature review of medium-density housing issues	● ● ●			
? What are holistic solutions to the technical issues that affect MDH?				
? Are the holistic solutions to the technical issues that affect MDH practical and acceptable to end users?				
? How can the solutions to the technical issues that affect MDH be rolled out to industry to encourage their uptake?				
Market research for MDH				
MDH fact sheets				
MDH housing information resource				

Better understanding of the range of technical issues the industry faces in developing MDH will help focus future research work on solutions

	2018	2019	2020	2021
2. The building industry has the skills to design and build quality and affordable MDH				
<p>❓ Who within the building industry will have the ability and interest to respond to the MDH need?</p> <p>Industry ability and interest in responding to MDH need</p>	● ● ● ●			
<p>❓ What is the skills gap in the ability of the industry to design and build quality, affordable and desirable MDH?</p> <p>Where are the skills gaps?</p>	● ● ● ●			
<p>❓ Who are the experts regarding MDH and how do we leverage their knowledge to benefit the rest of the industry?</p> <p>Leveraging MDH experts' knowledge</p>	● ● ● ●	● ● ● ●		
<p>❓ How do we get the tertiary education providers to focus on the skills gap regarding MDH when training new industry participants?</p>				
<p>❓ How do we encourage the existing industry to proactively upskill to address their skills gaps regarding MDH?</p>				
3. MDH buildings are maintained to sustain long-term performance				
<p>❓ What are the maintenance requirements for MDH?</p> <p>Knowing enough to maintain - Understanding the gaps in the knowledge of owners and residents around the maintenance requirements for MDH</p>	●			
<p>❓ What are the economic and social benefits of maintaining MDH during its lifecycle and how can we demonstrate them?</p>				
<p>❓ How do we make designers and builders aware of what they need to do to ensure that MDH buildings are maintainable?</p>				
<p>❓ What are the gaps in the knowledge for owners and residents around the maintenance requirements for their MDH buildings and how can these be closed?</p> <p>Residents' perspectives of maintaining MDH</p>			● ● ● ● ●	
4. Everyone has a shared understanding of how to optimise the journey through the building and resource consent process for MDH				
<p>❓ What is the real situation surrounding the building and resource consent process for MDH, e.g. timelines and perceived barriers?</p>				

Owners and managers of MDH buildings/ complexes will have access to information on maintenance requirements for different structures

	2018	2019	2020	2021
Getting MDH through the hoops - Building an evidence base outlining the barriers and constraints involved when taking MDH projects through the building and resource consents processes				
? What are the specific problems with the resource and building consent process for MDH, including the process and peoples' approach to the process?				
Understanding resource consent processes in New Zealand	● ●	● ●		
? How can we resolve the problems associated with the building and resource consent process for MDH?				
Industry perspectives on medium-density consent issues	● ● ● ●			
5. We have increased the acceptance of MDH in communities				
? What are the preferences of different demographics regarding MDH?				
Understanding the drivers of MDH				
Future first-home buyers and renters		● ● ● ● ● ● ● ●		
? How will the changing cultural diversity impact the demand for MDH?				
? What are the perceived barriers or advantages to living in or near MDH, e.g. safety and security?				
MDH liveability	● ● ● ●			
Community acceptance of MDH	● ● ● ● ●			
? How can we inform communities of the real benefits and costs of living in or near MDH?				
? How do we leverage our knowledge of MDH's benefits to increase its acceptance in communities?				

Developers will better understand the MDH choices for first-home buyers and renters in different regions of New Zealand, and which building features they might be willing to trade off

The building industry will better understand how communities or neighbourhoods perceive the problems and benefits of MDH, both before and after construction

New projects funded in 2018/19

Programme leadership

This investment continues to support the delivery of the programme, providing time and resources for engaging with key stakeholders and operating the programme's advisory group.

Levy investment	\$110,000
Timeframe	April 2018 - March 2019
Contact	research@branz.co.nz

Programme knowledge transfer

This investment helps to deliver key messages from the programme's research to identified external audiences.

Levy investment	\$50,000
Timeframe	April 2018 - March 2019
Contact	research@branz.co.nz

Industry-identified technical issues facing MDH

This project will identify what technical issues the building industry is encountering for developing MDH. The survey will inform the direction and next steps for research projects under the programme's success criterion 1.

Levy investment	\$130,000
Timeframe	December 2018 - December 2019
Contact	research@branz.co.nz

Residents' perspectives of maintaining MDH

The programme has identified a need for more knowledge of residents' experiences of maintaining MDH properties under various property management and tenure structures.

MDH residents in Auckland, Wellington, Christchurch and Tauranga will be surveyed on their specific maintenance requirements.

Levy investment	\$120,000
Timeframe	February 2019 - March 2020
Contact	research@branz.co.nz

Community acceptance of MDH

This research will examine the attitudes and experiences of residents in neighbourhoods where MDH developments are planned or were built recently.

The study aims to:

1. investigate communities' fears and concerns (as often reported anecdotally in the media) about proposed MDH developments
2. examine whether these fears and concerns are realised and/or dissipate after construction
3. identify what benefits new MDH developments can bring to residents and neighbourhoods
4. explore how the perceived benefits/downsides differ among individual developments and neighbourhoods.

Levy investment	\$350,000
Timeframe	April 2018 - March 2021
Contact	research@branz.co.nz

Future first-home buyers and renters

MDH has been identified as a key solution to New Zealand's housing pressures. However, the uptake of medium-density options is an ongoing issue. It is crucial to understanding future housing demand and how future home buyers' and renters' preferences are evolving.

An online survey will probe pre-first-home buyers and renters on their housing choices and what trade-offs they are willing to make. The research will identify regional similarities and differences

Levy investment	\$280,000
Timeframe	April 2018 - March 2020
Contact	research@branz.co.nz

NOTE

You can find all information and resources relating to past and current projects in this programme at branz.nz/mdh.



EXCEEDING THE MINIMUM

Why this is a priority

Modern buildings in New Zealand are often designed and built to meet minimum compliance requirements set out in the New Zealand Building Code and accompanying standards. In general, older properties do not meet all the requirements in the current version of the Code, which was last revised in 2004.

These requirements are not meant to be a target – though that is how they have largely been used. As a result, opportunities to provide houses that are warmer, drier, healthier, more accessible and with lower environmental impact can be missed.

Last year the Government made several announcements about increasing currently accepted minimums, such as:

- » The current Building Code will be reviewed.
- » The Government's 100,000 KiwiBuild homes will be built to a standard that exceeds the current Code.
- » The passing of the Healthy Homes Guarantee Act would set standards for rental properties.

While we await further details from the Government, currently accepted minimums are apparently being investigated. This has the potential to incorporate more above-minimum features or shift minimum requirements.

If consumers routinely opted for a standard above the minimum, the impact – structural, financial, environmental and social – could be significant. The immediate owners or occupants would benefit. It would also future-proof later generations against excessive risk. However, moving to a norm of exceeding the minimum will take a major shift in mindset from everyone involved: consumers, designers, architects and builders.

The story so far

This year, developers of New Zealand office building projects began to assess their environmental impacts using the lifecycle assessment (LCA) technique for the first time. This is a great milestone

for environmental performance of building in New Zealand – something not currently recognised in the Building Code. It is also a key step towards changing the mindset on building design.

Under this programme, several baseline studies are ongoing and due to be completed in 2018. Some are focussed on consumers – where they obtain information and how they judge the credibility of that information. Others target the construction industry – which exceeding-the-minimum features are optionally provided by group home builders and the barriers to exceeding these.

During the year, some of the shorter research projects commissioned at the start of the programme were completed. These included one by the Centre for Research, Evaluation and Social Assessment (CRESA) which focussed on the role and take-up of research in beyond-Code solutions for residential building. The report found the Building Act and the Building Code were inconsistent on performance dimensions. It also concluded research was an important element in improving the performance of homes. But just as important were regulatory initiatives, industry incentives, consumer education and accreditation, and industry development.

An aspect of building performance not currently recognised in the Code but of increasing importance to the industry is the environment. In 2016 New Zealand signed and ratified the Paris Agreement, which limits our greenhouse gas emissions and signals a commitment to shifting to a low-carbon economy.

Recent BRANZ-funded research has resulted in a framework for calculating the environmental impacts – including climate change – of new office building designs early in the process. The research was undertaken by BRANZ, Massey University and Victoria University of Wellington. It has yielded a suite of materials and tools (available at www.branz.co.nz/buildingLCA) to help designers better understand the lifecycle environmental impacts of their designs. Last year the first New Zealand office building projects began to assess their environmental impacts using this new technique.



KNOWLEDGE INTO ACTION

Building to rent

Housing affordability in 41 of 67 territorial authorities in New Zealand can be classed as 'severely unaffordable'. Around 85 per cent of New Zealand's rental stock is privately owned. In addition, the standard of rental housing is typically below that of owner-occupied housing, with renters more likely to report that their home feels cold. The number of rental properties is likely to grow over the next 20 years, by around 225,000 units. And a bigger proportion will be occupied by over-65s than in past years.

The *Building to rent* research project looked at how the rental stock could be improved, given affordability pressures. The analysis suggests for over half the existing rental stock, the cost to bring it up to the same standard as owner-occupied housing is less than \$5000. There is a need for more rental properties which are warmer, drier and healthier. BRANZ research investigated the potential to adopt overseas models for delivering better standards of rental property.

These models include:

- » build to rent, in which a tenant commits to a multi-year lease (5-15 years) and is responsible for completing the interior fit-out as they desire. This structure resembles a commercial lease.
- » using real estate investment trusts to encourage take up of build-to-rent models.
- » providing an Energy Performance Certificate for rental properties so prospective tenants can compare the energy costs of potential rentals, in addition to rents.

Employing such models could encourage more affordable new-build rental properties that at least meet the current Building Code. They would also far exceed the worst-performing rental properties currently available. Improvements in the rental sector look as if they need to be driven by the government. This is particularly so in a housing shortage when landlords can easily keep their properties tenanted, which fails to provide incentives for the market to lead change.



KNOWLEDGE INTO ACTION

Choice to exceed

Clients struggle to access relevant information on exceeding minimum standards. Buildings practitioners and clients often have different approaches to incorporating sustainability features in homes.

For occupants to achieve the benefits of homes built above minimum standards, a change is needed. As the BRANZ work identified and the Waitakere NOW Home® demonstrates, cost need not be a barrier to exceeding the minimum. Thoughtfully designed, higher-performing houses can be built without a higher premium to clients.

A key to changing attitudes is evidence-based information. Such information helps clients to choose house-performance options that suit the climate, their family needs and their budget, as well as what industry can realistically deliver. Providing

this information across multiple platforms that are informative, instructional or interactive could support both clients and the industry towards a whole-of-building, whole-of-life approach to housing design.

BRANZ will develop a framework for engaging with clients so they can more easily make decisions on exceeding the minimum. Future research is required into:

- » how to encourage the industry – especially group home builders and small to medium-sized enterprises (SMEs) – to engage with clients on the topic
- » how to support the industry with benefits focused information and advice on exceeding the minimum
- » what exceeding the minimum means in real terms for building performance.

The next chapter

New research projects recently begun or primed to start this year will look in detail at barriers and incentives to exceeding the minimum.

One project focusses on retrofitting insulation in residential properties. It seeks to better understand where homeowners and landlords obtain information about insulation, what advice they receive, how they view its credibility, and what training insulation installers receive. It is being conducted by Heathrose Research and Business and Economic Research Limited (BERL), with input from the Energy Efficiency and Conservation Authority (EECA).

Another project seeks to develop a set of double-glazing window details to help ensure the window achieves its designed thermal performance.

A Victoria University team will investigate how to ensure high-wall thermal performance in above-Code, timber-framed medium-density housing, regardless of how much framing is used.

Making a difference

Through this programme, consumers will come to fully understand that New Zealand's Building Code and standards are a minimum only. They will appreciate the benefits to be gained from exceeding the minimum.

Better informed consumers will raise their expectations for new builds and upgrades. Ultimately, the industry will respond by delivering higher-performing buildings.

Research carried out in this programme may also contribute to future Building Code and standards development.

Critical success criteria

1. Consumers and industry understand that the code and standards are a minimum that must be met but can be exceeded ("where we are now and where we want to get to").
2. The benefits of exceeding the minimum can be clearly articulated based on meaningful terms ("the limitations of what we have now and the benefits of exceeding the minimum are understood").
3. The barriers to exceeding the minimum have been addressed ("we understand the barriers to exceeding the minimum and the enablers for change").
4. Consumers expect and demand buildings that perform to a higher standard ("we focus on breaking down barriers to exceeding the minimum and changing consumer expectations").
5. The industry delivers buildings that perform cost-effectively to a higher requirement ("the industry is equipped to meet consumer expectations of higher performance").



PROGRAMME LEADER:
David Dowdell

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Coming in the year ahead

EXCEEDING THE MINIMUM

	2018	2019	2020	2021
NOTE	This timeline shows work to be carried out in 2018/19 and beyond. Work completed in previous years can be found in previous <i>Levy in Action</i> timelines. Or you can contact the programme leader for more information.			
PROGRAMME LEADERSHIP 2018/19	● ● ● ●	● ● ● ●		
1. Consumers and industry understand that the code and standards are a minimum that must be met but can and should be exceeded				
<p>❓ How do we effectively articulate to consumers and industry that the Code and standards are a minimum that can be exceeded?</p> <p>Measuring our sustainability progress</p>	● ● ● ●	● ● ● ●		
<p>❓ How do we develop an expectation of higher standards among consumers?</p>				
<p>❓ What should a 'roadmap for change' look like that can take us from where we are now to where we want to get to?</p> <p>How do we encourage consumers and industry to exceed the minimum?</p>		● ● ● ●		
2. The benefits of exceeding the minimum can be clearly articulated based on meaningful terms				
<p>❓ What are some examples of exceeding the minimum where the value can be clearly articulated and outweigh the cost?</p> <p>Quantifiable evidence for building beyond Code</p> <p>Doing better – Assessment of New Zealand research for currency and impact</p>	● ● ● ●	● ● ● ●		
<p>❓ Who benefits from exceeding the minimum (e.g. the designer, builder, occupant, landlord, community, society) and how?</p> <p>Who benefits from going beyond the minimum?</p>				
<p>❓ What minimums are already being exceeded now and what could be exceeded affordably?</p> <p>What standards can be exceeded to provide benefits?</p>	● ● ● ●			
<p>❓ How do we help consumers understand the limits of the houses they are currently living in?</p> <p>Tools for young people to understand how they can improve home performance</p>	● ● ● ●	● ● ● ●	● ● ● ●	

	2018	2019	2020	2021
3. The barriers to exceeding the minimum have been addressed				
<p>? Why doesn't the industry talk with consumers about the benefits of exceeding the minimum for new build, and what will encourage this?</p> <p>Exceed the minimum for volume home builders and their clients</p>	● ● ●	● ●		
<p>? Why doesn't the industry talk with consumers about the benefits of exceeding the minimum for retrofitting of existing homes, and what will encourage this?</p>				
<p>? What current hurdles exist in the delivery of new build houses that exceed the minimum, and how can these be overcome?</p> <p>The choice to exceed</p>	● ● ● ●			
Getting the stated performance in higher-specified windows – Tackling the window-wall junction		● ● ● ● ● ● ● ●	● ● ● ● ● ● ● ●	
Accurately calculating thermal performance in timber-framed medium-density housing across New Zealand	● ●	● ●		
<p>? What current hurdles exist that make exceeding the minimum when retrofitting existing homes less attractive, and how can these be overcome?</p> <p>When is good enough not good enough?</p>	● ● ● ●			
<p>? Why doesn't the real estate industry value features that exceed the minimum, and what will change this? Why don't landlords choose features that exceed the minimum and what will change this?</p> <p>Building to rent</p>	● ● ● ●			
<p>? Why don't mortgage lenders and insurance companies take into account investment in features that will change this?</p>				
<p>? What market mechanisms have been used internationally resulting in a shift towards exceeding the minimum, and what can we learn from these?</p>				
4. Consumers expect and demand buildings and communities that perform to a higher standard				
<p>? How can we extend the range of market mechanisms available to assess houses in a location-specific and holistic way in order to help consumers find out about alternative options that are available beyond the minimum standard?</p> <p>LCAQuick – Residential</p> <p>Understanding lifecycle design</p>	● ● ● ●	● ● ● ●		

Builders will have access to a compendium of window-wall junction solutions that are buildable without compromising weathertightness and thermal performance

Building designers will have a wider range of tools for testing the effects of different framing ratios on building performance, including interstitial moisture and energy/indoor temperature

	2018	2019	2020	2021
<ul style="list-style-type: none"> ❓ How can we help consumers request solutions that exceed the minimum by ensuring they receive targeted information at the right time? ❓ How do we improve the uptake of market mechanisms by consumers? ❓ How do we turn the industry into an advocate for the market mechanisms that are available to inform consumers about solutions that exceed the minimum? 				
<p>5. The industry delivers buildings and communities that perform to a higher requirement in a cost-effective way</p> <ul style="list-style-type: none"> ❓ What advice is being given by industry professionals to different types of consumers about exceeding current practice? ❓ How current, applicable and impartial is the advice that industry professionals are giving to consumers about exceeding minimum standards? ❓ What is the credibility and skills base of the industry professionals who advise consumers about the minimum standard? 				
<p>Supporting informed decision-making on retrofitting insulation: how might the credibility of advice to landlords and homeowners be improved?</p>	● ● ● ●			
<ul style="list-style-type: none"> ❓ How can the industry professionals who advise consumers about the minimum standard be educated and upskilled? ❓ How can we test building performance consistently, robustly and cost-efficiently, and how can achieved levels of performance be conveyed to consumers in a clear, understandable and meaningful way that facilitates easy comparison? 				

Homeowners and landlords are better informed on retrofitting insulation, and industry trains practitioners more effectively

New projects funded in 2018/19

Programme leadership

This investment continues to support the programme's delivery, providing time and resources for engaging with key stakeholders and operating the programme's advisory group.

Levy investment	\$110,000
Timeframe	April 2018 - March 2019
Contact	david.dowdell@branz.co.nz

Programme knowledge transfer

This investment helps to deliver key messages from the programme's research to identified external audiences.

Levy investment	\$50,000
Timeframe	April 2018 - March 2019
Contact	david.dowdell@branz.co.nz

How do we encourage consumers and industry to exceed the minimum?

Work in the programme so far has revealed the importance of behaviour change in the building system. Even when good-quality information is available about the benefits of exceeding the minimum, people don't always make the best choices. This project examines how to support change in building industry practices and consumer behaviour. It considers ways to encourage behaviours and decisions that will result in exceeding-the-minimum outcomes.

Levy investment	\$100,000
Timeframe	April 2018 - March 2019
Contact	casimir.macgregor@branz.co.nz

Getting the stated performance in higher-specified windows - tackling the window-wall junction

Technical information gaps still exist in areas such as window-wall junctions. Currently, the standard construction detail allows for the interior (warm) portion of an insulated glazing unit (IGU) frame to be exposed to the outdoor (cold) air temperature. This means the window's stated R value is not achieved. This research aims to provide a compendium of window-wall junction solutions for residential construction. Such solutions should be buildable without compromising weathertightness and thermal performance.

Levy investment	\$320,000
Timeframe	April 2018 - March 2020
Contact	roman.jaques@branz.co.nz

Accurately calculating thermal performance - what difference do framing ratios make?

Walls designed to achieve higher thermal performance may be compromised if higher framing ratios are used during building. This project collects data on framing ratios from design and build perspectives. It will then compare and test different calculation methods and tools to look at the effects of different framing ratios on building performance. We hope to gain better insights into interstitial moisture and energy/indoor temperature.

Levy investment	\$98,265
Timeframe	November 2017 - May 2018
Contact	michael.donn@vuw.ac.nz

Supporting informed decision-making on retrofitting insulation - improving the credibility of advice to landlords and homeowners

We know lifting the performance of existing housing stock can improve residents' health and wellbeing. This project aims to better understand where homeowners and landlords get their information about retrofit insulation, how they judge its credibility and what training the insulation installers receive. The project will make recommendations on how to provide this information and improve training. It will also provide broader insights into how such information can be shared with other building disciplines.

Levy investment	\$98,500
Timeframe	September 2017 - June 2018
Contact	heather.mcdonald@heathrose.co.nz

NOTE

You can find all information and resources relating to past and current projects in this programme at branz.nz/etm.



ELIMINATING QUALITY ISSUES

Why this is a priority

New Zealand is currently experiencing a housing supply and affordability crisis. The building and construction industry is needing to produce homes at record levels to meet this need. However, this pressure to deliver quantity – at speed – carries huge risks. Not least is a decline in quality.

Several BRANZ studies in recent years have exposed recurring instances of poor construction quality. These include poorly installed insulation, badly poured concrete slabs, non-compliant steel reinforcing and other materials, and non-compliant passive fire assemblies. Our research has sought solutions to these issues and worked with the industry to introduce changes in building practice. However, these have not always been translated into building improvements. To reverse that cycle, the industry needs to make a holistic shift in thinking and culture. Practitioners must consider the impact of their work on all aspects of society. They must be enlightened about how inferior quality work has a snowballing effect. And they must be inspired or persuaded to adopt quality solutions – for the current boom and beyond.

The story so far

The Eliminating quality issues programme has initially worked to understand the complexity and significance of the construction-quality challenges facing New Zealand. It has become clear that little systematic work in this area was undertaken before the programme came into being. Therefore, eliminating common quality issues now requires new thinking and untested approaches from the construction industry.

Early research has focussed on identifying and prioritising the quality issues that occur most often or that have the most impact. Significantly, we found that practices which allow moisture to penetrate a building envelope are still top priority.

We also found builders and clients differ on what quality means. Builders were likely to report quality as excellence or exceeding of expectations. Clients cited value for money or getting exactly what they paid for.

End-to-end communication between builder and client is critical for a shared understanding and a smooth building process.



KNOWLEDGE INTO ACTION

Prioritising quality

Before building quality can be met, builders and clients need to agree on what it is. They often have very different opinions and expectations of a project. This can not only strain their relationship but also damage the public's perception of the construction industry. Clear communication is a big part of this. But communication is not necessarily something the construction industry does well.

In this research, BRANZ interviewed both clients and builders to understand how they conceptualised quality. Clients felt it was about getting exactly what they paid for – or value for money. Builders felt it was more about excellence or exceeding clients' expectations.

Both sides of the equation even differed on how a builder was selected. Clients said they chose show-home quality and ability to get plans suited to their section and vision. Builders said they got most of their work through word of mouth.

Communication strongly influenced clients' perceptions of how well the building process was progressing. They wanted frequent, accurate and information-rich updates. Inaccurate and reactive communication sent out warning signals.

The research also explored which defects – or combination of defects – in new homes caused the most concern. It approached this from two standpoints: the building's long-term durability and usability, and the initial owner's perspective.

Industry professionals ranked technical building issues according to how often these occurred and the potential impact. Of highest priority were those practices that allowed moisture to penetrate the building envelope; damp timber used in enclosed spaces; and unbuildable designs. Also identified were incompatibility of materials; specifications that were inadequate or not followed; and materials not fit for purpose.



KNOWLEDGE INTO ACTION

Common residential housing defects

Understanding the barriers to consistent high quality in housing construction is an important step to changing the culture. This reinforces the importance of strategic initiatives such as Artisan, being delivered under the Industry Transformation Agenda.

This research found most major quality issues in New Zealand homes were not the result of inadequate Building Code clauses or accepted best practices. They were more likely to be caused by industry practitioners' ability and willingness to communicate and to achieve Building Code or best-practice requirements.

The research concluded that defects and rework were largely an unavoidable part of the building process. To ensure high-quality building, especially for New Zealand's mostly bespoke housing, continuous evaluation and quality assurance were essential.

Equally important for the industry were developing improved methods of detecting errors, communicating more effectively with clients; and managing errors for an efficient remediation. These processes would provide useful data for learning and for informing continuous-improvement strategies.

The next chapter

Ultimately, any measures adopted must help the industry track progress on eliminating common quality issues and improve its performance.

We are now ready to investigate the root causes of each persistent quality issue. We will also be measuring progress of the industry's change and investigate how we can measure new-build quality. Potential sources of data on new-build quality will be analysed for relevance, completeness, quality, efficiency and timeliness.

Over the next two years, we will undertake further work on barriers to the uptake of solutions. We will also investigate:

- » which practices the industry needs to change
- » what are the most effective ways to make these changes
- » who BRANZ needs to work with to influence the changes.

Critical success criteria

The building industry:

1. has identified common quality issues that occur in construction
2. understands why some previous work to solve common quality issues has not been successful
3. understands the need to change its practices
4. has determined the best way to reduce the incidence of common quality issues
5. has eliminated common quality issues by using existing knowledge
6. has eliminated quality issues by designing new solutions.



PROGRAMME LEADER:
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Coming in the year ahead

ELIMINATING QUALITY ISSUES

	2018	2019	2020	2021
NOTE	This timeline shows work to be carried out in 2018/19 and beyond. Work completed in previous years can be found in previous <i>Levy in Action</i> timelines. Or you can contact the programme leader for more information.			
PROGRAMME LEADERSHIP 2018/19	● ● ● ●	● ● ● ●		
1. The building industry has identified common quality issues that occur in construction				
<p>? What is a definition of quality that the industry will agree with?</p> <p>What is quality in buildings?</p>				
<p>? What are the common quality issues for all building types?</p> <p>Building pathology</p>	●			
Materials and characteristics of new buildings	● ● ● ●	● ● ● ●	● ● ● ●	● ● ● ●
Monitoring industry performance	● ● ● ●	● ● ● ●	● ● ● ●	● ● ● ●
Industry performance measures				
<p>? What are the causes of the common quality issues for all building types?</p> <p>Materials verification toolbox</p>		● ● ● ●		
<p>? How would we prioritise the most common quality issues (based on importance, impact and size)?</p> <p>Prioritising quality</p>	● ● ● ●			
2. The building industry understands why some previous work to solve common quality issues has not been successful				
<p>? What previous work has been completed to try and solve the common quality issues?</p> <p>Literature review of previous work completed to try to solve common quality issues</p>				
<p>? How aware are the different industry segments of existing solutions, and how well are these being applied?</p> <p>Awareness of solutions</p>		● ● ● ●	● ● ● ●	
<p>? What are the barriers that prevent the uptake of solutions?</p> <p>Knowing enough to ask</p>		● ● ● ●	● ● ● ●	

We will discover whether solutions exist for common defects, and where and how easily these solutions can be found. This will yield more focussed information and guidance on solutions for the building industry

Clients building new homes will have a greater stock of resources available on all aspects of the process and a better understanding of how to use these



Procurement negotiators will specify the required quality level of performance and features in new builds and renovations, along with cost

The building industry will have a better sense of how to measure issues of quality so monitoring can be improved

	2018	2019	2020	2021
<ul style="list-style-type: none"> ❓ Which of the most common quality issues require new solutions? ❓ Who needs to be involved in solving the most common quality issues? ❓ Which of the common quality issues are 'quick wins' that can be solved with little effort? 				
<p>5. The building industry has eliminated common quality issues by using existing knowledge</p> <ul style="list-style-type: none"> ❓ The specific questions are to be scoped based on the results of achieving success criteria 1-4 				
<p>6. The building industry has eliminated common quality issues by designing new solutions</p> <ul style="list-style-type: none"> ❓ The specific questions are to be scoped based on the results of achieving success criteria 1-4 				

New projects funded in 2018/19

Programme leadership

This investment continues to support delivery of the programme. It provides time and resources for engagement with key stakeholders and operation of the programme’s advisory group.

Levy investment	\$110,000
Timeframe	April 2018 - March 2019
Contact	matthew.curtis@branz.co.nz

Programme knowledge transfer

This investment helps deliver key messages from the programme’s research to identified external audiences.

Levy investment	\$50,000
Timeframe	April 2018 - March 2019
Contact	matthew.curtis@branz.co.nz

Awareness of solutions

This project focusses on why common quality issues persist in the building and construction industry. It aims to discover whether solutions exist for specific problems, and where and how easily these can be found. This information will help with design of programmes to raise awareness of solutions to common defects.

Levy investment	\$150,000
Timeframe	April 2018 - March 2020
Contact	matthew.curtis@branz.co.nz

Knowing enough to ask

This project will identify existing resources that inform new-build housing clients. It will consider how well clients use these resources during the building process.

This knowledge can support the development of resources for clients building new homes, so they can make more informed choices.

Levy investment	\$200,000
Timeframe	April 2018 - March 2020
Contact	casimir.macgregor@branz.co.nz

Procuring for quality

If procurement processes consistently focus on the lowest price for a build, quality will inevitably suffer. Lower quality of components may contribute to an unacceptable quality of building work overall.

This two-year project aims to quantify the value from changing procurement practices.

Levy investment	\$250,000
Timeframe	April 2018 - March 2020
Contact	matthew.curtis@branz.co.nz

Measuring new-build quality

This project focusses on how we can best measure elimination of quality issues. We will look at existing and potential new sources of information on new-build quality, scored against relevance, completeness, quality, efficiency and timeliness. This project will inform future decisions on monitoring as a step towards eliminating quality issues.

Levy investment	\$170,000
Timeframe	April 2018 - March 2020
Contact	matthew.curtis@branz.co.nz

NOTE

You can find all information and resources relating to past and current projects in this programme at branz.nz/eqi.



TOWARDS WARMER, DRIER AND HEALTHIER BUILDINGS

Why this is a priority

There are numerous – and sometimes complex – issues that prevent our current homes and buildings in New Zealand being warm, dry and healthy. In most cases, it's not just how buildings are built or renovated, it's also how they are used every day. In recent years New Zealanders have become increasingly aware of the poor condition of existing homes and the impact substandard housing can have on families.

Research abounds, both internationally and in New Zealand, on the links between our built environment and health issues. Cold air, dampness and mould are linked to asthma, respiratory infections, rheumatic fever and even mental health issues. Pollutants in the air cause allergies and various allergy-related conditions. In New Zealand the physical condition of places in which we live, work, play and study can affect workers' productivity or children's learning. Thus health issues are increasingly shaping building industry priorities.

It's not just our older houses that are to blame. We have seen evidence that new homes do not always provide a healthy indoor environment. There is a worrying trend of modern New Zealand buildings becoming more airtight without appropriate ventilation. The resulting build-up of moisture and trapping of pollutants in the indoor air bring ever more health risks. And so we need to find new ventilation solutions for all our buildings.

The cost of bringing buildings up to a healthy standard burdens the national and regional economies. Weathertightness issues ('leaky

buildings') are estimated to have cost homeowners around \$23 billion so far to put right. In recent years, issues with substandard roofs, especially of school buildings, have been identified. The health and social costs associated with poor-quality housing are also becoming increasingly apparent.

New factors such as climate change and modern indoor lifestyles place more pressure on our buildings to perform. With the huge amount of construction needed as our population expands, this gives the industry an opportunity to make design improvements from the ground up.

To help better understand and solve these issues, BRANZ established a multi-year Warmer, drier and healthier buildings (WDHB) programme. It provides evidence-based information to help home and building occupants, building owners and the building industry produce and maintain warm, dry, healthy environments. Ultimately New Zealanders should have homes that are warm, manage moisture properly and provide safe indoor environments.

The WDHB research programme builds on the WAVE (Weathertightness, air quality and ventilation engineering) programme, a six-year initiative that ended in October 2015. WAVE removed some of the guesswork around moisture and contaminant control in the New Zealand building stock. BRANZ is helping to avoid future issues resulting from changes to materials, designs and construction methods through further research that builds on the WAVE findings.

The story so far

The initial work of the Warmer, drier and healthier buildings programme was about understanding the issues from all angles and gathering information to plug gaps in our knowledge. To develop sustainable solutions, we first needed a good sense of existing and historic practice in New Zealand. We also needed to know how other countries tackle the issues of warmer, drier, healthier buildings: what works or doesn't.

Research within the WDHB programme in 2017/18 has continued to further develop an understanding of roofing systems and airtightness of our buildings. Airtightness is a key aspect of a building's performance affecting its energy efficiency, thermal comfort and indoor air quality. From previous work, we know we are progressively building more airtight houses. We also know newer houses are often underventilated. Our data, based on a survey of houses built since 1994, shows roughly a third had mean winter ventilation levels below international guidelines. The work is providing information that should lead to decisions balancing the competing roles of energy efficiency and quality of indoor environment. Any energy-efficiency improvements in our buildings need to be weighed against impacts in indoor air quality (IAQ) and ventilation.

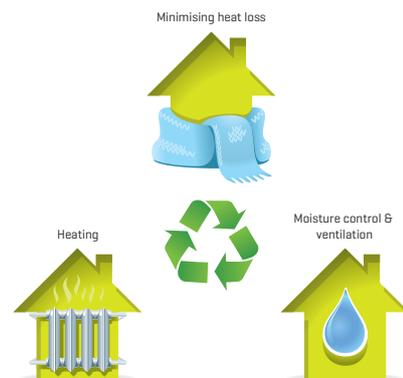
KNOWLEDGE INTO ACTION

Myth busting – how do occupants use their buildings and what needs to change?

Ground-breaking work has created new understanding on how building occupants behave and how this affects their home's condition and performance. Temperature and relative humidity are important influences on the comfort and health of building occupants. Cold temperatures and excessive moisture give rise to mould growth, presenting a health risk and causing building material deterioration.

This work looked at homes across New Zealand. It measured temperature and relative humidity over winter at locations in Auckland, Wellington, the upper South Island and Dunedin in 2016, and again in Wellington during 2017. We also determined a mould index at each home, which revealed mould growth in bedrooms and/or bathrooms of many homes. These results indicate a lack of heating and/or ventilation in these dwellings is causing mould growth, with potentially harmful health effects.

Importantly, we went a step further and looked beyond housing condition. We gathered new evidence about how heating and ventilation habits are contributing to these issues. When we build homes, we make assumptions about how people will occupy them. We needed to understand whether these assumptions are right. If we build homes with an expectation that people will open windows to ventilate, then we need to have confidence this is happening. If not, then we need to have a different conversation with the regulator and industry about how to meet the performance requirements of the Building Code. Based on insights from this new work, BRANZ's evidence suggests change is needed.





KNOWLEDGE INTO ACTION

The impact of poor-performing buildings on our children

Understanding how to improve our indoor environments could have a profound effect on the health and wellbeing of New Zealanders. A research project conducted by BRANZ together with the University of Auckland examined information from the 'Leading Light' group of children – part of the national longitudinal study *Growing Up in New Zealand*.

The work collected measurements of the indoor climate in the homes and schools of around 100 children. Preliminary measures suggested many homes New Zealand children live in could have poor indoor climates, which potentially puts their health and wellbeing at risk.

Based on these initial findings, we are now looking to link it to other *Growing Up in New Zealand* data. Measures will be linked to previously collected information about the family, home and school environments as well as to individual detailed descriptions of each child's health and development.

The children are using a 'time use diary' to describe the indoor climate of their home and school. By linking data from all sources, we are gaining remarkable insights into how indoor environments can affect an individual child's wellbeing.



KNOWLEDGE INTO ACTION

Lifting the quality of New Zealand homes

BRANZ's five-year House Condition Survey has become the go-to source of information on the state of New Zealand's homes. Over the past 12 months, BRANZ worked with Statistics New Zealand and other organisations to frame a 2018 Census question on house condition. For the first time, the Census asked residents whether their homes were damp or mouldy. This work, alongside work such as the House Condition Survey, will help paint a complete picture for the first time of the state of homes around New Zealand.

The most recent House Condition Survey report, published in early 2017, revealed rental properties throughout New Zealand were in poorer condition than owner-occupied ones. Further analysis of the survey has focussed on insulation, ventilation and heating – all important factors in maintaining a warm, dry, healthy home. Key findings were that almost half of all houses lack adequate insulation and are damp and mouldy, and bedrooms are unheated in 46 per cent of homes.

It is through this work that BRANZ has contributed to strengthening of the Residential Tenancies Act with new requirements for rental properties. In its regulatory impact statements, the Ministry of Business, Innovation and Employment (MBIE) has quoted the survey as the best source of information on the current condition of New Zealand rental housing.

BRANZ's research has also been at the heart of evidence to underpin further changes in the recently introduced Healthy Homes Guarantee Act. By reflecting the true state of New Zealand homes, the focus can then move to finding solutions to improving our ageing housing stock. This will continue to make up 35 per cent of New Zealand homes for the foreseeable future.

The next chapter

New Zealand must not only develop more new housing but also improve the condition of existing homes if it is to meet the needs of our growing population. Thus the demand for expertise and guidance on indoor environmental quality is accelerating. The industry has expressed a particular need for better understanding of how suboptimal performance affects energy consumption and occupants' health. The goals of a healthy home environment and energy efficiency can sometimes pull in opposite directions. Therefore, over the next year BRANZ will continue to collaborate with domestic and international researchers to assess the right path for New Zealand.

We will be building on a successful joint BRANZ and Massey University initiative involving designers, medical professionals, policymakers, manufacturers, builders and researchers. We have organised for international experts to come to New Zealand to share their expertise on ways New Zealanders can improve the airtightness and ventilation of their homes.

In 2018/19 our research is shifting from establishing the evidence base. The main focus now is on informing decision-makers and finding solutions to the most pressing problems in existing buildings that affect occupant health. Areas needing attention include weathertight cladding for medium-density buildings, ventilation in large-span roofs, airtightness and energy-saving. The programme will also look at new, more effective ways to communicate key insights and solutions to the industry as well as owners, suppliers and users of New Zealand buildings.

Making a difference

New Zealand will have warmer, drier and healthier buildings through a better understanding of the issues and exploring of solutions.

A comprehensive suite of information and a well-informed industry will help consumers make the best building decisions for their health.

The industry will receive fewer complaints about excess indoor moisture resulting from building flaws.

Health statistics will show a reduced incidence of respiratory diseases from poor-quality indoors environments.

Critical success criteria

1. There is a strong understanding of the issues that prevent our current homes and buildings from being warm, dry and healthy.
2. Solutions to developing warmer, drier and healthier homes and buildings in New Zealand have been successfully identified.
3. The industry understands the knowledge, ways of implementing the solutions and benefits provided.
4. Owners, suppliers and users of New Zealand buildings have the knowledge and understanding to make effective decisions for producing and maintaining warm, dry, healthy environments.



PROGRAMME LEADER:
Mark Jones

✉ mark.jones@branz.co.nz

Coming in the year ahead

WARMER, DRIER AND HEALTHIER BUILDINGS

	2018	2019	2020	2021
NOTE This timeline shows work to be carried out in 2018/19 and beyond. Work completed in previous years can be found in previous <i>Levy in Action</i> timelines. Or you can contact the programme leader for more information.				
PROGRAMME LEADERSHIP 2018/19	● ● ● ●	● ● ● ●		
1. There is a strong understanding of the issues that prevent our current buildings being warm, dry and healthy				
? What are the external, interstitial and internal moisture issues that prevent our current buildings from being warm, dry and healthy? New Zealand's experimental buildings	● ● ● ●	● ● ● ●	● ● ● ●	● ● ● ●
? What are the ventilation and indoor environmental quality-related issues that prevent our current buildings from being warm, dry and healthy?				
Occupant ventilation behaviour	● ● ● ●			
Airtightness of apartments		● ● ● ●	● ● ● ●	●
Indoor air quality in higher-performance homes – pilot	● ● ● ●	● ● ● ●		
Indoor environmental and fungal exposure in residential homes	● ● ● ●	●		
Keeping our children warm and dry (full study) – Evidence from Growing Up in New Zealand	● ●	● ● ● ●	● ● ● ●	● ●
? What are the other issues that prevent our current buildings from being warm, dry and healthy, and why are these a problem?				
Meth contamination of building materials		● ● ● ●	● ● ● ●	● ● ● ●
Pollutant levels in modern New Zealand homes and offices		● ● ● ●	● ● ● ●	● ● ● ●

We can more accurately quantify pollutant exposure levels in New Zealand homes, given indoor environmental parameters and occupant behaviour patterns

	2018	2019	2020	2021
3. Industry understands the knowledge, ways of implementing the solutions and benefits provided				
<p>? What are the most effective ways of communicating the benefits to industry?</p> <p>Roof design</p>	● ● ● ●			
		<div style="border: 1px solid gray; padding: 5px;"> Estimating how much roof ventilation is needed to avoid excessive moisture build-up is still a complex, specialised procedure. The industry will have easy-to-use information and guidance on solutions and benefits </div>		
<p>Roof ventilation: risk-analysis matrix for designer and councils</p>		● ● ● ● ● ● ● ●	● ● ● ● ● ● ● ●	
<p>? How can the solutions to the technical issues identified be rolled out to industry to encourage their uptake?</p> <p>? How is the research incorporated into the regulatory framework, e.g. Acceptable Solutions and Standards, and how are these adopted by industry and consenting authorities?</p>				
<p>Model buildings</p>		● ● ● ● ● ● ● ●	● ● ● ● ● ● ● ●	● ● ● ● ● ● ● ●
<p>? How does the market provide for implementation of solutions?</p>				<div style="border: 1px solid gray; padding: 5px;"> Robust evidence on indoor environmental quality in a wide range of home styles will inform NZ Building Code standards </div>
4. Owners, suppliers and users of New Zealand buildings have the knowledge and understanding to make effective decisions in producing and maintaining warm, dry and healthy environments				
<p>? What are the most effective ways of communicating the benefits to owners, suppliers and users?</p> <p>House Condition Survey – Contributing to national housing quality data and information needs</p>	● ●	● ● ● ● ● ● ● ●	● ● ● ● ● ● ● ●	
<p>? What knowledge/information do owners, suppliers and users need to make sound decisions when investing in, producing and maintaining warm, dry and healthy buildings?</p> <p>Feasibility of an updated residential energy-use study</p>		● ● ● ● ● ● ● ●	● ● ● ● ● ● ● ●	
<p>? How can the need for continual improvement to buildings be monitored and communicated?</p>				

New projects funded in 2018/19

Programme leadership

This investment continues to support the programme's delivery, providing time and resources for engagement with key stakeholders and operation of the programme's advisory group.

Levy investment	\$110,000
Timeframe	April 2018 - March 2019
Contact	mark.jones@branz.co.nz

Programme knowledge transfer

This investment helps deliver key messages from research in the programme to identified external audiences.

Levy investment	\$50,000
Timeframe	April 2018 - March 2019
Contact	mark.jones@branz.co.nz

Bringing health and building science together – Work with He Kainga Oranga

Many aspects of the Warmer, drier and healthier buildings research programme require health expertise to gauge how the existing indoor environmental quality (IEQ) affects people. This information is fundamental to developing better IEQ guidelines and measures for the building sector. BRANZ recognises the key public health expertise within the University of Otago's He Kainga Oranga (Housing and Health Research Programme). By working together, BRANZ and He Kainga Oranga can link substantial building physics expertise and public health expertise to help shape and improve New Zealand homes.

Levy investment	\$630,000
Timeframe	April 2018 - March 2023
Contact	manfred.plagmann@branz.co.nz

Growing up in New Zealand

The overall goal of this research is to provide new insights into how the indoor climate of homes and classrooms affects New Zealand children. We can achieve this for the first time by working with the Growing Up in New Zealand nationwide longitudinal study. This ground-breaking research is providing new evidence to shape changes that will lift the performance of our buildings. Through this, it will also improve the lives of New Zealand kids.

Levy investment	\$721,000
Timeframe	April 2018 - March 2021
Contact	s.morton@auckland.ac.nz

Chemical contamination of building materials

New Zealand has a well-documented problem of buildings being contaminated by a broad range of different chemical and biological pollutants. The key issue is: How do we test the susceptibility of building materials to chemical contamination? This work is supporting the design and standardisation of experimental methodologies for measure chemical contamination in buildings in the first instance. These standard methods will then support a consistent approach to research involving remediation and reducing the uncertainty that has existed about what can be considered 'clean'.

Levy investment	\$900,000
Timeframe	April 2018 - March 2021
Contact	kathryn.stokes@branz.co.nz

Pollutant levels in modern New Zealand homes and offices

Pollutants in New Zealand homes and the resulting exposure level can be modelled to provide an estimate of the health impact for occupants.

This project will develop a pollutant model based on measurements in occupied homes. This can quantify exposure levels given indoor environmental parameters and occupant behaviour patterns.

Levy investment	\$370,000
Timeframe	April 2018 - March 2021
Contact	manfred.plagmann@branz.co.nz

Smart ventilation and indoor environmental quality (IEQ)

This project will deliver novel ventilation methods in collaboration with an international project hosted by the IEA Air Infiltration and Ventilation Centre (AIVC). We aim to develop new, energy-efficient and healthy ventilation methods tuned for optimum performance. Primarily, we seek to answer these questions: Can smart ventilation systems provide a better health and energy outcome than conventional systems? What does such a system look like?

Levy investment	\$1250,000
Timeframe	April 2018 - March 2023
Contact	manfred.plagmann@branz.co.nz

Fungal exposures in New Zealand homes

This is a BRANZ collaboration with Auckland University (Growing Up in New Zealand project) and Massey University. BRANZ will measure building physics and IEQ parameters to help provide a richer dataset for Growing up in New Zealand's health impact indicators.

This will widen the already powerful Growing up project to provide more background about the homes (BRANZ) and schools (Massey) the children spend most of their time in.

The project will help to establish whether a link exists between exposure to fungi and children's health outcomes. We will also know more about the effects of fungal exposure in different locations, dwelling types and ages, and whether this needs further research.

Levy investment	\$380,000
Timeframe	April 2018 - March 2023
Contact	manfred.plagmann@branz.co.nz

Corrosion in vented roof cavities

Adding passive ventilation elements to roof cavities has been shown to remove excess moisture. This in turn decreases the likelihood of condensation and building performance problems. However, opening the roof cavity might increase the corrosion rates of metal components as an increased air exchange also adds salt particles to the attic space.

We will determine whether opening the roof cavities by installing passive ventilation elements results in higher corrosion of internal metal fixtures and components. We will compare two identical structures - one with and one without vent elements - close to a marine environment.

Levy investment	\$202,000
Timeframe	April 2018 - March 2020
Contact	stephan.rupp@branz.co.nz

Roof ventilation calculator

Determining the amount of roof ventilation required is part of designing a roof system. Recent research has created a calculation method to determine the ventilation requirements in a roof, given a rather large set of parameters. This manual long-hand calculation option was presented to around 1000 attendees at the science seminar in March 2017. The feedback was that working through manual mathematical calculations was too hard and they were unlikely to use it.

This project is to develop a simple-to-use, responsive design application for the calculation method. It would be based on a tablet prototype already developed by BRANZ for research purposes.

Levy investment	\$250,000
Timeframe	April 2018 - March 2021
Contact	margaret.mclachlan@branz.co.nz

Roof ventilation – A risk analysis matrix for designers and councils

BRANZ has developed a procedure to estimate how much roof ventilation is needed to avoid excessive moisture accumulating. However, there are limits to this method. In its current state, it requires expert background knowledge to use. If this method is to be made available to a larger industry audience, it needs to be accessible. We will create a simple-to-use, matrix tool which determines the risk of excessive roof cavity moisture and recommend position and free opening area for passive roof ventilation.

Levy investment	\$485,000
Timeframe	April 2018 - March 2020
Contact	stephan.rupp@branz.co.nz

Model buildings – Next generation of the Building Code

The government and the industry need robust evidence to inform changes to Building Code clauses that affect indoor environmental quality. This project will provide this solid base of evidence. The work will use BRANZ’s industry-leading experimental and computational practices. It will improve the agreement between simulations and reality so simulations can be used to help MBIE and others make decisions on building performance. This project aims to provide exemplar experimental data from 10 to 15 buildings. These will encompass a range of styles, from older houses to modern apartments.

Levy investment	\$1670,000
Timeframe	April 2018 - March 2023
Contact	stephen.mcneil@branz.co.nz

Feasibility of an updated residential energy-use study

This work will assess the feasibility and key stakeholder interest in carrying out an updated evaluation and model of residential energy use in New Zealand homes.

From 1995 to 2005, BRANZ carried out the Household Energy End-use Project (HEEP) to measure and model how New Zealand households use energy. Government departments and research organisations have used data and information from the HEEP study extensively. And this has provided the basis for policy development and design guidance. The results from HEEP have also raised awareness of the indoor conditions of our homes. Even though the data is more than 12 years old, it is often still quoted as a measure of the indoor environment of New Zealand’s housing stock.

Initial discussions with stakeholders suggest there is strong interest in updating this influential study. It should take into account the significant developments in energy-efficiency initiatives and technology improvements over the past decade.

Levy investment	\$290,000
Timeframe	April 2018 - March 2020
Contact	mark.jones@branz.co.nz

NOTE You can find all information and resources relating to past and current projects in this programme at branz.nz/wdwb.



LOW-CARBON TRANSITION – PROPOSED PROGRAMME

What and why

Climate change presents one of the biggest challenges facing the world today. The built environment has a core part to play in how our society adapts and seeks to mitigate the impacts of climate change.

BRANZ is scoping a programme to examine climate change and its impact on New Zealand building. It will bring together key industry, research and government partners to provide a focus for research that addresses unanswered questions. It will look

at how the construction industry can contribute to climate change mitigation and adaptation. It will also consider how well our buildings perform on energy efficiency and emissions.

The readiness for changing conditions that result from climate change ultimately has implications for the wellbeing of all New Zealanders. As an industry we need to take steps now to look at how we manage these issues.

The programme scoping will take a holistic approach. We need to address the physical buildings as well as how our behaviour influences climate change.

New Zealand has committed to addressing climate change:

- » New Zealand has signed and ratified The Paris Agreement, which commits us to achieving a 30 per cent reduction on our 2005 greenhouse-gas emissions by 2030. Article 4.1 of the Agreement aims to achieve net-zero carbon emissions between 2050 to 2100. Industrialised countries such as New Zealand are expected to lead this effort.
- » New Zealand's building sector should aim to achieve this target by 2050 or earlier. After all, buildings constructed now will still be operating during New Zealand's transition to a low-carbon economy. Due to the long life of buildings, we need to be considering their contribution to a low-carbon economy today.
- » New Zealand's greenhouse gas emissions have been rising. This trend is projected to continue over the next 10–20 years if we carry on as we have been (Royal Society, 2016). This contrasts with countries such as the United Kingdom, which already has policies and actions to reduce its emissions (PCE, 2017).
- » Buildings contribute to 20 per cent of New Zealand's greenhouse gas emissions (Royal Society, 2016). This is partly from how much energy they use. But the production of construction materials, the manufacture of products and the logistics and disposal of construction wastes also play a part. This does not consider that greenhouse gas emissions that arise offshore because of our demand for imported manufactured construction products, including emissions from these sources, increases the contribution of buildings.

- » The Deloitte Business NZ Election Survey has found climate change is one of the top 10 government-related issues for businesses (reported by the Sustainable Business Council).
- » BRANZ is undertaking a background report into the built environment and climate change as well as the transition to a low-carbon economy. This will contribute an evidence base for the Ministry for the Environment's (MfE) ongoing work in this area.

What we hope to achieve

The programme seeks to encourage research into climate change and the built environment. It will help prepare actionable research that encourages leadership, strategic direction and climate action in the built environment.

Plan for development in year ahead

A programme development plan will be completed in 2018. This will set out the programme's direction, research questions and success criteria. It will also outline how the programme will seek to create research impact. While the programme is being scoped, BRANZ is undertaking projects that inform its development. We will also address some immediate issues facing the building and construction industry.

How people can get involved

Development of the low-carbon economy programme is being managed by Dr Casimir MacGregor. A working group will help guide the initiative. It will comprise key New Zealand stakeholders such as MfE, MBIE and industry leaders. It will also include experts from BRANZ and other research organisations. Recognising the lessons from other countries, it will draw on international expert advisers such as Professor Tim Flannery, former Chief Commissioner of the Climate Commission in Australia.

If you'd like to know more, please contact Casimir MacGregor, casimir.macgregor@branz.co.nz

Project-level information on all new and existing projects

Climate change is one of the most important issues facing the New Zealand building industry and our built environment. It is as much a socio-cultural issue as an ecological one. There is much we can and should do to make sure our buildings – and our industry – respond to the issue as New Zealand transitions to a low-carbon society.

BRANZ research seeks to lay a strong foundation for the knowledge and tools that will encourage climate action across the sector.

The programme design begins in earnest in 2018. But we have already kick-started it with some research (outlined below) addressing some key issues affecting our climate future.

The built environment and climate change – transition to a low-carbon economy

This project explored how the built environment can contribute to New Zealand's transition to a low-carbon economy. The key focus is on how much climate change may affect the built environment and how this can be mitigated.

This was an exploratory piece of research. The first part reviews and summarises current knowledge of buildings and climate change. The second examines who the main New Zealand stakeholders (both people and organisations) are. The third part outlines solutions for preparing the built environment for a low-carbon economy.

The report suggests three key strategies:

1. For both new and existing buildings, improve energy efficiency, decrease the energy-supply carbon footprint, manage peak demand and decarbonise supply.
2. For building materials, reduce the level of embodied carbon.
3. Show strategic leadership by changing understanding, beliefs and practices on carbon usage in the built environment.

Levy investment	\$94,800
Timeframe	September 2017 – April 2018
Contact	casimir.macgregor@branz.co.nz

How can New Zealand construction deliver low-impact to zero-impact buildings?

In 2016, BRANZ and its research partners completed work on developing the New Zealand whole-building, whole-of-life framework. For the first time in New Zealand, this provided resources for calculating – and reducing – the environmental impacts of office building designs.

Environmental impacts currently calculated are climate change, stratospheric ozone depletion, air acidification, photochemical oxidant formation, eutrophication, and depletion of fossil fuels and minerals. A proposed research project explores how the New Zealand construction sector can dramatically cut environmental impacts in buildings. This will include region-specific guidance on low-to zero-impact solutions.

This research project is part of the International Energy Agency's Energy in Buildings and Communities (IEA-EBC) programme. It has begun a new research annex (Annex 72) on how we shift to lifecycle net low- to zero-impact buildings. Such an approach recognises the significance of climate change. But it also acknowledges the need for informed, balanced decisions that consider other environmental impacts.

Levy investment	\$1,575,000
Timeframe	April 2018 – March 2022
Contact	david.dowdell@branz.co.nz

Built-environment carbon budget

This research looks at how we can consider a carbon-neutral future in new buildings and retrofits of existing buildings. The research asks: “If each building had a carbon budget, what would it look like?” A carbon budget is the maximum total quantity of greenhouse-gas emissions allowable to meet climate change targets, over a specified time frame. This carbon budget project asks: “How can we empower immediate interim action on climate change? What is the baseline emission profile for the built environment in New Zealand?”

The research will provide transparency for the building sector's emission profile. It leverages work done by the Parliamentary Commissioner for the Environment (PCE), the Productivity Commission and MfE. The results will help guide the industry to act on climate change and provide a baseline for measuring the carbon emissions from buildings. Currently we do not have a reliable New Zealand figure.

Levy investment	\$185,000
Timeframe	December 2017 to March 2020
Contact	roman.jaques@branz.co.nz

BEES 2.0(A)

The Building Energy End-use Study (BEES 1) was a six-year project, over 2007-13. It monitored and examined energy and water consumption of commercial office, retail and mixed-use buildings around New Zealand. This provided ways to measure energy use in commercial buildings. It also provided new knowledge and understanding of resource use inside commercial buildings. The BEES 2(A) project had two phases. The first entailed six months of mining existing datasets (including BEES 1) and identifying future data sources and industry needs. It culminated in production of a digestible publication. The second phase build on the original BEES research and collaborates with key stakeholders to scope the next phase of empirical research. A collective vision and plan needs formulating before BEES 2.0 begins.

Levy investment	\$60,000
Timeframe	December 2017 to October 2018
Contact	casimir.macgregor@branz.co.nz

KEEPING PEOPLE AND BUILDINGS SAFE FROM FIRES – PROPOSED PROGRAMME

What and why

Fire in New Zealand's built environment has a significant social, economic and environmental impact each year. As cities become denser, sustainable but combustible building systems become more prevalent and demographics such as age and mobility change, the fire hazard increases. There is an evolving need for research into building fire safety. This work aims to identify key components of a fire research programme to solve these new and emerging issues.

What we hope to achieve

The programme aims to establish a research platform to co-ordinate New Zealand's fire research efforts in the built environment. This would be achieved through stakeholder consensus, pooling of resources and effective collaboration across the research community. By taking a multi-organisational, multi-disciplinary approach, BRANZ will help lead a conversation about how best to prioritise and deliver the work New Zealand needs.

Plan for development in year ahead

A Fire Research Stakeholder Group has been established with representation from key organisations. They include the Ministry of Business, Innovation and Employment (MBIE), Fire and Emergency NZ, the Fire Protection Association NZ, the Society of Fire Protection Engineers, the Institution of Fire Engineers NZ, Auckland Council

and the Insurance Council of NZ. The group also involves the major fire-research institutions: University of Auckland, Victoria University of Wellington, Heavy Engineering Research Association, University of Canterbury and Scion. Independent international experts from the US and the UK are also included. The purpose of this core group is to identify key issues that will shape the programme. It has already identified key fire research themes for the New Zealand built environment.

For more detailed programme development work, a project advisory group has been formed. This has representation from government, industry and the research community. The project advisory group will use the key issues identified by the stakeholder group and determine the programme's research focus. This will identify the programme's core outcomes, address priorities agreed on by the stakeholders and consider where investment will have the biggest impact.

How people can get involved

It is early days in developing this new programme. Though our work to date has featured strong stakeholder engagement, we also welcome contact from interested others. As the programme takes shape and work progresses, we expect research providers will get an opportunity to contribute. For example, a New Zealand research mapping exercise (capability and activity) will be undertaken and updated throughout the project. In addition, a trial of the programme framework will be conducted and research providers can submit proposals.

If you'd like to know more, please contact research@branz.org.nz

Project-level information on all new and existing projects

The Fire Research Stakeholder Group was established as part of the existing Preparing the Foundations for Risk-Informed Fire Safety Design project. The group identified these research areas:

Building users

- » Human behaviour in fire
- » Vulnerable populations
- » Fire brigade intervention

Health and sustainability

- » Health impact
- » Environmental impact
- » Economic impact
- » Interaction between sustainability and fire safety

Uncertainty

- » Quantitative risk analysis
- » Reliability of fire safety systems in buildings
- » Risk-informed acceptance criteria

Building resilience

- » Structural fire performance
- » Post-earthquake performance of buildings in fire
- » Material performance in fire



Building typologies

- » Fire safety in tall buildings
- » Fire safety in medium-rise buildings
- » Fire safety in residential buildings
- » Fire safety in upgrading existing buildings
- » Fire safety at the wildland-urban interface (WUI)

Material and system performance

- » External vertical fire spread
- » Reaction-to-fire behaviour
- » Compartment fire dynamics

Technology

- » Fire modelling
- » Collection and analysis of fire data

DISTINCT STANDALONE RESEARCH

BRANZ also invests the Building Research Levy in distinct pieces of research into industry needs outside the research programmes. This is part of BRANZ’s commitment to maintaining a balanced portfolio of research and maintaining investment in important research capability.

These standalone projects must also demonstrate how they address research priority themes from the Levy Investment Priority Statement.

Here are details of all new standalone research projects. A full list of all standalone projects under way in 2018/19, including those continuing from previous years, is presented in the appendix, page 78.

Alternative tenure models

New Zealand’s housing market has a relatively traditional tenure structure. Overseas, several alternative hybrid formats have been used in comparable economies. These formats may provide opportunities in the New Zealand context to improve housing and other household outcomes.

This research will investigate whether tenure models used overseas are applicable to New Zealand. It will consider whether these models could provide opportunities to improve access to affordable, good-quality housing with long-term security of tenure. The project will also look at different models to meet the needs of households as they age and at the different pressure points along the housing continuum. The research aims to demonstrate the opportunities offered by alternative tenure models and the institutional and legislative changes required to make these happen.

Levy investment	\$100,000
Timeframe	March 2018 – September 2018
Contact	ian.mitchell@livingstonassociates.co.nz

ArchEngBuild 2018

ArchEngBuild brings together 30 of New Zealand's best architecture, engineering and construction management students. They will collaborate on designing a future-focussed building development for the host centre. It is an investment in the skills of some of the industry's brightest future leaders.

ArchEngBuild recreates a real-life client brief reflecting the host city's aspirations and issues. This gives students a unique work experience before they start their working life. Students can experience cross-discipline collaboration, often for the first time. And they are encouraged to use the latest building materials, innovations and technology in their designs.

Levy investment	\$97,500
Timeframe	January 2018 - July 2018
Contact	archengbuild@branz.co.nz

Better post-disaster projections

With residential insurers now using cash settlements following a natural disaster, future construction workloads are less visible. It is unclear whether, how and when homeowners spend their cash settlement funds on construction works.

This project aims to understand homeowners' recovery intentions. This will help us to project residential recovery workloads for the remainder of the Canterbury recovery as well as for indicative future natural disasters. The project can support investment decisions across the construction supply chain, supporting better planning for post-disaster recovery in New Zealand.

Levy investment	\$100,000
Timeframe	February 2018 - March 2019
Contact	nick.brunsdon@branz.co.nz

Combustible facade fire safety

Recent international fires have raised concerns across the globe about the fire risks associated with combustible facades.

This project investigates how the fire risk of combustible facade materials is managed in New Zealand's building regulation and compliance documents. It will also undertake large-scale tests to determine an appropriate method to evaluate the fire risks.

The research will help keep New Zealanders safe from fires by informing development of building regulations related to facade construction. It will give greater confidence in the use of facade systems in New Zealand.

Levy investment	\$1,030,000
Timeframe	April 2018 - June 2021
Contact	kevin.frank@branz.co.nz

Cost-benefit analysis methodologies - An exploratory study of indoor environmental quality

BRANZ and other construction industry researchers often use cost-benefit analysis to communicate the benefits of building improvements. Many current methodologies only incorporate construction and energy costs without looking at health and other benefits.

This project will develop a cost-benefit analysis framework that incorporates a broader spectrum of benefits for quantifying building improvement benefits.

This will provide an evidence base from which to inform current policy debates and provide evidence to help drive building improvements. Over time, this will improve the standard of buildings in New Zealand.

Levy investment	\$150,000
Timeframe	April 2018 - March 2019
Contact	brian.berg@branz.co.nz

Fire-safe use of timber construction II

The system used to regulate all combustibile interior lining materials in New Zealand has proven to be a barrier to the use of exposed timber linings. This may be partially addressed with proposed changes to the New Zealand Building Code. However, sound engineering methodologies can give confidence in understanding of the real fire hazard in a wide range of room sizes and lining configurations.

This research will deliver innovative modelling capability. It will also support a more efficient compliance framework for reducing barriers to the use of timber-based materials in New Zealand buildings. It will inform improved design and analysis methodologies, giving flexibility in the use of exposed timber (or appropriately protected timber) in a wide range of mid-rise and tall buildings. This will support an efficient and consistent level of fire safety in timber buildings and reduce existing barriers to their construction.

Levy investment	\$1,120,000
Timeframe	January 2018 - September 2021
Contact	research@branz.org.nz

Good Practice Guide - Waterproof Membrane Decks

Waterproof decks are undergoing a resurgence in popularity as developers seek to incorporate outdoor spaces into medium-density housing and apartment developments. There is a history of weathertightness failures from poorly constructed and/or poorly specified waterproof membrane decks. Acceptable Solution E2/AS1 has limited coverage of waterproof membrane deck construction and covers only two membrane options.

A new good practice guide will include the design and construction of Code-compliant waterproof membrane decks and their ancillary features. Good practice guides incorporate updates to Code documents and standards to ensure industry practitioners have the latest information.

Levy investment	\$100,000
Timeframe	April 2018 - March 2019
Contact	margaret.mclachlan@branz.co.nz

House Condition Survey - Contributing to national housing quality data and information needs

For more than two decades, BRANZ has been at the forefront of providing evidence about the quality of New Zealand's housing stock through its House Condition Survey. This new project will review the survey to develop and integrate content into a digital housing assessment survey tool. It will also pilot a revised approach to collecting and sharing objective data on housing quality.

The needs for national data are changing and BRANZ is working with government on this. Key collaborations includes MBIE's work on housing quality and the inclusion of questions on housing and the physical environment in Statistics New Zealand's 2018 General Social Survey (GSS).

BRANZ is working with MBIE and Stats NZ on developing the survey content and with LINZ on developing the digital surveying tool. The revised survey content and application will be piloted on a subsample of houses included in the 2018 GSS. Learnings from the pilot will help inform understanding of the potential for smarter data collection, and sharing and application of national housing survey data.

Levy investment	\$510,000
Timeframe	January 2018 - March 2020
Contact	vicki.white@branz.co.nz

House foundations on sloping sites

Houses on sloping sites tended to perform poorly after the Canterbury earthquake sequence. Given many New Zealand homes can be built on sloping sites, this was a worry. This project focusses on the development of resilient construction practices for house foundations situated on sloping sites. It is supported by the Earthquake Commission (EQC).

The research analyses foundation performance on four light-timber-framed house foundation sites, each installed on a sloping site. The findings will be submitted to Standards New Zealand for improving provisions of the existing NZS 3604 standard as well as design guidance for retrofitting existing foundations. The latter will provide indications of the likely costs for retrofitting.

Increasing the resilience of houses on sloping sites gives residents the opportunity to remain in their homes after a major earthquake.

Levy investment	\$52,040
Timeframe	November 2017 – May 2019
Contact	graeme.beattie@branz.co.nz

Housing the future New Zealand

Statistics New Zealand has signalled the demographic changes we expect to see in New Zealand over the next 50 years. This project explores what those projected changes mean for the building and construction industry, and for housing New Zealanders into the future.

The project is focussed on family composition, household structure, age structure, ethnic composition, regional demand and models of tenure (rental versus owner-occupier) in future markets. It will deliver a baseline understanding of what the future of housing need looks like. This will inform planning and design of homes to meet that need.

Levy investment	\$150,000
Timeframe	March 2018 – March 2019
Contact	anne.duncan@branz.co.nz

Materials within geothermal environments

The general condition of properties in New Zealand's geothermal environments has been shown to be poorer than in other regions. Around 120,000 people live in more than 55,000 dwellings in geothermal environments. A recent BRANZ study revealed unusual material-degradation behaviours. These indicate the short-term testing data cannot be extrapolated to assess long-term durability and estimate service life of building materials in these environments.

This research will deliver a better understanding of the longer-term performance of building materials and protective coatings in geothermal environments. This will be new technical knowledge relevant to specific engineering design. It will also investigate why the unusual material degradation behaviours happen. This research supports the need to increase the durability, integrity and safety of buildings and infrastructural assets in New Zealand's geothermal environments.

Levy investment	\$440,000 new (\$230,000 existing)
Timeframe	April 2016 – September 2024
Contact	zhengwei.li@branz.co.nz

Mental health in the construction industry

International research shows that the construction industry suffers from higher rates of suicide and mental health issues than the general population does. In Australia, construction workers are six times more likely to die of suicide than in a workplace accident. They are also twice as likely to commit suicide as the general population. Countries such as Australia, the UK and the US have conducted research on this issue. They have implemented initiatives to reduce suicide and mental health issues as a fundamental part of health and safety.

This scoping study will establish whether further research is justified on this issue in New Zealand. It will involve consultation with representatives from the construction industry, the mental health sector, WorkSafe New Zealand, ACC and the Coroner's Office. The aim of this consultation is to gauge whether poor mental health is an issue requiring more thorough investigation and research.

Levy investment	\$50,000
Timeframe	April 2018 - September 2018
Contact	anne.duncan@branz.co.nz

Building Basics series - new editions

Building Basics is a series of practical, easy-to-read, well-illustrated publications for designers and builders. Their purpose is to ensure New Zealand achieves 'good' construction results. Since publication of the original works in 2012-13, legislative, acceptable solution and verification method changes have occurred, and new practices and products have been introduced. New editions of the current *Building Basics* series bring six titles up to date:

- » Insulation
- » Internal moisture
- » Minimising waste
- » Steel framing
- » Weathertightness
- » Your business

Levy investment	\$150,000
Timeframe	April 2018 - March 2019
Contact	margaret.mclachlan@branz.co.nz

Pressurisation system effectiveness

High-rise residential buildings with a single means of escape can rely on pressurisation systems for maintaining a safe environment for occupants as they exit. Information on the effectiveness of safe path pressurisation systems is limited.

This pilot study investigates the effectiveness of pressurisation systems at maintaining occupant tenability in fire-protected stair or corridor enclosures (safe paths) during fires. The findings can help engineers and stakeholders to confidently evaluate the effect of pressurisation systems on fire risk in buildings.

Levy investment	\$116,000
Timeframe	April 2018 - June 2019
Contact	kevin.frank@branz.co.nz

Regional waste auditing – Waste flows and composition

Waste generated from construction is estimated to be 50 per cent of the total volume going to New Zealand landfills. It contributes to greenhouse gas emissions and economic loss through wasted material and landfill costs. In 2002, the Ministry for the Environment (MfE) provided estimates of waste figures to landfill across industries and for different regions. This project proposes to update and expand on the work MfE and others have conducted, with a focus on the construction industry.

The research will quantify the volume and composition of construction waste by region. It also aims to understand drivers and barriers to recycling and reuse of construction waste in organisations. The work will inform regionally tailored sustainability initiatives, increase recycling and reuse, and reduce construction waste to landfill. This, in turn, will help New Zealand reduce its carbon impact.

Levy investment	\$175,000
Timeframe	April 2018 – April 2020
Contact	anne.duncan@branz.co.nz

ROBUST Building System testing

The ROBUST Building System testing programme is a collaborative New Zealand-Chinese project involving 2D shake-table testing of a full-scale, multi-storey resilient and repairable building system.

The testing will be conducted at the International Joint Research Laboratory on Earthquake Engineering (ILEE) facilities in Shanghai, China. The test specimen will represent a realistic New Zealand building with structural elements and floor diaphragms. It will also focus on non-structural elements such as ceilings, partitions and cladding. Earthquake energy will be dissipated using a range of frictional systems, many of them developed in New Zealand.

BRANZ is working alongside a national consortium of participants and sponsors to deliver this innovative research. Partners include Auckland University of Technology, Comflor, the Heavy Engineering Research Association (HERA), Steltech, Tectonus, the University of Auckland, the University of Canterbury, the Earthquake Commission (EQC), QuakeCentre and the QuakeCoRE. The project receives significant 2:1 matching funding from the Chinese research participants.

This 'all of New Zealand' test aims to develop new science on friction connections and non-structural elements. It will provide an exemplar of how economic resilient technology can protect a whole building.

Levy investment	\$50,000
Timeframe	March 2018 – February 2019
Contact	gregory.macrae@canterbury.ac.nz

Supporting the scoping of precast concrete floors research

Fallout from the Kaikoura earthquake includes the collapse of precast concrete flooring components in Wellington’s Statistics House and varying levels of damage to units in other buildings. This has raised new questions about the performance of these elements.

The details for these floor systems have been improved in new buildings. However, support conditions for units in existing buildings designed before 2006 could lead to significant damage – even collapse – in design level ground motions.

The Ministry of Business, Innovation and Employment (MBIE) established a working group to draft guidance that engineers can use for assessment of existing floors in the short term. These guidelines were due to be completed in March 2018. After that, engineers will need urgent direction on retrofit approaches to addressing vulnerable buildings.

Alongside this work, some questions about assessment of precast floors remain unanswered. Further research will help improve implementation of the working group’s guidelines. The group has developed a list of research issues that need to be addressed to more fully inform the guidance and provide medium-term retrofit solutions. This project is accelerating the detailed scoping of the work required to address these issues.

Levy investment	\$50,000
Timeframe	March 2018 - June 2018
Contact	nic@compusoftengineering.com

Seismic performance of precast concrete floors

Serious concerns were raised about the seismic performance of existing buildings with precast concrete floors in the Canterbury and Kaikoura earthquakes. Concrete buildings represent 80 per cent of existing multi-storey buildings in New Zealand. A challenge for New Zealand is understanding how to identify seismically vulnerable concrete buildings and what actions are needed to improve seismic resilience.

In consultation with QuakeCore, BRANZ identified the need to advance understanding in this area. This research will deliver a method and tool to appropriately assess the seismic performance of existing buildings with precast floors. It will help identify seismically vulnerable buildings that may require strengthening to improve the resilience of New Zealand’s building stock.

The research will be used in updating the national seismic assessment guidelines on precast floors. It will also inform MBIE’s Precast Advisory Group on future changes in precast floor practice.

Levy investment	\$610,000
Timeframe	February 2018 - January 2020
Contact	angela.liu@branz.co.nz

Small-scale greywater

As our population increases, so does the pressure on the freshwater resource. A possible alternative is greywater – excess water from showers, washing machines and hand basins.

This project aims to assess the quality of greywater and its implications for human health. It compares residential and commercial buildings, monitoring weekly samples from various greywater sources over a six-month period. This research hopes to inform decision-making around the use of greywater reuse systems, leading to more businesses and homes taking up greywater options for toilet flushing and irrigation. This could have a major impact on improved, sustainable use of water in New Zealand.

Levy investment	\$42,000
Timeframe	December 2017 - December 2018
Contact	anne.duncan@branz.co.nz

Structural adhesives

The Building Code requires evidence of a minimum durability of 50 years for all structural building elements. This prescriptive durability requirement also applies to the adhesives used in structural applications such as engineered wood products (EWPs).

Conventional resorcinol-based structural adhesives have a long history of use, providing evidence of their ability to meet durability requirements. Other adhesives, such as polyurethanes, are used extensively elsewhere in the world. But they are gaining increasing interest in New Zealand due to their potential environmental and production advantages. Without such a long history of use, research has been undertaken to provide a robust, fit-for-purpose test methodology for assessing the long-term durability of polyurethanes.

Building on existing work, two new streams of research are now being integrated into the existing structural adhesives project. The first stream will validate the spectroscopic methodology being developed for long-term durability prediction of polyurethane-based adhesives. The second stream aims to quantify the scale of the EWP market in New Zealand and the types and proportions of adhesives used. The research data will be used to provide support for the use of polyurethanes in EWPs, providing confidence that the products meet Building Code durability requirements.

Levy investment	\$450,000 new investment, in addition to \$555,000 existing investment
Timeframe	April 2018 - March 2020
Contact	catherine.nicholson@branz.co.nz

Understanding the construction cost gap

The perceived construction cost gap between New Zealand and Australia is still unclear. Previous studies have estimated the cost of construction in New Zealand to be 15-19 per cent more expensive. This research will use a novel approach to understand trans-Tasman differences in residential construction costs.

Actual costing data will be analysed with the support of Property Council New Zealand. Their members operate as group home builders in both countries and have offered their costing data. The project will also investigate where construction practices in Australia have been identified as contributing to lower construction costs.

New insight into the construction cost gap and those construction practices that help reduce the cost of construction can support future affordability initiatives in New Zealand.

Levy investment	\$150,000
Timeframe	February 2018 - March 2020
Contact	nick.brunsdon@branz.co.nz

SCHOLARSHIPS

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

The aims of the scholarship programme are to add diversity to BRANZ’s portfolio of investments, support future research and strengthen BRANZ’s relationship with tertiary education. The scholars must show how their research will inspire the building and construction industry to provide better buildings for New Zealanders.

Scholars with outstanding academic credentials and early-stage researchers pursuing innovative projects can apply for scholarships of up to \$25,000 a year for three years. Typically, master’s students gain one-year scholarships and PhD students three-year terms.

These are the 13 new postgraduate scholarships under way in 2018:

Andrew Walmsley
Men’s health and suicide prevention – An investigation into help-seeking behaviour among men within the construction industry

Andrew’s research investigates what barriers could prevent men working in the construction industry from seeking help for psychological distress. Greater awareness of mental health needs can help create a productive, safe and resilient workforce.

This research can provide employers with information to better support their worker’s mental health needs.

Timeframe	To be completed by February 2021
Contact	research@branz.org.nz

Armano Papageorge
Semi-autonomous off-site construction – Mass customisable and structurally optimised building elements with freeform 3D printing

Armano’s design-led research investigates freeform 3D printing of structurally optimised building components using parametric software. Structural optimisation software can identify where material should be concentrated for structural performance. Also, new techniques in material deposition allow material to be placed precisely with little or no waste.

Given the extensive waste generated by the building industry, an efficient alternative to typical construction methods is required. Parametric software and robotic fabrication can achieve mass customisation of building components. This potential manufacturing technology could dramatically reduce the amount of construction waste produced globally. It should significantly change how buildings are produced.

Timeframe	To be completed by April 2021
Contact	research@branz.org.nz

Emily Newmarch

Inspire better buildings through performance of thermal envelopes in extreme New Zealand climates

Emily's design-led research investigates the architectural implications of providing a thermal environment beyond the minimum insulation levels specified in the New Zealand Building Code. It will demonstrate how architects can simulate and calculate building performance by adjusting the method to comply with NZS 4218 and H1, specifically in colder New Zealand climates.

This research reaches out to two audiences. It communicates to architects the benefits of energy evaluation in achieving higher-performing buildings in New Zealand. And it shows consumers the benefits of exceeding the minimum in our communities as well as our homes. This research aims to encourage exceeding-the-minimum energy performance and benefits for occupant comfort through architecture. This will result in a future building stock that is warmer, drier and healthier.

Timeframe	To be completed by March 2019
Contact	research@branz.org.nz

Gerard Finch

Defab - Prefabricated architecture for a circular materials economy

The New Zealand building industry contributes more waste to landfill than all other sectors combined. To effectively reduce this impact we must change the way we circulate materials. Gerard's research proposes using highly efficient, computer-aided manufacturing and optimising of buildings for efficient assembly and disassembly. It will investigate how light-timber-framed buildings might be designed for easy deconstructing into individual material components that can be reused at their life's end.

Transitioning to a circular materials economy will reduce the harm our industry causes. In turn, this will build long-term resilience, generate business and economic opportunities, and provide environmental and societal benefits.

Timeframe	To be completed by April 2021
Contact	research@branz.org.nz

Glen Stricot-Tarboton

Robotic arm prefab panels - proof of concept

Glen's research aims to manufacture customisable prefab panels using a robotic arm as an alternative to current prefabrication methods.

The research will demonstrate that it is possible to create variations in a prefabricated building panel using parametric software. It will also create the foundational methods for a robotic arm to use several different tools.

This research is an essential step in moving towards a new building system with multiple robots producing Code-compliant building panels. Mass customisation with robotic arms is a building technology that could transform the building sector.

Timeframe	To be completed by March 2019
Contact	research@branz.org.nz

Jono MacIntyre

Predicting structural fire severity - an update

At present, the 'time equivalence' approach is commonly used for determining fire severity on a structure. Previous studies have expressed concern about the accuracy or applicability of time-equivalence methods, in New Zealand and abroad.

Initially, this research will formulate an energy balance of the thermal and imposed energy versus capacity of a simple structural-steel element. Then it will aim to modify and expand this to apply to other materials, such as reinforced concrete, composite construction and heavy timber.

Jono's project aims to develop a new approach to determining structural fire severity that addresses some of the concerns expressed.

Timeframe	To be completed by December 2020
Contact	research@branz.org.nz

Kimberley Russell
The triple constraint – Identifying successful BIM procurement

For a project to be considered successful, it must be completed on schedule, on budget and using quality methods. It must also achieve a high level of client satisfaction.

Kimberley’s investigation aims to understand the outcomes of a successfully procured BIM (building information modelling) project and how these align with the triple constraints of time, cost and quality. These outcomes will help reduce recurring mistakes on projects due to lack of understanding about BIM procurement.

BIM projects will become more successful, meeting cost, time and quality requirements. This will create a more streamlined, efficient and productive sector.

Timeframe	To be completed by March 2019
Contact	research@branz.org.nz

Mikayla Heesterman
Robotic connections – Customisable joints for timber construction

Mikayla’s research will provide evidence of a more resilient method of designing structures than currently exists. Using a robotic arm, mass production and mass customisation can be integrated into the construction industry. This method of building is more efficient, quicker and cheaper – but without compromising structural integrity and aesthetics.

Parametric software and robotic efficiency offers great possibilities for maximising precision and production. This can ultimately reduce costs, time and waste. It also increases sustainability through use of timber.

Timeframe	To be completed by March 2019
Contact	research@branz.org.nz

Nicole Allen
Multi-volcanic hazard impact assessment for residential buildings in the Auckland volcanic field

The Auckland volcanic field presents a substantial risk to Auckland City. A future eruption could damage more than 100,000 buildings, disrupt critical infrastructure and set back citizens’ social and economic wellbeing.

This research aims to illustrate the fragility of New Zealand building systems to multi-volcanic hazards and test the effectiveness of mitigation strategies. Nicole will test the impacts of interacting hazards and the impact of tephra (rock fragments and particles) on timber-framed roofing sections. Her research looks to support stronger buildings in New Zealand that can withstand the impact of a volcanic eruption.

Timeframe	To be completed by August 2020
Contact	research@branz.org.nz

Olivia Whyte
Sustainable urbanism and co-housing in the New Zealand context

The primary aim of Olivia’s research is to investigate new styles of living within the built environment for enhanced health and wellbeing as well as environmental outcomes.

Eco-housing and co-housing complexes are emerging in New Zealand. Many are adopting green, sustainable building practices that use the internationally recognised Passive House and Living Building codes. Co-housing could provide medium-density housing that still allows people to live sustainably within cities. It offers the potential to advance sustainability and address the current housing crisis.

Timeframe	To be completed by April 2019
Contact	research@branz.org.nz

Sandi Sirikhanchai

Balancing building energy consumption and the electrical grid of New Zealand

Sandi's research examines the interactions between buildings and the energy grid. It aims to understand how buildings could be used to support the grid by balancing supply and demand.

It will investigate the use of building-energy demand schedules, such as reducing energy demand for a set period, as a solution to two problems. These are avoidable investment in electricity infrastructure and flexibility issues of net-zero energy buildings.

Successful support from buildings will reduce the need for investment in new resources and materials for large-scale energy sources and grid infrastructure.

Timeframe	To be completed by March 2019
Contact	research@branz.org.nz

Sanjeev Ganda

A lifecycle environmental impact assessment of residential building thermal envelopes

Sanjeev's research assesses how residential thermal envelopes affect the environment. It starts with Building Code requirements then goes beyond these, testing industry best-practice methods. The research will begin to look deeper into whether residential buildings that use low energy are environmentally friendly.

This lifecycle analysis (LCA) will use BRANZ's New Zealand Whole-Building, Whole-of-Life Framework and methodology to calculate the impact across seven environmental indicators. The technique can help ensure that savings in one environmental impact do not cancel out increases in other environmental impacts.

Anticipated findings will benefit the construction industry, allowing designers to understand methods of designing environmentally friendly thermal envelopes in residential buildings.

Timeframe	To be completed by February 2019
Contact	research@branz.org.nz

Taylor Hubber-Davis

Integrating augmented reality with building information modelling to facilitate on-site construction

Taylor's research looks to determine the feasibility of augmented reality (AR) in construction. How might it aid in an industry-wide understanding of building information modelling (BIM)? BIM has many proven benefits for the construction industry. However, workers have limited knowledge or skill in using and accessing BIM information.

The use of AR can provide a clear visual understanding for workers on site in a virtual environment. It can optimise communication systems on a project and improve project workflows and productivity. As a pilot study, an AR mobile application will be developed and tested on a current construction project.

This research could ultimately produce evidence to show how AR can be integrated with BIM to improve on traditional construction methods and enhance the information process.

Timeframe	To be completed by March 2019
Contact	research@branz.org.nz

APPENDIX

ALL PROJECTS UNDER WAY IN 2018/19

NOTE

Levy in Action provides details of all new work funded in 2018/19. In addition to these projects, considerable work is already ongoing. If you would like to know more about any project listed here, please email research@branz.org.nz.

Project	Total project value
Embracing medium-density housing (MDH)	
Communication and knowledge transfer	\$50,000
Community acceptance	\$350,000
Construction quality survey	\$200,000
Future buyers and renters	\$280,000
Industry perspectives on MDH consenting issues	\$86,900
Liveability	\$200,000
Programme leadership	\$110,000
Residents' perspectives on maintenance	\$120,000
Skills	\$150,000
Technical issues	\$130,000
Understanding resource consent processes in New Zealand	\$92,190
Who has the ability to deliver?	\$190,000
Helping consumers understand and exceed the minimum	
Accurately calculating thermal performance in timber-framed MDH across New Zealand	\$98,265
Communication and knowledge transfer	\$50,000
Encouraging better building	\$100,000
Exceeding the minimum for volume home builders and their clients	\$78,540
Informed decision-making on retrofitting insulation	\$98,500

LCAQuick - Residential	\$188,000
Measuring sustainability	\$155,500
Performance of higher-specified windows	\$320,000
Programme leadership	\$110,000
Quantifiable evidence of going beyond the Code	\$150,000
Tools for young people to understand how they can improve home performance	\$99,800

Eliminating quality issues

Adopting new ways	\$130,000
Awareness of solutions	\$150,000
Clerk of works - costs and benefits	\$150,000
Communication and knowledge transfer	\$50,000
Knowing enough to ask	\$200,000
Measuring new-build quality	\$170,000
Procuring for quality builds	\$250,000
Programme leadership	\$110,000

Towards warmer, drier and healthier buildings

Air quality in high-performance houses	\$148,000
Airtightness of apartments	\$650,000
Airtightness trends	\$400,000
Building a team with He Kainga Oranga	\$630,000
Chemical contamination of building materials	\$900,000
Communication and knowledge transfer	\$50,000
Corrosion rates in vented cavities	\$202,000
Exploring the indoor environment in schools and homes	\$100,000
Feasibility of an updated residential energy-use study	\$290,000
Fungal exposures in New Zealand homes	\$380,000
Growing up in New Zealand	\$720,840
Indoor environment and fungal exposure	\$183,000
Internal moisture verification method	\$90,000

Model buildings for the next generation of the NZ Building Code	\$1,670,000
New Zealand's experimental buildings	\$345,000
Occupant behaviour	\$430,000
Pollutant levels in modern New Zealand homes and offices	\$370,000
Programme leadership	\$130,000
Ridge and fascia vent design and performance	\$175,000
Risk assessment - retrofitting wall insulation	\$310,000
Risk assessment tool for roof ventilation	\$485,000
Roof design pathway	\$200,000
Roof ventilation calculator	\$250,000
Smart ventilation and indoor air quality	\$1,250,000
Ventilation performance in large-span roofs	\$320,000

New programme development

Low-carbon transition - programme scoping	\$150,000
Keeping people and buildings safe from fires - programme scoping	\$185,300

Knowledge transfer and other core capability

Advisory services	\$430,000
Annual loss factor tool	\$150,000
Annual publications review	\$32,000
BRANZ Levy forecasts	\$74,000
BRANZfind	\$56,400
BUILD magazine	\$886,000
Builder's Mate	\$125,000
Building Basics series	\$150,000
Building Controls	\$300,000
Bulletin releases	\$150,000
Durability verification database	\$10,000
E-learning	\$90,000
Good Practice Guide - membrane decks	\$100,000
Guideline	\$30,000

LEVEL sustainability series	\$72,000
Prefab modular construction roadshow	\$15,000
Seminars	\$435,000
Weathering site	\$30,000
Webinars	\$24,000

Strategic initiatives (investment in 2018/19 only)

Artisan	\$382,000
Industry Transformation Agenda	\$562,000

Standalone projects led by BRANZ Ltd

Better post-disaster projections	\$100,000
Building energy end-use study (BEES 2)	\$60,000
B-RISK user support	\$79,400
Built-environment carbon budget	\$185,000
Career development map for the construction and infrastructure industry	\$226,500
Cost-benefit analysis methodologies	\$150,000
Corrosion in the Bay of Plenty environment	\$665,000
Construction cost disparity	\$150,000
Durability evaluation framework for innovative materials	\$570,000
Fire-safe use of timber construction II	\$1,120,000
Fire safety of combustible facades in New Zealand	\$1,030,000
Flood it - Tiny building flood assessments	\$324,000
Foundations on sloping sites	\$52,040
House Condition Survey - Contributing to national housing quality data and information needs	\$510,000
Heat pump performance issues	\$80,000
Housing the future New Zealand	\$150,000
Indoor air quality in new homes	\$53,500
Lifecycle analysis framework dissemination	\$256,000
Limiting fire spread by design	\$1,629,000
Low-impact buildings	\$1,575,000
Maintaining ALF 3.2	\$40,000

Materials performance testing methodologies	\$1,478,000
MDH information resource	\$110,000
Mental health in construction	\$50,000
Monitoring industry performance	\$180,000
New building characteristics	\$400,000
New House Owners Satisfaction Survey	\$250,000
Non-residential rainwater and greywater	\$355,000
Passive fire protection quality	\$398,567
Performance and effectiveness of smoke management	\$116,000
Positional material deterioration over building envelope	\$520,000
Preparing the foundation for risk-informed fire safety design	\$270,000
Regional waste minimisation	\$175,000
Seismic performance of precast concrete floors	\$610,000
Small-scale greywater	\$42,000
Specific design for multi-storey, light-timber-framed housing	\$620,000
Structural adhesives	\$1,005,000
Towards durable timber structures	\$400,000
Using COMSOL for building physics	\$80,000
WUFI	\$430,000

Standalone projects led by external providers

Alternative tenure models	\$100,000
ArchEngBuild 2018	\$97,500
BIM initiative	\$750,000
Ensuring affordable concrete supply post-2020	\$110,000
Improving the build quality	\$45,000
Installation and seismic restraints of interior walls and partitions	\$92,000
Novel hybrid damping devices and design techniques for damage avoidance	\$35,000
Quality preliminary investigation report	\$100,000
Robust building system testing	\$50,000
Scoping a precast concrete floors research programme	\$50,000
Specific design for multi-storey, light-steel-framed housing	\$80,000
Levy investment allocated in forthcoming 2018/19 Prospectus round	\$1,165,265

Scholarships (PhD and master's)

Andrew Walmsley: Men's health and suicide prevention – help-seeking behaviour among men within the construction industry	\$75,000
Armano Papageorge: Mass customisable structurally optimised building elements with freeform 3D printing	\$75,000
Audsley Jones: Self-centring dual-steel frames using buckling restrained braces	\$75,000
Cara Askew: Building management systems in existing, non-residential building stock	\$20,000
Dan Court-Patience: Performance of connections in diagonal buckling restrained braced frames	\$20,000
Emily Newmarch: Performance of thermal envelopes in New Zealand extreme climates	\$20,000
Gerard Finch: Prefabricated architecture for a circular materials economy	\$75,000
Glen Stricot-Tarboton: Robotic arm prefab panels	\$20,000
Glen Stricot-Tarboton: materials funding	\$32,000
Gye Simkin: Sensors to monitor performance of buildings in Christchurch	\$75,000
Jono MacIntyre: Predicting structural fire severity	\$75,000
Julia Thompson: Natural ventilation of spaces for large audiences	\$75,000
Kimberley Russell: Identifying successful BIM procurement	\$20,000
Mikayla Heesterman: Robotic construction – customisable joints for timber construction	\$20,000
Mike Bedford: Infectious disease risk associated with full-day childcare environmental conditions	\$75,000
Nicole Allen: Multi-volcanic hazard impact assessment	\$75,000
Olivia Whyte: Sustainable urbanism and co-housing	\$20,000
Peter Marriott: Limits of applicability of commonly used fire models in fire safety design	\$20,000
Phoebe Taptiklis: Assessing the relative impact of poor home maintenance on interior dampness	\$75,000
Rochelle Ade: Performance of Homestar-rated homes	\$75,000
Sandi Sirikhanchai: Balancing building energy consumption and the electrical grid	\$20,000
Sanjeev Ganda: A lifecycle environmental impact assessment of residential building thermal envelopes	\$20,000
Tayler Hubber-Davis: Integrating augmented reality with BIM to facilitate on-site construction	\$20,000
Vicky Southworth: Stormwater management technologies	\$20,000

NOTE

At the time of publication, the 2018/19 Prospectus round had not been completed. The investment decisions made through this round will be published as supplementary information to *Levy in Action* as soon as this round is complete.



**INSPIRING THE INDUSTRY TO PROVIDE
BETTER BUILDINGS FOR NEW ZEALANDERS**

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